University of North Carolina at Charlotte ET 11-17-11

New Graduate

Course and Curriculum Proposal from Department of Engineering Technology

Establishment of a Master of Science in Applied Energy and Electromechanical Systems

A. PROPOSAL SUMMARY AND CATALOG COPY

1. SUMMARY

The Department of Engineering Technology proposes the creation of a Master of Science in Applied Energy and Electromechanical Systems (MSEEM) degree program. The program will help to meet the workforce needs of Charlotte's growing and thriving power and energy related industries. The program will draw on the interdisciplinary strength of the Engineering Technology department, utilizing faculty from the Mechanical and Electrical Engineering Technology Programs. The proposed program consists of a 15-credit-hour common core and a capstone experience comprised of either a sequence of 15 credit-hours of major electives or a sequence of 6 credit hours of major elective courses, a 3-hour Research and Analytical Methods course and a formal 6-credit hour graduate thesis. The program will be offered through on-campus delivery.

The 30-credit hour degree program is outlined below:

I. Common Core Courses (15-credit hours)

ETGR 5272:	Advanced Engineering Analysis	3 credit hours
ENER 6120:	Energy Generation & Conversion	3 credit hours
ENER 6135:	Energy Transmission & Distribution	3 credit hours
ENER 6170:	Applied Mechatronics	3 credit hours
ENER 6150	Systems Dynamics	3 credit hours

II. Master's Thesis and Research Sequence (15-credit hours)

CMET 6160:	Research and Analytical Methods	3 credit hours
ENER 6900:	Master's Thesis & Research	6 credit hours
Major Electives		6 credit hours

OR

Coursework Sequence (15-credit hours)

Major Electives	15 credit hours

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

CMET 5270: Operation of Constructed Facilities	3 credit hours
CMET 6130: Building Information Modeling	3 credit hours
CMET 6140: Building Energy Management	3 credit hours
CMET 6155: Facility Instrumentation and Controls	3 credit hours

ENER 5250: Renewable Energy Systems	3 credit hours
ENER 5260: Hydrogen Production and Storage	3 credit hours
ENER 5275: Air Conditioning Systems	3 credit hours
ENER 5280: Fuel Cell Technologies	3 credit hours
ENER 5285: Applied Noise and Vibration Control	3 credit hours
ENER 6000: Special Topics in Energy or Electromechanical Systems	1-3 credits
ENER 6220: High Voltage Technology	3 credit hours
ENER 6235: Advanced Transmission	3 credit hours
ENER 6250: Advanced Instrumentation	3 credit hours
ENER 6260: CFD for Energy Applications	3 credit hours
ENER 6270: Dynamic Systems Control & Design	3 credit hours
ENER 6800: Independent Study Energy or Electromechanical Systems	1-3credits

Nearly half of the proposed coursework for the degree currently exists at UNC Charlotte. The degree leverages existing coursework within the MS Construction & Facilities Management program and provides cross-listings at the graduate (5000) level for a number of existing senior level courses. Only the following new graduate level courses will need to be created and developed:

ETGR 5272: Advanced Engineering Analysis	3 credits
ENER 6000: Special Topics in Energy or Electromechanical Systems	1-3 credits
ENER 6120: Energy Generation and Conversion	3 credits
ENER 6135: Energy Transmission & Distribution	3 credits
ENER 6150: System Dynamics	3 credits
ENER 6170: Applied Mechatronics	3 credits
ENER 6220: High Voltage Technology	3 credits
ENER 6235: Advanced Transmission	3 credits
ENER 6250: Advanced Instrumentation	3 credits
ENER 6260: Computational Fluid Dynamics for Energy Applications	3 credits
ENER 6270: Dynamic Systems Control & Design	3 credits
ENER 6800: Independent Study	1-3 credits
ENER 6900: Master's Research and Thesis	1-6 credits

2. PROPOSED CATALOG COPY

ETGR 5272: Advanced Engineering Analysis. (3) Prerequisite: ETGR 2272 or MATH 1242 with a grade of C or better and STAT 1220 with a grade of C or better. A continuation of engineering analysis to include additional topics and applications in vector operations, probability, and statistics. *(On demand)*

ENER 6000: Special Topics in Applied Energy or Electromechanical Systems. (3) Study of specific new areas emerging in the various fields of energy and electromechanical systems. May be repeated for credit. *(On demand)*

ENER 6120: Energy Generation and Conversion (3) Overview of energy use. Fossil fuel resources and energy conversion. Solar energy principles, solar collector,

photovoltaic cells and applications. Wind energy and wind turbines. Nuclear energy principles, nuclear reactors and power generation. Geothermal and Hydraulic energy conversion. Hydrogen energy, storage and transportation, Overview of fuel cell, fuel cell types and application. *(On demand)*

ENER 6135: Energy Transmission & Distribution (3) Power transmission and distribution network architectures. Transmission line models, parameters, and equivalent circuits. Symmetrical components. Power flow studies. Symmetrical and unsymmetrical faults. Transient operation and power system protection. Power system stability. Distribution optimization. *(On demand)*

ETGR 6150: System Dynamics (3) Pre or corequisite: ETGR 5272. Energy-based modeling of dynamic mechanical, electrical, thermal, and fluid systems to formulate linear state equations, including system stability, time domain response, and frequency domain techniques. Two lectures and one three-hour laboratory weekly. *(On demand)*

ENER 6260: Computational Fluid Dynamics for Energy Applications (3) Introduction to the use of commercial CFD codes to analyze flow and heat transfer in energy related problems. Finite difference and finite volume methods, SIMPLE model for incompressible flow, models of simple geometries are developed and studied, post processing and visualization. Overview of turbulence and turbulence modeling. *(On demand)*

ENER 6170: Applied Mechatronics (3) Prerequistie: ENER 6150 Analog electronic design for purposes of controlling electromechanical systems, including electromechanical sensors and actuators, analog electronic design of filters, state-space and classical controllers, and transistor-based servoamplifiers and high voltage amplifiers. Significant laboratory component with design and fabrication of circuits to control electromechanical systems. Implementation of digital controllers. Two lectures and one three-hour laboratory weekly. *(On demand)*

ENER 6220: High Voltage Technology (3) Covers concepts of high voltage generation, measurements, protection and safety. Students will study high electric fields theory, breakdown mechanisms in gases, liquids, and solid dielectrics. The high voltage insulation, including insulation coordination, will also be discussed. The course will also provide instructions on high voltage applications and safety. *(On demand)*

ENER 6235: Advanced Transmission Theory (3) Prerequisite: ENER 6135 or consent of instructor. This course provides instruction on network steady-state analysis; faults; protection systems; switching equipment; voltage and power static control; surge voltages and protection, transient operation and stability, "smart grid" enabling technologies. *(On demand)*

ENER 6250: Advanced Instrumentation (3) Prerequisite: ELET 2241 or ETME 3163.

This course provides methodologies for measurement, analysis and control of physical components of conventional and renewable energy conversion and storage systems. Two lecture hours and one three-hour laboratory weekly. *(On demand)*

ENER 6270: Dynamic Systems Control & Design (3) Prerequisite: ELET 4222 Control Systems or ETGR 6150 Systems Dynamics. This course covers dynamic systems control, its analysis and design. Analysis of linear feedback systems, deterministic and stochastic dynamic systems, their characteristics, robust stability and robust performance. Robust control, Kalman filter, and its design and compensation of deterministic and stochastic dynamic systems, including wind turbines system control and piezo (mechatronics) systems. *(On demand)*

ENER 6800: Independent Study in Applied Energy or Electromechanical Systems. (1-3) Prerequisite: Consent of graduate committee advisor. Individual investigation and exposition of results for a directed project in energy and electromechanical systems. May be repeated for credit. *(On demand)*

ENER 6900: Master's Thesis & Research. (1-6) Prerequisite: Consent of graduate committee advisor. Individual investigation culminating in the preparation and presentation of a thesis. May be repeated for credit. *(On demand)*

B. JUSTIFICATION.

1. Identify the need addressed by the proposal and explain how the proposed action meets the need.

Both emphases within the MS in Applied Energy and Electromechanical Systems (MSEEM) program will allow students to incorporate previous studies in electrical engineering/technology or mechanical engineering/technology into a multi-disciplinary course of study. The core of the program will provide competencies in mechatronics and systems, along with a broad introduction into the areas of renewable energy, power engineering, energy efficiency and sustainability. The energy emphasis will allow focused work in energy and/or power topics as part of the thesis or non-thesis degree option. Individuals focusing on the electro-mechanical emphasis will be prepared to contribute to the design, analysis, implementation and maintenance of industrial and power systems. All graduates of the MSEEM program will be well prepared for employment in numerous capacities that require a multidisciplinary approach to problem solving and implementation presented by complex electromechanical and mechatronic systems.

UNC Charlotte provides educational opportunities to residents of the largest metropolitan area in North Carolina and is located in one of the fastest growing energy hubs in the country. Charlotte is home to 240 companies that employ about 25,000 workers in Charlotte's energy sector. A number of large energy-based companies have major facilities located in the Charlotte area, including: Duke Energy, the nation's the second largest utility; The Shaw Group; Areva; Siemens; Westinghouse; Fluor; and Toshiba.

According to Jeff Merrifield of The Shaw Group, “A lot of companies are coming from around the country and around the world, placing facilities here and creating a network…” [Charlotte Chamber of Commerce, News 14].

The UNC Charlotte Lee College of Engineering is home to the Energy Production and Infrastructure Center (EPIC) which has as its mission to “enhance the available technical workforce, advance technology, and facilitate strategic industry-university collaboration for the global energy industry while supporting the Carolinas’ economic and energy security development”. By 2030, demand for electricity is expected to grow by 40 percent in this country. To meet this challenge, the energy environment is evolving rapidly, with innovations in progress to develop everything from electric vehicles, natural gas, wind, biomass, solar and nuclear. EPIC will train a new generation of engineers and conduct research in new energy technologies. In doing so, the Center will serve the diverse needs of existing and emerging energy companies, further positioning Charlotte as an energy hub. “EPIC will transform the future of our energy workforce and job development across this growing region,” said Dhiaa Jamil, Chief Generation Officer and Group Vice President for Duke Energy, who also chairs EPIC’s Industrial Advisory Board. [UNC Charlotte Spotlight, January 2011] The proposed MSEEM program aligns with and supports the mission of EPIC by providing an important resource to prepare students to enter the energy sector workforce and a graduate program to support energy-related research. The MSEEM program will provide a key element in achieving the workforce development and education required to meet the nation’s energy challenges.

This robust climate for energy, power, industrial and business services in the Charlotte region make UNC Charlotte an ideal fit for a Master of Science in Applied Energy and Electromechanical Systems degree program. UNC Charlotte’s Department of Engineering Technology has provided quality technical education for over 30 years. Our programs have met rigorous standards for specialized accreditation, and we have a long history of working with Charlotte area businesses and industries to supply graduates for the greater Charlotte region and throughout North Carolina. A large number of the departmental faculty have significant industrial and research expertise that will ensure the delivery of a technically robust and industrially relevant program. The Department has over 30 faculty with members with well over half actively engaged in energy management and systems solutions through sponsored research, industry sponsored senior design projects and other outreach including our emerging participation in the Envision Charlotte initiative to reduce uptown energy usage by 20% by 2016. The proposed program will only enhance the Department’s outreach and integration with the community, enlarge its scholarly research capacity, and produce much needed graduates for the Charlotte community.

The proposed new degree program is unique in that it will be the first graduate degree program in energy or electromechanical systems in the University of North Carolina system. Currently, The closest degree offered or planned in the UNC system, according to the UNC General Administration site (http://www.northcarolina.edu/programs/index.php, accessed November 3, 2011) is the Master’s in Electric Power Systems Engineering offered by NC State University effective

fall 2011. The proposed MSEEM program differs from the NC State program primarily in its multi-disciplinary nature and that students will be able to build on a solid energy/electromechnical core to tailor an individualized program of study that emphasizes application. In addition, a search through the National Center for Education Statistics, Institute of Education Sciences (http://nces.ed.gov/ipeds/) yielded no degrees containing the keywords energy or power at the master's level offered by four-year institutions in the United States.

Effective 2012, the U.S. Bureau of Labor Statistics (BLS) will report on "green" jobs, which will include all occupations related to natural resources, energy efficiency and generation/distribution of energy from alternative sources such as wind, solar and biomass (http://www.bls.gov/green/#definition). The BLS does not currently provide individual statistics on energy and power related occupations, with these positions incorporated into traditional electrical and mechanical engineering or the generic engineering, other, category. Although the electrical and mechanical engineering fields are projected to have a modest growth of 2-6% through 2018, a substantial number of positions will be created through the graying of the current workforce. As indicated in Figure 1, data from 2006 indicated that over 50% of the workforce employed in the generation, transmission and distribution of electric power was aged 45 and older. Natural attrition from these demographics, in conjunction with the push towards more renewable energy, will result in jobs related to the current grid and power generation/distribution paradigm as well as those encompassed in the BLS Green Power definition.

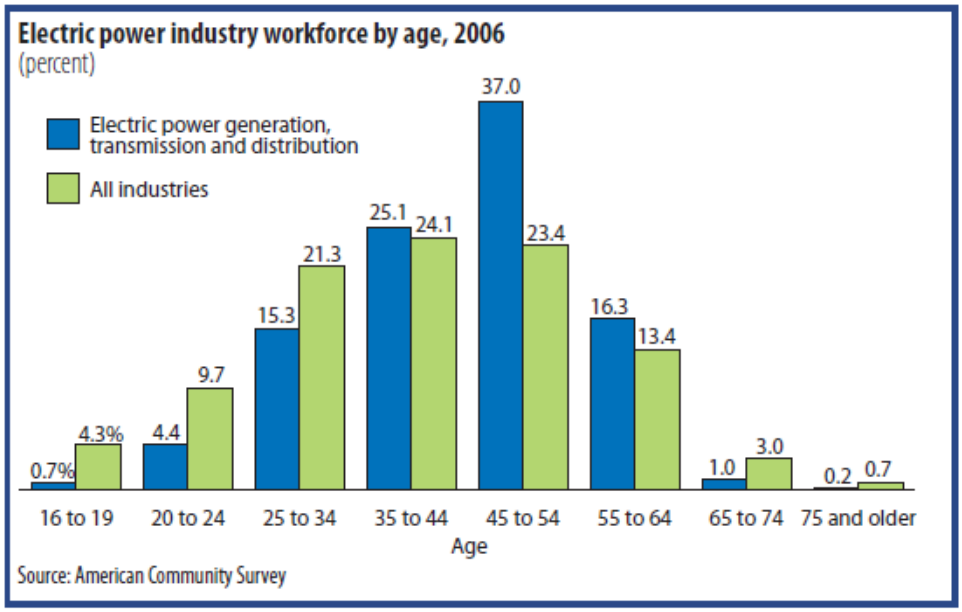

Figure 1: Source - Occupational Outlook Quarterly, Fall 2008

The U.S. Department of Energy August 2006 report to the U.S. Congress, *Workforce Trends in the Electric Utility Industry*

(http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/Workforce_Trends_Report_090706_FINAL.pdf), reiterated the necessity of power engineering education as well as expressing concern of the availability of educators to meet future demands. This fact, in conjunction with the focus of engineering education to satisfy the short-term application focus of industry, yielded the conclusion "To foster innovation to keep the United States on the forefront of technological advancement and to maintain our leadership position amidst international competition, strong support of strategic research at universities is critical." Figure 2 presents the qualitative summary of this report in terms of major professions of the power industry workforce.

Similarities	***Differences***	
	Lineworkers	*Power Engineers*
Demographics – dominated by "Baby-Boomers"	Industry very aware of retirement situation	Industry not completely aware of pending retirement impact
Loss of institutional knowledge as more retire	Short-term impact to utility operation	Long-term impact to national competitiveness
Mergers, cutbacks, and downsizing over the past two decades	Interest in field is growing	Interest in field is declining
In-house training programs being developed by industry to fill perceived voids	Training programs nearly doubled in last 10 years	University programs have declined over the past decade
Potential lack of qualified, interested replacements	High pay, especially for limited post-secondary education	Low pay, compared to other concentrations within electrical engineering

Figure 2: Lineworkers vs Power Engineers (Table 4 of DOE report)

The Department of Energy report concludes "Despite industry's apparent ability to meet short-term workforce demand on the applications side, the decline in support for basic power systems research and education is of concern. It is an engine for innovation, exploration and ingenuity, and is necessary for sustaining scientific advancement to maintain our competitive position in the world. In addition, due to the reticence in the electric industry, incremental decisions usually last 30-40 years, requiring a broader, long-term perspective. Thus the public-private partnerships should be considered to keep America's power research capabilities strong and secure." The unique combination of the status of Charlotte as an energy hub, the existence of EPIC on the UNC Charlotte campus and the proposed MSEEM program will provide this critical public-private partnership for both educational and research endeavors.

2. Discuss prerequisites/corequisites for course(s) including class-standing.

Students are required to hold a baccalaureate degree in physics, applied mechanics, engineering technology, engineering, or similar related field. All courses require graduate standing and acceptance into the MSEEM degree program.

Five common core courses are required for all students in the degree program and serve as prerequisites for several of the elective courses. Additional course specific prerequisites have been established to ensure students have adequate fundamentals to successfully complete the course. Students not satisfying the prerequisites or lacking the

required background will be required to remediate the deficiency prior to enrolling in the course.

ENER 6900, Master's Thesis and Research course requires departmental approval and is reserved and required for graduate students' participating in externally sponsored research projects. All other students are required to complete the non-thesis degree option.

3. Demonstrate that course numbering is consistent with the level of academic advancement of students for whom it is intended.

Course numbers have been established that correspond with Graduate School catalog guidelines and with the Office of the Provost's published academic policy on course numbering. URL: http://provost.uncc.edu/policies/course-numbering

4. In general, how will this proposal improve the scope, quality and/or efficiency of programs and/or instruction?

The MSEEM program will strengthen the existing degree programs in the Department of Engineering Technology. Academic infrastructure is in place to support laboratory experiences and computing needs of the program. The existing engineering technology programs (BSET) are growing quickly (Fall 2011 enrollments indicate approximately 800 Undergraduate Students in the Department) and will benefit from the synergy of the proposed MSEEM program. The program will enlarge the scholarly and research capacity of the faculty. As the Department's programs represent popular and lucrative career opportunities which are technologically-based and appeal to today's college-bound population, data indicate that this proposed program and all existing engineering technology programs will continue to grow at UNC Charlotte. Additionally, as the Charlotte Metro Area solidifies its role as the Energy Capital of the region, demand for graduates with this specific skill set will increase.

C. IMPACT.

1. What group(s) of students will be served by this proposal? (Undergraduate and/or graduate; majors and/or non-majors, others? Explain). Describe how you determine which students will be served.

The MSEEM degree program will serve admitted graduate students holding a baccalaureate degree in engineering technology, engineering, energy or similar related fields.

2. What effect will this proposal have on existing courses and curricula?
a. When and how often will added course(s) be taught?

Once the MSEEM degree program is fully established and enrolled, the required core courses will be offered once a year in the semester indicated in the course description

catalog copy. Elective courses will be offered on an on-demand basis depending on student interest. At full projected enrollment, it is anticipated that most elective courses will also be offered once a year or every other year.

b. How will the content and/or frequency of offering of other courses be affected?

The MSEEM degree program will share a Research Methods course and some elective courses with the graduate program in MSCFM and with the lower division MET major electives. No impact on the frequency of offering of these courses is expected. The content of these courses is not expected to change, although some adjustments will be made in the rigor and expectations of students at the graduate level in elective courses that include both undergraduate and graduate students.

c. What is the anticipated enrollment in course(s) added (for credit and auditors)?

Projected enrollments for the MSEEM program are as follows:

	Year 1: 2013-14	Year 2: 2014-15	Year 3: 2015-16	Year 4: 2016-17
Full-time	12	18	21	24
Part-time	6	9	12	15

Based on these projections, at fully established program enrollments courses will have anticipated enrollments of 20 to 40 students. This represents on campus participants.

d. How will enrollment in other courses be affected? How did you determine this?

The MSEEM degree program will share a Research Methods course and some elective courses with the graduate program in MSCFM and with the lower division MET major electives. The Research Methods course enrollment will increase accordingly. An increase in enrollment in these existing MSCFM courses is expected due to the addition of the MSEEM graduate students. In addition, there may be a slight increase in enrollment in select departmental undergraduate courses as some students remediate prerequisite or program deficiencies.

e. If course(s) has been offered previously under special topics numbers, give details of experience including number of times taught and enrollment figures.

Some courses that are currently offered as undergraduate major electives or as courses in the MSCFM program will be listed as electives for the proposed MS program. These courses are listed below.

Course	Corresponding Undergraduate Course	Title	Average Enrollment	Times Taught
CMET 5270		Operation of Constructed	10	1

		Facilities		
CMET 6130		Building Information Modeling	10	1
CMET 6160		Research Methods and Analytical Methods	10	1
CMET 6140	ETME 4245 (being renumbered to ENER 4140)	Energy Management	32	5
ENER 5250	ETME 4250 (being renumbered to ENER 4250)	Renewable Energy Systems	24	3
ENER 5275	ETME 3273 (being renumbered to ENER 4275)	Air Conditioning Systems	20	10
ENER 5280	ETME 4270 (being renumbered to ENER 4280)	Fuel Cell Technologies	10	1
ENER 5260	ETME 4260 (being renumbered to ENER 4260)	Hydrogen Production and Storage	4	1
ENER 5285	ETME 4114 (being renumbered to ENER 4285)	Applied Nose and Vibration Control	8	1

f. Identify other areas of catalog copy that would be affected, e.g., curriculum outlines, requirements for the degree, etc.

Additional catalog copy affected includes degree requirements and curriculum descriptions as indicated below:

Proposed Catalog Copy

Engineering Technology & Construction Management

•MS in Applied Energy and Electromechanical Systems (MSEEM)
•MS in Construction and Facility Management (MSCFM)
•Master's in Fire Protection & Administration (MFPA)

Department of Engineering Technology

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Graduate Director

Dr. Anthony L. Brizendine

Graduate Faculty

Anthony L. Brizendine, Professor & Chair
Nan Byars, Professor
Don Chen, Assistant Professor
Chung-Suk Cho, Assistant Professor
G. Bruce Gehrig, Associate Professor
Rodney Handy, Professor
John Hildreth, Assistant Professor
Jeffrey Kimble, Associate Professor
Steve Kuyath, Associate Professor
Na Lu, Assistant Professor
Sara McMillan, Assistant Professor
David Murphy, Associate Professor
Thomas Nicholas, Assistant Professor
Maciej Noras, Assistant Professor
Carlos Orozco, Associate Professor
Ron Priebe, Associate Professor
Peter Schmidt, Assistant Professor
Deborah Sharer, Associate Professor
Barry Sherlock, Professor
Ahmad Sleiti, Associate Professor
Patty Tolley, Associate Professor
Jozef Urbas, Assistant Professor
Sheng-Gou Wang, Professor
Wesley Williams, Assistant Professor
Aixi Zhou, Assistant Professor

Programs of Study

The Department of Engineering Technology provides opportunities for discipline-specific and multidisciplinary graduate-level education in applied energy and electromechanical systems, construction & facilities management, and fire protection & administration, and closely related areas.

Advanced course work and research are used to enhance professional development, improve technical competency, and initiate a life-long learning experience.

M.S. in APPLIED ENERGY AND ELECTROMECHANICAL SYSTEMS

Admission Requirements

- An earned undergraduate degree in engineering technology, engineering, energy or a closely related field
- An undergraduate GPA of 2.75 or better
- Acceptable scores on the verbal, quantitative, and analytical sections of the GRE
- Positive recommendations
- Acceptable TOEFL score is required if the previous degree was from a country where English is not the common language.
- Integral and differential calculus (MATH 1121 or 1241, and ETGR 2171 or MATH 1242 at UNC Charlotte or equivalent from other institution)
- Statistics (STAT 1220 or STAT 3128 at UNC Charlotte or equivalent from other institution)
- Other credentials as required by the Graduate School

Acceptability for admission is based upon the applicant's record and background as determined by the department.

Early-Entry to Graduate School

Exceptional undergraduate students at UNC Charlotte may be accepted into the graduate program and begin work toward a graduate degree before completion of the baccalaureate degree. An applicant may be accepted at any time after completion of 75 or more hours, although it is expected that close to 90 hours will have been earned by the time the first graduate course is taken.

To be accepted into this program, an undergraduate student must have at least a 3.2 overall GPA and have taken the appropriate graduate standardized test and have earned an acceptable score. If any early-entry student has not met the normal admission requirements of a 2.75 overall undergraduate GPA and a 3.0 junior-senior GPA at the end of his/her baccalaureate degree, she/he will be dismissed from the graduate program.

Students accepted into an early-entry program will be subject to the same policies that pertain to other matriculated graduate students. Generally, it will be assumed that early-entry students will finish their baccalaureate degrees before they complete 15 hours of graduate work.

Up to six hours earned at the graduate level may be substituted for required undergraduate hours. (Up to six hours of graduate work may be "double counted" toward both baccalaureate and graduate degrees.)

Application Deadline

Applications can be received by the Graduate Admission Office any time prior to the published deadlines. In order to be considered for assistantships and tuition grants for the following academic year, students should apply by March 1 for priority consideration. The first round of award decisions typically occurs by March 15. However, the Department will evaluate admission applications at any time complete applications are received by the Graduate School.

Assistantships

Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students.

Tuition Grants

Tuition grants including out-of-state tuition differential waivers and in-state tuition support are available on a competitive basis for both out-of-state and in-state students, respectively.

Degree Requirements

A minimum of 30 approved graduate credit hours is required for graduation. A student may fulfill the 30-hour requirement by pursuing one of the two study options:

a) 24 credit hours of course work plus 6 credit hours of thesis project
b) 30 credit hours of course work and a comprehensive examination.

Admission to Candidacy Requirements

Each student is required to submit a Plan of Study to the Department's Graduate Director before completing 18 hours of graduate credits.

Upon completion of a substantial amount of graduate work, each student must file an Admission to Candidacy to the Graduate School by the published deadline for the semester of graduation.

Application for Degree

Each student should submit an Application for Degree prior to graduation. If a student does not graduate in the semester identified on the Application, the student must complete a new form and repay the application fee to be considered for graduation in a subsequent semester.

Transfer Credit

The Department accepts the transfer of graduate courses (6 credits maximum) taken at another institution or from UNC Charlotte prior to admission to the master's program in energy and electromechanical systems.

Core Courses

All students must complete the following 15 credit common core:

ETGR 5272: Advanced Engineering Analysis
ENER 6120: Energy Generation & Conversion
ENER 6135: Energy Transmission & Distribution
ENER 6170: Applied Mechatronics
ENER 6150: Systems Dynamics

Capstone Experiences

Students pursuing a master's degree in energy and electromechanical systems have two options to complete the 30-credit hour program.

a) 24 hours of course work plus 6 hours of thesis project. Students choosing this option must complete the following 3-credit hour course:
   CMET 6160: Research and Analytical Methods

b) 30 hours of course work and a comprehensive examination.

Both options require the formation of a program committee.

The thesis option requires students to submit a written thesis and orally defend their work before their program committee.

All non-thesis students must complete an additional 6 credit hours of major elective coursework within their technical specialty and successfully pass a comprehensive written examination.

A student's comprehensive examination exam will be scheduled when he/she has at least 24 hours of course credit completed or in progress. The graduate director with assistance from the examining committee will coordinate the administration of examinations with the assistance from members of the graduate students' program committee. The

exam will measure the student's mastery of theories and applications in the selected area of specialization within the discipline. Students will have only two opportunities to receive passing marks on the examination.

Advising
Each student is supervised by his/her graduate advisor and a program committee.

Program Committee
The Program Committee shall consist of at least three graduate faculty members. A graduate faculty from outside the ETCM department or from outside the student's major area-of-study may serve as a member of the Program Committee. The student's ET graduate advisor shall chair the committee, and at least two members of the committee shall hold faculty status in the ETCM department.

Research Opportunity/Experience
Students in energy and electromechanical systems enjoy a curriculum with opportunities for interdisciplinary research, study abroad, and active participation in a growing research program. Programs of study can be tailored to suit individual needs and interests. The ETCM web site (www.et.uncc.edu) provides current areas of research conducted by the program faculty.

COURSES IN APPLIED ENERGY AND ELECTRO-MECHANICAL SYSTEMS

ENER 6000: Special Topics in Applied Energy & Electromechanical Systems. (3) Study of specific new areas emerging in the various fields of energy and electromechanical systems. May be repeated for credit. *(On demand)*

ENER 6120: Energy Generation and Conversion (3) Overview of Energy use. Fossil fuel resources and energy conversion. Solar energy principles, solar collector, photovoltaic cells and applications. Wind energy and wind turbines. Nuclear energy principles, nuclear reactors and power generation. Geothermal and Hydraulic energy conversion. Hydrogen energy, storage and transportation, Overview of fuel cell, fuel cell types and application. . *(On demand)*

ENER 6135: Energy Transmission & Distribution (3) Power transmission and distribution network architectures. Transmission line models, parameters, and equivalent circuits. Symmetrical components. Power flow studies. Symmetrical and unsymmetrical faults. Transient operation and power system protection. Power system stability. Distribution optimization. . *(On demand)*

ETGR 6150: System Dynamics (3) Corequisite: ETGR 5272. Energy-based modeling of dynamic mechanical, electrical, thermal, and fluid systems to formulate linear state equations, including system stability, time domain response, and frequency domain techniques. Two lectures and one three-hour laboratory weekly. *(On demand)*

ENER 6260: Computational Fluid Dynamics for Energy Applications (3) Introduction to the use of commercial CFD codes to analyze flow and heat transfer in energy related problems. Finite difference and finite volume methods, SIMPLE model for incompressible flow, models of simple geometries are developed and studied, post processing and visualization. Overview of turbulence and turbulence modeling. . *(On demand)*

ENER 6170: Applied Mechatronics (3) Prerequistie: ENER 6150 Analog electronic design for purposes of controlling electromechanical systems, including electromechanical sensors and actuators, analog electronic design of filters, state-space and classical controllers, and transistor-based servoamplifiers and high voltage amplifiers. . *(*Significant laboratory component with design and fabrication of circuits to control electromechanical systems. Implementation of digital controllers. Two lectures and one three-hour laboratory weekly. . *(On demand)*

ENER: 6220: High Voltage Technology (3) Covers concepts of high voltage generation, measurements, protection and safety. Students will study high electric fields theory, breakdown mechanisms in gases, liquids, and solid

dielectrics. The high voltage insulation, including insulation coordination, will also be discussed. The course will also provide instructions on high voltage applications and safety. *(On demand)*

ENER 6235: Advanced Transmission Theory (3) This course provides instruction on network steady-state analysis; faults; protection systems; switching equipment; voltage and power static control; surge voltages and protection, transient operation and stability, "smart grid" enabling technologies. . *(On demand)*

ENER 6250: Advanced Instrumentation (3) Prerequisite: ELET2241 or ETME3163. This course provides methodologies for measurement, analysis and control of physical components of conventional and renewable energy conversion and storage systems. Two lecture hours and one three-hour laboratory weekly. . *(On demand)*

ENER 6270: Dynamic Systems Control & Design (3) Prerequisite: ELET 4222 Control Systems or ETGR 5xxx Systems Dynamics. This course covers dynamic systems control, its analysis and design. Analysis of linear feedback systems, deterministic and stochastic dynamic systems, their characteristics, robust stability and robust performance. Robust control, Kalman filter, and its design and compensation of deterministic and stochastic dynamic systems, including wind turbines system control and piezo (mechatronics) systems. . *(On demand)*

ENER 6800: Independent Study in Applied Energy and Electromecanical Systems (1-3) Prerequisite: Consent of graduate committee advisor. Individual investigation and exposition of results for a directed project in energy and electromecanical systems. May be repeated for credit. *(On demand)*

ENER 6900: Master's Thesis & Research. (6) Prerequisite: Consent of graduate committee advisor. Individual investigation culminating in the preparation and presentation of a thesis. May be repeated for credit. *(On demand)*

M.S. IN CONSTRUCTION AND FACILITIES MANAGEMENT

Application Deadline

Applications can be received by the Graduate Admission Office any time prior to their published deadlines. In order to be considered for assistantships and tuition grants for the following academic year, students should apply by March 1 for priority consideration. The first round of award decisions typically occur by March 15. However, the Department will evaluate admission applications at any time complete applications are received by the Graduate School.

Early-Entry to Graduate School

Exceptional undergraduate students at UNC Charlotte may be accepted into the graduate program and begin work toward a graduate degree before completion of the baccalaureate degree. An applicant may be accepted at any time after completion of 75 or more hours, although it is expected that close to 90 hours will have been earned by the time the first graduate course is taken.

To be accepted into this program, an undergraduate student must have at least a 3.2 overall GPA and have taken the appropriate graduate standardized test and have earned an acceptable score. If any early-entry student has not met the normal admission requirements of a 2.75 overall undergraduate GPA and a 3.0 junior-senior GPA at the end of his/her baccalaureate degree, she/he will be dismissed from the graduate program.

Students accepted into an early-entry program will be subject to the same policies that pertain to other matriculated graduate students. Generally, it will be assumed that early-entry students will finish their baccalaureate degrees before they complete 15 hours of graduate work.

Up to six hours earned at the graduate level may be substituted for required undergraduate hours. (Up to six hours of graduate work may be "double counted" toward both baccalaureate and graduate degrees.)

Assistantships

Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students.

Tuition Grants

Tuition grants including out-of-state tuition differential waivers and in-state tuition support are available on a competitive basis for both out-of-state and in-state students, respectively.

Admission Requirements:

The minimum admission requirements for the program are:

a. An earned undergraduate degree in construction management, facility management, engineering technology, engineering, architecture or a closely related field
b. An undergraduate GPA of 2.75 or better
c. Acceptable scores on the verbal, quantitative, and analytical sections of the GRE
d. Positive recommendations
e. An acceptable TOEFL score is required if the previous degree was from a country where English is not the common language
f. Integral and differential calculus (MATH 1120 or 1121 or ETGR 3171 at UNC Charlotte or equivalent).
g. Statistics (STAT 1220 or STAT 3128 at UNC Charlotte or equivalent).
h. Other credentials as required by the Graduate School

Documents to be submitted for admission.

a. Official transcripts from all colleges and universities attended.
b. Official GRE scores.
c. Official TOEFL scores.
d. The UNC Charlotte application for graduate admission online.
e. Three professional recommendations.
f. Others as required by the Graduate School.

Degree requirements.

The proposed program leading to the Master of Science degree in Construction and Facilities Management is a 30 semester-hour program. The program would consist of an 18-credit hour common core, a 6-credit hour elective core in either construction management or facility management, and a capstone experience including either a sequence of 6-credit hours of major electives or a formal 6-credit hour graduate research thesis. At least 15 semester hours must be in courses numbered 6000 or above. The 30-credit hour degree program is outlined below:

Required Common Construction / Facilities Management Core Courses (18-credit hours)

CMET 5240	Safety & Risk Management	3 credit hours
CMET 5270	Operation of Constructed Facilities	3 credit hours
CMET 6130	Building Information Modeling	3 credit hours
CMET 6135	Advanced Construction Planning & Management	3 credit hours
CMET 6140	Building Energy Management	3 credit hours
CMET 6160	Research and Analytical Methods	3 credit hours

Students select one of the following technical cores:

Construction Management Core (6-credit hours)

CMET 6180	Alternative Project Delivery Methods	3 credit hours
CMET 6285	Quality Assurance in Construction	3 credit hours

Facilities Management Core (6-credit hours)

CMET 6145	Facilities Management Financial Analysis	3 credit hours
CMET 6250	Asset Management for Facility Managers	3 credit hours

Students select one of the following capstone options:

Non-Thesis Option (6-credit hours)

Major Elective		3 credit hours
Major Elective		3 credit hours

Thesis and Research Option (6-credit hours)

CMET 6900	Master's Thesis & Research	6 credit hours

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

CMET 6290	Temporary Structures in Construction	3 credit hours
CMET 6295	Design & Improvement of Construction Operations	3 credit hours
CMET 6000	Special Topics in Construction & Facilities Management	3 credit hours
CMET 6800	Independent Study in Construction & Facilities Management	3 credit hours
CMET 6155	Facility Instrumentation and Controls	3 credit hours
CMET 6255	Advanced Plant Layout and Design	3 credit hours

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.

Capstone Experiences

Students pursuing the Master of Science in Construction & Facilities Management have two options to complete the 30-credit hour program as follows:

a) 24 hours of course work plus 6 hours of thesis project, or
b) 30 hours of course work and a comprehensive examination.

Both options require the formation of a program committee. The thesis option is reserved for students who are attending the on-campus program and are performing research under formal graduate research or teaching assistantships. Students receiving such assistantships may be required to pursue the thesis option. The thesis option requires students to submit a written thesis and orally defend their work before their program committee.

All non-thesis students must complete 30 credits of coursework and successfully complete a formal comprehensive examination. The comprehensive examination is a written exam. A student's exam will be scheduled when he/she has at least 24 hours of course credit completed or in progress. The student's graduate advisor and the examining committee will coordinate the examination (to be offered once in the fall and once in the spring semesters), preparing the exam with the assistance of members of the student's program committee. The exam will measure the student's mastery of theories and applications in the selected area of specialization within the discipline. Students will have only two opportunities to receive passing marks on the examination.

Advising

Each student is supervised by his/her graduate advisor and a program committee.

Plan of Study Requirements

Each student is required to submit a Plan of Study to the Department's Graduate Director before completing 18 hours of graduate credits.

Application for Degree

Each student should submit an Application for Degree prior to graduation. If a student does not graduate in the semester identified on the Application, the student must complete a new form and repay the application fee to be considered for graduation in a subsequent semester.

Transfer Credit
The Department, at its discretion, may accept transfer of graduate courses (6 credits maximum) taken at another institution or from another program prior to admission to the master's program in construction and facility management. Only courses in which the student earned a grade of B or better may be transferred.

Grades required
All candidates must earn an overall 3.0 to graduate. Accumulation of one U grade will result in the suspension of the student's enrollment in the program.

Other requirements
The program has both a thesis and non-thesis track. After admission to candidacy, thesis students will complete a comprehensive oral exam while non-thesis students will complete a comprehensive written exam. Residence will be per Graduate School rules. There is no language requirement. While full-time students will typically take three semesters to complete the program, part-time students are expected to take no more than six years to complete the program as per Graduate School rules.

COURSES IN CONSTRUCTION AND FACILITIES MANAGEMENT

CMET 5240. Safety & Risk Management. (3) Prerequisite: CMET 4228 or consent of instructor. Topics of study will include causes and prevention of industrial accidents, hazardous processes and material, OSHA regulations and requirements, and design of accident prevention programs. (On Demand)

CMET 5270. Operation of Constructed Facilities. (3) Prerequisite: CMET 3224 and ETCE 3271 or consent of instructor. Topics of study will include acquisition, operation, maintenance, and disposal of building systems, structures, permanent interiors, furniture, and equipment; grounds and other exterior elements. (On Demand)

CMET 6000. Special Topics in Construction & Facility Management. (3) Study of specific new areas emerging in the various fields of construction and facility management. May be repeated for credit. (On Demand)

CMET 6130. Building Information Modeling. (3) Prerequisite: ETCE 1104 or ETGR 1104 or consent of instructor. Topics of study will include the creation, management, and application of building information models to the construction, operation, and maintenance of a facility. Focus will be on 2D and 3D computer models of building components, renderings, animations, and interfacing with analysis tools. (On Demand)

CMET 6135. Advanced Construction Planning & Management. (3) Prerequisite: ETCE 4126 or consent of instructor. Advanced methods for planning and controlling construction projects will be covered. Specific topics of study will include resource allocation, leveling and management, critical path method (CPM) and project evaluation and review techniques (PERT) of scheduling, project controls through cost-schedule integration, and schedule compression. (On Demand)

CMET 6140. Building Energy Management. (3) Prerequisite: ETCE 3271 or ETME 3143 or consent of instructor. Topics of study will focus on the integrated planning of energy efficient technologies for building environmental control systems. Introduction to the design, planning, and optimization of HVAC systems and technology needed to integrate the heating, cooling, natural ventilation, lighting, electricity, and building energy management systems into a building's structure and design. (On Demand)

CMET 6145. Facilities Management Financial Analysis. (3) Prerequisite: ETGR 3222 or ECON 2102 or consent of instructor. This course is a study of real property concepts, issues, and topics pertinent to the facility management professional to include fundamentals of commercial real estate investment, understanding market influences, contracts and property portfolio management. (On Demand)

CMET 6155. Facility Instrumentation and Controls. (3) Prerequisite: ETME 3163 or consent of instructor. This course covers design and analysis of industrial process control instrumentation. Topics include process control

devices and process control applications associated with industrial instrumentation and building and facility operation. (On Demand)

CMET 6160. Research and Analytical Methods. (3) Prerequisite: STAT 1220 or consent of instructor. This course focuses on analytical and research techniques applicable to construction and facility management problems. Topics of study include defining research problems, experiment design, measurement, sampling, and analysis. (On Demand)

CMET 6180. Alternative Project Delivery Methods. (3) Prerequisite CMET 3224 or consent of instructor. This course provides study of the many organizational arrangements between construction owners, designers, contractors, and financiers. Delivery methods studied include design-bid-build (DBB), design-build (DB), construction management (agency CM and CM@Risk), design-build-operate (DBO), and design-build-finance-operate (DBFO). (On Demand)

CMET 6250. Asset Management for Facility Managers. (3) Prerequisite: CMET 5270 or consent of instructor. Study of useful life of building and infrastructure systems and creating a process to manage their life cycles; emphasis on justifying and funding capital projects. (On Demand)

CMET 6255. Advanced Plant Layout and Design. (3) Prerequisite: CMET 5270 or consent of instructor. Topics of study include designing construction sites and facility plants with respect to material handling, equipment location, auxiliary services, capital requirements, safety, and personnel organization. (On Demand)

CMET 6285. Quality Assurance in Construction. (3) Prerequisite: CMET 6160 or consent of instructor. This course covers the principles and applications of quantitative methods of quality control to production processes with an introduction to process control charts, Pareto charts, and other quality analysis tools for the construction industry. (On Demand)

CMET 6290. Temporary Structures in Construction. (3) Prerequisite: ETCE 3163 or consent of instructor. Topics of study include temporary structures used to support construction operations such as concrete formwork, scaffolding systems, shoring systems, cofferdams, underpinning, slurry walls, and construction dewatering systems. (On Demand)

CMET 6295. Design & Improvement of Construction Operations. (3) Prerequisite: CMET 6135. Topics of study include design of construction operations based on productivity concepts. Techniques for collecting data, analyzing, and formulating solutions to improve construction operations will be emphasized. (On Demand)

CMET 6800. Independent Study in Construction & Facility Management. (3) Prerequisite: Consent of graduate committee advisor. Individual investigation and exposition of results for a directed project in construction and facility management. May be repeated for credit. (On Demand)

CMET 6900. Master's Thesis & Research. (1 – 6) Prerequisite: Consent of graduate committee advisor. Individual investigation culminating in the preparation and presentation of a thesis. May be repeated for credit. (On Demand)

MASTER OF FIRE PROTECTION & ADMINISTRATION

Application Deadline

Applications can be received by the Graduate Admission Office any time prior to their published deadlines. In order to be considered for assistantships and tuition grants for the following academic year, students should apply by March 1 for priority consideration. The first round of award decisions typically occur by March 15. However, the Department will evaluate admission applications at any time complete applications are received by the Graduate School.

Assistantships
Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students.

Tuition Grants
Tuition grants including out-of-state tuition differential waivers and in-state tuition support are available on a competitive basis for both out-of-state and in-state students, respectively.

Admission Requirements:
The minimum admission requirements for the program are:

i. An earned undergraduate degree in engineering, engineering technology, emergency management, or a related technical or scientific discipline. For the Fire Protection concentration, an undergraduate degree in engineering, engineering technology, or a related technical or scientific discipline is acceptable. For the Fire Administration concentration, a degree in engineering, engineering technology, emergency management, or a related discipline is acceptable.
j. An undergraduate GPA of 2.75 or better
k. Acceptable scores on the verbal, quantitative, and analytical sections of the GRE
l. Positive recommendations
m. An acceptable TOEFL score is required if the previous degree was from a country where English is not the common language
n. Integral and differential calculus (MATH 1121 or Math 1241 and ETGR 2271 or Math 1242 at UNC Charlotte or equivalent) is required for students pursuing the fire protection concentration.
o. Statistics (STAT 1220 or STAT 3128 at UNC Charlotte or equivalent).
p. Other credentials as required by the Graduate School

Documents to be submitted for admission.

g. Official transcripts from all colleges and universities attended.
h. Official GRE scores.
i. Official TOEFL scores.
j. The UNC Charlotte application for graduate admission online.
k. An essay detailing the applicant's motivation and career goals, along with any specific research and training interests.
l. Three professional recommendations.
m. Others as required by the Graduate School.

Degree requirements.
The minimum requirement for the MFPA degree is 30 credit hours beyond the baccalaureate degree. This includes a minimum of 24 hours of formal course work. Students enrolled will 1) take a common core of 12 credits which includes study in both fire protection and fire administration; 2) choose additional concentrated study of 6 credits in either fire protection or fire administration, and 3) select 12 credits of directed elective. Students who elect the thesis option must complete 6 credits of MFPA 6900 as part of the directed electives. Students who select the non-thesis option will complete 30 credits of coursework and complete a comprehensive exam. At least 15 semester hours must be in courses numbered 6000 or above. The 30-credit hour degree program is outlined below:

Common Core: (12 credits)

MFPA 5123 Human Behavior in Fire
MFPA 5132 Fire and Building Codes, Standards and Practices
MFPA 5223 Industrial Safety and Facilities Management
MFPA 6144 Fire Protection Systems

Students select one of the following 6-credit concentration cores:

Fire Administration Concentration Core (6-credit hours):

MFPA 6120 Public and Private Sector Interoperability
MFPA 6124 Fire Service and the Community

Fire Protection Concentration Core (6-credit hours):
MFPA 6103 Fire Dynamics
MFPA 6203 Fire Modeling

Students select 12 credits from the following directed electives to complete credit hour requirements for the degree:
MFPA 5150 Human Resource Management in Emergency Services
MFPA 6113 Fire Failure Analysis
MFPA 6126 Arson
MFPA 6164 Fire Science Laboratory
MFPA 6232 Structural Fire Safety
MFPA 6233 Performance-Based Design
MFPA 6243 Research Investigation
MFPA 6244 Fire Detection and Smoke Management
MFPA 6252 Law and Fire Safety
MFPA 6255 Leadership/Conflict Management in Public Emergency Services
MFPA 6260 Organization and Management of Public Fire Protection
MFPA 6270 Budgeting, Grants, Contracts and Finance in Emergency Services
MFPA 6800 Independent Study
MFPA 6900 Thesis (6 credits for thesis option)
CMET 5240 Safety & Risk Management
CMET 5270 Operation of Constructed Facilities
CMET 6130 Building Information Modeling
CMET 6140 Building Energy Management

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.

Capstone Experiences
Students pursuing a master's degree in fire protection and administration have two options to complete the 30-credit hour program as follows:

a) 24 hours of course work plus 6 hours of thesis project (MFPA 6900), or
b) 30 hours of course work and a comprehensive examination.

Both options require the formation of a program committee. The thesis option is reserved for students who are attending the on-campus program and are performing research under formal graduate research or teaching assistantships. Students receiving such assistantships may be required to pursue the thesis option. The thesis option requires students to submit a written thesis and orally defend their work before their program committee.

All non-thesis students must complete 30 credits of coursework and successfully complete a formal comprehensive examination. The comprehensive examination is a written exam. A student's exam will be scheduled when he/she has at least 24 hours of course credit completed or in progress. The student's graduate advisor and the examining committee will coordinate the examination (to be offered once in the fall and once in the spring semesters), preparing the exam with the assistance of members of the student's program committee. The exam will measure the student's mastery of theories and applications in the selected area of specialization within the discipline. Students will have only two opportunities to receive passing marks on the examination.

Advising
Each student is supervised by his/her graduate advisor and a program committee.

Plan of Study Requirements

Each student is required to submit a Plan of Study to the Department's Graduate Director before completing 18 hours of graduate credits.

Application for Degree
Each student should submit an Application for Degree prior to graduation. If a student does not graduate in the semester identified on the Application, the student must complete a new form and repay the application fee to be considered for graduation in a subsequent semester.

Transfer Credit
The Department, at its discretion, may accept transfer of graduate courses (6 credits maximum) taken at another institution or from another program prior to admission to the master's program in construction and facility management. Only courses in which the student earned a grade of B or better may be transferred.

Grades required
All candidates must earn an overall 3.0 to graduate. Accumulation of one U grade will result in the suspension of the student's enrollment in the program.

Other requirements
The program has both a thesis and non-thesis track. After admission to candidacy, thesis students will complete a comprehensive oral exam while non-thesis students will complete a comprehensive written exam. Residence will be per Graduate School rules. There is no language requirement. While full-time students will typically take three semesters to complete the program, part-time students are expected to take no more than six years to complete the program as per Graduate School rules.

COURSES IN FIRE PROTECTION & ADMINISTRATION

MFPA 5123 Human Behavior in Fire (3) *Prerequisite: ETFS 3103 and ETFS 3113 or permission of department.* Individual decision processes and behavior, modeling of people movement, calculation methods for egress prediction, egress design, and fire safety signs and alarm systems. (On Demand)

MFPA 5132 Fire and Building Codes, Standards and Practices (3) *Prerequisite: ETFS 3103 or permission of department.* History of fire safety regulation development; building fire characteristics, fire test methods, and fire safety of buildings and structures; contemporary building and fire codes, practices, and their enforcement. (On Demand)

MFPA 5150 Human Resources Management in Emergency Services (3) Cross-listed as MPAD 6134. *Prerequisite: permission of department.* A study of the context of public personnel fire/emergency services related administration; basic functions of job evaluation and compensation, employee rights and responsibilities; the legal constraints including equal opportunity, health and safety, collective bargaining; government productivity. (On Demand)

MFPA 5223 Industrial Safety and Facilities Management (3) *Prerequisite: ETFS 3123 or permission of department.* Investigation and analysis of hazard control principles relating to the management of personnel, facilities, and equipment, including control procedures, work-task analysis, risk identification and countermeasures, safety training, and pertinent safety management techniques. (On Demand)

MFPA 6103 Fire Dynamics (3) *Prerequisite: ETME 3143 and ETME 3244 or permission from the department.* This course introduces students to fundamentals of fire and combustion and is intended to serve as the first exposure to fire dynamics phenomena. The course includes fundamental topics in fire and combustion such as thermodynamics of combustion, fire chemistry, premixed and diffusion flames, solid burning, ignition, plumes, heat release rate curves, and flame spread. (On Demand)

MFPA 6113 Fire Failure Analysis (3) *Prerequisite: MFPA 6103 or permission of department.* This course provides knowledge for the development of fire investigation and reconstruction as a basis for determining fire

cause and origin and evaluating and improving fire safety design. Accident investigation theory and failure analysis techniques such as fire re-creation testing and modeling are presented. (On Demand)

MFPA 6120 Public and Private Sector Interoperability(3) *Cross-listed as MPAD 6290. Prerequisite: permission of department.* A study of multi-agency interoperability and the effective organization and management of emergency resources at various fire and large-scale emergency incidents. Includes a review of national standards and federal regulations impacting emergency incident management. Case studies of actual and theoretical incidents will be used to reinforce command and control concepts. (On Demand)

MFPA 6124 Fire Service and the Community (3) *Prerequisite: permission of department.* Theoretical concepts of public service to build an understanding of how the fire service fits within the community. (On Demand)

MFPA 6126 Arson (3) *Prerequisite: permission of department.* This course utilizes lecture and case studies of arson fires that were started for various reasons, including financial gain, revenge and to conceal other crimes. The criminal intent and the psychological aspects of the fire setter are discussed. (On Demand)

MFPA 6144 Fire Protection Systems (3) *Prerequisite: ETFS 3103, ETFS 3113 or permission of department.* An advanced study of various fire protection systems in regard to contemporary fire and life safety problems. Topics include: process of fire and smoke development, principles of active fire suppression and detection systems, hydraulics, automatic sprinkler systems, passive fire protection systems, structural fire resistance, installation and maintenance of fire protection systems. (On Demand)

MFPA 6164 Fire Science Laboratory (3) *Prerequisite: MFPA 6103 or permission of department.* This course provides overall instruction and hands-on experience with fire-science-related experimental measurement techniques. The objective is to expose students to laboratory-scale fire experiments, standard fire tests and state-of-the-art measurement techniques. (On Demand)

MFPA 6203 Fire Modeling (3) *Prerequisite: MFPA 6103 or permission from the department.* Modeling of compartment fire behavior is studied through the use and application of two types of models: zone and field. The zone model studied is CFAST. The field model studied is FDS. Focus on the understanding of each of these models is the primary objective in terms of needed input, interpretation of output and limitations. (On Demand)

MFPA 6232 Structural Fire Safety (3) *Prerequisite: ETGR 2102 or ETME 3123, ETME 3244 or permission of department.* This course provides the knowledge needed for structural fire safety design and analysis. Course topics include design philosophies and methods in fire safety engineering, principles of and approaches for structural design for fire safety, behavior of compartment fires, behavior of structural materials in fire, and structural fire safety of typical materials and their components. (On Demand)

MFPA 6233 Performance-Based Design (3) *Prerequisite: ETFS 6203 or permission of department.* This course covers practical applications of fire protection engineering principles to the design of buildings. Both compartmented and non-compartmented buildings will be designed for criteria of life safety, property protection, continuity of operations, operational management and cost. (On Demand)

MFPA 6243 Research Investigation (3) *Prerequisite: permission of the department.* This course provides students with opportunities in conducting research to tackle fire safety related real-world problems. With guidance from the instructor, students can work individually or as a team on a one-semester project. (On Demand)

MFPA 6244 Fire Detection and Smoke Management (3) *Prerequisite: ETFS 3103 or permission of department.* This course addresses the fundamentals and practices of fire detection and smoke management. Topics include: principles of fire detection, fire alarm technology, and contemporary fire detection and alarm systems; principles applicable to the design and analysis of smoke management systems; factors affecting smoke movement; smoke hazard assessment; airflow in buildings, performance characteristics of smoke control and management systems. (On Demand)

MFPA 6252 Law and Fire Safety (3) *Prerequisite: permission of department.* Responding to natural and manufactured building hazards requires a complex legal environment, including regulation and liability. Key topics include the use of model codes, administrative regulation, retrospective codes, federal preemption, arson, performance based codes, risk based regulation, engineering malpractice, product liability and disaster investigation. (On Demand)

MFPA 6255 Leadership/Conflict Management in Public Emergency Services (3) Cross-listed as MPAD 6141. *Prerequisite: permission of department.* The role of the administrator as a focal point in social change and the management of the conflict, which occurs. Perspectives on the negotiation and bargaining process will be reviewed. (On Demand)

MFPA 6260 Organization and Management of Public Fire Protection (3) *Cross-listed as MPAD 6104. Prerequisite: permission of department.* A presentation of modern management principles and techniques to the organization and delivery of the array of services that communities have come to expect from the fire service. The traditional and evolving roles of the fire service to protection, prevention, risk analysis and community service are also considered. (On Demand)

MFPA 6270 Budgeting, Grants, Contracts and Finance in Emergency Services (3) *Prerequisite: permission of department.* This course works to develop the understanding of strategic planning, contracting and budgeting practices as well as grant proposal writing with the emphasis on contract administration skills necessary to operation of a functioning governmental entity. (On Demand)

MFPA 6800 Independent Study (1-3) *Prerequisite: permission of department.* The MFPA program offers independent study and special study courses to allow students to pursue studies in areas for which there are no approved formal courses. Independent study courses can only be taken on a P/F basis. Special study courses can be taken for a grade if the paperwork indicates it will be taken A/F. Each requires a title, justification, and the method of evaluation. Courses taken for A/F grade may be used to satisfy degree requirements. May be repeated for credit. (On Demand)

MFPA 6900 Thesis (1-6) *Prerequisite: Consent of graduate committee advisor.* Individual investigation culminating in the preparation and presentation of a thesis. May be repeated for credit. (On Demand)

D. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

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

1. Personnel

a. Specify requirements for new faculty, part-time teaching, student assistant and/or increased load on present faculty.

It is anticipated that this new enrollment stream will warrant the addition of four new faculty members over the next four years to adequately deliver the program. Faculty in the Electrical and Mechanical Engineering Technology programs will be added through the campus' faculty line allocation process. These positions will be justified through enrollment growth and student credit hour production targets being met. Additionally, research capability and production will increase as new faculty and graduate students are added.

No adverse effect is anticipated on current faculty loads. In fact, the addition of new faculty hires in these two programs will provide additional catalyst for energy and electromechanical research, scholarly publication, and community outreach activity.

b. List by name qualified faculty members interested in teaching the course(s).

Anthony L. Brizendine, Professor & Chair
Nan Byars, Professor
Don Chen, Assistant Professor
Chung-Suk Cho, Assistant Professor
David S. Cottrell, Assistant Professor
G. Bruce Gehrig, Associate Professor
Rodney Handy, Professor
John Hildreth, Assistant Professor
Jeffrey Kimble, Associate Professor
Steve Kuyath, Associate Professor
Na Lu, Assistant Professor
Sara McMillan, Assistant Professor
David Murphy, Associate Professor
Thomas Nicholas, Assistant Professor
Maciej Noras, Assistant Professor
Carlos Orozco, Associate Professor
Ron Priebe, Associate Professor
Peter Schmidt, Assistant Professor
Deborah Sharer, Associate Professor
Barry Sherlock, Professor
Ahmad Sleiti, Associate Professor
Patty Tolley, Associate Professor
Jozef Urbas, Assistant Professor
Sheng-Gou Wang, Professor
Wesley Williams, Assistant Professor
Aixi Zhou, Assistant Professor

2. Physical Facility

The proposed MSEEM program will share facilities with the existing Construction Management, Civil ET, Electrical ET and Mechanical ET programs in the Smith Building. Laboratories currently exist to support fluid mechanics, stress analysis, thermodynamics, programmable logic control, and instrumentation and controls experimentation. Existing facilities are adequate to support the on-campus program at commencement and during the next decade.

3. Equipment and Supplies

Existing equipment and supplies are adequate to support the program.

4. Computer

Existing information technology services and MOSAIC engineering computing capabilities are adequate to support the program.

5. Audio-Visual

Existing audio-visual capabilities are adequate to support the program.

6. Other Resources

Other additional resources are not required.

7. Indicate source(s) of funding for new/additional resources required to support this proposal.

Existing facilities and equipment are in place. Any additional new facilities or equipment will be funded through normal university funding sources to include projected funding from RFP responses to calls from General Administration. Supplemental funding from public and private sources to include construction industry support will be utilized for program enhancements.

E. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

1. Library Consultation

Current monograph and journal holdings are adequate to support a portion of the proposed program. Library holdings related to energy infrastructure and production are not currently sufficient to support graduate level research as of today; however, with the addition of resources added through the allocation of funds for EPIC research collection additions, sufficient resources will be available by the time that the program begins. Available databases include: IEEE Xplore, ACM DigitalLibrary, and Compendex. The required memorandum from the library summarizing its consultation concerning the MSEEM program is included in Attachment C.

2. Consultation with other departments or units

The following consultations have occurred within the College of Engineering concerning this proposal:

Department of Electrical and Computer Engineering
Department of Mechanical Engineering and Engineering Science
College of Engineering Administrative Council (Dept. Heads and Deans)

Formal letters, memoranda or email correspondence of those consultations are included in Attachment B.

F. INITIATION AND CONSIDERATION OF THE PROPOSAL

1. Originating Unit

This course and curriculum proposal was initiated by the faculty of the Department of Engineering Technology.

This proposal for the M.S. in Applied Energy and Electromechanical Systems received unanimous approval by vote from the faculty of the Department of Engineering Technology on November 17, 2011 and was subsequently distributed to all COE departments and committees for consideration and comment.

The following have been consulted during the initiation of the intent to plan / request to establish / and/or curriculum proposal process for this program:

- ET, ELET and MET Industrial Advisory Boards – Unanimous Support
- Department of Engineering Technology Faculty – Unanimous Vote in Favor
- Lee College of Engineering Academic Policy & Curriculum Committee (CEAPCC)
- Lee College of Engineering Graduate Committee (EGC)
- Lee College of Engineering Dean

College of Engineering Faculty

2. Other Considering Units

The course and curriculum proposal will be subject to the standard faculty governance review processes established by the Department of Engineering Technology, the College of Engineering, the Graduate School, and the University of North Carolina at Charlotte.

G. ATTACHMENTS

1. Attachment A: Graduate Course Descriptions and Syllabi.

2. Attachment B: Consultation Documentation

Attachment A: Graduate Course Descriptions and Syllabi

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ETGR 5272 Advanced Engineering Analysis

Proposed Catalog Description:
ETGR 5272 Advanced Engineering Analysis. (3) Crosslisted as ETGR 4272. Prerequisite: ETGR 2272 or MATH 1242 with a grade of C or better and STAT 1220 with a grade of C or better. A continuation of engineering analysis to include additional topics and applications in vector operations, probability, and statistics.

Pre- or Co-requisites:

ETGR 2272 or MATH 1242 with a grade of C or better and STAT 1220 with a grade of C or better.

Objectives of the Course:

At the completion of the course students will be able to:

- Perform basic probability computations.
- Perform statistics computations.
- Perform vector operation computations.
- Apply statistics to the solution of engineering applications.
- Apply probability to the solution of discipline specific problems and engineering applications.
- Apply vector operations techniques to the solution of discipline specific problems and engineering applications.

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, and opportunities for student questions and discussion.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	5%
Tests:	50%
Quizzes:	20%
Final Exam:	25%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
D = 60-70%
F < 60%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

Custom Text w/supplements

Proposed Course Outline:

Probability and Probability Distributions……..Week 1
Typical distributions in engineering problems

Estimation of Population Central Values and Variances……...Week 2

One Sample Hypothesis Testing……....Week 3
Exam#1

Two Sample Hypothesis Testing……Week 4

One-way Analysis of Variance……...Week 5

Categorical Data…….Week 6

Linear Regression……...Week 7

Curve Fitting & Predictions……...Week 8
Engineering Applications & Exam#2

Vectors in two and three dimensions…….Week 9

Dot product and cross product……...Week 10

Vector fields……...Week 11

Vector differential calculus……Week 12
Exam #3

Directional derivatives……...Week 13

Gradient, divergence and curl of a vector……..Week 14

Vector integral calculus……..Week 15
Engineering Applications

Final Exam…….TBA

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ETGR 6120 - Energy Generation and Conversion

Proposed Catalog Description:

ETGR 6120. Energy Generation and Conversion. (3) Prerequisite: PHYS 1101 Introductory Physics I or equivalent (With Introduction to Thermodynamics, Electricity and Magnetism), Calculus (Differential Equations or Equivalent). Introduction to Power Generation and Power Plant Systems. Energy sources. Energy Conversion Systems. Fossil fuel resources. Solar energy principles, solar collector, photovoltaic cells and applications. Wind energy and wind turbines. Nuclear energy principles, nuclear reactors and power generation. Geothermal and Hydraulic energy conversion. Hydrogen energy, storage and transportation, Overview of fuel cell, fuel cell types and application. *(Fall)*

Pre- or Co-requisites:

PHYS 1101 Introductory Physics I or equivalent (With Introduction to Thermodynamics, Electricity and Magnetism), Calculus (Differential Equations or Equivalent).

Objectives of the Course:

At the completion of the course students will be able to:

- apply and analyze thermodynamic power cycles and the associated processes and fuels to actual design or study;
- compare energy conversion technologies based on economic and efficiency;
- apply basic principles of nuclear energy, solar energy, geothermal energy and wind energy conversion to an actual design or study;
- perform basic calculations of the design of energy storage technology.
- make energy-related decisions.

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of material in a standard lecture format and writing in the board, problem solving, discussion of case studies, discussion of assignments and projects, field visits and opportunities for student questions, discussions and presentations by students.

Means of Student Evaluation:

The students will be evaluated based on their ability to master what they learned in class. The final grade will be based upon the following proportions:

Homework Assignments	**30%**
Test #1	**15%**
Test #2	**15%**

Projects	**30%**
In class presentation	**10%**

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

5. Projects

The course will include two projects to give students an opportunity to apply what they have learned to a specific future energy generation and conversion problem or challenge. Students will produce a final written report. A list of possible topics and examples will be circulated separately. The subject area can be a topic of your own choosing, or you can choose one of the options I have identified.

Proposed Text:

Principles of Energy Conversion- The eBook by Professor Kenneth (can be downloaded free)
The course will be supplemented with lecture notes, cases studies, projects and weblinks that will be posted to the course website.

Other references
US Department of Energy Website is an excellent source of information, lectures, projects, technologies, etc. We will discuss and illustrate this in class.

Energy Conversion, D. Yogi Gaswami & F. Kreith, ed., CRC Press, ISBN 978-1-4200-4431-7 (2008).

Handbook of Energy Energy Efficiency and Renewable Energy, F. Kreith & D. Yogi Gaswami, ed., CRC Press, ISBN 0-8493-1730-4, (2007).

Proposed Course Outline:

Week 1 and 2: Introduction to Energy Generation and Conversion
- energy, energy classification, units
- energy conversion, conversion efficiency
- growth rates, peak oil, energy economics

Week 3 and 4: Introduction to Fuels
- coal, coal gasification
- petroleum,

Week 5, 6 and 7: Thermal-to-Mechanical Energy Conversion
- review of thermodynamics and power cycles
- availability (exergy) analysis
- Rankine power cycle
- Brayton power cycle
- Otto and Diesel power cycle
- Sources of Thermal Energy & Conversion
- nuclear energy, nuclear power production
- solar thermal energy conversion

Week 8 and 9: Electromagnetic-to-Electrical Energy Conversion
- introduction to photovoltaics

Week 10 and 11: Mechanical-to-Mechanical Energy Conversion
- introduction to wind energy

Week 12 and 13: Chemical-to-Electrical Energy Conversion
- introduction to fuel cells

Week 14 and 15: **I**ntroduction to Energy Storage
- Hydrogen
- Batteries
- compressed gas, flywheels

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6135 – ENERGY TRANSMISSION & DISTRIBUTION

Proposed Catalog Description:

ENER 6135: Energy Transmission & Distribution (3) Prerequisites: Proficiency in circuit analysis, Calculus (Differential Equations or Equivalent). Power transmission and distribution network architectures. Transmission line models, parameters, and equivalent circuits. Symmetrical components. Power flow studies. Symmetrical and unsymmetrical faults. Transient operation and power system protection. Power system stability. Distribution optimization. (*On demand)*

Pre- or Co-requisites:

Proficiency in circuit analysis. Calculus (Differential Equations or Equivalent).

Objectives of the Course:

At the completion of the course students will be able to:

- Analyze power transmission and distribution systems
- Perform power flow analysis.
- Perform symmetrical and unsymmetrical fault analysis.
- Perform transient and stability analysis of a power system..

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	10%
Exam 1:	30%
Exam 2:	30%
Final Exam:	30%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is strongly encouraged but is not enforced. Students are responsible for catching up with any material that is missed due to absence from lectures.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

Proposed Text:

Power System Analysis & Design, J.D. Glover and M. Sarma, and T. Overbye, 5th edition, CL-Engineering, 2011. ISBN-13: 978-1111425777

Power System Analysis, J.G. Grainger and W.D. Stevenson, McGraw Hill,1994. ISBN-13: 9780070612938

Proposed Course Outline:

Week 1: Transmission line characteristics, parameters and equivalent circuits.
Week 2: Transmission line structures.

Week 3: Substations, transformers.
Week 4: Insulators, conductors.
Week 5: Computational techniques for distribution systems.
Week 6: Calculation of power losses, voltage regulation techniques.
Week 7: Voltage-sag analysis and calculation. Equipment and component modeling.
Week 8: Distribution power flow analysis.
Week 9: Line-to-ground faults.
Week 10: Line-to-line faults.
Week 11: Transients in power systems.
Week 12: Protection systems.
Week 13: Stability and reliability evaluation.
Week 14: Simulation techniques for reliability and stability analysis.
Week 15: Optimization techniques.

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6000 – SPECIAL TOPICS IN APPLIED ENERGY OR ELECTROMECHANICAL SYSTEMS

Proposed Catalog Description:

ENER 6000. Special Topics in Construction & Facility Management. (3) Study of specific new areas emerging in the various fields of applied energy or electromechanical systems. May be repeated for credit. *(On demand)*

Pre- or Co-requisites:

Consent of graduate advisor.

Objectives of the Course:

By the end of the course, students will be able to research and analyze problems in an emerging field of applied energy or electromechanical systems.

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	15%
Mid-term Exam:	25%
Course Project:	25%
Final Exam:	25%
Participation:	10%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

Text to be selected based on course topic and instructor preference.

Proposed Course Outline:

Outline to be selected based on course topic and instructor preference.

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6150 – SYSTEM DYNAMICS

Proposed Catalog Description:

ENER 6150. System Dynamics. (3) Pre or Corequisite: ETGR 5272. Energy-based modeling of dynamic mechanical, electrical, thermal, and fluid systems to formulate linear state equations, including system stability, time domain response, and frequency domain techniques. Two lectures and one three-hour laboratory weekly.

Pre- or Co-requisites: Pre or Corequisite: ETGR 5272.

ETGR 5272 or consent of instructor.

Objectives of the Course:

At the completion of the course students will be able to:

- Model multiple domain systems.
- Analyze, design and select hardware based on system models.
- Construct laboratory realizations based on design and modeling.

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	15%
Mid-term Exam:	25%
Course Project:	25%
Final Exam:	25%
Participation:	10%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture and during scheduled laboratory sessions is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

System Dynamics, Katsuhiko Ogata, Prentice Hall, 2003

ISBN-13: 9780131424623

Proposed Course Outline:

Week 1: System Dynamics Overview
Week 2: Laplace Transforms
Week 3: Mechanical Systems Overview
Week 4: Transfer Function Modeling
Week 5: State Space Modeling
Week 6: Electrical and Electromechanical Systems
Week 7: Fluid and Thermal Systems
Week 8: Time Domain Analysis
Week 9: Frequency Domain Analysis
Week 10: Sensors and Feedback
Week 11: Multiple Domain Modeling
Week 12: Block Diagrams in MATLAB
Week 13: SIMULINK
Week 14: Physical Plant Control Hardware
Week 15: Physical Plant Control Software

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6170 – APPLIED MECHATRONICS

Proposed Catalog Description:

ENER 6170. Applied Mechatronics. (3) Analog electronic design for purposes of controlling electromechanical systems, including electromechanical sensors and actuators, analog electronic design of filters, state-space and classical controllers, and transistor-based servo-amplifiers and high voltage amplifiers. Significant laboratory component with design and fabrication of circuits to control electromechanical systems. Implementation of digital controllers. Two lectures and one three-hour laboratory weekly.

Pre- or Co-requisites:

ENER 6150 or consent of instructor.

Objectives of the Course:

At the completion of the course students will be able to:

- Model multiple domain systems.
- Analyze, design and select hardware based on system models.
- Construct laboratory realizations based on design and modeling.

Instructional Method:

The course is presented in a mixed laboratory and lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, construction projects to be completed and tested in the laboratory and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	15%
Mid-term Exam:	25%
Course Project:	25%
Final Exam:	25%
Participation:	10%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture and during scheduled laboratory sessions is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

Mechatronics: A Multidisciplinary Approach, William Bolton, Prentice Hall, 2008
ISBN-13: 9780132407632

Proposed Course Outline:

Week 1:	Mechatronics Overview
Week 2:	Circuit Modeling
Week 3:	Analog Semiconductor Devices
Week 4:	Digital Controls
Week 5:	Motors and Generators
Week 6:	Transformers
Week 7:	High Voltage Devices
Week 8:	Windmills
Week 9:	Turbines
Week 10:	Sensors and Feedback
Week 11:	Multiple Domain Coupling
Week 12:	Project Consulting and Execution
Week 13:	Project Consulting and Execution
Week 14:	Project Consulting and Execution
Week 15:	Project Consulting and Execution

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ETEL 6220 - HIGH VOLTAGE TECHNOLOGY

Proposed Catalog Description:

ETEL 6220: High Voltage Technology (3) Covers concepts of high voltage generation, measurements, protection and safety. Students will study high electric fields theory, breakdown mechanisms in gases, liquids, and solid dielectrics. The high voltage insulation, including insulation coordination, will also be discussed. The course will also provide instructions on high voltage applications and safety.
.

Pre- or Co-requisites:

Knowledge of circuit analysis, basic calculus and differential equations, elementary matrix analysis

Objectives of the Course:

At the completion of the course students will be able to:

- Understand and safely utilize basic high voltage test techniques.
- Understand and model high voltage phenomena and their applications.
- Design high voltage insulation.

Instructional Method:

The course is presented in a lecture format combined with computer laboratory experiments using modeling software (Comsol Multiphysics, Matlab) and in-class demonstrations. The course will incorporate a high voltage insulation design project along with multiple activities involving research, discussion and student presentation assignments.

Means of Student Evaluation:

Students will be evaluated on their ability to design and analyze distribution and transmission systems. Student performance in the course will be evaluated on the following basis:

Homework:	25%
Mid-term Exam:	25%
Course Projects:	25%
Final Exam:	25%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is strongly encouraged but not enforced.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

High Voltage Engineering Fundamentals, John Kuffel, E. Kuffel, W. S. Zaengl, Newnes, 2000
ISBN: 978-0-7506-3634-6

Proposed Course Outline:

Week 1: Generation of high voltages.
Week 2: Measurement of high voltages: DC, AC and transients.
Week 3: Electrostatic fields. Electric field distribution.
Week 4: Electric field distribution, cont.

Week 5: Electric fields computations and modeling.
Week 6: Applications of high electric fields.
Week 7: Electrical breakdown in gases.
Week 8: Breakdown in solid and liquid dielectrics.
Week 9: Non-destructive insulation test techniques.
Week 10: High voltage safety.
Week 11: Overvoltages, testing procedures.
Week 12: Insulation coordination.
Week 13: Design and testing of external insulation.
Week 14: High voltage equipment: cables, switchgear, substations, transformers.
Week 15: High voltage equipment maintenance and aging issues.

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ETEL 6235: ADVANCED TRANSMISSION THEORY

Proposed Catalog Description:

ENER 6235: Advanced Transmission Theory (3) Prerequisite: ETGR 6135: Energy Transmission & Distribution or consent of the instructor. This course provides instruction on network steady-state analysis; faults; protection systems; switching equipment; voltage and power static control; surge voltages and protection, transient operation and stability, "smart grid" enabling technologies.. (*On demand*)

Pre- or Co-requisites:

ETGR 6135: Energy Transmission & Distribution or consent of the instructor.

Objectives of the Course:

At the completion of the course students will be able to:

- Design power transmission and distribution systems
- Design protection systems for power transmission and distribution network.

Instructional Method:

The course is presented in a lecture format combined with computer laboratory experiments using power system modeling software (ETAP). The course will incorporate a power system design project along with multiple activities involving research, discussion and student presentation assignments.

Means of Student Evaluation:

Students will be evaluated on their ability to design and analyze distribution and transmission systems and their protection. Student performance in the course will be evaluated on the following basis:

Homework:	25%
Mid-term Exam:	25%
Course Projects:	25%
Final Exam:	25%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is strongly encouraged but is not enforced. Students are responsible for catching up with any material that is missed due to absence from lectures.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

Modern Power System Analysis, D. P. Kothari and T. Nagrath, 1st ed., McGraw-Hill 2008, ISBN-13: 9780073404554

Electric Power Transmission System Engineering Analysis and Design, T. Gonen, 2nd ed., CRC Press 2009, ISBN-13: 9781439802540

Proposed Course Outline:

Week 1: Characteristics and performance of power transmission lines. Long line equations. Tuned power line.
Week 2: Power flow studies. Load flow methods.
Week 3: Optimal system operation.
Week 4: Methods of symmetrical fault analysis. Symmetrical components.
Week 5: Unsymmetrical fault analysis. Case studies.
Week 6: Selection of protective equipment. Device coordination analysis
Week 7: Transmission reliability studies and modeling.
Week 8: Transient operation. Parameter estimation.
Week 9: Whole system design – case study.
Week 10: Power system security.
Week 11: State estimation of power systems.
Week 12: Compensation issues. STATCOM and FACTS.
Week 13: Load forecasting.
Week 14: Smart grid technologies.
Week 15: Renewable energy sources.

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6250 – ADVANCED INSTRUMENTATION

Proposed Catalog Description:
ENER 6250: Advanced Instrumentation (3) Prerequisite: ELET2241 or ETME3163.
This course provides methodologies for measurement, analysis and control of physical components of conventional and renewable energy conversion and storage systems. Two lecture hours and one three-hour laboratory weekly.

Pre- or Co-requisites:

ELET 2241 or ETME 3163

Objectives of the Course:

At the completion of the course students will be able to:

- Select appropriate transducers for the measurement of mechanical, electrical, or chemical phenomenon
- Select the appropriate components and settings for data acquisition
- Design a calibration scheme for an instrument
- Efficiently troubleshoot an instrumentation design for sources of error and noise

Instructional Method:

The course is presented in a lecture format with an accompanying lab session which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, computer based simulations, and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, to efficiently complete hands on exercises in a laboratory setting, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	10%
Mid-term Exam:	25%
Course Project:	20%
Final Exam:	25%

Lab Exercises: 10%
Participation: 10%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. Late homework will incur a penalty of -20% on the assignment.

5. Electronic Devices

The use of cell phones, beepers, or other communication devices is disruptive, and is therefore

prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period. Students are permitted to use computers during class for note-taking and other class-related work only. Those using computers during class for non-class related work will asked to leave the classroom for the remainder of the class period.

Proposed Text:

Introduction to Instrumentation and Measurements, 2nd Edition, Robert Norton, CRC Press, 2005. ISBN-13: 978-0849337734
Or
Building Scientific Appartus, 4th Edition, Norman A. Anderson, Cambridge University Press, 2009. ISBN-13: 978-0521878586

Proposed Course Outline:

Week 1:	Standards and Measurements
Week 2:	Analog Signals
Week 3:	Digital Signals
Week 4:	Transient and Steady State Signals
Week 5:	Review of Electronics
Week 6:	Mechanical Transducers
Week 7:	Electrical Transducers
Week 8:	Chemical Transducers
Week 9:	Data Acquisition
Week 10:	Error Analysis
Week 11:	Noise: Sources and Solutions
Week 12:	Calibration
Week 13:	Data Filtering
Week 14:	Data Reduction & Representation
Week 15:	Novel and Emerging Sensors

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6260 - Computational Fluid Dynamics for Energy Applications

Proposed Catalog Description:

ENER 6260. Computational Fluid Dynamics (CFD) for Energy Applications. (3)
Prerequisite: Course in Math. Undergraduate course in heat transfer and undergraduate course in fluid dynamics. This course covers the fundamentals and the advances of the finite difference-finite volume, finite element and meshless computational fluid dynamics techniques with applications in energy systems. Introduction to the use of commercial CFD codes to analyze flow and heat transfer in energy related problems. SIMPLE model for incompressible flow, models of simple geometries are developed and studied, post processing and visualization. Overview of turbulence and turbulence modeling. *(Spring)*

Pre- or Co-requisites:

Course in Math. Undergraduate course in heat transfer and undergraduate course in fluid dynamics or consent of instructor.

Objectives of the Course:

At the completion of the course students will be able to:

- write a CFD code for 1-D and simple 2-D cases.
- use and analyze the performance of commercial CFD code
- design and analyze CFD experiments for energy systems applications.
- compare CFD results with experimental results and understand the limitations.
- .model turbulence and to use existing turbulence models for certain applications

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of material in a standard lecture format and writing in the board, problem solving, discussion of case studies, sessions on trouble shooting, discussion of assignments and projects and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

The students will be evaluated based on their ability to solve CFD problems and to apply what they learned in class to actual situations.
The final grade will be based upon the following proportions:

Homework Assignments	**20%**
Test #1	**15%**
Test #2	**15%**
Projects	**50%**

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

5. Projects

The course will include 4 projects to give students an opportunity to apply what they have learned to a specific CFD problem or challenge. Students will produce a final written report. A list of possible topics and examples will be circulated separately. The subject area can be a topic of your own choosing, or you can choose one of the options I have identified.

Proposed Text:

Computational fluid mechanics and heat transfer By John C. Tannehill, Dale Arden Anderson, Richard H. Pletcher. ISBN 10: 156032046X / 1-56032-046-X. ISBN 13: 9781560320463. Publisher: Hemisphere Pub. Publication Date: 1997. Class notes and lectures.

Other references
Computational Fluid Dynamics by John Anderson, ISBN-10: 0070016852 | ISBN-13: 978-0070016859 | Publication Date: February 1, 1995 | Edition: 1

Proposed Course Outline:

Week 1:	CFD applications in energy systems,
Week 2:	Basic equations and numerical analysis,
Week 3:	Assumptions and errors,
Week 4:	Numerical solution techniques and discretization.
Week 5:	Mesh generation
Week 6:	Near wall treatment
Week 7:	Boundary conditions
Week 8:	Review of current CFD work in energy systems
Week 9:	Examples and case studies of CFD applications in energy systems and fuel cells.
Week 10:	Examples and case studies of CFD applications in fuel cells.
Week 11:	Introduction to turbulence modeling
Week 12:	Two-equation turbulence models
Week 13:	Reynolds Stress Turbulence Model
Week 14:	Introduction to Commercial CFD packages
Week 15:	Parallel computing, post processing and presenting results.

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ETEL 6270 – DYNAMIC SYSTEMS CONTROL & DESIGN

Proposed Catalog Description:

ETEL 6270. Dynamic Systems Control & Design. (3) Prerequisite: ETEL 6170 or ELET 4242 or consent of instructor. This course covers dynamic systems control, its analysis and design. Analysis of linear feedback systems, deterministic and stochastic dynamic systems, their characteristics, robust stability and robust performance. Robust control, Kalman filter, and its design and compensation of deterministic and stochastic dynamic systems, including wind turbines system control and piezo (mechatronics) systems.

Pre- or Co-requisites:

ETEL 6170 or ELET 4242 or consent of instructor.

Objectives of the Course:

At the completion of the course students will be able to:

- Analyze robust stability of control systems;
- Understand digital computer control;
- Formulate wind generators and modeling;
- Analyze direct and indirect field oriented control of variable-speed wind energy systems;
- Understand Kalman filter; and
- Analyze distributed power system security analysis.

Instructional Method:

The course is presented in a lecture format which will include the following elements as appropriate: presentation of factual material in a standard lecture format, interactive demonstrations of methods to be applied in assignments, and opportunities for student questions, discussion, and presentations by students.

Means of Student Evaluation:

Students will be evaluated on their ability to answer factual questions regarding material presented in the class and assigned texts, to correctly solve problems using methods presented in the class, and to participate productively in critical discussion of course material. Student performance in the course will be evaluated on the following basis:

Homework:	10%
Exam 1:	40%
Exam 2:	50%

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Attendance

Attendance at lecture is required, although exceptions will be made for reasons such as illness or family emergency. Excessive absences will result in a reduced classroom participation score at the instructor's discretion, and will negatively impact the overall course grade.

3. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

4. Homework and Assignments

All homework and assignments are due on the dates determined by the instructor. No late homework and project will be accepted. Students must have a cumulative overall score of at least 80% on homework assignments in order to receive a passing grade for the course.

Proposed Text and References:

Journal papers, IEEE.

Lecture Notes.

Control System Design, Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Prentice Hall, 2001. ISBN: 978-0-139-58653-8.

Power Conversion and Control of Wind Energy Systems, Bin Wu, Yongqiang Lang, Navid Zargari and Samir Kouro, Wiley-IEEE Press, 2011. ISBN: 978-0-470-59365-3

Proposed Course Outline:

Week 1:	Introduction
Week 2:	Deterministic and stochastic dynamic systems
Weeks 3-4:	Robust stability analysis of control systems
Weeks 5-6:	Digital computer control
Weeks 7-8:	Wind generators and modeling
Weeks 9-10:	Direct & indirect field oriented control of variable-speed wind energy systems
Weeks 11-12:	Kalman filter
Weeks 13-14:	Distributed power system security analysis
Week 15:	Presentations

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6800 – INDEPENDENT STUDY IN APPLIED ENERGY OR ELECTROMECHANICAL SYSTEMS

Proposed Catalog Description:

ENER 6800. Independent Study in Applied Energy or Electromechanical Systems. (3)
Prerequisite: Consent of graduate committee advisor. Individual investigation and exposition of results for a directed project in applied energy or electromechanical systems.. May be repeated for credit. *(On demand)*

Pre- or Co-requisites:

Consent of graduate committee advisor.

Objectives of the Course:

By the completion of this course students will be able to demonstrate proficiency in independently researching and completing a directed project in applied energy or electromechanical systems.

Instructional Method:

No formal lecture. However, students will meet periodically over the course of the semester with their graduate advisor for mentoring and direction on their selected project.

Means of Student Evaluation:

Students will be evaluated based on the technical accuracy and completeness of their directed project.

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Grading Policy

Grades will be assigned on the following scale:

A = 90-100%
B = 80-90%
C = 70-80%
U = 0-70%

Proposed Text:

None

Proposed Course Outline:

None

PROPOSED COURSE DESCRIPTION AND SYLLABUS
ENER 6900 – MASTER'S THESIS & RESEARCH

Proposed Catalog Description:

ENER 6900. Master's Thesis & Research. (1 – 6) Prerequisite: Consent of graduate committee advisor. Individual investigation culminating in the preparation and presentation of a thesis. May be repeated for credit. *(On demand)*

Pre- or Co-requisites:

Consent of graduate committee advisor.

Objectives of the Course:

By the completion of this course students will be able to demonstrate proficiency in independently researching, completing and defending a thesis quality project in applied energy or electromechanical systems.

Instructional Method:

No formal lecture. However, students will meet periodically over the course of the project with their graduate advisor for mentoring and direction on their research project.

Means of Student Evaluation:

Students will be expected to prepare a formal written research thesis and to successfully present and defend their research in front of their graduate committee.

Specific Course Policies:

The following policies apply to students in this course:

1. Academic Integrity

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at: http://www.legal.uncc.edu/policies/ps-105.html. A set of links to various resources on plagiarism and how to avoid it is available at the UNCC Library website: http://library.uncc.edu/display/?dept=instruction&format=open&page=920.

2. Grading Policy

Grades will be assigned on the following scale:

A = Successful defense of research thesis
U = Unsuccessful defense of research thesis

Proposed Text:

None

Proposed Course Outline:

None

Attachment B: Consultation Documentation

Internal Consultation Letters:

- Alison Bradley – UNC Charlotte Library
- Scott Smith, Chair, Dept. of Mechanical Engineering & Engineering Science, UNC Charlotte
- Ian Ferguson, Chair, Dept. of Electrical & Computer Engineering, UNC Charlotte
- Alan Dow, Chair, Dept. of Mathematics, UNC Charlotte

Library Consultation

UNC CHARLOTTE

J. Murrey Atkins Library
Consultation on Library Holdings

To: Peter Schmidt
From: Alison Bradley
Date: 10/18/11
Subject: MS Applied Energy and Electro-Mechanical Systems

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley **Date: 10/18/11**

Check One:

1. Holdings are superior ____
2. Holdings are adequate ____
3. Holdings are adequate only if Dept. purchases additional items. __x__
4. Holdings are inadequate ____

Comments:
Current monograph and journal holdings are adequate to support a portion of the proposed program. Library holdings related to energy infrastructure and production are not currently sufficient to support graduate level research, but with the existing allocation for EPIC research collections they will be able to support research by the time that the program begins. Available databases (including IEEE Xplore, ACM Digital Library, and Compendex)

LC Subject Heading	Total items	Periodicals	Electronic resources	Government Documents
Power Resources	1417	22	203	790
Electric Power	1509	30	520	794
Electric Power Plants	298	0	40	196
Power Transmission	15	2	3	6
Electric Power Systems	350	10	141	116
Mechatronics	13	0	6	0

Evaluator's Signature

10/18/11

Date