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University Council

March 15, 2019

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Dear Colleagues:

The attached proposal from the College of Engineering to offer the existing major in Engineering (M.S.) with a Non-Thesis option will be an agenda item for the March 22, 2019, Full University Curriculum Committee meeting.

Sincerely,

John Maerz, Chair
University Curriculum Committee

cc: Interim Provost Libby V. Morris
Dr. Rahul Shrivastav

**Proposal to Add a Non-Thesis Option to the M.S. in Engineering**

Submitted to: Dr. Suzanne Barbour
Dean, Graduate School

Submitted and Prepared by: Lawrence A. Hornak, Ph.D., Associate Dean for Research and Graduate Studies

**Basic Information**:

Proposed Change: Establishing a non-thesis option for in the major in Engineering (M.S.) and its associated emphasis areas for students pursuing a non-research, professionally-oriented career path.

Start Date: Fall 2019

**Program Description**:

The College of Engineering requests that a non-thesis path be added as an option for the major in Engineering (M.S.). While the M.S. with thesis is a key credential for students in the engineering disciplines continuing on to doctoral study, the majority of master's students in engineering, both at UGA and nationally, either complete their M.S. and then begin their professional careers or complete their M.S. part-time while employed. Nationally, the vast majority of the over 200 engineering programs in the United States offer non-thesis programs to serve this student population and employer need. We anticipate that a non-thesis option for UGA's Engineering (M.S.) will expand opportunities for students who are either in, or wish to directly enter, a professional career.

The Engineering (M.S.) provides students with the opportunity for training oriented to solving complex problems that may transcend engineering disciplines or fields. The current Areas of Emphasis in Civil Engineering (CE), Electrical and Computer Engineering (ECE), or Mechanical Engineering (ME) under the major in Engineering (M.S.) enable students to more deeply focus their master's course work in either a specific disciplinary specialty or interdisciplinary area to meet the student's career objectives. For the thesis M.S., selection of an Area of Emphasis is optional as the thesis serves to provide specific focus to the student's program of study. For the proposed non-thesis M.S. option, students will be required to select an area of emphasis in order to achieve this focus in their studies. The requested non-thesis M.S. contains all the courses already required of thesis M.S. students and will include the same elective course sets now offered across the emphasis areas.

Non-thesis students will be advised in assembly of a coherent program of study by a faculty advisor or graduate director in the School of their chosen Area of Emphasis. Non-thesis M.S. students will replace the minimum research (6 credits) and thesis hours (3 credits) with 6 hours of additional Area of Emphasis courses and 3 hours of elective credits at the 6000–8000 level for a total of 33 credits. Thus, the number of total credit hours for both thesis and non-thesis tracks are identical.

Depending on the area of emphasis chosen and the degree objective of the student, the non-thesis option can be coursework only, or it can include no more than 3 credit hours of a project and report (ENGR 7010, Project-Focused Masters Research) under the guidance of a faculty member. Such a non-thesis project and report is generally not research-oriented, but deals with other aspects of an engineering problem. The current ME and ECE emphasis areas all require a 3-credit-hour project report for the proposed non-thesis MS option.

The following table outlines the program of study that is required for the current thesis option and the proposed non-thesis option.

| **Current** M.S With Thesis with an Area of Emphasis in Electrical and Computer Engineering or an Area of Emphasis in Mechanical Engineering | | **Proposed** M.S. Non-Thesis with an Area of Emphasis in Electrical and Computer Engineering or an Area of Emphasis in Mechanical Engineering | |
|---|---|---|---|
| | | | |
| Courses | 24 | Courses | 33 |
| Elective Courses: 23 hours | | Required Emphasis Area Courses: 9-15 hours | |
| or | | Additional Emphasis Classes or School Approved Engineering Courses: 6 hours* | |
| Elected Emphasis Area: 9-15 hours | | | |
| Elective Coursework: 8-14 hours | | Graduate Seminar: 1 hour | |
| and | | | |
| Graduate Seminar: 1 hour | | | |
| Research and Thesis (9 credits)<br>ENGR 7000, Master's Research<br>ENGR 7300, Master's Thesis | 6<br>3 | Additional Coursework: 11-17 hours, that must include 3 hours of ENGR 7010, Project-Focused Masters Research | |
| | | | |
| Minimum Total Credit Hours: | 33 | Minimum Total Credit Hours: | 33 |

* For students doing a non-thesis option from the ECAM School of Engineering, a minimum of 15 hours of coursework must be in ECAM approved Engineering courses.

**Faculty Vote**

Consistent with our College's Faculty Governance, the College Curriculum Committee composed of faculty member representatives from each of our schools voted on and approved by majority vote the non-thesis M.S. proposal.

**Justification for the Proposed Non-Thesis M.S. Option**

The requested non-thesis option rounds out our Engineering (M.S.) offerings and makes us competitive with our peers in recruitment of professionally-oriented students into our program. Among UGA's peer comparator group, 13 of 15 or nearly 90 percent offer master's students in engineering disciplines a non-thesis option. These include Virginia Tech, Michigan State, University of Kentucky, Iowa State, University of Arizona, University of Iowa, North Carolina State University, University of Florida, Ohio State, Purdue, University of Missouri – Columbia, Stony Brook, UC Davis. This reflects the fact that there exist significant opportunities for students with the additional training possible

with an M.S. degree that do not require completing research and a thesis.

The establishment of a non-thesis option for the M.S. in Engineering will:

- Enable the UGA College of Engineering to recruit students interested in a terminal professional master's,
- Encourage our own B.S. Engineering students to stay for an additional year to complete a 5-year Double Dawgs B.S.-M.S. program, and
- Better serve local industry in their recruitment, retention, and training of professional talent through providing a master's opportunity locally for their engineering employees.

**Admission Procedure for Domestic Applicants**

As with the thesis M.S., students will apply using the established Graduate School Application process for admission. Those applications will be reviewed by the Graduate Admissions and Advisory Committee of the College which has faculty representatives from each of our three Schools and is chaired by the College's Graduate Coordinator. The admissions standards will be the same for students applying for either the thesis or non-thesis option.

**Admission Procedure for International Applicants**

Other than the graduate school international admissions and test score requirements, the basic admission procedure will be the same for international as well as domestic applicants.

**Impact on Current Students**

We do not anticipate any adverse impact on current M.S. students. The positive impact will be to give our existing students another option for a program they need for their desired careers. In addition, this program will contribute to our planned growth of our graduate enrollment enabling us to offer a more robust set of courses on a more regular basis for our students. As with the availability of any new program or program track, students currently enrolled in the Engineering M.S. or Ph.D. program will have the option of changing to a non-thesis M.S. (and completing their chosen emphasis requirements) or continuing with the current degree objective. We do not anticipate that many of our current students will switch to a non-thesis option.

**Financial Impacts**

There is adequate capacity in existing courses. The growth in graduate student enrollment expected will result in more regular and expanded offering of courses which currently have FTE committed to them but often may not make minimum enrollment. No new faculty, facilities, or services will be required to implement a non-thesis option for the M.S. degree. Thus, no new funds are required.

**Assessment**

We currently have a strong assessment plan for our graduate program. We will make necessary adjustments for the non-thesis M.S. track so that this program can be properly assessed. We currently envision assessment to include both direct and indirect measures to evaluate the student learning outcomes through longitudinal study of the students. Direct measures include, evaluating student performance in core courses in the program, required project report(s), any professional exams students take. Indirect measures include analysis of data collected through our exit survey of graduate students, and feedback from employers and prospective employers through our recruitment fairs

and our school and college advisory boards.

# Electrical and Computer Engineering Area of Emphasis Courses

Coursework fulfilling the ECE Emphasis Area credit hour requirement for the M.S. in Engineering degree may be chosen from one or more of the areas below. Courses will be reviewed each academic year and updated as needed to reflect new areas in the field.

**Track 1: Control Systems**

- CSCI(ENGR) 8940 - Computational intelligence (4 hours)
- ELEE 8240 - Instrumentation programming (3 hours)
- ENGR 8220- Microfluidic Transport Phenomena (3 hours)
- ENGR 8930 - Optimization Theory and Engineering Applications (3 hours)

**Track 2: Electronics & Photonics**

- CSEE(CSCI) 8840 - Advanced Image Analysis (3 hours)
- ELEE 8310 - MEMS Design (3 hours)
- ELEE 8510 - Microwave Photonics (3 hours)
- ELEE 8530 - Advanced Optics and Photonics (3 hours)
- ENGR 8570 - Topics in Advanced Microscopy (3 hours)
- PHYS 8201 - Advanced Electromagnetic Theory I (3 hours)
- PHYS 8202 - Advanced Electromagnetic Theory II (3 hours)

**Track 3: Cyber-physical Systems**

- CSCI 8250 - Advanced Cyber Security (4 hours)
- CSCI 8380 - Advanced Topics in Information Systems (4 hours)
- CSCI 8820 - Computer Vision and Pattern Recognition (4 hours)
- CSCI(ENGR) 8940 - Computational intelligence (4 hours)
- CSEE 8300 – Principles of Cyber-Physical Systems (3 hours)
- CSEE 8830 - Virtual Reality and Augmented Reality User Interface Design (3 hours)
- CSEE(CSCI) 8840 - Advanced Image Analysis (3 hours)
- ELEE 8240 - Instrumentation programming (3 hours)
- ENGR 8990 - Advanced Topics in Engineering (1-3 hours)

# Mechanical Engineering Area of Emphasis Courses

As a requirement of the M.S. Engineering Degree with Emphasis in Mechanical Engineering, students must complete a minimum of 9 credit hours selected from among the list below. Students will work with their graduate advisor to select the most appropriate specialty area and coursework.

## *Design, Optimization, and Manufacturing*

- CHEM 8880, Nanomaterials: Engineering and Characterization (3 hours)
- CVLE/MCHE 8640, Advanced Strength of Materials (3 hours)
- ELEE 4220/6220, Feedback Control Systems (3 hours)
- ELEE 4230/6230, Sensors and Transducers (3hours)
- ELEE 4260/6260, Introduction to Nanoelectronics (3 hours)
- ELEE 4540/6540, Applied Machine Vision (3 hours)
- ELEE 6210, Linear Systems (3 hours)
- ELEE 8310, MEMS Design (3 hours)
- ENGR 6350, Introduction to Finite Element Analysis (3 hours)
- ENGR 6920, Theory of Design (3 hours)
- ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 hours)
- MCHE 4360/6360, Robotic Manipulators (3 hours)
- MCHE 6390, Advanced Mechanical Vibration (3 hours)
- STAT 6315 Statistical Methods for Researchers (4 hours)

## *Energy, Fluid, and Thermal Systems*

- CVLE (MCHE) 8160, Advanced Fluid Mechanics (3 hours)
- ENGR 4350/6350, Introduction to Finite Element Analysis (3 hours)
- ENGR 4490/6490, Renewable Energy Engineering (3 hours)
- ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 hours)
- MCHE 4650/6650, HVAC Systems for Buildings and Industry (3 hours)
- MCHE 8170, Advanced Heat Transfer (3 hours)
- MCHE 8380, Continuum Mechanics (3 hours)
- PHYS 4300/6300, Thermodynamics and Kinetic Theory (3 hours)
- PHYS 8301, Statistical Mechanics I (3 hours)
- STAT 6315, Statistical Methods for Researchers (4 hours)

## *Mechanics and Materials*

- BIOE 4740/6740, Biomaterials (3 hours)
- BIOE 4760/6760, Biomechanics (3 hours)
- CVLE (MCHE) 8350, Nonlinear Finite Element Analysis (3 hours)
- CVLE (MCHE) 8640, Advanced Strength of Materials (3 hours)
- ENGR 6350, Introduction to Finite Element Analysis (3 hours)
- ENGR 8103, Computational Engineering: Fundamentals, Elliptic, and Parabolic Differential Equations (3 hours)
- ENGR 6270, Computational Nanomechanics (3 hours)
- MCHE 8380, Continuum Mechanics (3 hours)

# Approvals on File

**Proposal:** Offer the existing major in Engineering (M.S.) with a Non-Thesis option

**College:** College of Engineering

**Department:** College of Engineering

**Proposed Effective Term:** Fall 2019

School/College:

- Associate Dean for Research and Graduate Studies, Dr. Lawrence Hornack, 1/16/2019
- College of Engineering Dean, Dr. Donald Leo, 1/16/2019

Graduate School:

- Graduate School Dean, Dr. Suzanne Barbour, 3/20/2019