Academic Program Review

Engineering Graduate

Master's Program

Self-Study Report

Academic Years 2011-2015

Table of Contents

Preface and History

The last review of the Graduate Engineering program at the University of Tennessee, Chattanooga (UTC) was in 2010. The major recommendations resulted from the previous program review included increasing the number of graduate assistants, decreasing faculty teaching loads, and creating a higher profile for the program through enrichment of student experience. During the years ensuing the visit, these recommendations have all been addressed. The number of graduate assistants has increased 50%, from 8 in 2010 to 12 in 2015. This along with hiring more faculty and adjunct professors helped to decrease the overall teaching load for each faculty member. For the program enrichment, the program has been enhanced by course offerings for students to study with peers majoring in other disciplines and to work with those peers through activities sponsored by the Graduate Students Association (GSA). The SimCenter, a research center focusing on engineering and scientific simulation and modeling, has been fully integrated with the program and supports the research activities of the engineering graduate program.

Other minor recommendations made in the last program review included increasing courses offered online, continuing to increase enrollment, updating computer resources, allocating additional space for graduate students, growing secretarial support, and increasing library resources. These issues have also been successfully addressed. For online courses, some Mechanical Engineering and the new Automotive Systems Engineering courses are offered online. The Electrical Engineering concentration courses can now be taken fully online. The program enrollment grew, new computers are in use, the graduate student space was enlarged, additional support staff members

were hired, and the new library, which opened in January 2015, now carry pertinent onsite and online research materials.

A. History of the University of Tennessee at Chattanooga

The University of Tennessee at Chattanooga is a metropolitan university located in the southeastern corner of the state of Tennessee. Chattanooga's metro area has a population of approximately 500,000 people who reside in not only Chattanooga, but also portions of North Georgia and Northeastern Alabama.

The University of Tennessee at Chattanooga (UTC) became part of the University of Tennessee System in 1969. The System consists of four major campuses located in Chattanooga, Knoxville, Martin, and Memphis. Governance is provided through a UT System President, Chancellors on each campus, and a UT Board of Trustees. The Governor of the State appoints Board members and serves as Chairman of the Board.

Prior to becoming part of the UT System, the university was a private university, known as the University of Chattanooga (UC). UC was founded by an agency of the Methodist Episcopal Church in 1886. Other institutions in the Chattanooga area, including Chattanooga City College (CCC), a predominately African-American University, became part of the UT System merger in 1969.

At the time of the merger in 1969, UC's student population was slightly more than 2,200. Now as a public institution, UTC serves approximately 12,000 students. Approximately 11 percent of UTC's students are enrolled in graduate programs. Overall, UTC's students represent not only Tennessee (coming from 70 Tennessee counties), but also more than 40 states and 40 foreign countries.

B. Background of the Graduate Engineering Program

The Master of Science (MS) degree in Engineering (http://www.utc.edu/college-engineering-computer-science/graduate-programs/msengr.php) at UTC is designed for people with engineering or science backgrounds who are seeking technical advancement in their field of expertise. The program has seven concentrations: chemical, civil, computational, electrical, industrial, mechanical, and automotive systems engineering. These, along with any respective focus areas, are listed in Table 1.

Table 1. Program Concentrations and Focus Areas

Concentration	Available Focus Areas
Chemical	Environmental
	Chemical Sciences
Civil	
Electrical	Power and Energy
	Communications and Signal Processing
	Microelectronics and Computer Systems
	Power Systems Management
Computational	
Industrial	
Mechanical	Energy
	Mechanics
Automotive Systems	

The graduate engineering curriculum is made of courses coming from four different areas, as shown in Table 2. To earn a master's degree in engineering, graduate students must complete a minimum of 30-31 credit hours with the thesis option, or 31-33 credit hours with the project option.

Table 2. Areas of Graduate Engineering Program		
Area I	Mathematics or Engineering Analysis	3-6 Hours
Area II	Approved Electives in Mathematics, Science, or Engineering	6-9 Hours
Area III	Engineering Concentration	12-16 Hours
Area IV	Thesis or Special Project and/or Internship	6 Hours

Within the guideline shown in Table 2, the graduate engineering program at the College of Engineering and Computer Science ensures the curriculum, with sound academic practice, meets individual student's needs. Toward that end, a student can choose their courses from a number of focus areas, called concentrations. Concentrations in the engineering master's program are supported by four areas of courses, consisting of math or engineering analysis, concentration, and thesis/project courses. With the approval of the Graduate Engineering Committee, students can fulfill the six hours of 5000-level courses and three hours of Engineering Project course or six hours of Thesis course when they perform work in industry or in governmental organizations. Required semester credit hours for graduation range from 30 to 33, depending on the student's selection of thesis or project.

Part I. Learning Outcomes

1.1. Learning Outcomes

The desired learning outcomes of the MS Engineering program graduates are as follows:

- **Communication:** Communicate and present effectively
- **Engineering Fundamentals:** Understand and apply engineering fundamentals
- **Technical Writing:** Writing a thesis or project

1.2. Program Evaluation

The outcomes of the MS Engineering program are regularly evaluated using rubrics developed by the College to measure students' mastery of engineering fundamentals along with communication and technical writing skills.

Workshops focused on writing and presenting a thesis and/or project are provided each semester to enhance students' preparation for these assessments. Additionally, students who pursue a master's degree in engineering without an undergraduate engineering degree are required to take additional undergraduate courses prior to beginning graduate-level engineering courses to ensure they acquire vital foundational skills.

Building on the goal to enhance student achievement, the Electrical Engineering Department now offers a Graduate Seminar (1 hr.) course to inform graduate students of the expectations for this concentration, introduce faculty and their areas of expertise, develop students' professional connections through guest speakers from campus and industry, and assist students with project selection and technical writing. Other departments are now considering offering an optional Research Methodologies course

to assist graduate students who choose the thesis option with writing and presentation.

A. Theses or Projects

The thesis or project is the application of engineering theory to the real world. To complete a thesis or project, students must conduct a literature review of topics related to the thesis/project, collect and analyze the data, and draw conclusions, which culminates in the submission of the final thesis/project. Projects are usually more applied research and stem from real world situations. On the other hand, a thesis requires a more theoretical work. Documentation of professional quality and an oral defense are required for both the thesis and project options. Below are the steps that graduate students must follow to complete the thesis/project:

- Identify a potential thesis/project of interest and discuss it with the faculty adviser;
- Write a proposal;
- Develop a schedule;
- Select committee members;
- Conduct literature review;
- Collect data;
- Analyze data;
- Write conclusions and recommendations; and
- Write the thesis or project report and present it.

For the last two years, graduate engineering students have completed a variety of theses/projects in collaboration with various local and regional industries. Table 3 shows a selected list of these theses or projects.

Table 3. Short List of Theses/Projects Completed by UTC Engineering Students			
Student	**Thesis/Project Title**	**Committee Chair**	**Program**
1	Combined heat and power: technology review and analysis for a residential building	Dhamshala, Prakash	Mechanical Engineering
2	Glycerin and the market	Jones, Frank	Chemical Engineering
3	Heat of combustion of algae for use in a diesel engine	Thomas, Tricia	Chemical Engineering
4	Fast bus protection using iec 61850	Eltom, Ahmed	Electrical Engineering
5	Transformer load tap changer control using IEC 61850 GOOSE messaging	Eltom, Ahmed	Electrical Engineering
6	Heat and mass transfer models of the University of Tennessee at Chattanooga distillation column	Henry, Jim	Chemical Engineering
7	Analysis of two-stage shunt capacitor bank protection deficiencies with mitigation suggested	Eltom, Ahmed	Electrical Engineering
8	Pavement management analysis of Hamilton County using HDM-4 and HPMA	Onyango, Mbakisya	Civil Engineering
9	Analysis and implementation of a high-order reconstruction algorithm for an unstructured finite volume flow solver	Sreenivas, Kidambi	Computational Engineering
10	Potential energy cost savings by use of building roofs as thermal storage of a multi-storied building	Dhamshala, Prakash	Mechanical Engineering

B. Assessment and Follow up actions

The performance of graduate students are assessed using student evaluations given during each semester. These evaluations' results are reviewed at the Departmental level to make corrective actions, if necessary. In addition, each course has a folder, either electronically or hard copy, where faculty keeps their materials, graded work, students' artifacts, etc.

Students' learning performance is assessed based on the three learning outcomes, from section 1.1, as follows:

- **Communication:** The College of Engineering and Computer Science provides thesis workshops throughout the semester to prepare students for their final capstone/thesis presentations. The thesis oral communication assessment rubric for graduate students evaluates organization, content, presentation length, visual aids, attention to audience and speaking skills. The written communication assessment rubric for graduate students evaluates drafting, editing, revision, final draft, and timing. These rubrics are shown in Appendix I. The minimum requirement for the program is to have a 75% average performance for all three criteria. The latest assessment conducted in 2015 shows, all students meet the minimum requirement for this criteria and no follow up action is necessary.
- **Engineering Fundamentals:** The latest assessment conducted in 2015, students with engineering undergraduate degrees do well in engineering fundamentals, but others are in need of additional assistance. Even though the average exam grades, 80%, are above the minimum requirement, a follow up action was deemed necessary for students without engineering undergraduate degrees. These students are now required to take

additional bridge courses prior to taking 5000-level engineering courses.

- **Technical Writing:** The latest assessment shows, students do a good job in technical writing, evaluated using theses and projects. However, more assistance is needed for international students. A planned follow up action is to develop a research methodologies course that can be optionally taken by students to improve their technical writing skills.

1.3. Use of Evaluation Information

The College of Engineering and Computer Science has a Graduate Curriculum Committee with representation from each department, which reviews and makes necessary changes in the graduate curriculum every year based on student evaluations and assessment results (Section 1.2, B), as shown in Figure 1.

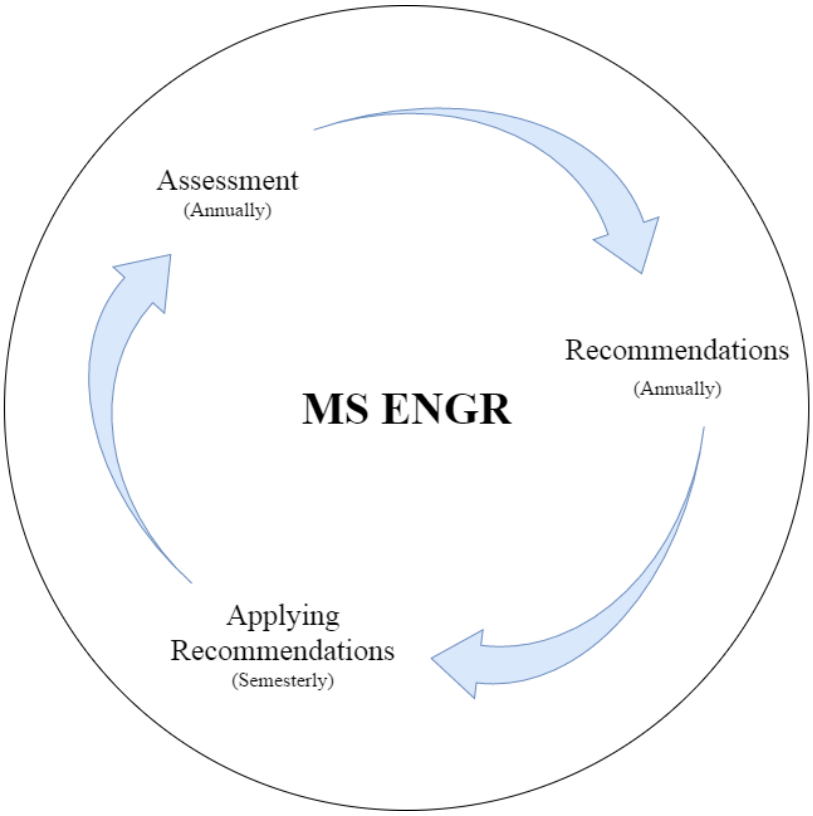

Figure 1. MS Engineering Assessment Cycle

1.4. Institution's Mission

The MS Engineering program is designed to align directly with the UTC and College of Engineering and Computer Science's mission, vision, and values, as shown in Table 4.

Table 4. Alignment of Mission, Vision, and Values

	UTC	College of Engineering and Computer Science
Mission	The University of Tennessee at Chattanooga is a driving force for achieving excellence by actively engaging students, faculty and staff; embracing diversity and inclusion; inspiring positive change; and enriching and sustaining our community. At UTC… we develop a community on campus…enable students to go into the global community and achieve… provide a nurturing environment that connects students, community and opportunity.	1) Educate and train future technical & engineering management workforce for Tennessee, the nation, and beyond. 2) Discover new knowledge in engineering, management, technology, and computer science. 3) Engage communities through scholarship, service and economic development.
Vision	We Engage Students, Inspire Change and Enrich Community. We nurture students through community connections… tied to our values and our region… grounded in Chattanooga… a great drawing card… we value our place.	To be a preeminent college of engineering, engineering management, technology, and computer science in education and applied research.
Core Values/ Goals	• Students are the primary reason we exist as an institution. • We live integrity, civility and honesty. • We relentlessly pursue excellence. • We embrace diversity and inclusion. • Creativity, inquiry and scholarship are our culture. • We teach… we learn… we interact… we nurture… we grow citizens for tomorrow… we do the basics and more.	• Enrich Student Experience • Cultivate excellence in teaching and learning • Enhance applied research capabilities of the college for broader impact to the society • Engage community through scholarship and service with leadership and distinction • Enhance national/international reputation and recognition

Part II. Curriculum

2.1. Curriculum Review

The MS Engineering curriculum has been revised multiple times in the last five years to appropriately address the needs of current students and attract new students. Specifically:

1) A new concentration, Automotive Systems Engineering, has been added;
2) Additional graduate courses are now available online; and
3) New graduate courses have been added to enhance student learning and preparation for real world.

A new Automotive Systems Engineering concentration was launched in the Fall of 2016 in response to the local demand created by a changing business environment and a changing student population. The curriculum is designed to provide students with the knowledge and skills necessary to function effectively in automotive work environments.

To increase the flexibility of the MS Engineering Program, some of the courses in the Automotive Systems Engineering and Mechanical Engineering concentrations are offered online, the Electrical Engineering concentration can now be taken fully online, and there are plans for other concentrations to follow suit.

Finally, there are a number of undergraduate and graduate engineering courses that are similar to each other. These courses have different syllabi, course descriptions and course numbers, but can sometimes share lectures. This has resulted in a decreased teaching load for faculty and a larger peer group for graduate students. Please see Section 2.3 for details on the additional requirements of graduate courses.

2.2. Course Scheduling and Offerings

The curriculum has been designed to be flexible and convenient with courses offered regularly, enabling students to make timely progress towards their degrees. Students can finish their master's degrees in engineering in two years by taking two courses per semester (including summers). At least two core courses and two elective courses are offered each fall and spring semester, in addition to the "Special Topics in Engineering" and "Thesis/Project" courses. Table 5 shows the courses that have been offered in the past two years and the enrollment in each.

Table 5. Graduate Engineering Courses Offered in the Last Two Years.

Course Enrollment* offered in Past Two Years								
COURSE INFORMATION			ACADEMIC YEAR 2014-2015			ACADEMIC YEAR 2015-2016		
NO.	TITLE	CREDIT HOURS	FALL	SPRING	SUMMER	FALL	SPRING	SUMMER
ENGR								
5010	Intro to Nuclear Power Engr	3	3					
5040	Dec Making & Optimiz Techng	3	3				1	
5260	Water & Wastewater Treatment	4		6				
5320	Advanced Thermodyns	4	11			1		
5340	Transport Phenomena	4		7			5	
5380	Heat Conduction & Radiation	4	2	5		2	1	
5420	Finite Element Analysis	4						
5449	Engr Analyis Renew Energy Res	4		2			5	
5520	Reliability Engineering	3				3		
5540	Technical Project Management	3	2					
5600	Statically Indeterminate Struc	4				3		
5660	Adv Civil Engr Materials	3	3					
5680	Infrastr Sys Analysis & Design	3	4					
5900	Engineering Project	3	5	9			3	6
5910	Spec Top in Reliabil in Exper	3	1					
	Spec Top in Thrml Comp Design	3	4			1		3
	Special Topics in Chem Process	3	1					
	Special Topics in Frac Distill	3	4					
	Spec Top in Adv Engr Analysis	3		7				
	Spec Topics in Advn Con Tec	1		1				
	Special Topics in Finite Elm A	3		3				
	Special Topics in Geotech Engr	4		1				
	Special Topics in Nuclear Powe	3		2				
	Advd Fluid Mechanics	3				3		
	Automotive Engineering	3				6		
5920	Graduate Internship in Engr	1	1	2	1	3	3	2
5997	Individual Studies	9				1		
5999	Thesis	4		1				8
	Thesis	6	15	11	6	10	8	
ENEE								
5000	Graduate Seminar	1		21			11	
5020	Linear Systems	3	19			9		
5030	Digital Signal Processing	3	3			3		
5110	Digital Communications	3					3	
5520	Power System Operations	3		14			6	
5610	Power Electronics & Drives	3		15			7	
5620	Power System Protection	3	12			19		
5630	Set and Test Digital Relays	3		6			7	
5650	Sustainable Elec Energ Sys	3				18		
5660	Smart Power Systems Dist	3		19			13	
5700	Microcomputer Applications	3				2		
5720	Power Sys Analysis and Design	3	6	3			6	
5910	Artifical Neural Networks	3	12					
	Power System Stability and Con	3	8			7		
	Advnce Elec and Integrt Circts	3		1				
	Network Communications	3		1				
	Wireless Embedded Systems	3		2				
	Fuzzy Logic and Intel Cntrl Ap	3				10		
	Advc Fuzzy and AI Controls App	3					2	
	Real-Time Embedded Systems	3					4	
5997	individual Studies	3					1	
5999	Thesis	4	1	2		2	2	

2.3. Comparison with Similar Undergraduate Courses

The MS Engineering program curricula frequently covers academic contents that build off the fundamentals taught in undergraduate courses. In such cases, graduate coursework delves deeper into the conceptual points of the field. Students are encouraged to spend time on key derivations rather than focusing solely on outcomes as a way of illustrating methods they will find useful. The syllabi for two graduate courses (Advanced Engineering Economy and Advanced Quality Control) and their respective undergraduate courses (Engineering Economy and Quality Control and System Reliability) are provided in Appendices H and G, respectively, as examples.

2.4. Alignment with Learning Outcomes

The MS Engineering program has clear learning outcomes related to communication skills, engineering knowledge, and technical writing skills that graduate students must master to successfully complete the program. The outcomes are aligned with the MS Engineering curriculum as shown in Figure 2.

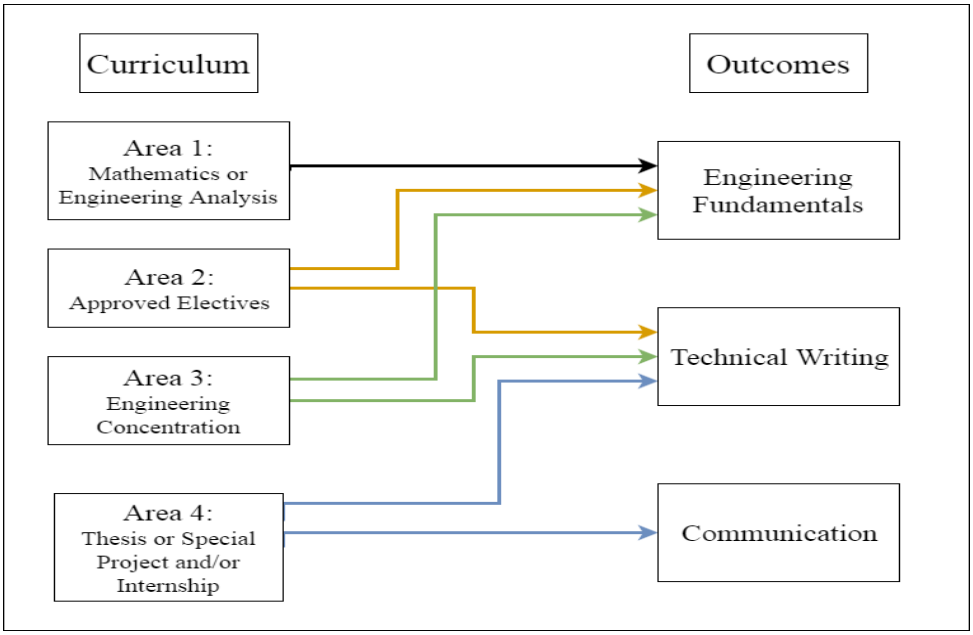

Figure 2. MS Engineering Curriculum Alignment with Program Outcomes

2.5. Curricula Structure

A. Engineering Program Curricula Samples

Below are examples of the graduate program curricula for sample Engineering concentrations. Other sample curricula, requirements, and course descriptions for all other concentrations can be found in the Graduate Catalog at http://catalog.utc.edu/preview_entity.php?catoid=17&ent_oid=745&returnto=567. The MS Engineering program aims to ensure that knowledge of the literature of the discipline is incorporated in its curriculum, as can be seen from course syllabi, shown in Appendix H.

Engineering: Automotive Systems, M.S.

Area II Details (approved math or science plus any course in Area III)

Area III: Specialty Details (18 hours)

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1 course from this group

- **ENGR 5060 - Automotive Engineering**
- **ENGR 5160 - Mechatronics I**

1 course from this group

- **ENGR 5420 - Finite Element Analysis**
- **ENGR 5440 - Applied Mechanics**

2 courses from this group

- **ENCM 5100 - Computational Fluid Dynamics I**
- **ENCM 5340 - Viscous Flow Theory**
- **ENEE 5700 - Microcomputer Applications**
- **CPSC 5170 - User Interface Development**
- **CPSC 5720 - Real-Time Embedded Systems**
- **ENGR 5210 - Advanced Simulation and Modeling**
- **ENCM 5210 - Introduction to Parallel Algorithms**

2 courses from this group

- **ENGR 5590 - Systems Engineering and Analysis**
- **ENGM 5520 - Reliability Engineering**
- **ENGM 5560 - Quality Management Systems**
- **ENGM 5570 - Advanced Quality Control**
- **ENGM 5580 - Advanced Engineering Economy**
- **An approved Graduate Business course in Finance or Strategic Management**

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Chemical: Chemical Sciences, M.S.

Area I: Mathematics Component* (3-6 hours)

- **MATH 5470 - Applied Mathematics for Science and Engineering I**
- **MATH 5480 - Applied Mathematics for Science and Engineering II**
- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Additional Information and Notes

*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Additional Requirements (6-9 hours)

- **ENGR 5580 - Advanced Engineering Economy**

Area III: Specialty (12-16 hours)

- **ENGR 5320 - Advanced Thermodynamics**
- **ENGR 5340 - Transport Phenomena**
- **ENGR 5360 - Mass Transfer Operations**

1 course selected from:

- **ENGR 5260 - Water and Wastewater Treatment Systems**
- **ENGR 5280 - Air Pollution Control Systems**

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Chemical: Environmental, M.S.

Area I: Mathematics Component* (3-6 hours)

- **MATH 5470 - Applied Mathematics for Science and Engineering I**
- **MATH 5480 - Applied Mathematics for Science and Engineering II**
- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Additional Information and Notes

*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Additional Requirements (3 hours)

- **ENGR 5580 - Advanced Engineering Economy**

Area III: Specialty (6-9 hours)

- **ENGR 5260 - Water and Wastewater Treatment Systems**
- **ENGR 5280 - Air Pollution Control Systems**
- **ENGR 5320 - Advanced Thermodynamics**
- **ENGR 5340 - Transport Phenomena**
- **ENGR 5360 - Mass Transfer Operations**

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Civil, M.S.

Area I: Mathematics Component* (3-6 hours)

- **MATH 5470 - Applied Mathematics for Science and Engineering I**
- **MATH 5480 - Applied Mathematics for Science and Engineering II**
- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Additional Information and Notes

*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Approved Electives (6-9 hours)

Area III: Specialty (12-16 hours)

- **ENGR 5420 - Finite Element Analysis**
- **ENGR 5580 - Advanced Engineering Economy** or
- **ENGM 5580 - Advanced Engineering Economy**
- **ENGR 5600 - Statically Indeterminate Structures**
- **ENGR 5640 - Advanced Structural Analysis and Design**

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Computational Engineering, M.S.

Area I: Mathematics Component (3-6 hours)

- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Area II: Electives (6-9 hours) selected from

- **ENGR 5380 - Heat Conduction and Radiation**
- **MATH 5620 - Numerical Solution of Partial Differential Equations I**
- **CPSC 5170 - User Interface Development**
- **ENCM 5010 - Introduction to Computational Fluid Dynamics** (requires approval of graduate committee)
- **ENGR 5340 - Transport Phenomena**
- **ENGR 5420 - Finite Element Analysis**

Area III: Specialty (12-15 hours)

- **ENCM 5100 - Computational Fluid Dynamics I**
- **ENCM 5160 - Grid Generation**
- **ENCM 5210 - Introduction to Parallel Algorithms**
- **ENCM 5340 - Viscous Flow Theory**
- **ENCM 5400 - Computational Structural Dynamics I**
- **ENCM 5500 - Practicum in Structured and Unstructured Flow Solver Development**
- **ENCM 7100 - Computational Fluid Dynamics II**
- **ENCM 7160 - Adaptive and Dynamic Grid Generation**
- **ENCM 7340 - Viscous Flow Computation** (Prerequisite: ENGR 634)

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Electrical, M.S

Area I: Engineering Analysis (3 hours)

- **ENEE 5020 - Linear Systems**

Area II: Approved Electives (9 hours)

- Two approved graduate courses out-of-specialty (specialty list below) and/or out-of-department (6 hours)
- One course from Electrical Engineering (3 hours)

Area III: Engineering Concentration (12 hours)

- **One course from Electrical Engineering (3 hours)**
- **Three courses from a single specialty**
- **ENEE 5000 - Graduate Seminar**

Power and Energy Systems

- **ENEE 5520 - Power System Operations**
- **ENEE 5610 - Power Electronics and Drives**
- **ENEE 5620 - Power System Protection**
- **ENEE 5630 - Setting and Testing Digital Relays**
- **ENEE 5640 - Transients in Power Systems**
- **ENEE 5650 - Sustainable Electric Energy Systems**
- **ENEE 5720 - Power System Analysis and Design**

Communication and Signal Processing

- **ENEE 5010 - Stochastic Processes**
- **ENEE 5030 - Digital Signal Processing**
- **CPSC 5560 - Computer Data Communications**
- **ENEE 5110 - Digital Communications**

Microelectronics and Computer Systems

- **ENEE 5030 - Digital Signal Processing**
- **ENEE 5150 - Advanced Digital Design**
- **CPSC 5560 - Computer Data Communications**
- **ENEE 5700 - Microcomputer Applications**
- **CPSC 5700 - Advanced Computer Architecture**

Area IV: Specialty Option (6 hours)

One of the options below

Thesis option:

- Two or more semesters of ENGR 5999r -Thesis (6 hours total)

OR

Coursework option:

- Two additional approved graduate courses (6 hours)

Program Total: 31 hours

Engineering: Industrial, M.S.

Area I: Engineering Analysis Component* (3 hours)

- **ENGR 5700 - Advanced Statistics and Design of Experiments**

Additional Information and Notes

*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Electives (6-9 hours) selected from

- Any graduate level engineering courses or other courses with adviser approval

Area III: Specialty (12-16 hours)

- **ENGR 5040 - Decision Making and Optimization Techniques** or
- **ENGM 5040 - Decision Making and Optimization Techniques**

- **ENGR 5520 - Reliability Engineering** or
- **ENGM 5520 - Reliability Engineering**

- **ENGR 5540 - Technical Project Management** or
- **ENGM 5540 - Technical Project Management**

- **ENGR 5570 - Advanced Quality Control** or
- **ENGM 5570 - Advanced Quality Control**

- **ENGR 5580 - Advanced Engineering Economy** or
- **ENGM 5580 - Advanced Engineering Economy**

- **ENGR 5590 - Systems Engineering and Analysis**

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Mechanical: Energy, M.S.

Area I: Mathematics Component* (3-6 hours)

- **MATH 5470 - Applied Mathematics for Science and Engineering I**
- **MATH 5480 - Applied Mathematics for Science and Engineering II**
- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Additional Information and Notes

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*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Approved Electives (6-9 hours)

Area III: Specialty (12-16 hours)

- **ENGR 5320 - Advanced Thermodynamics**
- **ENGR 5340 - Transport Phenomena**
- 5000-level approved elective 3-4 hours

- **ENGR 5360 - Mass Transfer Operations** or
- **ENGR 5380 - Heat Conduction and Radiation**

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

Engineering: Mechanical: Mechanics, M.S.

Area I: Mathematics Component* (3-6 hours)

- **MATH 5470 - Applied Mathematics for Science and Engineering I**
- **MATH 5480 - Applied Mathematics for Science and Engineering II**
- **MATH 5600 - Numerical Analysis I**
- **MATH 5610 - Numerical Analysis II**

Additional Information and Notes

*With approval of the graduate adviser, students can take an equivalent course in this area.

Area II: Approved Electives (6-9 hours)

Area III: Specialty (12-16 hours)

- **ENGR 5420 - Finite Element Analysis**
- **ENGR 5440 - Applied Mechanics**
- **ENGR 5640 - Advanced Structural Analysis and Design**
- 5000-level approved elective 4 hours

Area IV: Thesis (6 hours) or Project + Additional Coursework (9 hours)

Thesis option:

- Two or more semesters of **ENGR 5999r - Thesis** (6 hours total)

OR

Project + Coursework option:

- Two additional approved graduate courses (6 hours)
- **ENGR 5900 - Project** (3 hours)

Program Total: 30 hours (Thesis), 33 hours (Project + Coursework)

B. Certificate Programs

The College offers the following five Post-Baccalaureate Engineering Certificate programs:

- Nuclear Engineering
- Power System Protection
- Smart Grid
- Smart Power Distribution
- Sustainable Electric Energy

An example of the admission and course requirements for one of the certificate programs (Power System Protection) is shown below. The requirements for other certificates can be found at http://catalog.utc.edu/content.php?catoid=17&navoid=567.

Power System Protection Post-Baccalaureate Certificate

Admissions Requirements

Students will be admitted into the certificate program if either:

A. They have a bachelor's degree in an appropriate field with significant professional experience and are approved by the Electrical Engineering Graduate Coordinator

B. They meet the admission requirements of the Graduate School as stated in the Graduate Catalog, are admitted to the Electrical Engineering M.S. program, and have satisfied all prerequisite courses assigned by the Electrical Engineering Graduate Coordinator.

Core Courses: (6 hours)

- **ENEE 5620 - Power System Protection**
- **ENEE 5630 - Setting and Testing Digital Relays**

Select from Approved Electives: (6 hours)

- **ENEE 5030 - Digital Signal Processing**
- **ENEE 5520 - Power System Operations**
- **ENEE 5720 - Power System Analysis and Design**
- Special Topics Courses approved by the department head

Total: 12 credit hours

2.6. Professional Practice

The MS Engineering program engages students in professional practices and training experiences by offering a variety of seminars, local internship opportunities, and job fairs throughout the year. Students are informed of these via email, bulletin boards, and e-boards. In addition, theses and projects also act as professional practice resources. Examples of these can be seen in Table 3, Section 1.2.

2.7. Online and In-Class Parity

As mentioned earlier, all MS Electrical Engineering courses, and some Mechanical and Automotive Systems Engineering courses are offered online. Students in these courses are monitored and evaluated actively through Blackboard (online software package) to ensure progress and achievements are on-par with students attending the same courses on campus.

Online students are required to participate in discussion forums regularly to fulfil their class participation goals and make sure they keep up with the lectures. Normally, both in-class and online students share assignments and exams.

2.8. Pedagogical Methods

Graduate courses are usually offered in the evenings or late afternoons to accommodate working students. Each course uses Blackboard software to display class materials, create discussion boards, and post assignments. This system helps students keep up with coursework if they are unable to attend class due to work or illness.

Online offerings are supported by Mediasite to record lectures both synchronously and asynchronously. The College of Engineering and Computer Science has internal technical support personnel and one staff member who is fully responsible for maintaining Mediasite. In addition, Graduate Assistants are trained to assist faculty in administrating online graduate-level courses.

Part III. Student Experience

3.1. MS Engineering Program Enrollment and Peer Identification

It is important for students to identify with peers during their studies as it contributes to a positive learning experience and promotes team building skills. Peer study groups facilitate understanding of course materials and assignments. The integrated nature of UTC's MS Engineering program is designed to create an appropriate environment for peer interaction through a variety of activities, such as group projects, engineering clubs, and professional student chapters. Within most courses, students are arranged into groups to complete assignments and projects, collaboratively. In addition, students are encouraged to join on-campus clubs, professional student chapters and student bodies such as the Graduate Student Association (GSA). These activities will help students connect with peers outside their discipline.

The MS Engineering program and concentrations provide online-accessible education in the theory and applications of engineering and prepares students for successful careers in industry, government, and academia. The diverse concentrations help students apply tools and techniques in engineering through individual and team-based projects and promote life-long learning and service to the engineering profession. The program objectives are to produce graduates who:

- Function as successful professionals in a variety of engineering disciplines
- Function effectively in multidisciplinary environments
- Adapt to various environments
- Participate in further knowledge building opportunities

- Are progressing towards Professional Registration (e.g., Professional Engineering certificate)

A. Admission Requirements

Applicants must meet the requirements below to be admitted to the Engineering master's program at UTC:

- Hold a baccalaureate degree from a regionally accredited college or university or foreign equivalent;
- Have a minimum grade point average (GPA) of 2.7 on a 4.0 scale *or* a 3.0 in the senior year;
- Have a minimum of 550 paper-based, *or* 213 computer-based, *or* 79 internet-based TOEFL score *or* 6.0 on the IELTS for international students;
- Submit a letter of recommendation from a senior manager *or* a professor;
- Submit official transcripts from each institution previously attended; and
- Complete the Graduate School application form and pay a non-refundable fee.

B. Recruitment

Students are primarily recruited into the Engineering master's program through marketing efforts directed toward local and regional companies, including faculty visits. Faculty members visit companies to inform them of the program. Alumni of the MS Engineering program also come to these recruitment meetings to answer any questions from prospective students.

The College of Engineering and Computer Science website (http://www.utc.edu/CECS) is updated regularly, and publications related to the MS Engineering program, such as brochures, flyers, posters, etc. are distributed at

recruitment meetings. The publications are also sent to universities across the United States at least once a year. Alumni of the MS Engineering program also play a crucial role in recruitment efforts by informing their colleagues, friends, and family members about the program and the availability of courses online.

Recruitment related links:

- 2015-2016 Year in Review: https://www.utc.edu/college-engineering-computer-science/pdfs/cecs-2015-16-year-in-review-final.pdf.
- University information website: http://www.utc.edu/about/
- Graduate School website: http://www.utc.edu/graduate-school/.

C. Enrollment

Figure 3 below shows the Graduate engineering program enrollment data over the past five years. The decline in enrollment during the end period of the data occurred due to the SimCenter re-organization and temporary suspension of new admissions to the Computational Engineering Graduate Program.

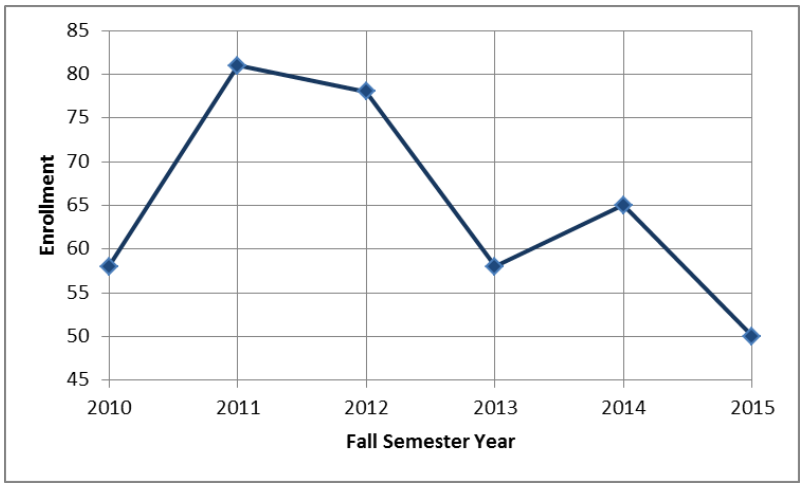

Figure 3. Graduate Engineering Program Enrollment Data*

**Source: Office of Planning, Evaluation, and Institutional Research.*

It is important to note that the number of students in the MS Engineering program rose to more than 60 students in 2016. Table 6 shows the enrollment data in detail for each graduate engineering concentration between 2010 and 2015. "N/A" indicates concentration was suspended or not yet established.

Table 6. Graduate Engineering Program Enrollment Data

Major	Fall 2010	Fall 2011	Fall 2012	Fall 2013	Fall 2014	Fall 2015
Chemical	7	8	N/A	N/A	N/A	N/A
Chemical: Chemical Science	N/A	N/A	6	3	7	7
Chemical: Environment	N/A	N/A	3	2	1	0
Civil	7	10	10	8	7	4
Computational	17	18	20	18	10	3
Electrical	18	26	19	17	25	26
Industrial	N/A	1	1	1	3	2
Mechanical	9	18	N/A	N/A	N/A	N/A
Mechanical: Energy	N/A	N/A	17	8	7	3
Mechanical: Mechanics	N/A	N/A	2	1	5	5
Total	**58**	**81**	**78**	**58**	**65**	**50**

D. Degrees Awarded

The number of degrees awarded in the Graduate Engineering Program over the years has increased by more than 200% since 2011. Figure 4 shows numbers of degrees awarded between 2011 and 2015.

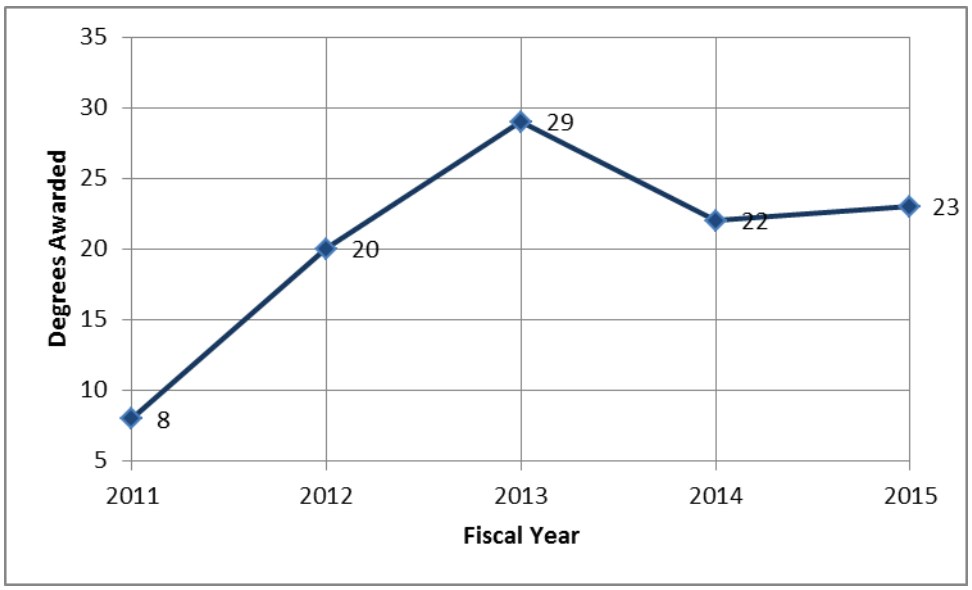

Figure 4. Master of Science in Engineering Degrees Awarded per Academic Year*

**Source: Office of Planning, Evaluation, and Institutional Research.*

3.2. Quality Evaluation

Students have the opportunity to provide feedback on the program and evaluate faculty's teaching effectiveness through surveys conducted online prior to final exams each semester. Students are routinely notified through e-mail and by the instructors in class to log on and complete the survey. As an example, student faculty ratings for Fall 2015 are provided in Appendix C.

3.3. Professional Development Opportunities

The MS Engineering program provides adequate professional development opportunities through membership in professional associations such as Tau Beta Pi, Associated General Contractors (AGC), Graduate Student Association (GSA), American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), National Society for Black Engineers (NSBE), the Society of Woman Engineers (SWE), etc. These organizations encourage students to attend

conferences and workshops, help students network and find jobs, and provide students with opportunities for publication.

The Career and Student Employment Center provides free resources to assist students in finding employment opportunities in line with their qualifications. Its mission is to provide students with tools to be successful in their job search and to be prepared with the right documents for an interview. For more information visit https://www.utc.edu/career-student-employment. The College of Engineering and Computer Science also organizes College-level job fairs twice a year, one in the fall and one in the spring, to assist students in finding jobs (http://www.utc.edu/college-engineering-computer-science/student-employment/day-of-networking.php).

3.4. Enrichment Opportunities

To provide adequate enrichment opportunities, the MS Engineering program hosts a variety of seminars conducted by local professional speakers from the Tennessee Valley Authority (TVA), Volkswagen (VW), Coca Cola, etc. These seminars, offered free and situated conveniently in UTC auditoriums, create an environment that facilitates student engagement with local industries and enriches students' education.

3.5. Diverse Perspectives

The MS Engineering program aims to expose students to various perspectives and experiences throughout the program. Field trips to TVA, VW, Electrical Power Board (EPB), Amazon, Miller Industries, McKee Foods Corp. and others are held regularly to introduce students to various work environments. Guest speakers from these companies and many others are brought in to clssroom by professors every semester to impart practical knowledge and provide opportunities for discussion.

3.6. Academic Support

The availability of instructional resources has improved with the opening of the new library building in January 2015. The program's instructional equipment and facilities within the College of Engineering are adequate. Most of the classrooms have state-of-the-art technology, and a variety of laboratories in the College increase learning and research opportunities for graduate students, such as Control Systems Lab, Circuits Lab, Fluid Mechanics Lab, Materials Lab, and others (http://www.utc.edu/college-engineering-computer-science/research-centers/laboratories.php).

Graduate students also have a study room on the second floor, EMCS 241, which provides a quiet study environment. Technical support is provided by technical personnel staffed by the College of Engineering and Computer Science, along with graduate assistants.

Part IV. Faculty

4.1 Engineering Graduate Coordinators

The College of Engineering and Computer Science has 40 tenured and tenure-track faculty and 18 non-tenured faculty members. Of those, 39 faculty members (tenured, tenure-track, and lecturer) are distributed across the three Engineering departments with MS Engineering program concentrations, as shown in Table 7. They are all qualified to teach graduate level courses and advise graduate students. The expenditures of the faculty are provided in Appendix A.

Table 7. Graduate Engineering Program Faculty

Department	Number of Faculty	Encompassed Graduate Programs
Civil and Chemical Engineering	11	Chemical Engineering
		Civil Engineering
Mechanical Engineering	20	Mechanical Engineering
		Computational Engineering
		Industrial Engineering
		Automotive Systems Engineering
Electrical Engineering	8	Electrical Engineering

Each department has a graduate coordinator who is responsible for the graduate concentration in his/her discipline. The main responsibilities of graduate coordinators are to advise graduate students, review all prospective graduate students' applications, recruit graduate students to their concentrations, write and propose all graduate curriculum changes, and teach graduate level courses. In addition, one Graduate Director represents the graduate engineering program at the Graduate Council. All graduate coordinators for the College meet at least once per semester to discuss the curriculum, assistantships, recruitment, resources, and other related issues. Table 8 shows the list of graduate coordinators in each Engineering discipline in the College.

Table 8. List of Graduate Engineering Coordinators	
Graduate Program	**Graduate Coordinator**
Chemical Engineering	Dr. Soubantika Palchoudhury
Civil Engineering	Dr. Weidong Wu
Computational Engineering	Dr. James Newman
Electrical Engineering	Dr. Raga Ahmed
Industrial Engineering	Dr. Philip Kazemersky
Mechanical Engineering	Dr. Prakash Dhamshala
Automotive Systems Engineering	Dr. Will Sutton

All full-time and part time faculty meet the high credential standards set by the program and SACSCOC guidelines. Short background information for each graduate coordinator in the graduate engineering programs, along with the Director of Graduate Programs, is as follows:

Dr. Neslihan Alp is the Associate Dean, Department Head of Engineering Management & Technology, and the Director of Graduate Programs for the College of Engineering and Computer Science at UTC. Dr. Alp has a Ph.D. in Engineering Management from the University of Missouri-Rolla, M.S. in Industrial Engineering and a B.S. in Engineering Management from Istanbul Technical University. She has also completed a two-year Post-Doctorate study in Engineering Management at the University of Missouri-Rolla. Dr. Alp joined UTC in 1999. Her areas of interest include quality control and reliability engineering, project management and scheduling, plant layout design, operations research and optimization, engineering economy and financial analysis, lean manufacturing, six-sigma, and distance learning.

Dr. Soubantika Pachoudhury is a Visiting Assistant Professor in the Civil and Chemical Engineering Department, and is responsible for the Chemical Engineering graduate concentration. Dr. Pachoudhury has a B.S. in Chemical

Engineering from the National Institute of Technology, Durgapur, India (2008), and a M.S. and Ph.D. in Chemical and Biological Engineering from the University of Alabama, Tuscaloosa, Alabama (2010 and 2012 respectively). Dr. Pachoudhury joined UTC in August 2015. Her areas of interest include nanochemistry, environmental nanoscience, and nanoparticle-DNA interactions and material characterization, especially transmission and scanning electron microscopy.

Dr. Weidong Wu is an Assistant Professor in the Civil and Chemical Engineering department, and is responsible for the Civil Engineering graduate concentration. Dr. Wu has a B.S. in Civil Engineering from the Huazhong University of Science and Technology (1998), along with an M.S. and Ph.D. in Civil Engineering from the University of Mississippi (2008). Dr. Wu joined UTC in 2013. His areas of interest include computational mechanics, computational modeling of materials, finite element method and computational fluid dynamics, and infrastructure hazard evaluation and protection.

Dr. James C. Newman III is a Professor in the Mechanical Engineering department and the Assistant Director of the SimCenter, and is responsible for the Computational Engineering graduate concentration. Dr. Newman has a B.S. in Mechanical Engineering (1993) and M.S. in Aerospace Engineering (1994) from Old Dominion University, along with a Ph.D. in Mechanical Engineering from Virginia Polytechnic Institute and State University (1997). Dr. Newman joined UTC in 2011. His areas of interest include multidisciplinary analysis and design optimization, sensitivity analysis, fluid-structure interaction and computational structural dynamics.

Dr. Raga Ahmed is an Assistant Professor in the Electrical Engineering department, who is responsible for the Electrical Engineering graduate concentration. Dr. Ahmed has a B.S. in Electrical Engineering from the University of Khartoum, Khartoum, Sudan (1988), an MEE in Electrical and Computer Engineering from Rice University, Houston, Texas (1993), and a Ph.D. in Electrical and Computer Engineering from the Georgia Institute of Technology, Atlanta, Georgia (2013). Dr. Ahmed joined UTC in 2013 as a faculty member, but taught as an adjunct from 2009 to 2012. Her areas of interest include motor design optimization through finite element analysis, and motion control. Her past experience includes designing and implementation of menu-driven data manipulation tools.

Dr. Prakash Dhamshala is a professor in the Mechanical Engineering department and is responsible for the Mechanical Engineering graduate concentration. Dr. Dhamshala has a B.E. in Mechanical Engineering from Osmania University, Sri Venkateswara, India (1970), an M.S. in Mechanical Engineering from the University of Miami, Florida (1972), and a Ph.D. in Mechanical Engineering from the Georgia Institute of Technology (1978). Dr. Dhamshala joined UTC in 1981. His areas of interest include energy efficiency technologies; development of computer codes for zero-energy buildings; energy recovery technologies; smart cities compatible with smart grid issues; air-conditioning and refrigeration; engineering analysis of renewable energy resources; solar, wind, bioenergy, geothermal and hybrid-energy systems; thermal energy storage technologies, including phase change materials containing nanoparticles; fuel-cells application for CCHP technologies; developing computer codes for carbon-foot prints; and developing energy and water nexus solutions.

Dr. Will Sutton is a professor in the Mechanical Engineering department, and is responsible for the Automotive Systems Engineering graduate concentration. Dr. Sutton has a B.S., M.S. and Ph.D. in Mechanical Engineering from North Carolina State University (1973, 1975, and 1981, respectively). Dr. Sutton joined UTC in 2008. His areas of interest include thermodynamics, heat transfer, and automotive engineering.

4.2. Faculty Teaching Load

Most graduate level courses, on-campus and online, are taught by full-time graduate faculty in the College. For the MS Engineering program, faculty teaching loads are aligned with the highly individualized nature of graduate instruction. In the case of graduation projects, and dissertations, specialized professors are assigned to guide the student on an individual basis. Figure 5 shows the average Student Credit Hour (SCH) per Total Faculty FTE generated by a university faculty member, a college faculty member, and the engineering program faculty member for each fall semester for four years staring 2012 and Table 9 shows the average SCH production per various FTE faculty categories for each fall semester.

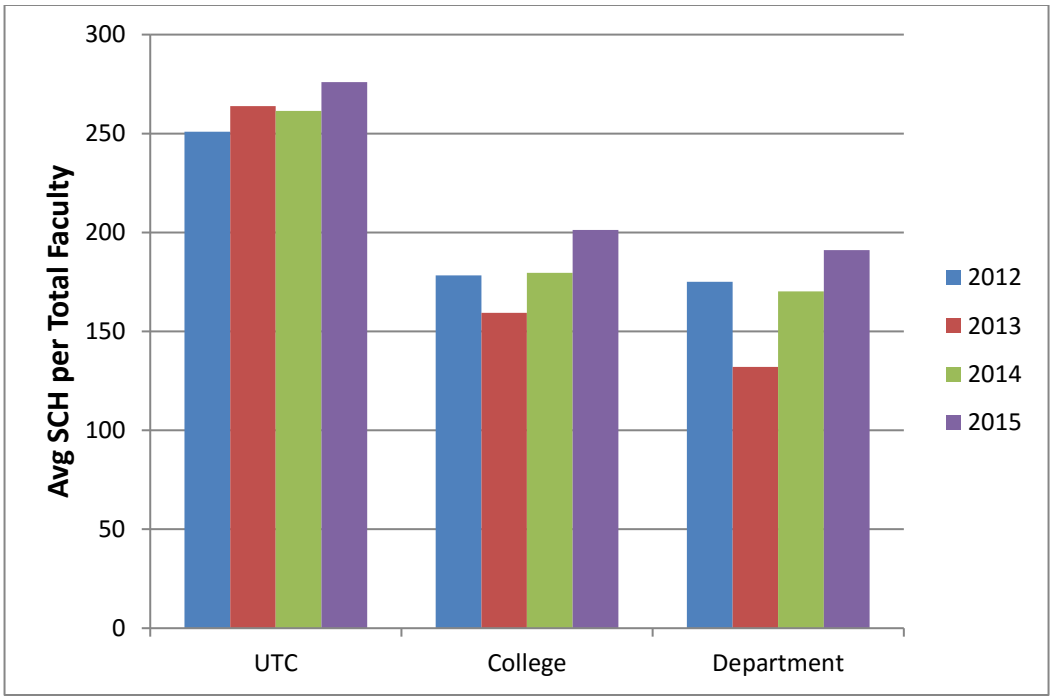

Figure 5. SCH per Total Faculty FTE per Fall Semester year

Table 9. SCH/FTE Faculty/Fall Semester/Year				
		UTC	**College**	**Department**
2012	Adjunct	315	197	177
	NTT	253	148	165
	T/TT	219	187	176
	Total	**251**	**178**	**175**
2013	Adjunct	337	201	123
	NTT	278	147	164
	T/TT	222	153	132
	Total	**264**	**159**	**132**
2014	Adjunct	306	355	282
	NTT	319	145	188
	T/TT	225	162	157
	Total	**261**	**180**	**170**
2015	Adjunct	362	288	255
	NTT	277	166	89
	T/TT	249	194	199
	Total	**276**	**201**	**191**
Key: T: Tenured Faculty / TT: Tenure-Track Faculty / NTT: Non Tenure-Track Faculty				

4.3. Faculty Diversity

Students enrolled in the MS Engineering Program are increasingly diverse. Studies have shown the importance of faculty diversity to enrolling and retaining students from diverse backgrounds. College faculty members have demonstrated a positive impact in shaping campus culture and encouraging students from multiple groups of minorities and genders to enroll and persist through graduation. The diversity of faculty and graduate major enrollment are presented in Appendix B.

4.4. Faculty Professional Development

The MS Engineering faculty strive for continuous professional development, which can advance teaching methods, scholarship and practice. Ongoing, current and past research projects led by faculty members by draw external funds such as grants and awrds. Annual conferences, worshops, expos, meetings, and a multitude of organizational gatherings are regularly attended by faculty. An example Curriculum Vitae of MS Engineering Faculty is shown in Appendix F. Other CVs can be viewed online at http://www.utc.edu/college-engineering-computer-science/profiles/

4.5. Improvement Processes

The faculty actively engages in regular planning, evaluation, and improvement activities that measure and advance student success. To enrich and improve the curriculum, which is maintained at the department level, faculty members may propose changes including curriculum, program goals, and an overall assessment process based on feedback from students and inputs during departmental meetings. The department reviews the proposal and, if approved, submits it to the graduate coordinator committee. The committee then reviews and approves the proposed changes. Once approved, the

university implements the changes in the following academic year.

4.6. Faculty evaluation

The program uses an appropriate process to incorporate the faculty evaluation system explained in detail in Chapter 3 of the Faculty Handbook (http://www.utc.edu/faculty-senate/handbook.php). Generally, supervisors rank their faculty based on overall performance. The annual Evaluation and Development by Objectives (EDO) process is the main tool used to assess faculty at UTC. The process measures quality of teaching, research, and service. The annual EDO evaluation consists of objectives, reports and evaluation. The department head's EDO sample format can be found at http://www.utc.edu/academic-affairs/pdfs/1-provost-page-forms/dept-head-evaluation-rev6-2015.pdf. Please refer to Section 3.2 for student ratings of faculty, as they are another assessment used for evaluation.

Part V. Learning Resources

5.1. Equipment and Facilities Evaluation

The College of Engineering and Computer Science regularly evaluates its facilities and equipment and makes improvements where necessary. For example, the College is committed to creating an environment that places personal safety and health of the students and faculty first by regularly evaluating laboratories. The College's safety manual describes policies and procedures that govern access to labs, including handling of hazardous materials, inspection, and inventory control. Anyone accessing the labs to use equipment or handle materials within the college must follow accepted procedures and adhere to the published policies, which are easily accessible by students and faculty. The Laboratory Safety Manual can be viewed at https://www.utc.edu/college-engineering-computer-science/pdfs/laboratorysafetymanual.pdf.

5.2. Learning and Information Resources

Students and faculty have access to information resources to support teaching and learning primarily through the newly constructed UTC library. Additionally, The Walker Center for Teaching and Learning supports faculty by offering development sessions and other teaching resources. Section 5.3 provides more information on the Walker Center, and the following subsections provide information on the new UTC Library.

A. UTC Library General Information

The mission of the UTC Library is to support the teaching and research of faculty and students at the University of Tennessee at Chattanooga through the

collections of scholarly materials and development of services to promote and enhance the university's curriculum and research endeavors.

The Library has 21 faculty librarians, 14 staff specialists, and over 700 hours of student help to support the UTC community. The total library budget for 2016 was approximately $3.7 million.

UTC opened a new library facility in January 2015. This new 184,725 square foot facility is open 125 hours per week during the academic semester and combines traditional library services like reference, research assistance, and circulation with cutting edge amenities like the Studio featuring recording space, high-spec computing hardware and software, 3D modeling and printing, and video/audio equipment circulation. Furthermore, the library now houses important student and faculty service points including The Center for Advisement, The Writing and Communication Center, and the Walker Center for Teaching and Learning. The new library also boasts 37 group study rooms, practice presentation rooms, 8 conference rooms, and a computer lounge with access to 142 Windows and 36 Macintosh computers. Finally, the library houses unique and historical book and manuscript collections, University Archives, and the permanent University art collection within a climate controlled state-of-the-art Special Collections facility. The New UTC Library page provides more detailed information on features of the library and services offered. An informational sheet is also available in Appendix D. Additional information about the UTC Library is available at http://www.utc.edu/library.

B. Library Collections and Services 2015-2016

As of July 1, 2016, the Library has available 70,197 serial titles, including open access titles, through subscriptions to full-text resources, databases, journal packages, and individual journals. Of those, 10,998 are direct subscriptions in print, microfilm, and digital forms. Many core journal titles for Engineering (Progress in Energy and Combustion Science, Journal of Catalysis, Applied Energy, Building and Environment, Engineering Structures, Transportation, Journal of Hydrology, Journal of Building Physics, Pattern Recognition, Progress in Quantum Electronics, International Journal of Plasticity, Applied Thermal Engineering, Combustion and Flame, Rapid Prototyping Journal, and International Journal of Engineering Science) are made available through large multidisciplinary journal packages and databases without an impact on the direct allocation for Engineering. The Library has identified 2487 print and electronic journals that support Engineering subjects. Of these 2487 journal titles and databases, Engineering is currently responsible for $61,946.00 of the total $1,046,245.28 spent toward ongoing serial and database subscriptions.

The UTC Library provides access to electronic resources with the following databases supporting Engineering: Compendex, the IEEE All Society Periodicals Package, and the Association of Computing Machinery journals package. In addition, the Library makes available numerous multidisciplinary databases such as OmniFile, Academic OneFile, and Web of Science to supplement subject-specific resources. Access to thousands of online full-text journals is also available through large packages from premier publishers like

Taylor and Francis, Sage, Springer, Wiley, and Elsevier. See Appendix E for a sample listing of engineering journals available in the UTC Library. A comprehensive list of journals is available upon request.

As of July 1, 2016, the Library's print (466,255) and electronic (274,647) monograph collection consists of 740,902 unique titles, of which 31,968 bear the call numbers T, TA, TC-TH, TJ-TL, TN, TP, and TS, which are appropriate to the study of Engineering. The Library's collection of physical (22,344) and online streaming (75,652) audio/visual (A/V) material consists of 97,996 unique titles, of which 186 are appropriate to Engineering. Each year, a portion of the Library's materials budget is allocated to purchase books, audio/visual materials, and other one-time resources. The 2015-2016 Library allocation for one-time expenditures for Engineering was $5,000.00 from a total amount of $148,000.00 spent across all academic departments. In 2015-2016, 177 A/V items and 518 books were checked out by faculty and students in Engineering.

C. Services

The Library offers interlibrary loan (ILL) service at no cost to students and faculty who need to acquire materials that are not owned or accessible by the Library. Patrons can submit and track progress of requests, receive email notification of materials that have arrived, and obtain articles electronically through the electronic ILL management system, ILLiad. The Library also participates in a nationwide program, Rapid ILL, which expedites article delivery to the patron. In 2015-2016, 7,995 ILL borrowing requests were filled for the UTC community; of those, 675 were filled for faculty and students in Engineering.

The Library offers a well utilized Course Reserve service for faculty and students so that faculty may place high demand materials on reserve to ensure they are available to students. The Library also provides a scanning service for faculty, ensuring high quality and accessible scans of materials related to research and courses. In 2015-2016, there were no Engineering materials on reserve.

The Library has generous circulation policies and allows semester long borrowing of monographs for students and yearlong borrowing for faculty members. In 2015-2016, monographs and A/V materials circulated 26,413 times. In addition, the Library circulates laptop computers, other tech equipment (cameras, calculators, ebook readers, and more), and group study rooms are available to students. Last year, laptops and other equipment circulated 44,515 times, while group study rooms had over 21,795 reservations.

The Library boasts a busy, well-respected, and growing instruction program. In 2015-2016, instruction librarians taught a total of 362 courses and reached 5,827 students across all academic disciplines. Librarians work closely with faculty to design instruction sessions tailored to course and assignment objectives. Librarians teach much needed information literacy and research skills, as well as the basics of citation style and strategies for avoiding plagiarism. Nine instruction sessions were conducted for Engineering, which reached 186 students.

The Library's reference desk is open 91 hours per week to assist faculty and students with research queries. In addition to face-to-face assistance, the Library offers online reference services in the form of real-time instant messaging assistance, an email reference service, and traditional telephone services. In the last

year, UTC librarians answered 13,976 reference questions. One-on-one research consultation is also available to any student seeking in-depth assistance. In the 2015-2016 academic year, librarians provided 496 individual research sessions.

A Library Liaison program is in place where a librarian is assigned to each academic department to enhance communication, collection development, and general support. Librarians are matched with departments based on educational background, work experience, and subject expertise. Typical library liaison activities involve attending departmental meetings, distributing information about new services or resources, organizing one-time purchase requests, teaching classes, creating subject guides, meeting with students and faculty, and more. The current Engineering Liaison, Michael Bell, maintains the Engineering Subject Guide, which links to electronic resources, websites, and other information to help students and faculty in their research.

Since opening in January, 2015, the Studio functions as the library's service point for multimedia production and design. Services include: high-spec PCs and comprehensive design software including Adobe Creative Cloud, Autodesk applications, Camtasia, and SketchUp. Equipment circulation includes: A/V gear and accessories, prototyping hardware, and other peripherals, A/V production rooms for lighting/photography/videography and audio production, 3D printing services, and consultation, instruction, curriculum development, and help at point-of-need. In 2015-2016, 189 workshops and consultations were offered to the UTC community. One workshop on 3D Printing was provided for students enrolled in ENIE 3580.

The Library is now home to the Writing & Communication Center (WCC), which offers all UTC students, faculty, and staff one-on-one assistance with any type of writing, speech or presentation, at any stage of the composition process. Having completed its first full year as part of the library, the WCC experienced record usage and growth. In 2015-2016, 2,174 consultations were provided to the UTC community; of those, 28 were provided to students in Engineering and Computer Science courses.

5.3. Materials and Support Staff

The MS Engineering program provides adequate materials and support staff to encourage research and publication. The Walker Center for Teaching and Learning promotes excellence in teaching, learning and the use of technology through dialogue, inquiry, and research. To fulfill these goals, the Center maintains a trustworthy environment to those it serves. The Center also offers faculty feedback and opportunities for reflection on their teaching. Please visit https://www.utc.edu/walker-center-teaching-learning/ for more information.

Administrative Assistance staff are a dependable resource for departments to rely on. Graduate Research Assistants are also hired every academic year to collaborate with the faculty. The Library (section 5.2) provides sufficient material for almost all areas of research interest.

Part VI. Support

6.1. Operating Budget

The MS Engineering program's internal and external support are consistent with the budget needs of the program. Figure 6 and Table 10 show the internal and external grants received by the faculty in the department. Appendix A shows the operating budget for the College.

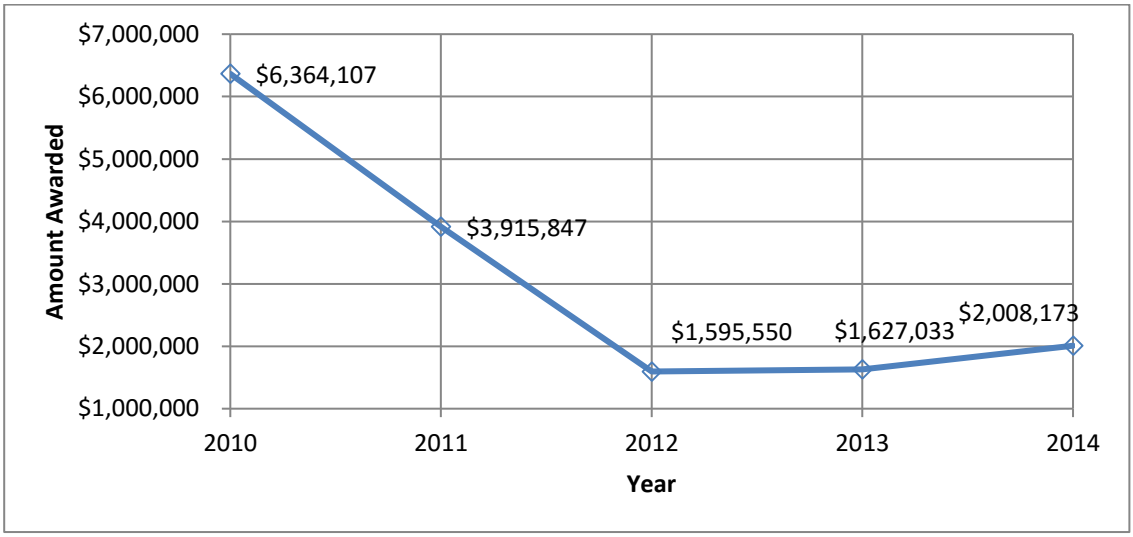

Figure 6. External Grants (Funded Proposals, FY 2010 through FY 2014)

The drop off in grants is attributed to the SimCenter's re-organization. Now that the re-organization is complete, the amount of grants is starting to increase in 2014.

Table 10. Internal (UC Foundation) Support

Name of Award/Grant	Dept. Awards	Total Awards	Dept. Awards As % Of Total Awards
Provost Student Research Award (joint faculty/student grants) (AY12-13 through AY15-16)	4	27	14.81%
Faculty Development Grants** (individual and group) (FY11 - FY15)	9	164	5.49%
Faculty Research Grants** (FY11 - FY15)	2	35	5.71%
Faculty Development and Research Grants *** (FY15 - FY16)	3	50	6.00%
Faculty Sabbaticals and Study Leaves** (AY11 - AY16)	0	6	0.00%
Faculty Summer Fellowships** (Sum11 - Sum16)	0	21	0.00%
QEP Grant Awards (AY11 - AY16)	4	85	4.71%
QEP Faculty Awards* (AY12 - AY16)	0	13	0.00%

*New in 2012 / **Unable to break apart undergraduate from graduate / *** During the FY15-16 Faculty Development and Research Grants were combined / AY - Academic Year / FY - Fiscal Year

6.2. Enrollment and Effectiveness

Enrollment and graduation rates are key components of accountability at UTC. A high quality experience has been integrated throughout the graduate program in order to maintain high enrollment rates. Faculty builds strong relationships with students through smaller classes and one-on-one meetings, and serves as primary mentors of students. The faculty also encourages local industries to hire MS program students,

enabling the maintenance of a high student enrollment and retention rates. Please see Section 3.1 for recruitment details and enrollment numbers.

6.3. Program Responsiveness

The MS Engineering program is responsive to changing local, state, regional and national needs. As mentioned in Section 2.1, the curriculum contents are reviewed regularly, partly to respond to changing regional needs. The new Automotive Systems Engineering concentration, launched in Fall 2016, is an example of such response to a changing business environment and student population. The curriculum is designed to provide students with the needed knowledge and skills to function effectively in dynamically changing automotive industry.

Since the last program review, a strategic plan for the College of Engineering and Computer Science has been under development to further propel the responsiveness of programs it contains, including the MS Engineering Program. This strategic plan will take effect for the 2015-2020 period and can be seen at http://www.utc.edu/college-engineering-computer-science/pdfs/cecs-strategic-plan-approved-09082016.pdf.

6.4. Graduate Student Data Collection and Placement Evaluation

Graduate students are connected to the College's LinkedIn page (https://www.linkedin.com/groups/6715787) upon graduation. The LinkedIn page helps the College stay connected with alumni and where they currently work. Since 2015, the College has also completed an Annual Review, which is distributed to all alumni in addition to the local and regional businesses. The latest review can be found at http://www.utc.edu/college-engineering-computer-science/about-us/annual-review.php.

6.5. Procedure Review

The MS Engineering program's procedures are regularly reviewed to ensure alignment to institutional policies and mission. This is done every year to comply with and maintain the standards contained in the guidelines of the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), the recognized regional accrediting body in the eleven U.S. southern states.

Appendix A. Expenditures

Table 11. Expenditures					
	2011-12[1]	**2012-13[1]**	**2013-14[1]**	**2014-15[1]**	**2015-16[1]**
Actual Expenditures[2]	$4,091,650	$4,594,928	$4,594,928	$4,973,168	$4,154,436
Fall Adjunct Salaries[2]	$55,667	$92,500	$65,000	$78,000	$64,000
Spring Adjunct Salaries[2]	$84,500	$81,500	$114,500	$77,500	$76,500
FT Faculty FTE[2]	22.8	26.5	26.5	28.0	26.0
Total Major Enrollment	63	58	40	55	50
Fall SCH[3]	369	296	218	509	307
Spring SCH[3]	403	489	516	537	300
Expenditures per FT Faculty FTE	$185,606	$179,960	$180,167	$183,167	$165,190
Expenditures per Student Major	$67,172	$82,223	$119,361	$93,249	$85,899
Expenditures per SCH	$5,482	$6,075	$6,505	$4,903	$7,076
[1] FY data is July 1 - June 30					
[2] Data contains total department (graduate and undergraduate) results					
[3] Data came from ENCE, ENCH, ENCM, ENEE, ENEV, ENGR, ENIE, ENME, and ENNE					

Appendix B. Diversity

Table 12. Diversity of Faculty and Graduate Major Enrollment

Fall 2015

Graduate Engineering Enrollment		
	Female	**Male**
Multiple Races	0	2
Unknown	3	1
American Indian	0	0
Asian	7	10
Hispanic	0	0
Native Hawaiian or Other Pacific Islander	0	0
African American	1	4
White	3	19
Total	**14**	**36**

FT Faculty[1]		
	Female	**Male**
Multiple Races	0	0
Unknown	0	0
American Indian	0	0
Asian	1	4
Hispanic	0	1
African American	2	6
White	2	17
Total	**5**	**28**

[1] FT faculty included in above table were those paid from E accounts for Chemical Engineering (E041320) and Engineering-Dean Office (E041301).

Appendix C. Student Ratings

Table 13. Student Ratings of Faculty

Student Rating of Faculty Fall 2015								
Engineering								
	Completely Agree (%)	**Mostly Agree (%)**	**Slightly Agree (%)**	**Neither Agree Nor Disagree (%)**	**Slightly Disagree (%)**	**Mostly Disagree (%)**	**Completely Disagree (%)**	**Unable to Judge (%)**
The instructor is willing to help students.	69	16	7	2	3	1	1	2
The instructor encourages students to be actively engaged in learning the content of this course.	62	20	8	4	2	2	2	2
The instructor provides timely feedback on assignments and exams.	56	18	9	4	5	3	5	2
The instructor includes activities and assignments that help students learn the content of this course.	59	17	11	6	3	3	2	2
The instructor clearly communicates expectations of students for this class.	58	16	10	4	5	3	4	2
The instructor expects high quality work from students.	66	18	8	4	2	1	1	3
Overall, this class has provided an excellent opportunity for me to increase my knowledge and competence in its subject.	58	18	10	5	3	2	4	2
College of Engineering & Computer Science								
	Completely Agree (%)	**Mostly Agree (%)**	**Slightly Agree (%)**	**Neither Agree Nor Disagree (%)**	**Slightly Disagree (%)**	**Mostly Disagree (%)**	**Completely Disagree (%)**	**Unable to Judge (%)**
The instructor is willing to help students.	67	17	7	3	3	1	1	2
The instructor encourages students to be actively engaged in learning the content of this course.	61	19	9	4	2	2	2	2
The instructor provides timely feedback on assignments and exams.	56	18	9	4	5	3	5	2
The instructor includes activities and assignments that help students learn the content of this course.	58	16	12	5	4	3	2	2
The instructor clearly communicates expectations of students for this class.	58	16	10	4	5	3	3	2
The instructor expects high quality work from students.	67	18	8	4	2	1	1	3
Overall, this class has provided an excellent opportunity for me to increase my knowledge and competence in its subject.	58	18	10	5	3	2	4	2
Total University								
	Completely Agree (%)	**Mostly Agree (%)**	**Slightly Agree (%)**	**Neither Agree Nor Disagree (%)**	**Slightly Disagree (%)**	**Mostly Disagree (%)**	**Completely Disagree (%)**	**Unable to Judge (%)**
The instructor is willing to help students.	72	15	7	2	2	1	1	2
The instructor encourages students to be actively engaged in learning the content of this course.	70	15	8	3	2	1	1	1
The instructor provides timely feedback on assignments and exams.	64	17	9	3	3	2	3	2
The instructor includes activities and assignments that help students learn the content of this course.	63	16	9	4	3	2	3	2
The instructor clearly communicates expectations of students for this class.	65	16	8	3	3	2	3	1
The instructor expects high quality work from students.	73	16	6	3	1	1	1	2
Overall, this class has provided an excellent opportunity for me to increase my knowledge and competence in its subject.	65	15	8	4	2	2	4	2

Appendix D. Library Information

New University Library Facts:

- 180,000 square feet
- 5 floors
- Opened January 2015

Details:

The new LEED-certified library is chock full of new strategic campus partnerships and is the premier location for student academic needs outside the classroom. New and expanded partnerships represented in the new building include: Art Department, Center for Advisement and Student Success, Copy Services, Information Technology Division, Disability Resources Center, Southern Writers, Walker Center for Teaching and Learning, and Writing and Communication Center. Designed with a robust technological infrastructure and themes of transparency, collaboration, and flexibility, student access and success was at the center of building planning processes.

- 37 study rooms (29 small, 7 medium, 1 large)
- 2 practice presentation rooms
- 24 hour student study space, opened Sunday to Thursday
- 4 lounges (2 quiet, computer and graduate student)
- Starbucks
- Information Commons (research assistance and 175+ computers)
- Studio 305: advanced media studio and creator space
- Seating for over 2,100

- 7 classrooms
- 8 seminar and conference rooms
- 29 faculty and graduate student carrels
- 2 visiting scholar rooms
- Grand reading room
- Moveable compact stacks with storage for ~600,000 volumes
- New material browsing area (think more Barnes and Noble)
- Media viewing room
- Expanded special collections storage with unique climate controls
- New auditorium housing 2 lecture halls of ~225 seats each adjacent to the new library.

Appendix E. Journals

The majority of journals are available online and can be accessed through the UTC Library Journals Search feature. Full-text journals (online and print) at UTC Library that include engineering-related content are presented below.

Table 14. Full-text Journals
ACM Transactions on Design Automation of Electronic Systems
ACM Transactions on Embedded Computing Systems
ACM Transactions on Sensor Networks
ACM Transactions on Speech and Language Processing
ACM Transactions on Storage
ACTA Automatica Sinica
Advanced Cement Based Materials ACBM
Advanced Composites Bulletin
Advanced Engineering Materials
Advanced Functional Materials
Advanced Imaging
Advanced Materials
Advanced Materials and Composites News
Advanced Materials and Processes
Advanced Materials for Optics and Electronics
Advanced Packaging: An IHSGroup Publication
Advances in Building Energy Research
Advances in Civil Engineering
Advances in Engineering Software
Advances in Mechanical Engineering
Advances in Optical Technologies
Advances in Power Electronics
Advances in Tribology
American Fastener Journal
American Machinist
Analog Integrated Circuits and Signal Processing
Annals of Nuclear Energy
Annual Review of Environment And Resources
Applied Energy
Applied Microwave and Wireless
Applied Solar Energy

Applied Superconductivity
Applied Thermal Engineering
Archives of Civil and Mechanical Engineering
Archives of Computational Methods in Engineering
Archives of Computational Methods in Engineering State of the Art Reviews
Artificial Intelligence in Engineering
Asian Journal of Control
Assembly Engineering
AT and T Technology
Australian Electronics Engineering
Australian Journal of Civil Engineering
Australian Journal of Electrical and Electronics Engineering
Australian Journal of Mechanical Engineering
Australian Journal of Multi Disciplinary Engineering
Australian Journal of Structural Engineering
Automatic Control and Computer Sciences
Automatic Merchandiser
Automation and Remote Control
Automotive Design and Production
Automotive Manufacturing and Production
Automotive Production
Bell Labs Technical Journal
Biologically Inspired Cognitive Architectures
Biometric Technology Today
Biosurface and Biotribology
Bridge Design and Engineering
British Corrosion Journal: A Publication of the Metals Society
Broadcast Engineering
Building Products
Bulletin of Earthquake Engineering
Bulletin of Engineering Geology and the Environment
Bulletin of Materials Science
Card Technology Today
Case Studies in Thermal Engineering
Cee and See Renewable Energy Report
Cement and Concrete Composites
Cement and Concrete Research
Chemical Vapor Deposition
Circuit World

Circuitree
Circuits Assembly: The Magazine For Surface Mount and Board Level Assembly
Circuits Systems and Signal Processing
Civil Engineering and Environmental Systems
Cognition Technology and Work
Communication Systems Design
Communications in Numerical Methods in Engineering
Composite Interfaces
Composite Structures
Composites
Composites Engineering
Composites in Manufacturing
Composites Manufacturing
Composites Science and Technology
Composites Technology Engineering and Manufacturing Solutions For Industry
Computational Mechanics
Computer Methods in Applied Mechanics And Engineering
Computers and Fluids
Computers and Geotechnics
Computers and Structures
Computing Systems in Engineering: An International Journal
Concrete
Concrete Concepts
Construction and Building Materials
Consulting Specifying Engineer
Contemporary Stone and Tile Design
Control and Intelligent Systems
Control Engineering
Control Engineering International
Control Engineering Practice
Control Solutions International
Corrosion Engineering Science and Technology
Corrosion Science
Cost Engineering: A Publication of the American Association of Cost Engineers
Current Opinion in Solid State and Materials Science
Design Automation for Embedded Systems
Design Engineering
Designing for User Experiences
Diesel Progress North American

Dynamics and Control
Earthquake Engineering and Engineering Vibration
Earthquake Engineering and Structural Dynamics
EE Evaluation Engineering
Electric Light and Power
Electric Machines and Power Systems
Electric Power Components and Systems
Electric Power Systems Research
Electrical Apparatus
Electrical Construction and Maintenance
Electrical Engineering
Electrical Engineering = Archiv Fuìˆr Elektrotechnik
Electrical Engineering In Japan
Electro Manufacturing
Electronic Device Failure Analysis
Electronics
Electronics Letters
Electronics Manufacturing Engineering
Energy
Energy and Buildings
Energy Conversion and Management
Energy Engineering
Energy Research and Social Science
Energy Science and Engineering
Energy Sources
Energy Storage Materials
Engineers Digest
Engineering
Engineering Analysis with Boundary Elements
Engineering Applications of Artificial Intelligence
Engineering Computations
Engineering Failure Analysis
Engineering Fracture Mechanics
Engineering Geology
Engineering in Life Sciences
Engineering Management Journal
Engineering Optimization
Engineering Studies
Engineering with Computers

EPRI Journal
Ergonomics
Ergonomics in Design
Esd The Electronic System Design Magazine
Estonian Journal of Engineering
European Journal of Environmental and Civil Engineering
European Journal of Wood and Wood Products
European Transactions on Electrical Power
European Transactions on Telecommunications
Experimental Heat Transfer
Experimental Mechanics
Experimental Techniques
Experimental Thermal and Fluid Science
Fatigue and Fracture Of Engineering Materials And Structures
Fiber and Integrated Optics
Fiber Optic Sensors and Systems Fosâ²
Fiberoptic Technology
Fibers
Flow Measurement and Instrumentation
Flow Turbulence and Combustion
Fluid Dynamics
Foundations and Trends in Communications and Information Theory
Foundations and Trends in Electronic Design Automation
Foundations and Trends in Signal Processing
Frontiers in Energy
Frontiers in Energy Research
Frontiers in Neurorobotics
Frontiers in Robotics and Ai
Frontiers of Information Technology and Electronic Engineering
Frontiers of Materials Science
Frontiers of Mechanical Engineering
Frontiers of Structural and Civil Engineering
Fuel Cells
Fuel Cells Bulletin
Fusion Engineering and Design
Geomechanics and Geoengineering: An International Journal
Geomechanics for Energy and the Environment
Geosystem Engineering
Granular Matter

Heat and Mass Transfer = Waiˆrme Und Stoffuiˆbertragung
Heat Recovery Systems and CHP
Heat Transfer Engineering
High Performance Composites
High Performance Polymers
High Temperature Materials and Processes
Home Energy
Hydraulic and Mechanical MRO
IBM Journal of Research and Development
IEEE ACM Transactions on Audio Speech and Language Processing
IEEE Antennas and Wireless Propagation Letters
IEEE CAA Journal of Automatica Sinica
IEEE Circuits and Devices
IEEE Circuits and Devices Magazine
IEEE Circuits and Systems Magazine
IEEE Communications Magazine
IEEE Communications Society Magazine
IEEE Communications Surveys and Tutorials
IEEE Computer Applications in Power Cap
IEEE Control Systems
IEEE Control Systems Magazine
IEEE Design and Test
IEEE Electrification Magazine
IEEE Industrial Electronics Magazine
IEEE Industry Applications Magazine
IEEE Journal of Oceanic Engineering
IEEE Journal of Photovoltaics
IEEE Journal of Quantum Electronics
IEEE Journal of Selected Topics in Signal Processing
IEEE Journal of Solid State Circuits
IEEE Journal of The Electron Devices Society
IEEE LCSThe Magazine of Lightwave Communications Systems
IEEE Microwave Magazine
IEEE Photonics Journal
IEEE Power Electronics Letters
IEEE Robotics and Automation Magazine
IEEE Signal Processing Magazine
IEEE Solid State Circuits Magazine
IEEE Transactions on Antennas and Propagation

IEEE Transactions on Applications and Industry
IEEE Transactions on Applied Superconductivity
IEEE Transactions on Audio
IEEE Transactions on Audio and Electroacoustics
IEEE Transactions on Audio Speech and Language Processing
IEEE Transactions on Automatic Control
IEEE Transactions on Automation Science and Engineering
IEEE Transactions on Broadcast and Television Receivers
IEEE Transactions on Cable Television
IEEE Transactions on Circuit Theory
IEEE Transactions on Circuits and Systems
IEEE Transactions on Circuits and Systems For Video Technology
IEEE Transactions on Cognitive Communications and Networking
IEEE Transactions on Communication and Electronics
IEEE Transactions on Communication Technology
IEEE Transactions on Communications
IEEE Transactions on Component Parts
IEEE Transactions on Components and Packaging Technologies
IEEE Transactions on Components Hybrids and Manufacturing Technology
IEEE Transactions on Components Packaging and Manufacturing Technology
IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems
IEEE Transactions on Computers
IEEE Transactions on Device and Materials Reliability
IEEE Transactions on Electronic Computers
IEEE Transactions on Energy Conversion
IEEE Transactions on Industrial Electronics and Control Instrumentation
IEEE Transactions on Industry and General Applications
IEEE Transactions on Industry Applications
IEEE Transactions on Medical Imaging Ieee
IEEE Transactions on Microwave Theory and Techniques
IEEE Transactions on Nuclear Science
IEEE Transactions on Parts Hybrids and Packaging
IEEE Transactions on Plasma Science
IEEE Transactions on Power Apparatus and Systems
IEEE Transactions on Power Systems
IEEE Transactions on Robotics:
IEEE Transactions on Robotics and Automation
IEEE Transactions on Semiconductor Manufacturing
IEEE Transactions on Services Computing

IEEE Transactions on Signal and Information Processing Over Networks
IEEE Transactions on Signal Processing
IEEE Transactions on Smart Grid
IEEE Transactions on Sustainable Energy
IEEE Transactions on Systems Man and Cybernetics
IEEE Transactions on Systems Man and Cybernetics
IEEE Transactions on Systems Science and Cybernetics
IEEE Transactions on Ultrasonics Engineering
IEEE Transactions on Vehicular Communications
IEEE Transactions on Vehicular Technology
IEEE Transactions on Very Large Scale Integration VLSI Systems
IEEE Translation Journal on Magnetics in Japan
IEEJ Transactions on Electrical and Electronic Engineering
IERI Procedia
IET Renewable Power Generation
IET Wireless Sensor Systems
IETE Journal of Education
IETE Journal of Research
IETE Technical Review
Independent Energy
Industrial Distribution
Industrial Laser Solutions for Manufacturing
Industrial Lubrication and Tribology
Information Visualization
Injection Molding
Instrumentation and Control Systems I And Cs
Integrated Ferroelectrics
Integrating Materials and Manufacturing Innovation
Integration: The VLSI Journal
Intelligent Automation and Soft Computing
Intelligent Service Robotics
International Applied Mechanics
International Conference on Control Automation and Robotics Proceedings
International Conference on Mobile Communications Networking and Applications
International Construction
International Journal for Computational Methods in Engineering Science and Mechanics
International Journal for Numerical and Analytical Methods in Geomechanics
International Journal for Numerical Methods in Biomedical Engineering
International Journal for Numerical Methods in Engineering

International Journal of Adaptive Control and Signal Processing
International Journal of Advanced Robotic Systems
International Journal of Ambient Energy
International Journal of Antennas and Propagation
International Journal of Applied Ceramic Technology
International Journal of Bioengineering and Technology
International Journal of Biotechnology for Wellness Industries
International Journal of Circuit Theory and Applications
International Journal of Communication Systems
International Journal of Control
International Journal of Corrosion
International Journal of Damage Mechanics
International Journal of Digital Multimedia Broadcasting
International Journal of Electrical Engineering Education
International Journal of Electrical Power and Energy Systems
International Journal of Electronics
International Journal of Emerging Sciences
International Journal of Energy and Environment
International Journal of Energy Research
International Journal of Energy Sector Management
International Journal of Engineering Business Management
International Journal of Engineering Science
International Journal of Fatigue
International Journal of Fluid Power
International Journal of Fracture
International Journal of Geomate
International Journal of Green Energy
International Journal of Heat And Fluid Flow
International Journal of Human Computer Studies
International Journal of Imaging Systems And Technology
International Journal of Impact Engineering
International Journal of Infrared And Millimeter Waves
International Journal of Intelligent Unmanned Systems
International Journal of Marine Energy
International Journal of Mechanics and Materials in Design
International Journal of Microwave and Millimeter Wave Computer-Aided Engineering
International Journal of Modelling and Simulation
International Journal of Multiphase Flow
International Journal of Numerical Methods For Heat and Fluid Flow

International Journal of Optomechatronics
International Journal of Plasticity
International Journal of Plastics Technology
International Journal of Polymeric Materials
International Journal of Power and Energy Systems
International Journal of Precision Engineering and Manufacturing
International Journal of RF and Microwave Computer Aided Engineering
International Journal of Robotics and Automation
International Journal of Robust and Nonlinear Control
International Journal of Rock Mechanics and Mining Sciences and Geomechanics
International Journal of Rotating Machinery
International Journal of Satellite Communications
International Journal of Satellite Communications and Networking
International Journal of Self Propagating High Temperature Synthesis
International Journal of Social Robotics
International Journal of Speech Technology
International Journal of Steel Structures
International Journal of Stem Education
International Journal of Sustainable Energy
International Journal of Sustainable Engineering
International Journal of Technology and Human Interaction
International Journal of Thermal Sciences = Revue Geìneìrale De Thermique
International Journal of Vehicular Technology
International Journal of Wireless Information Networks
International Journal on Interactive Design and Manufacturing
International Transactions on Electrical Energy Systems
International Water Power and Dam Construction
Inverse Problems in Engineering
Inverse Problems in Science and Engineering
Iranian Journal of Science and Technology Transactions of Civil Engineering
Iranian Journal of Science and Technology Transactions of Electrical Engineering
Iranian Journal of Science and Technology Transactions of Mechanical Engineering
IRE Transactions on Antennas and Propagation
IRE Transactions on Audio
IRE Transactions on Broadcast And Television Receivers
IRE Transactions on Broadcast Transmission Systems
IRE Transactions on Broadcasting
IRE Transactions on Circuit Theory
IRE Transactions on Communications Systems

IRE Transactions on Component Parts
IRE Transactions on Electron Devices
IRE Transactions on Electronic Computers
IRE Transactions on Human Factors in Electronics
IRE Transactions on Industrial Electronics
IRE Transactions on Instrumentation
IRE Transactions on Nuclear Science
IRE Transactions on Production Techniques
IRE Transactions on Radio Frequency Interference
IRE Transactions on Reliability and Quality Control
ISPRS Journal of Photogrammetry and Remote Sensing
ISRN Civil Engineering
ISRN Mechanical Engineering
Journal of Acoustic Emission
Journal of Applied Mathematics
Journal of Civil Engineering And Management
Journal of Communications And Computer Engineering
Journal of Communications Technology And Electronics
Journal of Composite Materials
Journal of Computational Electronics
Journal of Computer Aided Materials Design
Journal of Computers
Journal of Earthquake Engineering JEE
Journal of Elastomers And Plastics
Journal of Electroceramics
Journal of Electronic Materials
Journal of Electronic Testing
Journal of Electronics China
Journal of Energy Chemistry
Journal of Energy Storage
Journal of Engineering And Technology
Journal of Engineering Design
Journal of Engineering Design And Technology
Journal of Engineering Education
Journal of Engineering Mathematics
Journal of Engineering Physics and Thermophysics
Journal of Engineering Technology
Journal of Engineering Thermophysics
Journal of Environmental Engineering and Science

Journal of Failure Analysis and Prevention
Journal of Field Robotics
Journal of Friction and Wear
Journal of Fusion Energy
Journal of Information Display
Journal of Infrared Millimeter and Terahertz Waves
Journal of Intelligent and Robotic Systems
Journal of Intelligent Material Systems and Structures
Journal of Lightwave Technology
Journal of Location Based Services
Journal of Machinery Manufacture and Reliability
Journal of Machining and Forming Technologies
Journal of Magnesium and Alloys
Journal of Management and Engineering Integration
Journal of Materials Engineering
Journal of Materials Engineering and Performance
Journal of Materials for Energy Systems
Journal of Materials Research
Journal of Materials Research and Technology
Journal of Materials Science
Journal of Materials Science and Technology
Journal of Materials Science Letters
Journal of Mechanical Science and Technology
Journal of Mechatronics and Intelligent Manufacturing
Journal of Micro Bio Robotics
Journal of Nanomaterials
Journal of Nondestructive Evaluation
Journal of Nuclear Science and Technology
Journal of Porous Materials
Journal of Reinforced Plastics and Composites
Journal of Robotic Systems
Journal of Robotics
Journal of Rock Mechanics and Geotechnical Engineering
Journal of Sandwich Structures and Materials
Journal of Signal Processing Systems For Signal Image and Video Technology
Journal of Structural Control
Journal of Superhard Materials
Journal of Sustainable Mining
Journal of Technology Computer Aided Design TCAD

Journal of the AIEE
Journal of the Chinese Institute of Engineers = Zhongguo Gong Cheng Xue Kan
Journal of the Mechanics and Physics of Solids
Journal of the Society for Information Display
Journal of Thermal Stresses
Journal of Thermoplastic Composite Materials
Journal of Usability Studies
Journal of Vibration and Control JVC
Journal of Vibroengineering
Journal of Visualization
Journal of VLSI Signal Processing
Journal of Wind Engineering and Industrial Aerodynamics
Journal of Wood Science
Journal of Wuhan University of Technology
Ksce Journal of Civil Engineering
Laser and Photonics Reviews
Lasers and Optronics
Leukos
Lighting Design and Application
Lubrication Engineering
Lubrication Science
Machine Design
Machining Science and Technology
Mainframe Computing
Manufacturing Engineering
Materials and Design
Materials and Structures
Materials at High Temperatures
Materials Letters
Materials Research Innovations
Materials Science
Materials Science and Engineering A Review Journal
Materials Science and Engineering B Solid State Materials for Advanced Technology
Materials Science and Technology MST: A Publication of the Institute of Metals
Materials Science in Semiconductor Processing
Materials Technology
Materials Today Proceedings
Mathematical and Computer Modelling of Dynamical Systems
Mathematical Modelling of Systems

Mathematical Problems in Engineering
Mathematics and Mechanics of Solids Mms
Measurement and Control
Measurement Techniques
Mechanical Engineering
Mechanics Based Design of Structures and Machines
Mechanics of Advanced Materials And Structures
Mechanics of Solids
Metals and Materials International
Metalworking Digest
Microelectronics and Reliability
Microelectronics International
Microfluidics and Nanofluidics
Microgravity Science and Technology
Microscale Thermophysical Engineering
Military Robotics
Mineral Processing and Extractive Metallurgy Review
Mobile Communications International
Modelling and Simulation in Engineering
Modelling and Simulation in Materials Science And Engineering
Modern Machine Shop
Modern Power Systems
Modified Mustangs and Fords
Moscow University Mechanics Bulletin
Motion System Design MSD
Motion System Field Guide
Multidiscipline Modeling in Materials and Structures
Municipal and Industrial Water and Pollution Control
Nano Structures and Nano Objects
Nanomaterials and Nanotechnology
Nanoscale and Microscale Thermophysical Engineering
Nature Photonics
NDT And E International
NDT Update
Networking Management
New Civil Engineer: Magazine of the Institution of Civil Engineers
Nondestructive Testing and Evaluation
Nuclear Engineering and Technology
Nuclear Engineering International

Photonics and Nanostructures Fundamentals and Applications
Plasma Devices and Operations
Point of Beginning
Polymer Composites
Polymer Science
Polymer Testing
Polymers and Polymer Composites
Powder Technology
Power Engineering
Power Quality Assurance
Powergrid International
Precision Toolmaker
Premise Wiring
Probabilistic Engineering Mechanics
Procedia Engineering
Procedia Materials Science
Proceedings of the Estonian Academy of Sciences
Proceedings of the Institution of Mechanical Engineers
Proceedings of the International Symposium of Human Factors and Ergonomics in Healthcare
Product Engineering and Production IEEE, Transactions On
Product Engineering and Production IRE, Transactions On
Production Engineering
Production Machining
Professional Engineering
Progress in Energy and Combustion Science
Progress in Nuclear Energy
Protection of Metals and Physical Chemistry of Surfaces
Quality and Reliability Engineering International
Radio Electronics and Communications Systems
Rapid Prototyping
Rare Metal Materials and Engineering
Refractories and Industrial Ceramics
Refrigeration Service and Contracting
Reinforced Plastics
Renewable and Sustainable Energy Reviews
Renewable Energy Focus
Research in Engineering Design
Research in Nondestructive Evaluation
Residential Systems

Robotics and Autonomous Systems
Robotics Today
Rock Mechanics and Rock Engineering
Russian Electrical Engineering
Russian Microelectronics
Semiconductors
Sensing and Imaging
Sensor Review
Sensors
Sensors and Actuators
Sesi Journal Journal of the Solar Energy Society of India
Sigbed Review
Signal Image and Video Processing
Site Management and Technology
Soil Dynamics and Earthquake Engineering
Soil Mechanics and Foundation Engineering
Soils and Foundations
Solid Fuel Chemistry
Solid State Electronics
Solid State Technology
Sound and Vibration
Space Communications
Steel Construction Design and Research
Stereophile
Strength of Materials
Structural and Multidisciplinary Optimization
Structural Concrete Journal of the FIB
Structural Safety
Structural Survey
Structure and Infrastructure Engineering Maintenance Management Life Cycle
Design and Performance
Structures
Super Streetbike
Surface Engineering
Survey Review
Surveying and Land Information Systems
Sustainable Energy Grids and Networks
Sustainable Energy Technologies and Assessments
Sustainable Materials and Technologies

Systems Engineering Theory and Practice
Teleconnect: The Voice of the Telephone Interconnect Industry
Telematics and Informatics
Texture Stress and Microstructure
The IES Journal
The International Journal of Mechanical Engineering Education
The International Journal of Robotics Research
The Journal of China Universities of Posts and Telecommunications
The Motion Systems Distributor
The PCIA Washington Bulletin
The Photogrammetric Record
The PT Motion Systems Distributor
Theoretical and Applied Fracture Mechanics
Theoretical and Applied Mechanics Letters
Thermal Engineering
Tooling and Production
Tools and Technology: The Newsletter of the American Precision Museum
Transactions of The American Institute of Electrical Engineers
Transactions of the IRE Professional Group on Antennas and Propagation
Transactions of the IRE Professional Group on Communications Systems
Transactions of the IRE Professional Group on Industrial Electronics
Transactions of the Institute of Measurement and Control
Transactions of the IRE Professional Group on Audio
Transactions of the IRE Professional Group on Circuit Theory
Transactions of the IRE Professional Group on Electron Devices
Transactions of the IRE Professional Group on Nuclear Science
Transactions of the IRE Professional Group on Quality Control
Transactions on Emerging Telecommunications Technologies
Transportation Science
Tunnelling and Underground Space Technology
Tunnels and Tunnelling
Tunnels and Tunnelling International
Turkish Journal of Engineering and Environmental Sciences
Vision Systems Design
West Indian Journal of Engineering
Wind Energy
Windpower Monthly Newsmagazine
Wireless Business and Technology
Wireless Cellular

Wireless Communications and Mobile Computing
Wireless Communications IEEE, Transactions on
Wireless Networks
Wireless Personal Communications
Wood Material Science and Engineering
Wood Science and Technology
World Tunnelling and Subsurface Excavation

Appendix F. Example Curriculum Vitae

A. Resume of James C. Newman III

Education

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State University, July 1997
M.S., Aerospace Engineering, Old Dominion University, May 1994
B.S., Mechanical Engineering, Old Dominion University, May 1993

Employment

***Professor**, (August 2011 -Present)*
University of Tennessee Chattanooga, Department of Computational Engineering, SimCenter: National Center for Computational Engineering, Chattanooga, TN

***Joint Faculty Appointment**, (April 2014 – Present)*
Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

***Associate Professor**, (July 2002 – August 2011)*
Mississippi State University, Department of Aerospace Engineering, Computational Simulation and Design Center, Engineering Research Center, Mississippi State, MS

***Assistant Professor**, (August 1997 -May 2002)*
Mississippi State University, Department of Aerospace Engineering, Computational Simulation and Design Center, Engineering Research Center, Mississippi State, MS

***NASA Fellow/Graduate Research Assistant**, (June 1994 July 1997)*
Virginia Polytechnic Institute and State University, Department of Mechanical Engineering, Blacksburg, V A.

NASA GSRP Fellow, NASA Langley Research Center, Hampton, VA

***Engineering Consultant,** (May 1995 - July 1997)*
Eagle Aeronautics, Inc., Newport News, VA

Research Areas

Dr. Newman has been active in the areas of multidisciplinary analysis, sensitivity analysis, and computational design optimization since 1994. Prior to this, Dr. Newman's focus area was in the simulation of complex-steady and unsteady moving boundary configurations using both unstructured grid and structured grid domain-decomposition techniques. Dr. Newman has developed software to perform computational fluid-structure, and fluid-thermal, interaction and analysis as well as pioneered new algorithms for evaluating multidisciplinary sensitivity derivatives and for uncertainty analysis. Additionally, he has worked closely with NASA, Navy, DIA/MSIC, and Army researchers to incorporate these techniques into analysis software to provide

computational design capabilities, and has utilized them for industrially relevant design solutions.

Honors and Awards
2002 Office of Naval Research Young Investigator Program Award
1997/2008/2009 IMAGE (Increase Minority Access to Graduate Education) Faculty Award
1994 NASA GSRP (Graduate Student Researcher Program)

Fellowship Recipient
1991 NASA LaRSS (Langley Research Summer Scholar) Recipient

Academic Specialties
"Methods and Apparatus for Asymmetrical Fairing," U.S. Patent No. 8,157,216. April 17, 2012.

Professional Activities
Senior Member, American Institute of Aeronautics and Astronautics (AlAA)
Member, American Society of Mechanical Engineers (ASME)
Member, American Society of Engineering Educators (ASEE)
Pi Tau Sigma (Mechanical Engineering Honorary)
Tau Beta Pi (Engineering Honorary)

Reviewer
Archival Journals
AIAA Journal
Journal of Aircraft
International Journal of Computational Fluid Dynamics
International Journal for Numerical Methods in Engineering
Journal of Computers and Fluids
International Journal of Structural and Multidisciplinary Optimization
Book Reviews John Wiley & Sons
Proposal Reviews National Science Foundation (NSF) Small Business Innovation Research (SBIR) Program (2000, 2003)
Conference Proceedings
Mississippi State Conference on Differential Equations and Computational Simulation
AIAA Conference Papers

Refereed Journal Articles
1. Anderson, W.K., Wang, L., Newman III, J.C., and Kapadia, S., "Extension of the Petrov-Garlerkin Time-Domain Algorithm for Dispersive Media," *IEEE Microwave and Wireless Components Letters*, Vol. 23, No. 5, 2013.

2. Blades, E., and Newman III, J.C., "CFD-Based Design Optimization of a Large Payload Fairing," *AIAA Journal of Spacecraft and Rockets*, Vol. 50, No. 5, Sept. 2013.

3. Balasubramanian, R., and Newman III, J.C., "Adjoint-Based Error Estimation and Grid Adaptation for Functional Output: Applications to Two-Dimensional, Inviscid, Incompressible Flows," *Computers & Fluids,* Vol. 38, No. 2, Feb. 2009, pp. 320-332.

4. Yamada, Y, Newman III, J.C., and Newman Jr., J.C., "Elastic-Plastic Finite-Element Analyses of Compression Precracking and Its Influence on Subsequent Fatigue-Crack Growth," *J. of ASTM Int.,* Vol. 5, No.8, Sept. 2008.

5. Balasubramanian, R., and Newman Ill, J.C., "Comparison of Adjoint Based and Feature Based Grid Adaptation for Functional Outputs," *Int. J. Numer. Meth. Fluids,* Vol 53, No. 10, April 2007, pp. 1541-1569.

6. Balasubramanian, R., and Newman III, J.C., "Discrete Direct and Discrete Adjoint Sensitivity Analysis for Variable Mach Flows," *Int. J. Numer. Meth. Engng.,* Vol. 66, No.2, April 2006, pp. 297-318.

7. Newman III, J.C., Whitfield, D.L., and Anderson, W.K., "A Step-Size Independent Approach for Multidisciplinary Sensitivity Analysis," *J. Aircraft,* Vol. 40, No.3, May-June 2003, pp. 566-573.

8. Burg, C.O.E., and Newman III, J.C., "Computationally Efficient, Numerically Exact Design Space Derivatives via the Complex Taylor's Series Expansion Method*," Computers and Fluids,* Vol. 32, No.3, March 2003, pp. 373-383.

9. Anderson, W.K., Newman III, J.C., Whitfield, D.L., and Nielsen, E. J., "Sensitivity Analysis for the Navier- Stokes Equations on Unstructured Meshes Using Complex Variables," *AIAA J.,* Vol. 39, No.1, Jan. 2000, pp. 56-63.

10. Newman III, J.C., Taylor III, A. C., Barnwell, R.W., Newman, P.A, and Hou, G.J.-.W., "Overview of Sensitivity Analysis and Shape Optimization for Complex Aerodynamic Configurations," *J. Aircraft,* Vol. 36, No. 1,1999, pp. 87-96.

11. Newman III, J.C., Newman, P.A, Taylor III, A.C., and Hou, G.J.-.W., "Efficient Nonlinear Static Aeroelastic Wing Analysis," *Computers and Fluids,* Vol. 28, Nos. 4-5, May-June 1999, pp. 615-628.

12. Singh, K.P., Newman III, J.C., and Baysal, 0., "Dynamic Unstructured Method for Flows Past Multiple Objects in Relative Motion," *AIAA J.,* Vol. 33, No.4, April 1995, pp. 641-649.

Book Chapters

1. Oloso, A., Taylor III, A.C., and Newman III, J.C., "Aerodynamic Design Optimization Using Advanced CFD Codes," Computational Fluid Dynamics Review 1998 (Eds. M.M. Hafez and K. Oshima), World Scientific Publishing Co., 1998, pp. 560-572.

2. Newman III, J.C., Pankajakshan, R., Whitfield, D.L., and Taylor, L.K., "Computational Hydrodynamic Design Using RANS," Symposium on Naval Hydrodynamics, National Academies Press, 2003, pp. 991-1001.

Conference Proceedings

1. Liu, C., Newman III, J.C., and Anderson, W.K., "A Streamline/Upwind Petrov Galerkin Overset Grid Scheme for the Navier-Stokes Equations with Moving Domains," *Proceedings of the 32nd AIAA Applied Aerodynamics Conference*, AIAA Paper 2014-2980, Atlanta, GA, June 2014.

2. Ahrabi, B.R., Anderson, W.K., and Newman III, J.C., "High-Order Finite-Element Method and Dynamic Adaptation for Two-Dimensional Laminar and Turbulent Navier-Stokes Equations," *Proceedings of the 32nd AIAA Applied Aerodynamics Conference,* AIAA Paper 2014-2983, Atlanta, GA, June 2014.

3. Hasbestan, J.J., Newman III, J.C., and Arabshahi, A., "A New Approach to Mesh Adaptation Procedure using Linear Elasticity for Geometries Undergoing Large Displacements," *Proceedings of the 4th Joint US-European Fluids Engineering Division Summer Meeting,* FEDSM2014-22010, Chicago, IL, Aug. 2014.

4. Janus, J.M., Newman III, J.C., Ivancic, P., and Luke, E., "Conservative Fluid-Structure Data Transfer Algorithm for Mismatched-Mesh Simulations," *Proceedings of the 21st AIAA Computational Fluid Dynamics Conference,* San Diego, CA, June 2013.

5. Kapadia, S., Anderson, W.K., Newman III, J.C., "Computational Analysis and Design of Solid Oxide Fuel Cells," *ASME 10th International Fuel Cell Science, Engineering & Technology Conference,* San Diego, CA, July 2012.

6. Ochinero, T., Deiters, T., Higgins, .J.E., Blades, E., and Newman III, J.C., "Design and Testing of a Large Composite Asymmetric Payload Fairing," *Proceedings of the 50th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference,* AlAA Paper 09-2696, Palm Springs, CA, May 2009.

7. Burgreen, G.W., and Newman III, J.C., "Robust Simulation of CFD-Predicted Hemolysis," *NIH/FDA/NSF Computational Modeling for Cardiovascular Devices Meeting Proceedings,* Rockville, MD, June 2009

8. Yamada, Y, Newman III, J.C., and Newman Jr., J.C., "Elastic-Plastic Finite-Element Analysis of Compression Pre cracking and Its Influence on Subsequent Fatigue-Crack-Growth Behavior," *Proceedings of the 7th International ASTM/ESIS Symp. on Fatigue and Fracture,* Tampa. FL, Nov. 2007.

9. Newman III, J.C., and Blades, E.L., "Parallel Optimization Strategy for Large-Scale Computational Design, *Proceedings of the 3rd AIAA Multidisciplinary Design Optimization Specialists Conference,* AIAA Paper 071930, Waikiki, HI, April 2007.

10. Blades, E.L., and Newman III, J.C., "Aeroelastic Effects of Spinning Missiles," *Proceedings of the 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference,* AIAA Paper 072243, Waikiki, HI, April 2007.

11. Blades, E.L., and Newman III, J.C, "Computational Aeroelastic Analysis of an Unmanned Aerial Vehicle using U2NCLE," *Proceedings of the AIAA Dynamics Specialists Conference,* AIAA Paper 07-2237, Waikiki, HI, April 2007.

12. Balasubramanian, R., and Newman III, J.C., "Comparison of Adjoint-based and Feature-based Grid Adaptation for Functional Outputs," *Proceedings of the 36th AIAA Fluid Dynamics Conference and Exhibit,* AIAA Paper 06-3314, San Francisco, CA, June 2006.

13. Groner III, B.J, Lee, M.A, Moorhead, R.J., Martin, J.P., Newman III, J.C., "Concurrent Visualization of a Parallelized Computational Fluid Dynamics Code," *International Society for Modeling and Simulation, HPC Spring Simulation Multiconference,* Huntsville, AL, April 2006.

14. Groner, J., Lee, M., Martin, J., Moorhead, R. J., and Newman III, J.C., "A Concurrent Visualization System for High-Performance Computational Simulations," *IEEE Visualization 2005 Proceedings Compendium*, March 2005.

15. Balasubramanian, R., and Newman III, J.C., "Discrete Direct and Discrete Adjoint Sensitivity Analysis for Arbitrary Mach Number Flows," *SIAM Conference on Computational Science and Engineering,* Orlando, FL, February 2005.

16. Brewer, W.H., Newman III, J.C., and Burgreen, G.W., "Computational Design of Propulsors For Improved Cavitation Performance," *Bound Proceedings of the 8th International Conference on Numerical Ship Hydrodynamics*, Busan, Korea, September 2003.

17. Burg, C.O.E., Sheng, C., Newman III, J.C., Brewer, W.H., Blades, E., and Marcum, D.L., "Verification and Validation of Forces Generated by an Unstructured Flow Solver," *Bound Proceedings of the 16th Computational Fluid Dynamics Conference,* AIAA Paper 03-3983, Orlando, FL, June 2003.

18. Newman III, J.C., Pankajakshan, R., Whitfield, D.L., and Taylor, L.K., "Computational Design Using RANS," *Bound Proceedings of the 24th Symposium on Naval Hydrodynamics,* Fukuoka, Japan. July 2002.

19. Janus, J.M., and Newman III, J.C., "Aerodynamic and Thermal Design Optimization for Turbine Airfoils," *Proceedings of the 38th Aerospace Sciences Meeting & Exhibit,* AIAA Paper 00-0840, Reno, NV, January 2000.

20. Newman III, J.C., Whitfield, D.L., and Anderson, W.K., "A Step-Size Independent Approach for Multidisciplinary Sensitivity Derivatives," *Bound Proceedings of the 17th Applied Aerodynamics Conference,* Vol. 1, pp. 1-12, AIAA Paper 99-3101, June 1999.

21. Anderson, W.K., Newman III, J.C., Whitfield, D.L., and Nielsen, EJ., "Sensitivity Analysis for the Navier-Stokes Equations on Unstructured Meshes Using Complex Variables," *Bound Proceedings of the 14th Computational Fluid Dynamics Conference,* Vol. 1, pp. 381-389, AlAA Paper 99-3294, June 1999.

22. Newman III, J.C., Taylor III, A.C., and Barnwell, R.W., "Aerodynamic Shape Sensitivity Analysis and Design Optimization of Complex Configurations Using Unstructured Grids," *Bound Proceedings of the 15th Applied Aerodynamics Conference,* Vol. 1, pp. 420-431, AIAA Paper 97-2275, June 1997.

23. Taylor III, A.C., Oloso, A, and Newman III, J.C., "CFL3D.ADII (Version 2.0): An Efficient, Accurate, General-Purpose Code for Flow Shape-Sensitivity Analysis," *Bound Proceedings of the 15th Applied Aerodynamics Conference,* Vol. 1, pp. 188-197, AlAA Paper 97-2204, June 1997.

24. Newman III, J.C., Newman, P.A, Taylor III, A.C., and Hou, G.J.-W., "Nonlinear Aerodynamic Design Optimization of a Flexible Wing," *Bound Proceedings of the 6th AIAA/NASA/USAF Multidisciplinary Analysis and Optimization Symposium,* Vol. 2, pp. 36-46, AIAA Paper 96-4108, September 1996.

25. Newman III, J.C., and Taylor III, A.C., "Three-Dimensional Aerodynamic Shape Sensitivity Analysis and Design Optimization Using the Euler Equations on Unstructured Grids," *Bound Proceedings of the 14th Applied Aerodynamics Conference,* Vol. 1, pp. 177-189, AlAA Paper 96-2464, June 1996.

26. Newman III, J.C., Taylor Ill, A.C., and Burgreen, G.W., "An Unstructured Grid Approach to Sensitivity Analysis and Shape Optimization Using the Euler Equations," *Bound Proceedings of the 12th Computational Fluid Dynamics Conference,* Vol. 1, pp. 69-80, AIAA Paper 95-1646, June 1995.

27. Singh, K.P., Newman III, J.C., and Baysal, O., "Dynamic Unstructured Method for Flows Past Multiple Objects in Relative Motion," *Proceedings of the 32nd Aerospace Sciences Meeting & Exhibit,* AIAA Paper 94-0058, Reno, NV, January 1994.

28. Newman III, J.C., and Baysal, O., "Transonic Solutions of a Wing/Pylon/Finned Store Using Hybrid Domain Decomposition," *Bound Proceedings of the 38th Atmospheric Flight Mechanics Conference,* Vol. 1, pp. 441450, AIAA Paper 92-4571, August 1992.

29. Fouladi, K., Baysal, O., and Newman III, J.C., "Hybrid Domain Decomposition for Configurations with Multiple Non-Similar Components," *Bound Proceedings of the5th*

SIAM Conference on Domain Decomposition Methods for Partial Differential Equations, May 1991.

Reports (unrestricted list)

1. Thompson, D., Luke, E., Newman III, J.C., Janus, J.M., Tong, X., and Moore, C., "Development of a Strategy for Simulating Blast-Vehicle Interaction," U.S. Army RDECOM-TARDEC Contract W56HZV-08-C-0126, Final Report, Sept. 2010.

2. Marcum, D., Newman III, J.C., Thompson, D., Blades, E. L., Walters, K., and Hughson, M., "Enhanced Computational Aerodynamic Analysis: Volumes 1 to 4," MSSU-BCoE-HPC2-06-04, April 2006. (also Final Contract Report, Defense Intelligence Agency/Missile and Space Intelligence Center).

3. Newman III, J.C., "A New Approach for Discrete Sensitivity Analysis Using Complex Variables," MSU Report, MSSU-COE-ERC-04-09, September 2004.

4. Newman III, J.C., "Matrix Inversion by the Complex Taylor Series Expansion Method with Application to Discrete-Adjoint Sensitivity Analysis," MSU Report, MSSU-COE-ERC-04-08, September 2004.

5. Marcum, D.L., Newman III, J.C., Burg, C.O.E., Burgreen, G.W., Sheng, C., Blades, E., Remotigue, M., and Brewer. W., "Computational Engineering Research Supporting the Analysis and Design of Marine and Aerospace Vehicles," MSU Report, MSSU-COE-ERC-04-0S, June 2004. (also Final Report, Office of Naval Research)

6. Sheng, C., Newman III, J.C., Remotigue, M., Chen, J.P., Marcum, D.L., and Whitfield, D.L., "Development of Unstructured Computational Capabilities Applicable to MSU TURBO with an Arbitrary Mach Number Algorithm," MSU Report, MSSU-COE-ERC-02-l6, October 2002.

7. *Computational Simulation and Design Center Staff*, "Computational Engineering Research Supporting the Analysis and Design of Marine and Aerospace Vehicles," MSU Report, MSSU-COE-ERC-02-09, May 2002. (also Final Report, Office of Naval Research)

8. Newman III, J.C., and Whitfield, D.L., "Sensitivity Derivative Analysis for Use in Computational Design Optimization," Final Report, Lockheed Martin Aeronautical Systems, March 2001. (modified for external release as MSU Report MSSU-COE-ERC-01-06, September 2001).

9. Newman III, J.C., "Aero-Structural Interaction, Analysis, and Shape Sensitivity," Final Report, NASA Langley Research Center, Jan. 2000.

10. Newman III, J.C., Anderson, W.K., and Whitfield, D.L., "Multidisciplinary Sensitivity Derivatives Using Complex Variables," MSU Report, MSSU-COE-ERC-98-08, July 1998.

Dissertation/Thesis

1. Newman III, J.C., “Integrated Multidisciplinary Design Optimization Using Discrete Sensitivity Derivatives for Geometrically Complex Aeroelastic Configurations,” PhD Dissertation, Virginia Polytechnic Institute and State University, July 1997.

2. Newman III, J.C., “Flow Simulations About Steady-Complex and Unsteady Moving Configurations Using Structured-Overlapped and Unstructured Grids,” MS Thesis, Old Dominion University, May 1994.

B. Resume of Prakash R. Damshala, Ph.D, P.E

Name: Prakash R. Damshala

Academic Rank: Director of Graduate Studies, and Professor, Department of Mechanical Engineering, CECS, UTC

Education
Georgia Institute of Technology, Ph.D. (M.E.), September 1978
University of Miami (Florida), M.S. (M.E.), January 1972
Sri Venkateswara / Osmania University (India), B.E. (M.E.), January 1970

Academic Experience

Professor, M.E Department, CECS, University of Tennessee, Chattanooga (8/88 – Present)
Director of Graduate Studies in Mechanical Engineering at UTC (2014- present), served as Chair for P/T Committee for the CECS and serving as a Chair for Faculty Promotion and Tenure Committee for the M.E Department. Worked on Design and Second Law Analysis of Air-Conditioning Systems, Cogeneration, CHP, Energy Recovery Systems, Solar Energy Systems for Zero-Energy Buildings and Communities. Worked on Analysis of Energy Efficiency and Energy Storage Technologies. Developed Computer Software for Efficient Design and Analysis of Thermal Systems and for Evaluation of Carbon Footprint for Industrial Institutions and Products.

Text Books
1. " Thermal Science Laboratory Manual " by Prakash R. Damshala.
2. " Design and Analysis of Thermal Components and Systems" by Prakash R.Damshala, Document Center, The University of Tennessee, Chattanooga, January 2003
3. "A Modern Approach to Design of Air Conditioning and Refrigeration Systems"

by Prakash R. Damshala and P.V. Kadaba, Part of the manuscripts is under completion.

Software Development

1. "Heat" software developed by Prakash R. Damshala to accompany the Thermal ScienceLab Manual. It is also designed to be used in other thermal science Courses, 1991.
2. A Research Tool to Perform Transient Thermal and Economic Analysis of Building Energy Costs using hourly weather data, 1998.
3. A software to assist in selection of insulation for replacement of Asbestos on Steam Lines of Fossil Fuel Power Plants developed for an EPRI project, 1988.
4. A software to perform Thermoeconomic Analysis of CHP (Combined Heat and Power) Systems, 1999.
5. "TERSA, Transient Energy Recovery Systems Analysis".

6. A software to determine the Carbon Footprint of an Industrial Company and its Products.

Associate Professor, CECS, University of Tennessee, Chattanooga (8/81 – 88)
Taught a Variety of M.E courses, Advised on M.S Theses. Consulted with TVA on several engineering projects (1986-2000) related to fossil power plants and secured a grant.

Assistant Professor, M.E Department, Youngstown State University (9/77 – 81)
Taught a Variety of M.E courses, Advised on M.S and undergraduate Theses.

Visiting Assistant Professor, M.E Department, New _Mexico State University (1/77 – 7/77)
Taught a Variety of M.E courses, and wrote a research proposal for a grant.

Professional Registration
Professional Engineer, State of Tennessee (To be Reactivated soon)
Professional Engineer, State of Ohio (Not Active)

Professional Societies
Member of ASHRAE Handbook (Systems & Equipment) Committee, (2004-‘08), (2016-‘20)
Member of ASME
Member and Faculty Advisor of ASHRAE Student Chapter
Vice-Chair for ASHRAE Handbook Chapter 5.5 Air-To-Air Energy Recovery

Awards
1. Nominated for the University Distinguished Professor Award by the Dean of Engineering at YSU.
2. Received special award for scoring the highest grade in the P. E. examination for the state of Ohio.
3. Listed in Who’s Who Among America’s Teachers in 2000, 6th Edn, Volume 2.

Service Activities
Serving as a Faculty Advisor to ASHRAE Student Chapter, as a Vice-Chair of ASHRAE T.C 5.5 Committee, served for four years as member of ASHRAE Handbook Committee, one year as a member of ASHRAE Professional Development Committee, served as member of Faculty Senate, member of university academic standards committee, as a member of school’s graduate curriculum committee, as a member of school’s rank and tenure committee, as a board member of Tennessee Valley Chapter of ASHRAE for the last five years and offered F.E refresher courses.

Publications, Reports, Presentations, Thesis and Engineering Project Advisement
1. “Development of Numerical Model for Thermal Energy Storage Using Phase Change Material” Engineering Project, by Udbhav Reddy Kalva, Engineering Project Advisor, Prakash Damshala, December 2015

2. “Development of Numerical Model for Thermal and Desiccant Wheels” Engineering Project, by Phani Kumar Tangirala, Engineering Project Advisor, Prakash Damshala, May 2015

3. “Development of Numerical Model for DeVap System for a Zero Energy Building” Engineering Project, by Manoj Kadiyala, Engineering Project Advisor, Prakash Damshala, May 2015

4. “Comparative Analysis of the Levelized Cost of Energy (LCOE) for Photovoltaic Panels, Concentrative PV Panels and Parabolic Trough Collectors” Engineering Project, by Juan C. Sanchez, Engineering Project Advisor, Prakash Damshala, December 2014

5. “Alternate Cooling Methods in Electric Thermal Power Plants for Water Conservation” Engineering Project by William E. Webster IV, Engineering Project Advisor, Prakash Damshala, December 2014

6. “Assessment of Compressed Air Energy Storage System (CAES)” M.S Thesis by Patrick M. Johnson, Thesis Advisor, Prakash Damshala, May 2014

7. “Water Desalination and Purification Using Sustainable Energy Technologies” M.S Thesis by Michael Louis Broggi, Thesis Advisor Prakash Damshala, April 2013.

8. “Analysis of Solar Assisted Absorption Chiller for a Commercial Building” M.S Thesis by Gnananesan Antonyraj, Thesis Advisor, Prakash Damshala, December 2012

9. “Development of an Energy Storage Tank Model” M.S Thesis by Robert Buckley, Thesis Advisor, Prakash Damshala, December, 2012

10. “Combined Heat and Power, Technology Review and Analysis for a Residential Building,” M.S Thesis by Nadine Reinert, Thesis Advisor, Prakash Damshala, November 2012

11. “Potential Energy Cost Savings by Use of Building Roofs as Thermal Storage of a Multi-Storage Building” M.S Thesis by Ahmed Shelbaya, Thesis Advisor, Prakash Damshala, December 2012

12. “Energy Efficiency’s Role in a Zero Energy Building: Simulating Energy Efficient Upgrades in a Residential Test Home to Reduce Energy Consumption” M.S Thesis by Drew Frye, Thesis Advisor, Prakash Damshala, May 2011

13. “Economic Analysis of Using Gasifier to Meet the Building Loads of Light Commercial Building,” presented by Prakash Damshala, SET International Conference, Shanghai, China, August 2010

14. “Dynamic Analysis of Grid Connected Hybrid System of PV Panels and Wind

Turbines for a light Commercial Building" M.S Thesis by Bhavin Madhu, Thesis Advisor, Thesis Advisor, Prakash Damshala, May 2010

15. "Economic Analysis of Biomass Fired Gasifier to Meet the Building Loads of a Light Commercial Building" M.S Thesis by Madan Nellore, Thesis Advisor, Thesis Advisor, Prakash Damshala, May 2010

16. "Assessment of Liquid Desiccant Cooling Systems" M.S Thesis by Shermanda S. Williams, Thesis Advisor Prakash Damshala, May 2007

17. "Economic Benefits of Advanced CHP Systems" by Prakash Dhamshala, Proceedings of CLIMA 2005 Congress" in Laussane, Switzerland, October, 2005

18. "Thermoeconomic Analysis of Cogeneration System for HVAC Applications in Commercial and Industrial Buildings " M.S Thesis by James Nathan Pugh, Thesis Advisor, Prakash Damshala, May 2004

19. "Energy Cost Savings with Use of DOAS Systems in Various Cities in U.S" by Prakash Damshala, Proceedings of ASME World Congress, Washington D.C, Nov 2003

20. "Energy Cost Savings due to Use of Energy Recovery System with Dedicated Outside Air Systems (DOAS)", by Prakash Dhamshala Seminar presented ASHRAE Annual Meeting in Kansas City, MO, June 2003

21. "A Multi-Purpose Thermal Design Project that Works " by Prakash Dhamshala and Robert Bailey, published in The International Journal of Mechanical Engineering Education, Volume 30, Number 2, April 2002.

22. "A Computer Design Project for an Energy Recovery System" by Prakash R. Damshala, a paper presented at ASEE southeastern conference held at Charleston, SC in April 2001

23. "Numerical Analysis of Solar Storage (Trombe) Wall for Identifying Optimal Energy Recovery Conditions " by Prakash R. Dhamshala and Robert Bailey, a paper presented at ASEE southeastern conference, April 2000 at Blacksburg, Virginia.

24. "Electronic ASHRAE Handbook" by Prakash Dhamshala presented at the monthly meeting of ASHRAE regional chapter meeting for professional development credits, February 2001.

25. "Thermoeconomic Analysis of a CHP System by Iterative Numerical Techniques" by Prakash R. Dhamshala, Transactions of ASHRAE February 2000, Vol 106, Part 1.

26. "Evaluation of Centrifugal Chillers" by Prakash Dhamshala presented at the monthly meeting of the ASHRAE Regional Chapter for professional development credits, February, 2000

27. “Global Warming and Air Pollution” by Prakash Dhamshala presented to the Lion’s Club Group, Hyderabad, India, June 1999

28. “Thermodynamic and Thermoeconomic Optimization of Combined Heat and Power System” M. Thesis by Zeeshan Khan, Thesis Advisor, Prakash Damshala, June, 1998

29. "Multi-Purpose Design Project for Engineering Students of Coming Century," by Prakash Dhamshala, a paper presented at ASEE Annual Meeting in June 1997, at Milwaukee, WI

30. "A Comprehensive Heat Transfer Design Experiment," by Prakash Dhamshala, a paper presented at ASEE Annual Meeting in June 1997 at Milwaukee, Wisconsin

31. "An Experimental Design Project in Fluid Mechanics," by Prakash Dhamshala, a paper presented at ASEE Annual Meeting in June 1997 at Milwaukee, Wisconsin

32. “Computer’s Role in Efficient Design of Heat Exchanger for Energy Recovery” by Prakash Damshala, a paper presented at ASEE Annual Meeting in June 1997 at Milwaukee, WI

33. “Computer’s Role in Effective Design in Electronic Cooling “ by Prakash Damshala, a paper presented at ASEE Annual Meeting in June 1997 at Milwaukee, WI

34. "Investigation of Opportunities to Reduce Energy Consumption and Costs in a School Building Using Detailed Computer Simulation Program," M.S Thesis by Chinnakaruppan Sathappan, Thesis Advisor, Prakash Dhamshala May 1996

35. "Computer Modeling for Thermal and Stress Analysis of Slag Monitor for Utility Boilers," by Prakash Damshala, a report submitted to TVA March 1995

36. "Computer Modeling of Phase Change Materials for Optimum Results," M.S Thesis by Pornpimo Vongsansunee, Thesis Advisor, Prakash Dhamshala August 1995

37. "Development of ANSYS Model for Tube Failures Fossil Fueled Boilers," M.S Thesis by Z. Konziak, Thesis Advisor, Prakash Dhamshala August 1995

38. "Impact of Alternate Refrigerant on Evaporator Design and Analysis of Compact Heat Exchangers," M.S Thesis by Parag Dadeech, Thesis Advisor, Prakash Damshala April 1994

39 "Comparative Analysis of Four Different Heat Pumps for Maximum Energy Cost Savings," M.S Thesis by Abdulla Udaipurwala, Thesis Advisor Prakash Damshala April 1992

40. "Assessment of ASD Heat Pumps for Commercial Applications," by Prakash Damshala, a report submitted to TVA, February 1992

41. "Fabrication, Instrumentation and Development of Data Acquisition System for Thermal Experiments," M.S Thesis by B. H. Farlett, Thesis Advisor, Prakash Damshala April 1990.

42. "Components of Energy Conservation in Residential Buildings," M.S Thesis by Md. Kazemian, Thesis Advisor, Prakash Damshala, April 1989

43. “Broad-Based Assessment of Asbestos Insulation Substitutes for Steam Lines in Fossil Fuel Power Plants," by Prakash Damshala, EPRI Report, April 1989-RP1266-50.

44. "Modeling of Slag Monitor and Water Tubes in Utility Boilers," Prakash Damshala and G. P. Sasmal, a report submitted, TVA, May 1989

45. “Development of Numerical Model for Determination of Thermal Stresses Induced in the Water-Wall Boiler Tubes” M.S Thesis by Gyanendra Prasad Sasmal, Thesis Advisor Prakash Damshala, May 1988

46. "Industrial Insulation for Steam Lines of Fossil Fuel Power Plants," by Prakash. Damshala and Jerry D. Fourroux published in Power, May 1988 issue

47. "Introduction to Computer Era Through HVAC Education," by Prakash Damshala, published in ASHRAE Transactions 1987, Vol. 93, Pt. 1 and also presented in Winter Annual Meeting of ASHRAE in New York 1987

48. "Simulation of Solar Ponds with Simple Atmospheric Insolation Model.” M.S Thesis byTom Eldridge, Thesis Advisor, Prakash Damshala, April 1987

49. "Economic Impact of Ice Storage Systems on Building Energy Costs," M. Thesis by Bheroze Ghorbani, Thesis Advisor, Prakash Dhamshala, April 1986

50. "Evaluation and Simulation of Solar Augmented Heat Pump Water Heating System," M.S Thesis by Robert Steele, Thesis Advisor, Prakash Damshala, April 1986

51. “Optimization of Power Production from Salt Gradient Solar Ponds," M.S Thesis by C. Amin, Thesis Advisor, Prakash Damshala, April 1983

52. "Optimization of Point-Focusing Distributed Receiver Solar Thermal Electric System using a Simple Solar Insolation Model," M.S Thesis by M. Akbari, Thesis Advisor, Prakash Damshala, August 1983

53. "Influence of Rankine Fluid/Cycle and the Regional Solar Insulation on the Solar Rankine Systems," M.S. Thesis by Kaushik Choudhary, Thesis Advisor, Prakash Damshala, at Youngstown State University, April 1981

54. "Optimization of Heat Exchanger for Solar Concentrators," by Prakash Damshala presented at the National Forum of Solar Cooling and Heating, Miami Beach, Florida, Dec.1976, and also published in the proceedings of the conference.

55. "Experimental Solar Heat Supply System with Fixed Mirror Concentrators for the Heating and Cooling of Buildings," by J.R. Williams and Prakash Dhamshala the final report presented to ERDA, 1975.

Research Grants

1. " Survey of Literature for Development of Knowledge Based Expert System For HVAC Applications," Prakash Damshala, CECA Grant of $2,500 in Summer of 1986.

2. " A Proposal for Preparing a Plan for UTC Operation of the TVA Non-Convection Solar Pond as an Energy Engineering Field Laboratory," James Cunningham, Prem Chopra, Prakash Damshala, James Hiestand, and Ron Cox. TVA Grant of $10,000. Contract No. TV-48192A, Task No. UTC-86015.

3. " Development of Simple Model for Radiant Barrier Insulated Systems," Prakash Damshala, TVA Grant $48,089 for 1986-87 academic year. Contract No. TV-48192A, Task No. UTC-86016.

4. Contractual work with TVA for research work on "Insulations, Thermal Storage, Desiccant Cooling, End-use Energy Storage Options. Refractories In Cyclone Boilers, and Numerical Modeling of Slag Monitor Probe," $50,000 until the end of September 1988.

5. "Broad-Based Assessment of Asbestos Insulation Substitutes for Steam Lines In Fossil Fuel Power Plants," Grant from EPRI for $39,820 contract 1988-RP1266-50.

6. Contractual work with TVA for graduate assistantships, $10,000 January 1988.

7. "Assessment of ASD heat pumps for Commercial Applications," TVA Grant $10,564 for 1991-92 Contract No. TV-85688V, Task No. UTC-394-536.

7. "Computer Simulations on Slag Monitor," TVA Grant $23,922 for 1992-93, Contract No. TV-85688V, Task No. UTC-394-598.

8. “Design and Construction of Energy Recovery Demonstration Model” ASHRAE Grant for $ 5000, 2007

9. “Development of Software to Estimate the Carbon Footprint of PlayCore Plant” PlayCore, Fort Payne, Alabama, $ 24,000, May 2014.

Professional Development Activities in the Last Five Years

Attended Professional Development Courses on Energy Management Practices,

Combined Heat and Power, Building Demand Response and Coming Smart Grid Jan, 2015.

Attended ASHRAE's winter annual meetings for the last 18 years.

Appendix G. Undergraduate Syllabi Examples

THE UNIVERSITY of TENNESSEE CHATTANOOGA

College of Engineering and Computer Science

Term: Summer II 2016

Course Subject/Number: ENGR 3520 **Section(s):** 02 D **CRN**: 31290

Title: Engineering Economy

Schedule: TBA On-line

7 hours of self-paced learning (Blackboard & Adobe Connect) per week

Contact Information:	**Instructor:**	Jan M. Evans
	Office Location:	EMCS – 235
	Office Phone:	423-425-5786
	Fax	423-425-5818
	Office Hours:	Tu & Th 3:00 – 5:00 PM and by appointment. Since a number of unscheduled meetings may be added to my calendar, it is best to email me for an appointment at least 24 hours in advance
	E-mail Address:	Jan-Evans@utc.edu

ADA STATEMENT: Attention: If you are a student with a disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Disability Resource Center (DRC) at 425-4006 or come by the office, 102 Frist Hall http://www.utc.edu/Administration/DisabilityResourceCenter/

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CATALOG DESCRIPTION:

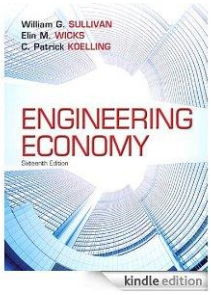
ENGR 3520 - Engineering Economy (3) Credit Hours

Economic decision making for engineering systems. Choice of alternatives by equivalent annual cost, rate-of-return, present worth, and benefit-cost methods. Tax influences, statistical decision making, replacement policy. Fall, spring and summer semesters. Lecture 3 hours.

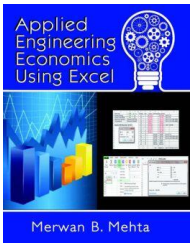
Prerequisite: ENGR 2220 or MGT 2110 and MATH 1910 or MATH 1950 with minimum grades of C or department head approval.

Differential Course Fee will be assessed.

Textbook:



Required: William G. Sullivan, Elin M. Wicks, C Patrick Koelling, *Engineering Economy, 16th Edition*, Prentice Hall, 2015. ISBN-13: 978-0-13-343927-4



Recommended: Merwan B. Mehta, *Applied Engineering Economics Using Excel*, Industrial Press, 2015. ISBN: 978-0-83-113501-0

Supplemental Texts: (not required, but may be used as reference)

Blank, L. T., and A. J. Tarquin. *Engineering Economy*, 7th ed. (New York: McGraw-Hill, 2005). ISBN-13: 978-0-07-337630-1.

Fabrycky, W. J., G. J. Thuesen, and D. Verma. *Economic Decision Analysis*, 3rd ed. (Upper Saddle River, NJ: Pearson-Prentice Hall, 1998.) ISBN-13: 978-0-13-028128-9.

Horngren, Charles T, Srikant M. Datar and Madhav V. Rajan, *Cost Accounting* 15th Edition Upper Saddle River, NJ: Pearson Prentice Hall, 2012.) ISBN-13: 978-0133428704

Internal Revenue Service *Publication 534. Depreciation*. U. S. Government Printing Office, revised periodically.

Park, C. S. *Contemporary Engineering Economics*, 6th ed. (Upper Saddle River, NJ: Pearson- Prentice Hall, 2011).ISBN-13: ISBN 0-13-611848-8

White, J. A., K. E. Case, and D. B. Pratt. *Principles of Engineering Economic Analysis*, 6th ed. (New York: John Wiley & Sons, 2012). ISBN-13: 978-1118163832

Software: Microsoft Office (2007, 2010, 2013 or 2016) with access to Excel,

Each student should also have a scientific calculator.

Additional references will be listed in Blackboard, including cases, articles and notes.

Purpose of Course: Most of the engineering and construction projects that you will undertake during your career will have to meet three (3) major tests in order to be built:

1. *The project must be technically sound and workable*. Most of the classes that you will take as part of your degree program are intended to ensure that you have the knowledge and background to design technically sound and workable projects.
2. In a free market economy, *a successful project must make an economically attractive investment*. If your technically sound engineering/construction design cannot make money, no one will build it. This is where this class comes in. As an engineer it is not part of your undergraduate degree program to make you an expert in business and finance, but it is necessary that you know how to assess whether the earnings from a project will satisfy investors sufficiently to obtain the capital to build the project. **This is the class where you will learn how to assess whether the earnings potential of a project will make it the type of endeavor in which people will invest.**
3. *The project must be legal to complete and you as a professional must follow ethical standards*. A big part of this has to do with environmental soundness, and Dr. Sullivan emphasizes sustainability in the text. Your individual degree program should provide additional training for you in this last area, but legal and ethical perspectives will be emphasized throughout the course.

Course Topics:

1. *Foundations*: Cash Flow Factors, Combining Cash Flow Factors, Nominal and Effective Interest Rates

2. *Decision Making:* Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (Single Project), Rate of Return Analysis (Multiple Projects)

3. *Choices Among Alternatives*: Methodology, MARR, IRR, ERR, and Multiple Attributes

4. *Sensitivity Analysis:* Breakeven Analysis, Formalized Sensitivity Analysis, Graphical Techniques

5. *Applications:* Replacement and Retention Decisions, Benefit/Cost Analysis, Selection of Independent Projects Under Budget Limitation

6. *Advanced Topics:* Effects of Inflation, Depreciation Methods, After-Tax Economic Analysis

ABET Rubrics Addressed (2013):

1. Student Outcome A: Ability to apply fundamental knowledge, techniques, skills, and tools, as evidenced by interim assignments and examinations
2. Student Outcome B: Use math, science, and engineering technology principles to solve problems, as evidenced by examinations.
3. Student Outcome F: Identify, analyze, and solve engineering technology problems.
4. Student Outcome L: Knowledge of basic economics of business.

Course Objectives: The instructor intends to accomplish the following during the course:

- Provide the student with a background in engineering economic principles in the following areas: interest and equivalence, economic analysis of alternatives, depreciation, income taxes, estimating, decision-making, risks, financial statement, and economic analysis of operations. (1)

- Provide the student with analytical skills necessary to formulate and solve basic problems in engineering economic studies including computer based solutions. (2, 3)
- Help students develop and appreciation for the impact of economic decision making in design and operations and the implication of these choices in the corporate environment. (4)

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

- Define and provide examples of the time value of money and demonstrate the effects of depreciation, income taxes, inflation and price change in engineering economic analysis problems. (1)
- Evaluate projects from a financial perspective, as optimizing financial performance of a project is a key responsibility of the engineer and technologist in the decision making process, including the use of EXCEL spreadsheets, cash flow diagrams and financial functions to model and solve engineering economic analysis problems utilizing proper units. (2).
- Identify critical factors necessary to provide solutions to problems and eliminate superfluous or redundant material. (3)
- Assess the economic viability of engineering and construction projects and avoid financial mistakes through the analysis of money and its impact on decision making including computer based tools. (1,2)
- Understand major concepts and techniques of engineering economic analysis that are needed in the decision making process, including, but not limited to, the following areas: interest and equivalence, economic analysis of alternatives, depreciation, income taxes, decision-making, risks, financial statement, and economic analysis of operations. (1,3)
- Perform well on the engineering economy portion of the FE examination (1,2,3)

Instructional Methodology: The most effective and efficient use of our most limited resource – instructional time- requires wholehearted preparation by both the instructor and the student. Read the assigned material before viewing the lecture and submit the problems and Take the quizzes by the due date. Class participation is not part of the final grade and but will be considered by the instructor in determining the final grade.

The class is arranged in the form of twenty (20) modules, developed by Dr. E.H. McMahon and used by him successfully for a number of years. For each of the modules, a specific topic will be covered by a lecture, a problem set and a quiz. After reading the material in the text, you should listen to the lecture and do the interim assignments (you can repeat the problem sets as many times as you want). While copies of the PowerPoint slides used for the lecture will be available, you should not consider reviewing the slides to be an adequate substitute for the lecture. Additional material will be made available through the lecture presentation and response to student questions will generally be done via e-mail or by pre-scheduled office conference. Class time will be available to review the interim assignments by answering specific student problems. *Interim assignments (out of class problem sets/interim assignment problems) are to assess the student's understanding of the material and his/her ability to solve problems* similar to those which

will be on the exams, so copying solutions from another student or the solutions manual will not be beneficial. Individual help will be available by contacting the instructor.

The limited out of class problem sets given in this class are sufficient to allow you to see how things discussed in lecture are done, and to help you gage whether or not you have learned how to do the problems. They are not sufficient for purposes of *drilling* the techniques and procedures or having you learn by the shear mass of the number of times you have performed a particular task. Similarly, with reading assignments from the text book, this class has been designed with the view that your major topical learning resource is lecture and working problems. With these constraints in mind this class has been designed with a two tier learning structure – on-line instruction and individual preparation.

Weekly (after modules for the previous week have concluded) an exam on the material covered since the previous exam will be made available on line which must be completed and submitted by noon of the following Monday (you generally only get one try at the exam). These interim exams will be taken online and you must submit your written calculations by attaching them to Blackboard. **The final will be administered live during the scheduled final exam date time for this class in classrooms on the 4th Floor of EMCS. You must be present, in person, for the final.**

Nature of Course:

The course is online. The lectures and the interim assignment problems reviews will be recorded using Adobe Connect.

Each week one week of work at a time will be posted beginning on Wednesday, June 29th.

Many of you may not have taken a course online and you should understand that this form of instruction requires discipline on the part of the student. You must keep up with the class and devote the same amount of time to listen to the lectures as an in-class student would (approximately seven (7) hours per week) in addition to the time to complete the interim assignments, quizzes and tests. The course material will be on Blackboard, including course information, announcements, lecture notes, interim assignment answers, quizzes, test, and grades.

The class is arranged in the form of modules. For each module there is a lecture, a interim assignment problems set, a review of the interim assignment problems, and a quiz. These must be done in sequence. All of the work for the week will be due by midnight the following Tuesday. You should stay on schedule and complete the modules assigned each week. If you are unable to complete the assigned work on time

you should email me before the due date. In any case work that is more than a week late will not be graded and you will receive a ZERO.

You will listen to the lecture, check that you have reviewed it, the interim assignment problems will appear and you will do the interim assignment problems (you can repeat the interim assignment problems as many times as you want), the review of the interim assignment problems will become available and you mark when you have reviewed it, then a quiz will appear (you only get one try at the quiz). Once you have completed the quiz the next module will be able to be accessed.

For the quizzes beginning with Quiz #8 you will have to submit a document or spreadsheet with your quiz. If you do not submit the document or spreadsheet, you will receive a zero on these assignments. A calculation document or spreadsheet on a exam must be submitted when the exam is submitted in order to receive credit on the exam.

In addition to the quizzes and interim assignments, there will be a five (5) interim exams and a final examination. The exam will be taken online and you must submit your written work by attaching it to Blackboard. The final will be administered live on August 8th at 5:00 – 8:00PM EDT. You must be present, in person, for the final or have a human resource person or another person authorized by the instructor monitor the final examination.

Your work must be your own. You are not permitted to work with others on the quizzes or exams. If it is determined that you are collaborating with others by either giving or receiving information, you will receive a zero.

Online Class: Online students will need to have or purchase a head set in order to get quality audio for the lectures. It is important that the headset be of reasonable quality. The following are suggested: Logitec Clear Chat Comfort, Logitec Premium, H530 or Plantronics Audio 350 Ultimate or 625. If you have a question about the suitability, please email the instructor

Blackboard: Blackboard will play a significant role in the conduction of this class. Assignments will be made and submitted via Blackboard; examinations will be administered on Blackboard; and grades will be posted on Blackboard. If you are unfamiliar with Blackboard, you may use the Student Help 101 button, enroll in an on-line training course, or contact the Walker Teaching Resource Center to register for a classroom course.

EMAIL The easiest and quickest way to communicate with me is via UTC e-mail. I will communicate important information with you using your UTC student e-mail. You are responsible for assuring your UTC e-mail account is valid and for systematically reading your e-mail. Your failure to read your email will not relieve you of any responsibility associated with the communication. During the first week after the semester begins I will send an email to you. I will notify you in class that this has been sent. If you do not receive it, please notify me immediately so we resolve the matter in a timely fashion.

Please check your UTC email on a regular basis. I do not have the means to contact students via personal accounts for mass mailings (announcements, etc.). If you have problems with accessing your email account, contact the Help Desk at 423/425-4000.

Class Guidelines:

This syllabus will generally remain static but the class schedule is subject to change with prior written notification on UTC Online (Blackboard), by email, and/or in class.

***Evidence of cheating on any graded work will not be tolerated**. The guilty party or parties will receive a zero on the work and/or may be subject to being reported to the Honor Council.*

Letter grading:	90 -100%	A
	80 – 89%	B
	70 – 79%	C
	60 – 69%	D
	Below 60%	F

Grading Policy:

This course utilizes facilitated lectures and a series of interim assignments to assist students in achieving the course learning outcomes. The assessment criteria for the stated student learning outcomes will include quizzes, , five interim exams, and a final exam. Interim assignments are student exercises to provide review and practice in problem solving and will not be part of the final grade.

1. **Interim Exams (**60**%):** There will be five (5) interim exams, each worth 150 points**.** All exams will be on-line, will be open-book, open-notes, and you will have approximately four (4) days to complete the exercise. There is no time limit, but once you have begun the exam you must complete and submit it. The best four (4) scores on the five (5) exams will be used in determining your semester grade. (i.e. You can drop your lowest grade). *No make-up examinations will be given.*

2. **Final Examination (20%):** There will be a comprehensive final examination, worth 200 points. While this exam will be on-line, open-book, and open-notes, you will have to be present in EMCS classroom to be assigned at the scheduled final exam period to complete the exercise. *No make-up examinations will be given*. If you are ill (with a doctor's excuse) alternate evaluation may be substituted.

3. **Module Quizzes (20%):** This course requires student participation in order to be successful. The grade you score on each of the twenty (20) module quizzes will count ten (10) points. All module exams count equally and if you miss one you will score a zero.

Details on Grading Methodology:

Unless otherwise stated, grades on exams will be assigned as detailed below:

- An answer will be marked "correct" if it's 100% correct.
- **If you do not show your work (calculations), but have a correct final answer, it will be marked "wrong" and only partial credit would be given.** This class is not intended to reinforce the adage "It's better to be lucky than good."
- If an answer has arithmetic errors, but is conceptually correct, a portion of the total points associated with that particular problem will be deducted.
- If an answer is conceptually and mathematically wrong it will be marked "wrong", and the student will not receive any credit**.**
- Note also, partial credit would be provided if you have a wrong answer but have listed the information given in the correct terms and have shown the correct steps of calculations, including cash flow diagram where applicable.
- Some assignments require the students to provide the instructor with an electronic spreadsheet **[not a .pdf file of the spreadsheet]** with the solutions to certain problems. In that case, an answer will be marked 100% "correct" if both the numerical values and the Excel function used are correct. Points will be taken off for mathematical errors and NO CREDIT will be given if the incorrect financial function is used.

Class Schedule:

A separate class schedule with specific topics will be issued which may be modified as necessary. The general schedule will be:

Week 1:	Modules 0 – 3	
Week 2:	Modules 4 – 6	Interim Exam 1
Week 3:	Modules 7 – 9	Interim Exam 2
Week 4:	Modules 10 – 13	Interim Exam 3
Week 5:	Modules 14 – 16	Interim Exam 4
Week 6:	Modules 17 – 20	Interim Exam 5
Monday August 8 5:00 – 8:00 PM		Final Exam

THE UNIVERSITY of TENNESSEE CHATTANOOGA

College of Engineering and Computer Science
Department of Engineering Management and Technology

Term: Fall 2013

Course: **Subject/Number:** ETEM 4570 **Section:** 0 **CRN:** 40443
ENIE 4570 0 41913

Title: Quality Control and System Reliability

Schedule: **Time:** 12:15 – 1:30 p.m. **Day(s):** Tuesday - Thursday
Location: EMCS 407

Contact Information:

Instructor: Jan M. Evans
Office Location: EMCS - 235
Office Phone: 423-425-5786
Fax number: 423-425-5818

Office Hours:

Mon	1:30 – 3:00 pm
Tues	9:30 – 12:00 am
	1:30 – 3:00 pm
Wed	1:30 – 3:00 pm
Thurs	9:30 – 12:00 am
	1:30 – 3:00 pm

and by appointment

E-mail Address: Jan-Evans@utc.edu

Attempts will be made to respond to student inquiries within one day.

ADA STATEMENT: Attention: If you are a student with a disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or a special accommodation in this class or any other class, call the Office for Students with Disabilities at 425-4006, come by the office - 102 Frist Hall or see http://www.utc.edu/OSD/

If you find that personal problems, career indecision, study and time management difficulties, etc. are adversely affecting your successful progress at UTC, please contact the Counseling and Career Planning Center at 425-4438 or http://www.utc.edu/Administration/CounselingAndCareerPlanning/

Textbook (Required): Besterfield, Dale H.; *Quality Improvement, Ninth Edition*, Prentice Hall., 2013. ISBN 0-13-262441-9.

Additional reference texts are included in the *Bibliography* section of the On-line material.

Software Requirements: Microsoft Office (versions 2007, 2010 or 2013): Word, Excel, PowerPoint and Visio.

Supplemental Software: QM for Windows, PQ Systems software (including *CHARTrunner)* and the *Solver* add-on to Excel may also be used.

NB: Some proprietary software may not be compatible with Blackboard.

Course Description: 2012-2013 Undergraduate Catalog

ENIE 4570 - Quality Control and System Reliability (3) Credit Hours

The design and analysis of quality systems. Fundamental coverage of statistical process control, quality control concepts, control charts, product specifications, process control, acceptance sampling systems, and other means of assurance widely used in many industries to improve product and service quality and to reduce costs. Introduction to reliability considerations and calculations. Fall semester. Lecture 3 hours.

Prerequisites: ENGR 2220 with a minimum grade of C or MGT 2120 and MATH 1830 or 1910 with minimum grades of C or department head approval.

Course Objectives: Upon completion of this course, the successful student will be able to:

1. Calculate measures of central tendencies and dispersions from samples. [b,f]
2. Construct control charts for variable and attributes and interpret the data. [a, b, c]
3. Recognize techniques to improve process performance. [c, f]

4. Understand the concepts of specification and tolerance. [a, c]
5. Understand the concepts of Total Quality Management (TQM). [k, m]
6. Differentiate between random variation and controllable variation within a process. [a, b]
7. Provide the theoretical and practical tools for the design, production, testing, and maintenance of engineering systems and components having a predictably low probability of failure. [c,d]
8. Appreciate the ethical and societal responsibilities of engineers and managers in the practice of quality control. [i, j]

Course Outline: The class material covered will be as follows:

1. Introduction to Quality (approximately 2 weeks)
   a. Definitions and Dimensions of Quality
   b. Fundamentals of Probability
   c. Fundamentals of Statistics
2. Total Quality Management and Lean Manufacturing (~ 2 weeks)
   a. Principles and Practices
   b. Tools and Techniques
   c. ISO 9000 and 14000
   d. TPM
3. Control Charts for Variables (~3 weeks)
   a. Specifications
   b. Process Capability
   c. Six Sigma
4. Control Charts for Attributes (~2weeks)
   a. Non-conformities
   b. Process Capability
   c. Uses of the *p*, *np*, *c*, and *u* Charts
5. Acceptance Sampling (~2 weeks)
   a. Lot-by-Lot Sampling
   b. Sampling Plan Design
   c. Operating Characteristic Curves
6. Reliability (~2 weeks)
   a. Fundamental Aspects
   b. Availability and Maintainability
   c. Life Testing
7. Quality Management and Planning (~1 week)
   a. Quantitative and Qualitative Tools
   b. Supply Chain and Vendor Certification
   c. Product Liability

Detailed assignments are listed in the *Course Schedule* section of the On-line material.

Letter grading: 90 -100 A

80 – 89	B
70 – 79	C
60 – 69	D
Below 60	F

I plan to use UTC Online (Blackboard) to administer tests, post grades, make assignments, provide solution sets and provide materials I feel will benefit your course progress. It is your responsibility to systematically check UTC Online.

Grading Policy:

1. **Examinations (40%):** There will be two (2) interim examinations worth 20% each Make-up tests will not be given.

2. **Interim Assignments (20%):** Interim evaluations will include, but not be limited to case studies, problem sets, article critiques, and computer exercises. Late submission will be penalized; no work will be accepted after solutions are made available.

3. **Experiential Exercises (20%):** Students will perform eight (8) exercises demonstrating application of knowledge gained in the class including, but not limited to, probability and statistics, use of measuring instruments, control charts for variables, control charts for attributes, operating characteristic curves, reliability, and availability and maintainability. Laboratory reports will be submitted.

4. **Presentation (15%):** Each student will make an oral presentation and submit a written report on a quality topic.

5. **Class Attendance and Participation (5%):** Everyone is assumed to be an adult and will attend class if at all possible. If you are not present, you cannot participate, so you will receive no credit. If you are ill prepared or inattentive in class, you also will not receive full credit.

Class Guidelines:

This syllabus is subject to change if conditions currently unforeseen develop with prior written notification on UTC online, by email, and/or in class.

Horizontal learning (from fellow classmates) is important in gaining maximum benefits from this course, so participation and contribution within your groups is extremely important, and failure to play a positive part in the group submission will adversely affect your course grade.

The use of cell phones or other communication devices is strictly prohibited during lectures, tests, laboratories or presentations.

Evidence of cheating on any graded work will not be tolerated*. The guilty party or parties may be subject to receiving a zero on the work and/or being reported to the Honor Council.*

EMAIL The easiest and quickest way to communicate with me is via UTC e-mail. I will communicate with the class using email. You are responsible for assuring your UTC email account is valid and for systematically reading your email. Your failure to read your email will not relieve you of any responsibility associated with the communication. During the first week after the semester begins I will send an email to you. I will notify you in class that this has been sent. If you do not receive it, please notify me immediately so we resolve the matter in a timely fashion.
Please check your UTC email on a regular basis. If you have problems with accessing your email account, contact the Help Desk at 423/425-4000.

Appendix H. Graduate Syllabi Examples

THE UNIVERSITY of TENNESSEE CHATTANOOGA

College of Engineering and Computer Science
Department of Engineering Management and Technology

Term: Spring 2017

Course Subject/Number: ENGM 5570 **Section(s):** 0 D **CRN**: 27653

Title: Advanced Quality Control

Credits: 3 graduate credits

Schedule: **Time:** 3:25 – 4:40 pm **Day(s):** Monday – Wednesday

Required Classes: W 1/11; M 2/13; W 3/8; M 4/24

Location: EMCS 202

Contact Information:

Instructor: Jan M. Evans

Office Location: EMCS – 235

Office Phone: Office 423-425-5786
Fax 423-425-5818

Office Hours: Mon 1:30 – 3:15 pm
4:45 - 5:15 pm
Tues 12:00 – 3:00 pm
5:00 – 5:30 pm
Wed 1:30 – 3:15 pm
4:45 - 5:15 pm
Thurs 1:00 – 3:00 pm
and by appointment

E-mail Address: Jan-Evans@utc.edu

HONOR CODE PLEDGE (from the UTC Student Handbook):

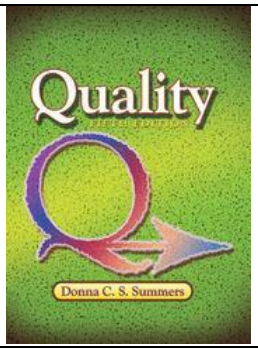
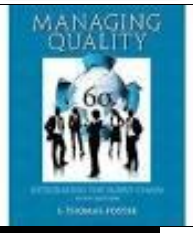
I pledge that I will neither give nor receive unauthorized aid on any test or assignment. I understand that plagiarism constitutes a serious instance of unauthorized aid. I further pledge that I exert every effort to ensure that the Honor Code is upheld by others and I will actively support the establishment and continuance of a campus-wide climate of honor and integrity.

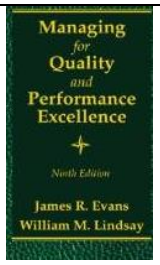
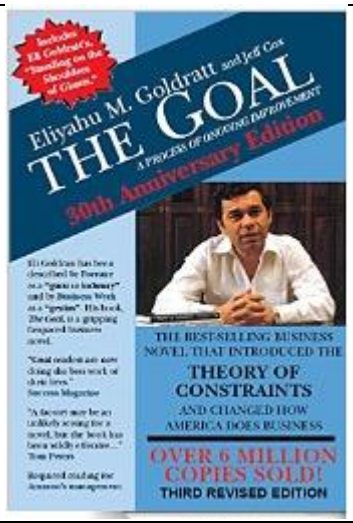
Accommodation Statement*:* If you are a student with a disability (e.g. physical, learning, psychiatric, vision, hearing, etc.) and think that you might need special assistance or special accommodations in this class or any other class, call the Disability Resource Center (DRC) at 425-4006 or come by the office, 102 Frist Hall. .

Academic Acknowledgement: The Academic Acknowledgement section includes student confirmation of receipt of the course syllabus and understanding of the UTC Honor Code. The Academic Acknowledgement process is designed to incorporate student engagement strategies while also serving as a proxy for federal financial aid enrollment confirmation requirements. More information about the Academic Acknowledgement can be found at http://www.utc.edu/walker-center-teaching-learning/academic-acknowledgement.php.

Once courses are automatically made available to students on the first day of classes, students will click on the link to access and must complete a required activity in every course in which they are enrolled. For this activity, students will acknowledge receipt of the course syllabus and UTC's Honor Code. It is not included as part of the course grade. Once students complete the activity it will be automatically recorded. This activity should be completed by students during the first few days of classes during each fall term.

Counseling Statement: If you find that you are struggling with stress, feeling depressed or anxious, having difficulty choosing a major or career, or have time management difficulties which are adversely impacting your successful progress at UTC, please contact the Counseling and Personal Development Center at 425-4438 or go to utc.edu/counseling for more information.

Textbook (required):		Donna C.S. Summers, *Quality*, Fifth Edition, Prentice-Hall, 2010.ISBN: 978-0-13-159249-0.
Textbook (recommended):		Glen Gee, Wes Richardson, & Bill Wortman, *Certified Quality Engineer Primer*, 9th Edition, Quality Council of Indiana, West Terre Haute, IN 2012.
		S. Thomas Foster, *Managing Quality: Integrating the Supply Chain*, 5th edition, Pearson/Prentice Hall, 2013. ISBN-13: 978-0-13-273798-2
Supplemental Texts:		Dale H. Besterfield, *Quality Improvement*, Ninth Edition, Pearson, 2013. ISBN: 978-9-13-262441-1.
		Donna C. Summers, *Quality Management*, 2nd Edition, Pearson/Prentice Hall, 2009. ISBN-13: 978-0-13-500510

		Donna C. Summer, *Lean Six Sigma*, Prentice Hall, 2011. ISBN-13: 978-0-13-512510-6.
		Russell T. Westbrook, editor, *The Certified Manager of Quality/Organizational Excellence Handbook*, 4th Edition, American Society of Quality, 2013.
		Joseph Defeo, *Juran's Quality Management and Analysis*, 6th Edition, McGraw-Hill, 2015. ISBN-13: 978-0-07-352344-6.
		Evans, J.R. and W.M. Lindsay, *Managing for Quality and Performance Excellence*, Thompson Southwestern, Eighth Edition, 2012. ISBN-13: 978-1285069463
		Goldratt, E.M. and J. Cox, *The Goal*, 3rd Revised Edition, North River Press, 2004.ISBN-13: 978-0-88426-274-8 [Theory of Constraints]

Significant use of technical literature will be made in this course.

Additional text references will be listed in Blackboard, as well as copies of example problems, cases, articles and notes.

Software Requirements: Microsoft Office (versions 2010, 2013 or 2016): Word, Excel, PowerPoint and Visio.

Supplemental Software: The *Solver* add-on to Excel may be used, as well as QM for Windows and PQ Systems software (including *CHARTrunner* as discussed in Appendix 7 of the text) may also be used.

NB: Some proprietary software may not be compatible with Blackboard.

Course Description: [**2016-17 Catalog] 5570 Advanced Quality Control -** (3) Credit Hours

The design and analysis of quality systems. Fundamental coverage of statistical process control, quality control concepts, control charts, product specifications, process control, acceptance sampling systems, and other means of assurance widely used in many industries to improve product and service quality and to reduce costs. Background in undergraduate statistics or equivalent. Knowledge of probability and statistical methods, numerical analysis, design of experiments, and hypothesis

Prerequisite: department head approval. Strongly Recommended: Introductory Statistics (MGT 5710 or Engineering 2220 or equivalent.)

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

1. Know the specific characteristics, techniques, and insights that are necessary to apply and interpret different types of control charts appropriately.
2. Know how to diagnose and analyze problems that cause variation in the manufacturing, process and service industries.
3. Know how to construct, interpret and utilize a variety of control charts for effective process, machine, and product control.
4. Understand and utilize the concept of process capability as it relates to statistical process control.
5. Know the basic philosophies surrounding quality management.
6. Understand and utilize basic problem-solving tools and techniques.
7. Be able to utilize computer software to create control charts.
8. Know how to present information clearly and unambiguously, make judgments based on that information and clearly communicate conclusions.

Certified Quality Engineer - Body of Knowledge:

The Certified Quality Engineer is a professional who understands the principles of product and service quality evaluation and control. This body of knowledge and applied technologies include, but are not limited to, development and operation of quality control systems, application and analysis of testing and inspection procedures, the ability to use metrology and statistical methods to diagnose and correct improper quality control practices, an understanding of human factors and motivation, facility with quality cost concepts and techniques, and the knowledge and ability to develop and administer management information systems and to audit quality systems for deficiency identification and correction

Certified Six Sigma Green Belt.- Requirements (ASQ)

Here are the requirements and exam specifics for a Certified Six Sigma Green Belt.

Work Experience

Six Sigma Green Belts are employees who spend some of their time on process improvement teams. They analyze and solve quality problems, and are involved with Six Sigma, lean or other quality improvement projects.

The Six Sigma Green Belt certification requires three years of work experience in one or more areas of the Six Sigma Green Belt Body of Knowledge.

Candidates must have worked in a full-time, paid role. Paid intern, co-op or any other course work cannot be applied toward the work experience requirement.

Education

Educational waivers are not granted.

Expectations

Here are the minimum expectations of a Certified Six Sigma Green Belt.

- Operates in support of or under the supervision of a Six Sigma Black Belt.
- Analyzes and solves quality problems.
- Involved in quality improvement projects.
- Participated in a project, but has not led a project.
- Has at least three years of work experience.
- Has ability to demonstrate their knowledge of Six Sigma tools and processes.

BODY OF KNOWLEDGE

Included in this body of knowledge are explanations (subtext) and cognitive levels for each topic or subtopic in the test. These details will be used by the Examination Development Committee as guidelines for writing test questions and are designed to help candidates prepare for the exam by identifying specific content within each topic that can be tested.

Except where specified, the subtext is not intended to limit the subject or be all-inclusive of what might be covered in an exam but is intended to clarify how topics are related to the role of the Certified Six Sigma Green Belt. The descriptor in parentheses at the end of each subtext entry refers to the highest cognitive level at which the topic will be tested. A complete description of cognitive levels is provided at the end of the document.

The material in this course, as documented in the textbook, should satisfy the requirements for the body of knowledge.

General Expectations:

This is a graduate level course and as such students will be expected to perform at a higher level than would be expected in an undergraduate course. Where a student in an undergraduate course would be expected to generally gain knowledge and comprehend its meaning with perhaps minimal to moderate application, as a graduate student in this class you will be expected to analyze scenarios and real-life case studies with the goal of synthesizing information obtain in this course, other related courses and life experiences

to provide cogent evaluation and recommendations that would result in positive, beneficial impact regarding an issue.

Not only must you read appropriate text assignments, but literature in trade and scholar journals must be read and used in class discussions, examinations, and special projects and /or reports. Examinations will be primarily essay requiring the student to write lucid arguments and defenses for answers. Rote recall of textbook or journal reading assignments as responses for examination essays may be consider satisfactory, but not evident of the higher order learning outcomes expected of students in this course.

Specific Attendance & Contribution Requirements for Required Classes:
Participants are expected to attend all face-to-face class sessions as specified in the course schedule. Face-to-face course meetings as well as discussion forums include interacting in a meaningful way that contributes to your learning as well as the learning of others through the use of course material and your experiential learning as a basis for your data-informed opinion. *If a participant feels that s/he has an impossible conflict (such as scheduled work requirements, excessive travel, medical or personal problem), s/he should consult the instructors ahead of time.*

Instructional Methodology:

Learning is experienced not only through the traditional lecture/examination format, but also through experiential exercises, including but not limited to case studies, problem sets, discussion questions and projects. All of these techniques will be utilized in this course, using both individual exercises and teams to facilitate shared learning experiences. Lecture/discussion sessions will utilize one or more days of the class time each week, with the experiential exercises utilizing the self directed course time. All exams will be taken on-line and will not require any of the allocated class time.

From time to time outside speakers may address the class and share their personal experiences. Videos of previous guest speakers will also be used. Class members are responsible for material covered by outside speakers just as you would from the instructor.

The most effective and efficient use of our most limited resource – classroom time- requires wholehearted preparation by both the instructor and the student before class. Read the assigned material before class and submit the problems and assignments by the due date. Class participation is part of the final grade and will be determined by the instructor. Please note that attendance is NOT considered participation.

Letter grading:	90 -100%	A
	80 – 89	B
	70 – 79	C
	60 – 69	D
	Below 60	F

Grading Policy:

6. **Examinations (40%)**: There will be two examinations, each worth 20%. All exams will be on-line, will be open-book, open-notes, and you will have several days (including a weekend) to complete the exercise. **No make-up examinations will be given**. If you are ill (with a doctor's excuse), appropriate work may be substituted.

7. **Interim assignments [IA] (20%):** These will include, but not be limited to, individual submissions of problem sets, technical article critiques and discussion questions. Review of the problem sets will be made via Adobe Connect in order not to detract from the lecture/discussion time. Late submission will be penalized; **no work will be accepted after solutions are made available**.

8. **Experiential Exercises [EE] (20%):** These will include, but not be limited to, group submissions of case studies and viewing presentations of guest lecturers. Late submission will be penalized; **no work will be accepted after solutions are made available**

9. **Project (15%):** Each student will work as part of a team**.**. The size of the teams may vary from 4 – 6 members depending upon enrollment. Evaluation will include a written report and an oral in-class presentation by the team members. Peer evaluations will be included in the Participation grade.

10. **Class Attendance and Participation (5%):** Graduate courses are expected to be interactive. Everyone is assumed to be an adult and will attend class if at all possible. On-line students will be expected to utilize discussion boards and chat rooms for comments and supplementary input. If you are not present or do not utilize the discussion board, you cannot participate, so you will receive no credit. If you are ill prepared, you also will not receive full credit.

Tentative Class Schedule:

Week	*Text Ref*	*Topic*	*Assignment Due*
1	CH 1	a. Introduction & Overview b. Quality Basics	-
2	CH 2	a. Quality Advocates b. Group Assignments	Personal Information; Group Preference
3	CH 3	a..Quality Improvement b. Problem Solving	IA 1
4	CH 4	a. Fundamentals of Statistics b. Data Analysis	EE 1: Case Study 3.1; view Jack Sample/Richard Burke Presentation
5	CH 5	a. Control Charts for Variables b. Taking Corrective Action	IA 2
6	CH 5	a. Revised Control Charts b. Quality at the Source	EE 2: Case Study 4.2; view Six Sigma versus Seven Basic Quality Tools video
7	CH 6	a. Process Capability b. 6σ vs Specifications	IA 3
8	CH 7	a. Special Control Charts b. SPC Techniques	EE 3: Case Study; view Bob Crates Presentation
9	CH 8	a. Discrete vs Continuous Probability b. Approximations	Examination 1 CH 1-7
10	CH 9	a. Control Charts for Attributes b. Selection of Control Chart	IA 4
11	CH 10	a. System Reliability b. OEE and Availability	EE 4: Case Study 6.1; view Ted Alexander Presentation
12		a. Acceptance Sampling b. OC Curves	IA 5
13	CH 11-12	a. Quality Costs b. Advanced Topics in Quality	EE 5: Case Study 9.1; view Doug Brock Presentation
14	CH 13 – 15	a. Product Liability c. Bench Marking & Auditing d. Quality Systems	Examination 2 CH 8-15
15			Project Presentations; Peer Evaluations

Class Guidelines:

I plan to use UTC-Online (Blackboard) to post grades, assignments, solution sets and materials I feel will benefit your course progress. Because of federal guidelines, grades cannot be communicated via e-mail

EMAIL The easiest and quickest way to communicate with me is via e-mail. I will communicate with you using email and Announcements. You are responsible for assuring your UTC email account is valid and for systematically reading your email. Your failure to read your email will not relieve you of any responsibility associated with the communication. During the first week after the semester begins I will send an email to you. I will notify you in class that this has been sent. If you do not receive it, please notify me immediately so we resolve the matter in a timely fashion.
Please check your UTC e-mail on a regular basis. If you have problems with accessing your email account, contact the Help Desk at 423/425-4000.

The use of cell phones or other communication devices is strictly prohibited during lectures, tests, laboratories or presentations.

Your work must be your own. You are not permitted to work with others on the examinations. If it is determined that you are collaborating with others by either giving or receiving information, you will receive a zero on the examination and may fail the course. On submitted assignments, if you copy material from another source, the source must be cited. Refer to Honor Code Pledge listed above.

THE UNIVERSITY of TENNESSEE CHATTANOOGA

College of Engineering and Computer Science

Term: Fall 2016

Course Subject/Number: ENGR 5580 **Section(s):** 0 C (in-class) **CRN**: 42016

Title: Advanced Engineering Economy (3 hrs graduate credit)

Schedule: **Time:** 5:30 – 8:00 pm **Day(s):** Tuesday

Location: EMCS 231

Contact Information:

Instructor: Jan M. Evans

Office Location: EMCS – 235

Office Phone: 423-425-5786
Fax 423-425-5818

Office Hours:

Mon	1:30 – 3:15 pm
	6:45 – 8:00 pm
Tues	1:00 – 5:15 pm
Wed	1:30 – 3:15 pm
	6:45 – 8:00 pm
	and by appointment

E-mail Address: Jan-Evans@utc.edu

Academic Acknowledgement: The Academic Acknowledgement section includes student confirmation of receipt of the course syllabus and understanding of the UTC Honor Code. The Academic Acknowledgement process is designed to incorporate student engagement strategies while also serving as a proxy for federal financial aid enrollment confirmation requirements. More information about the Academic Acknowledgement can be found at http://www.utc.edu/walker-center-teaching-learning/academic-acknowledgement.php.

Once courses are automatically made available to students on the first day of classes, students will click on the link to access and must complete a required activity in every course in which they are enrolled. For this activity, students will acknowledge receipt of the course syllabus and UTC's Honor Code. It is not included as part of the course grade. Once students complete the activity it will be automatically recorded. This activity should be completed by students during the first few days of classes during each fall term.

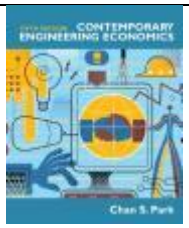
GRADUATE CATALOG DESCRIPTION (2015-16):

ENGR 5580 - Advanced Engineering Economy (3)

The design and analysis of financial strategies in a technical environment. Emphasis is on the application of these strategies in competitive industry. Core topics include review and application of basic engineering economy concepts, mathematical techniques and models, treatment of risk and uncertainties, cost of capital, demand and price elasticity as it applies to capital investment decisions, financial statements, financial ratio analysis, taxes and inflation, capital budgeting, and financial planning. Special topics include ethics and legal perspectives. Background in undergraduate engineering economy or equivalent. Knowledge of time value of money, benefit-cost methods, tax influences, and statistical decision making..

Prerequisite: department head approval; strongly recommended: undergraduate Engineering Economy (equivalent to ENGR 3520).

Textbook:

Required:		Park, C. S. *Contemporary Engineering Economics*, 6th ed. (Upper Saddle River, NJ: Pearson- Prentice Hall, 2016). ISBN13: 9780134105598
Suggested		Canada, John R., William G. Sullivan, Dennis J. Kulonda *Capital Investment Analysis for Engineering and Management* 3rd ed. (available in paperback). (Upper Saddle River, NJ, 2004.) ISBN-13: 978-0-13-143408-0.

Supplemental Texts: (not required, but may be used as reference)

Engineering Economics:

Blank, L. T., and A. J. Tarquin. *Engineering Economy*, 7th ed. (New York: McGraw-Hill, 2005). ISBN-13: 978-0-07-337630-1.

Fabrycky, W. J., G. J. Thuesen, and D. Verma. *Economic Decision Analysis*, 3rd ed. (Upper Saddle River, NJ: Pearson-Prentice Hall, 1998.) ISBN-13: 978-0130281289.

Sullivan, William G., Elin M. Wicks, C Patrick Koelling, *Engineering Economy, 16th Edition*, Prentice Hall, 2015. ISBN-13: 978-0133439274 This is the text we use in undergraduate ENGR 3520.

White, J. A., K. E. Case, and D. B. Pratt. *Principles of Engineering Economic Analysis*, 6th ed. (New York: John Wiley & Sons, 2012). ISBN-13: 978-1118163832

Accounting and Finance:

Gallagher, Timothy J ,*Financial Management Principles and Practice* 5th Edition (Upper Saddle River, NJ: Pearson Prentice Hall, 2013.) ISBN-13: 978-1930789159 This is a good financial management reference.

Horngren, Charles T, Srikant M. Datar and Madhav V. Rajan, *Cost Accounting* 15th Edition (Upper Saddle River, NJ: Pearson Prentice Hall, 2012.) ISBN-13: 978-0133428704. This is a good management accounting reference.

Internal Revenue Service *Publication 534. Depreciation*. U. S. Government Printing Office, 2013. (revised periodically.)

Kieso, Donald E. , Jerry J. Weygandt, Terry D. Warfield, *Intermediate Accounting*, 15th edition (New York: John Wiley & Sons, 2013). ISBN-13: 978-1118159644. This is a good financial accounting reference.

Maskel, Brian, Bruce Baggaley, *Practical Lean Accounting*,(New York: Productivity Press, 2004.) ISBN-1: 978-1563272431,

Quantitative Methods:

Hillier, Frederick S., Gerald J. Lieberman, *Introduction to Operations Research* 9th ed. (New York: McGraw-Hill, 2010). ISBN: 0073376299 This text is used as a text in undergraduate Operations Research classes.

Additional references will be listed in Blackboard, including cases, articles and notes.

Software: Microsoft Office (2003, 2007, 2010, or 2013) with access to Solver add-on to Excel.
Each student should also have a scientific calculator.

Overview:

This course is an integral part of the Engineering Management program, because it is focused on applications of economics and finance in making effective engineering decisions. Since many aspects of engineering involve selection of an optimal alternative based on both technical as well as economic criteria, a robust working knowledge of engineering economics is an important skill to have for any Engineering Manager. The set of engineering economic tools and techniques that students will take away from ENGM 5580 will serve as powerful tools to aid in selecting, designing, implementing and improving any engineering or construction project. A major goal of the course is to develop an ability to make sound decisions using various engineering economics techniques, thereby facilitating the evaluation and selection of alternative solutions.

Course Objectives:

In this course the students will be exposed to the analysis of financial data and revisit the concepts of interest rates and time value of money previously studied as undergraduates.

Students will be able to make choices between alternative projects using a set of basic tools and techniques of engineering analysis, including the time value of money, internal rate of return and benefit cost ratio. Furthermore, the student will be able to gather a comprehensive knowledge about advanced engineering economics topics like depreciation of assets, after tax cash flows and inflation. In addition, the student will gain knowledge about important decision making tools like sensitivity analysis, risk analysis, mathematical modeling and simulation.

Course Outcomes:

Upon completion of this course, the successful student will be able to make sound economic decisions and to manage and lead an economic analysis for business planning, capital investments, management of operations and projects in a technical environment. Specific skills will include, but not be limited to:

1. Appreciate the scope and environment of financial management.
2. Determine valuation of financial assets
3. Calculate capital-budgets, cost of capital, and financing mix.
4. Practice working capital management.
5. Evaluate alternatives considering risk and uncertainty
6. Conduct multi-attributed decision making.
7. Understand the role domestic and international finance plays in Engineering Management

Course and Text Material:

The primary text for this course is *Contemporary Engineering Economics,* 6th Edition, by Chan S. Park. Most reading assignments, homework, and class problems will be based on this text. Additional material will be drawn from *Capital Investment Analysis for Engineering and Management* 3rd edition by Canada, et al . The students are strongly recommended to purchase a personal copy of either of these texts, even older editions. Also, bring your calculator to class every day as this course will involve a lot of mathematical calculations. All other material, (e.g. lecture notes, documents, Interim Assignments, Experiential Exercises, etc.) is located on Blackboard. Students should access Blackboard and download the material they need to complete the course. The

course schedule provides the lesson topics and class discussions**. The due dates for the out of class assignments and the examinations are also provided in the schedule.**

As a part of this course, you will be expected to use MS Excel® on a regular basis.

General Expectations:

This is a graduate level course and as such students will be expected to perform at a higher level than would be expected in an undergraduate course. Where a student in an undergraduate course would be expected to generally gain knowledge and comprehend its meaning with perhaps minimal to moderate application, as a graduate student in this class you will be expected to analyze scenarios and real-life case studies with the goal of synthesizing information obtain in this course, other related courses and life experiences to provide cogent evaluation and recommendations that would result in positive, beneficial impact regarding an issue.

Not only must you read appropriate text assignments, but literature in trade and scholar journals must be read and used in class discussions, examinations, and special projects and /or reports. Examinations will be primarily essay requiring the student to write lucid arguments and defenses for answers. Rote recall of textbook or reading assignments as responses for examination essays may be consider satisfactory, but not evident of the higher order learning outcomes expected of students in this course.

Instructional Methodology:

Learning is experienced not only through the traditional lecture/examination format, but also through experiential exercises, including but not limited to case studies, problem sets, discussion questions and projects. All of these techniques will be utilized in this course, using both individual exercises and teams to facilitate shared learning experiences. Lecture/discussion sessions will utilize one day of class time each week, with the Interim Assignments and Experiential Exercises utilizing the self-directed course time. All exams will be taken on-line and will not require any of the allocated class time. **The final exam will be taken at the scheduled time by all students, both in-class and on-line.**

From time to time outside speakers may address the class and share their personal experiences. Videos of previous guest speakers will also be used. Class members are responsible for material covered by outside speakers just as you would from the instructor.

The most effective and efficient use of our most limited resource – classroom time- requires wholehearted preparation by both the instructor and the student before class. Read the assigned material before class and submit the problems and assignments by the due date. Class participation is part of the final grade and will be determined by the instructor. Please note that attendance is NOT considered participation.

Instructional Requirements via Blackboard:

Blackboard will play a significant role in the conduction of this class. Assignments will be made and submitted via Blackboard; examinations will be administered on Blackboard; and grades will be posted on Blackboard. The following information is supplied for all students. All students will be using Blackboard for the course. The online students will be relying on the online lectures via Adobe Connect. The online lectures are also archived and are available for in-class students as well as online students for review.

Course Material: Microsoft Power Point, Acrobat Reader, Word, and Excel course handouts and the lectures Adobe Connect are available on Blackboard.

Announcements: Important messages about the course will be posted under the "Announcements" link in Blackboard, please check this at least every other day.

Student Participation: Whenever possible students should be available during the class time to receive the live lecture in the classroom or over Adobe Connect. Online students are encouraged to participate in the Adobe Connect during class. If you are not available during class time you should listen to the lecture and participate in the discussion board as soon as possible after the class.

Out of Class Assignments

- *Interim Assignments*: All Interim Assignments are to be done individually; however, you may reference someone else on the assignment, if you went to him or her for assistance, without penalty. . This is intended to develop the habit of recognizing contributions.

- *Experiential Exercises*: There will be a team project with representatives either in-class and online students in each group (virtual teams). The projects will include individual assignments and an overall team result. On Experiential Exercises, participants should indicate what contribution each group member made to the assignment.

Discussion Board: "Discussion board" on Blackboard is a part of class participation.

E-Mail Policy: Students can e-mail to the instructor anytime, the instructor will respond promptly. I will set up a discussion board for questions about the lectures. I encourage you to post your questions here so that other student can participate in answering the questions and view the answers.

Reference websites for the online course assistance

UTC Blackboard help website: http://www.utc.edu/learn/student-resources/index.php or contact the Walker Teaching Resource Center to register for a classroom course.

EMAIL The easiest and quickest way to communicate with me is via UTC e-mail. I will communicate important information with you using your UTC student e-mail. You are responsible for assuring your UTC e-mail account is valid and for systematically reading your e-mail. Your failure to read your email will not relieve you of any responsibility associated with the communication. During the first week after the semester begins I will send an email to you. I will notify you in class that this has been sent. If you do not receive it, please notify me immediately so we resolve the matter in a timely fashion.

Please check your UTC email on a regular basis. I do not have the means to contact students via personal accounts for mass mailings (announcements, etc.). If you have problems with accessing your email account, contact the Help Desk at 423/425-4000.

Class Guidelines:

This syllabus will generally remain static but the class schedule is subject to change with prior written notification on UTC Learn (Blackboard), by email, and/or in class.

The use of cell phones or other communication devices is strictly prohibited during lectures, tests, or presentations.

Evidence of cheating on any graded work will not be tolerated*. The guilty party or parties will receive a zero on the work and/or may be subject to being reported to the Honor Council. See Honor Code referenced above*

Letter grading:	90 -100%	A
	80 – 89%	B
	70 – 79%	C
	60 – 69%	D
	Below 60%	F

Grading Policy:

This course utilizes facilitated lectures and a series of Interim Assignments and Experiential Exercises to assist students in achieving the course learning outcomes. The assessment criteria for the stated student learning outcomes will include:

Interim Exams (40%): There will be four (4) interim exams, each worth 100 points**.** All exams will be on-line, will be open-book, open-notes, and you will have approximately four (4) days to complete the exercise. There is no time limit, but once you have begun the exam you must complete and submit it. *No make-up examinations will be given*. If you are ill (with a doctor's excuse) alternate evaluation may be substituted.

Final Examination (15%): There will be a comprehensive final examination, worth 150 points. While this exam will be on-line, open-book, and open-notes, you will have to register in EMCS 231, or have a proctor monitor the exam, at the scheduled final exam period to complete the exercise. *No make-up examinations will be given*. If you are ill (with a doctor's excuse) alternate evaluation may be substituted.

Interim Assignments (10%): There will be five (5) out of class individual assignments worth twenty (20) points apiece during the semester. These involve problem sets, technical article critiques and case studies. All Interim Assignments are to be done individually; however, you may reference someone else on the assignment, if you went to him or her for assistance, without penalty.

Experiential Exercises (35%): The class will be divided into groups of four (4) to six (6) participants [depending upon enrollment], hopefully each involving a heterogeneous mix of participants (e.g. in-class and on-line, different countries of origin, varied work experience, length of time in program, diverse undergraduate majors, etc.). Projects will include stock market competition, a simulation, a model involving risk and uncertainty, and a business analysis. Submissions will be for the entire group, indicating what contribution each group member made to the assignment.

Details on Grading Methodology:

Unless otherwise stated, grades on exams will be assigned as detailed below:

- An answer will be marked "correct" if it's 100% correct.
- **If you do not show your work (calculations), but have a correct final answer, it will be marked "wrong" and only partial credit would be given.** This class is not intended to reinforce the adage "It's better to be lucky than good."
- If an answer has arithmetic errors, but is conceptually correct, a portion of the total points associated with that particular problem will be deducted.
- If an answer is conceptually and mathematically wrong it will be marked "wrong", and the student will not receive any credit**.**
- Note also, partial credit would be provided if you have a wrong answer but have listed the information given in the correct terms and have shown the correct steps of calculations, including cash flow diagram where applicable.
- Some assignments require the students to provide the instructor with an electronic spreadsheet **[not a .pdf file of the spreadsheet]** with the solutions to certain

problems. In that case, an answer will be marked 100% “correct” if both the numerical values and the Excel function used are correct. Points will be taken off for mathematical errors and NO CREDIT will be given if the incorrect financial function is used.

UTC COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

ORAL COMMUNICATION RUBRIC FOR GRADUATE STUDENTS

Name of Student: _____ **Major:** _____ **Date:** _____

Instructions: Please mark your score in the last column for each category as described below, and put your total score in the last row.

	1	2	3	4	Score
Organization	Unclear focus, no background information, no outline	Clear focus but no background information, little or no outline	Development is clear with a well- defined outline, but transitions need refinement	Development is clear through use of specific and appropriate examples; transitions are clear and create a succinct and even flow	
Content	Topic is unclear, information appears randomly chosen, poor application of fundamentals	Topic is clear, but supporting information is disconnected and shows poor application of fundamentals	Topic is clear and contains many relevant points and appropriate application of fundamentals, but somewhat unstructured	Exceptional use of material that clearly relates to the focus; abundance of various supported materials	
Presentation Length	Greatly exceeding or falling short of allotted time	Exceeding or falling short of allotted time	Remained close to the allotted time	Presented within the allotted time	
Visual Aids	Poor selection and use of visual aids technology, and not readable images	Appropriate selection and use of visual aids, but use of poorly resolved images	Appropriate selection and use of visual aids, well-focused images	Very good selection and use of visual aids with clearly readable images that complimented talk	
Attention to Audience	No attempt to engage audience	Little attempt to engage audience	Engaged audience and held their attention most of the time	Engaged audience and held their attention throughout with creative articulation, enthusiasm, and clearly focused presentation	
Speaking Skills	Monotone; speaker seemed uninterested in material	Little eye contact; fast speaking rate, little expression, mumbled	Clear articulation of ideas, but some lack of confidence with material	Exceptional confidence with material displayed through poise, clear articulation, eye contact, and enthusiasm	
Comments:				**TOTAL SCORE**	

Name of Reviewer: _____ **Signature of Reviewer:** _____

WRITTEN COMMUNICATION RUBRIC FOR GRADUATE STUDENTS

Name of Student: _____ **Major:** _____ **Date:** _____

Instructions: Please mark your score in the last column for each category as described below, and put your total score in the last row.

	1	2	3	4	Score
Drafting	Requires excessive guidance and prompting from teacher. Is unable to write independently.	Requires occasional guidance and prompting from teacher to write independently. Written work is inconsistent.	An independent writer who requires little guidance or prompting from teacher to write. Written work is usually detailed and creative.	Requires no guidance or prompting from teacher to write independently. Written work is creative and detailed. Student enjoys writing.	
Editing	Student often ignores peer and teacher edits, turning in final products with grammatical and spelling errors. Student does not edit his or her own work at all.	Student accepts peer and teacher edits, but does not edit his or her own work.	Student accepts peer and teacher edits. Student usually edits his or her own work, catching accidental grammatical and spelling errors.	Student accepts peer and teacher edits. Student is also exceptionally meticulous about editing his or her own work, catching most grammatical and spelling errors.	
Revision	Student resists the revision process, making few or no changes from first to final draft.	Student makes minor revisions when necessary. Accepts some constructive criticism from teacher.	Student accepts constructive criticism well from peers and teachers and often comes up with creative and appropriate revision ideas of his or her own.	Student makes full use of the revision process, soliciting and accepting constructive criticism from peers and teachers and implementing his or her own ideas for revision.	
Final Draft	Final draft shows little evidence of editing and revision.	Final draft shows some evidence of editing and revision.	Final draft shows clear evidence of editing and revision.	Final draft shows clear evidence of thoughtful editing and revision.	
Attitude	Shows no enthusiasm for or commitment to the writing process.	Shows some enthusiasm for and commitment to the writing process.	Usually shows enthusiasm for and commitment to the writing process.	Shows exceptional enthusiasm for and commitment to the writing process.	
Timing	Student does not submit any written work on time.	Student submits the work on time with minimum changes.	Student submits the work on time with required changes.	Student submits the work on time with required changes and by providing additional writing materials.	
Comments:				**TOTAL**	

Name of Reviewer: _____ **Signature of Reviewer:** _____