ENGINEERING

ELECTRICAL ENGINEERING AND PHYSICS

Interim Chair: John Hepp, Ph.D.

• Master of Science in Electrical Engineering (M.S.E.E.)
• Master of Science in Engineering Management

MECHANICAL ENGINEERING

Chair: Henry Castejon, Ph.D.

• Master of Science in Mechanical Engineering (M.S.M.E.)
• Master of Science in Engineering Management

BIOENGINEERING

Gregory Harms, Ph.D., Program Co-director & Advisor – Biomedical Track
William Terzaghi, Ph.D., Program Co-director & Advisor - Synthetic Biology Track

• Master of Science in Bioengineering
MASTER OF SCIENCE IN BIOENGINEERING

Master of Science in Bioengineering

Point of Contact: Prahlad Murthy, Ph.D.

Program Features

Wilkes University’s Master of Science degree in Bioengineering combines engineering concepts and analysis with biology, medicine, health, and computer science to teach students the fundamentals of developing new medical devices, treatments and materials. The 36-credit program offers students the opportunity to select from one of two available majors, Biomedical Engineering or Synthetic Biology. Biomedical Engineers develop artificial limbs, joints, tissues and organs as well as design diagnostic equipment, monitoring devices and drug delivery systems. Synthetic Biologists create organisms, which either produce useful biochemicals for therapeutic applications, or perform unique functions, such as creating useful biochemicals for therapeutic and industrial applications or detecting or detoxifying biohazardous chemicals.

Students will have the opportunity to work with faculty who are leaders in their fields, including specialists in the latest medical device designs, imaging systems, bioengineering and metabolic technologies.

Admissions Requirements

The Wilkes program is designed for those with a bachelor's degree in engineering or biology seeking training in bioengineering and also for those seeking to strengthen credentials for medical or other professional schools. Individuals with undergraduate degrees in other science disciplines may also be considered. Applicants must submit an online application, official undergraduate transcripts, and 2 letters of reference from science or engineering faculty.

International applicants must also submit a statement of financial guarantee and a WES evaluation of their undergraduate transcript.

All applicants must submit an official Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) score, in addition to the previously-listed admissions requirements if the language of instruction of the applicant’s undergraduate degree was not English. In some cases, proof of the applicant’s language of undergraduate instruction may be requested and required.

Program Requirements

Students enrolling in the Bioengineering program will be assigned an advisor in the chosen track at the time of admission. Students are strongly encouraged to contact their advisor to discuss program prerequisites, course selections, research opportunities, and other programmatic questions.

The program has a common set of core courses for both majors. All students must take the 6 credits of core bioengineering courses, BEGR 409 Introduction to Bioengineering and BEGR 411 Integrated Product Development, at the start of the program. Students then enroll in 6 courses (18 credits) designated for their chosen major and 6 credits of electives. Students will complete their program with 6 credits of thesis work or can request in special cases and with the directors’ approval to do a 3 credit project and take one additional elective course, for a total of 36 program credits.

Biomedical Major Program Plan

<table>
<thead>
<tr>
<th>First Semester (Fall)</th>
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<tbody>
<tr>
<td>BEGR 401: Applied Engineering Analysis</td>
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<tr>
<td>BEGR 409: Introduction to Bioengineering</td>
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<tr>
<td>BEGR 411: Integrated Product Development</td>
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<tr>
<th>Second Semester (Spring)</th>
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<tbody>
<tr>
<td>BEGR 421: Biofluidics and Microfluidics</td>
</tr>
<tr>
<td>BEGR 415: 3-D Modeling of Human Anatomy and Physiology</td>
</tr>
<tr>
<td>BEGR 488: Biomedical Devices and Design</td>
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<table>
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<tr>
<th>Third Semester (Fall)</th>
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<tbody>
<tr>
<td>BEGR 451: Mechatronics/Bioinstrumentation</td>
</tr>
<tr>
<td>BEGR 474: Imaging in Biomedicine</td>
</tr>
<tr>
<td>BEGR 599: Thesis/Project (3 Credits)</td>
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<tr>
<th>Fourth Semester (Spring)</th>
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<tr>
<td>BEGR 599: Thesis/Project (3 Credits)</td>
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<tr>
<td>Elective</td>
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<td>Elective</td>
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Suggested electives for Biomedical majors include:

- BEGR 452: Nanotechnology
- BEGR 477: Cellular Biophysics
- BEGR 408: BioMEMs
- BEGR 498: Biomechanics – Muscular-Skeleton Mechanics

Students may also elect to take courses from the Synthetic Biology track, in consultation with their advisor, for their elective credits.

Synthetic Biology Program Plan
First Semester (Fall)
BEGR 409: Introduction to Bioengineering
BEGR 411: Integrated Product Development
BEGR 430: Introduction to Bioinformatics Applications

Second Semester (Spring)
BEGR 424: Molecular Biology
BEGR 465: Biochemistry
BEGR 477: Cellular Biophysics

Third Semester (Fall)
BEGR 501: Practicum in Synthetic Biology I
BEGR 599: Thesis/Project (3 Credits)
Elective

Fourth Semester (Spring)
BEGR 502: Practicum in Synthetic Biology II
BEGR 599: Thesis/Project (3 Credits)
Elective

Possible electives for Synthetic Biology majors include:

- BEGR 426: Immunology and Immunochemistry
- BEGR 427: Medical Microbiology
- BEGR 429: Virology
- BEGR 474: Imaging in Biomedicine

Students may also elect to take courses from the Biomedical track, in consultation with their advisor, for their elective credits.

Degree Requirements
All candidates for the Master of Science in Bioengineering degree must complete a program of thirty-six (36) credits.

Bioengineering.................................................................
Master of Science in Electrical Engineering (M.S.E.E.)

Point of Contact: Prahald Murthy, Ph.D.

Courses are available days and evenings.

Admission Requirements

Applications are invited from individuals who possess a B.S. degree in Electrical Engineering from an accredited institution. Applicants not meeting the requirements may be provisionally admitted and will be required to take sufficient undergraduate courses to make up deficiencies.

To be considered for admission, the applicant must submit the following minimum requirements:

1. Submit to the Graduate Admissions Office a completed graduate application for admission with payment of appropriate application fee.
2. Submit two letters of recommendation from previous academic faculty and/or from current or previous supervisors, if employed.
3. Demonstrate satisfactory performance as an undergraduate by providing a complete set of official undergraduate transcripts.
4. International students: Refer to page 10 for additional admissions requirements.

Degree Requirements

Thirty (30) credit hours are required for the M.S.E.E. degree. These include the following:

<table>
<thead>
<tr>
<th>Credits</th>
<th>Courses</th>
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<tbody>
<tr>
<td>12</td>
<td>EE 403, EE 405, EE-414, and EE-460</td>
</tr>
<tr>
<td>18</td>
<td>Students should choose either the thesis or the non-thesis option. In either case at least two courses (for 6 credits) must be chosen from the following: EE-442, EE-445, EE-465, and EE-471. Other courses may be chosen from graduate level courses in EE/CS and an approved course from the Business Administration program.</td>
</tr>
</tbody>
</table>

Non-thesis option: 3 credits of EE-590 are required. Students should submit a well-documented report to the department.

Thesis option: Six credits of thesis (EE-590) are required. The thesis shall be defended in an open forum. Three faculty members constitute a Thesis Committee with the Thesis Advisor as Chair.

Students who opt to complete a thesis may select from posted research topics or proposed areas of interest of the faculty and submit a proposal of their thesis to the Department. Final decision of topic and advisor will be taken by the Department in accordance with Department guidelines. Ordinarily, these topics will touch on one or more of the following areas: Communication, Navigational Systems; Computers, Digital Systems; Microelectronics; Microwaves and Antennas; Power, Control Systems; Software Engineering. Some of the highly specialized and state-of-the-art laboratories available for students include Communications, Thick-Film Processing, Microelectronics, Microwaves, Antennas, Machines and Controls, Digital Design.

Both full and part-time students are limited to a maximum of three thesis credits in any single semester.

The minimum acceptable grade point average is 3.0. (See Grade Regulations.)

Advanced standing or transfer credit is limited to six (6) graduate credits. Petitions should be submitted to the Engineering and Physics Division and should document minimum competency defined as relevant graduate course work at an accredited institution with an earned minimum grade of 3.0 (0-to-4 scale) or equivalent expertise.

Financial Aid

A limited number of assistantships are available for full-time students. Applicants should possess superior academic qualifications and provide good scores in the GRE (General and Engineering).

Electrical Engineering.................................................................8
MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

Master of Science in Engineering Management

Point of Contact: Prahlad Murthy, Ph.D.

The Master of Science in Engineering Management is a 36 credit-hour program that integrates 9 credit hours of required MBA program content with 27 hours of graduate engineering and elective content. The program is committed to the successful development of the upward-bound technical talent in industry. Entering students enjoy a curricular breadth and flexibility unique to Wilkes University because of leadership development strengths in the Sidhu School of Business.

The program emphases include decision processes, systems modeling, uncertainty analysis and risk assessment. Graduates will learn to effectively address and communicate the growing complexities of organizational performance and decision processes as they prepare for leadership roles in technical staff and technology management such as project planning and execution, production flow, logistics, demand forecasting, and quality improvement. The program also prepares students for further academic endeavors that may lead to post-graduate or doctoral studies in Engineering Management, Industrial Engineering or other related disciplines.

Admission Requirements

An ABET-accredited baccalaureate Engineering degree is preferred but not required. Applicants with other four-year degree preparations (e.g. BS or BA) may meet entrance requirements once the necessary foundation content is satisfied. Entry standards include the following:

1. Experience
   - Post-baccalaureate industrial/professional work experience preferred.
2. Application:
   - Submitted with payment of appropriate application fee. (International students: Refer to the International Students section of this bulletin for additional admission requirements).
3. Academic Preparation-Official Transcripts are Required:
   - Demonstrate satisfactory performance as an undergraduate as evidence with a complete set of official undergraduate transcripts to be submitted to the Graduate Admissions Office.
   - To be accepted on a regular basis, candidates for the degree must have obtained a cumulative GPA of at least 3.0. Prospective students with a GPA of less than 3.0 may be conditionally accepted into the program. To be reclassified to regular status, the conditionally accepted student must attain no less than a 3.0 for each of the first six credit hours of graduate coursework taken. Failure to maintain the minimum 3.0 in any course will result in dismissal of the conditionally accepted student.

Applications not holding an ABET-accredited undergraduate or graduate engineering degree must demonstrate or accrue the following preparation prior to enrolling in EGM courses:

- Mathematics: 12 hours (calculus, differential equations and statistics, or approved equivalent)
- Engineering economy or equivalent: 3 hours
- Science (chemistry and/or physics): 12 hours of approved coursework
- Engineering: 12 hours of approved coursework
- Demonstrated ability with computer programming and/or numerical analysis techniques
- Professional Recommendations
  - Applicants must submit two letters of professional recommendation.

Degree Requirements

The Masters of Science Degree in Engineering Management requires a minimum of thirty-six (36) credit hours consisting of twenty-seven (27) credits in CORE courses and nine (9) elective credit hours.

Required Courses

EGM 510, EGM 515, EGM 516, EGM 520, EGM 525, EGM 530, MBA 501, MBA 505 and MBA 552.

Elective Options: Students have three options for distributing the remaining 9 hours of graduate elective credit:

2. Industry project option: 3 hrs project (EGM 580 & 581) plus 6 hrs approved elective coursework (EGM/EE/CSE/MBA).
3. 9 hours approved coursework distributed as follows: EGM/EE - 3 hrs; EGM/EE/CSE/MBA - 6 hrs.

Engineering Management.................................................................12
MASTER OF SCIENCE IN MECHANICAL ENGINEERING (M.S.M.E.)

Point of Contact: Yong Zhu, Ph.D.

Admission Requirements
Applications are invited from individuals who possess a B.S. degree in Mechanical Engineering or close fields from an accredited institution. Applicants not meeting the requirements may be provisionally admitted and will be required to take sufficient undergraduate courses to make up deficiencies.

To be considered for admission, the applicant must submit the following minimum requirements:

- Submit to the Graduate Admissions Office a completed graduate application for admission with payment of appropriate application fee
- Submit two letters of recommendation from previous academic faculty and/or from current or previous supervisors, if employed.
- Demonstrate satisfactory performance as an undergraduate by providing a complete set of official undergraduate transcripts.
- International students: Refer to page 10 for additional admissions requirements.
- To be accepted on a regular basis, candidates for the degree must have obtained a cumulative GPA of at least 3.0. Prospective students with a GPA of less than 3.0 may be conditionally accepted into the program.

Degree Requirements
The Master of Science in Mechanical Engineering program requires thirty (30) credits of graduate level course work. The program consists of 15 credits of mandatory core courses. Students have the option of a six-credit thesis or a three-credit project with an additional three-credit technical elective. Students may select 9/12 additional credits hours from the list of technical electives.

Typical Course Sequence

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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<tbody>
<tr>
<td>ME-401 – Applied Engineering Analysis</td>
<td>ME-436 – Solid Mechanics</td>
</tr>
<tr>
<td>ME-411 – Product Development</td>
<td>ME-442 – Material Science</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>Technical Elective</td>
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<tr>
<th>Third Semester</th>
<th>Fourth Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Elective</td>
<td>Technical Elective</td>
</tr>
</tbody>
</table>

Thesis/Project Option:
Graduate students are strongly recommended to select the thesis option to complete their graduate course work. However, they may choose a three-credit hour project option.

Technical Electives
Technical electives may be selected from the technical elective graduate course list. In addition, up to one graduate level course from any Engineering or Science field is transferable.

Non-thesis option: 3 credits of ME 599 are required. Students should submit a well-documented report to the department.

Thesis option: Six credits of thesis ME 599 are required. The thesis shall be defended in an open forum. Three faculty members constitute a Thesis Committee with the Thesis Advisor as Chair.

Students who opt to complete a thesis may select from posted research topics or proposed areas of interest of the faculty and submit a proposal of their thesis to the Department. Final decision of topic and advisor will be taken by the Department in accordance with Department guidelines. Ordinarily, these topics will touch on one or more of the following areas: structural Analysis, Thermal Sciences, Finite Element Method, Solid Mechanics, Dynamics, MEMS, control Systems, Robotics, Mechatronics, energy conversion.

Both full- and part-time students are limited to a maximum of three thesis credits in any single semester.

The minimum acceptable grade point average is 3.0. (See Grade Regulations)

Advanced standing or transfer credit is limited to three (3) graduate credits. Petitions should be submitted to the Mechanical Engineering and Engineering Management Department, and should document minimum competency defined as relevant graduate course work at an accredited institution with an earned minimum grade of 3.0 (0-to-4 scale) or equivalent expertise.

Financial Aid
A limited number of assistantships are available for full-time students. Applicants should possess superior academic qualifications and provide good scores in the GRE (General and Engineering).

Academic Integrity
At Wilkes the faculty and the entire University community share a deep commitment to academic honesty and integrity. The following are considered to be serious violations and will not be tolerated:

1. Plagiarism: the use of another’s ideas, programs, or words without proper acknowledgment
2. Collusion: improper collaboration with another in preparing assignments, computer programs, or in taking examinations
3. Cheating: giving improper aid to another, or receiving such aid from another, or from some other source.
4. Falsifying: the fabrication, misrepresentation, or alteration of citations, experimental data, laboratory data, or data derived from other empirical methods.

Mechanical Engineering.......................................................... 13
BEGR. BIOENGINEERING

BEGR-401. APPLIED ENGINEERING ANALYSIS
Credits: 3 (Two hours of lecture and two hours of lab per week)
This course is a graduate level course whose focus is to present, illustrate and apply the calculus of single, multivariable and vector-valued functions to a variety of mechanical and electrical engineering and physics topics at an advanced level. Topics include ordinary differential equations, series solutions of ordinary differential equations and special functions, inner product spaces, vector analysis, operator algebra, matrix methods and eigenvalue problems, Fourier series and integrals, complex variables, Sturm-Liouville theory, transform methods and partial differential equations. (Cross-listed with ME-401)

BEGR-408. BIOMEMS
Credits: 3 (Three hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
This course is about the basic foundations for the understanding of electrical, mechanical and chemical transducers in biomedical applications through learning fabrication, design and analysis. The course will have lectures to cover the theory and practical applications of imaging. Some of the lectures and assignments will be in our materials fabrication laboratories.

BEGR-409. INTRODUCTION TO BIOENGINEERING
Credits: 3 (Three hours of lecture per week)
This course first covers some essential information of bioengineering and includes the required research ethics curriculum for the program. The course also samples the wide variety of bioengineering options for students who plan to enter one of the degree tracks. The beginning lectures briefly describe the scientific basis for bioengineering both from biological and engineering standpoints. Bioengineering faculty will then describe the bioengineering options in the particular engineering tracks and courses as well as the research conducted by faculty in the department. (Required for all students in Bioengineering)

BEGR-411. INTEGRATED PRODUCT DEVELOPMENT
Credits: 3 (Three hours of lecture per week)
Organizational issues and decision-making for capital investments in new technologies. The product development and commercialization process is traced from research and development and marketing activities through the implementation phase involving the manufacturing function. Term project is a commercialization plan for a new manufacturing technology. (Cross-listed with ME-411) (Required for all students in Bioengineering)

BEGR-415. 3-D MODELING IN HUMAN ANATOMY AND PHYSIOLOGY
Credits: 3 (Two hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
This is a one-semester course that will provide a foundation in Human Anatomy and Physiology for Graduate Engineering students in preparation for the design and evaluation of biomedical devices. Topics to be covered include: anatomical terminology; cell, tissue and organ structure; as well functional anatomy of muscles, joints, nervous, cardiovascular, respiratory, digestive, and urinary systems. Laboratory exercises will include 3D modeling of these systems and physiological recording of muscle contraction, action potentials, EEG, ECG, heat rate, pulse, and respiratory movements.

BEGR-421. BIOFLUIDICS AND MICROFLUIDICS
Credits: 3 (Three hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
Students learn how to mathematically and quantitatively describe fluid flow throughout organ systems and biomedical devices. Other topics covered include how flow correlates with diseases.

BEGR-424. MOLECULAR BIOLOGY
Credits: 3 (Three hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
An introduction to molecular biology and how it is studied. Topics covered include genome structure, transcription, translation, chromatin structure and its role in gene expression, and techniques for studying gene expression and for genetic engineering. The goal is to learn enough molecular biology to figure out how to identify target genes or combinations of genes and how they might be engineered to produce desired products or to engineer organisms with desired capabilities. (Cross-listed with BIO-324)

BEGR-426. IMMUNOLOGY AND IMMUNOCHEMISTRY
Credits: 3 (Three hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
Immunology and Immunchemistry provides an introduction to mammalian host defense. The molecular mechanisms that account for the antigen-antibody interaction are explored, as are ways in which this interaction influences the evolution of lymphocyte populations. Mechanisms of acquired immunity, including interactions among lymphocyte subpopulations, are discussed. Lymphocyte differentiation is addressed as a developmental problem, and defense against infection is approached as an integrated response. (Cross-listed with BIO-326)

BEGR-427. MEDICAL MICROBIOLOGY
Credits: 3 (Three hours of lecture and three hours of lab per week)
Fees: Lab Fee - $104
Medical Microbiology provides a professional-level introduction to microbiology that is focused on application of microbiology to the study of infectious disease. Principles of molecular cell biology and biochemistry are applied to an understanding of factors influencing interactions between microbial pathogens and their hosts. Adaptations that have evolved in vertebrate hosts to limit infection are considered along with parasite adaptations that have evolved to overcome such defenses. Infection control strategies - epidemiological and chemical - are also introduced. (Cross-listed with BIO-327)

BEGR-429. VIROLOGY
Credits: 3 (Three hours or lecture per week)
Virology provides an introduction to the biology of viruses and virus-like agents. A consideration of viruses in terms of their molecular architecture and genome organization is followed by a survey of strategies employed for reproductive success of viruses, focused on the traditional 'stages' of attachment, entry, transcription, translation, genome replication, assembly and release. The course provides an overview of the major groups in the Baltimore classification, and introduces topics in host interaction and control. (Cross-listed with BIO-329)

BEGR-451. MECHATRONICS/BIOINSTRUMENTATION
Credits: 3 (Two hours of lecture and one hour of lab per week)
Fees: Lab Fee - $104
Mechatronics is a multidiscipline technical area defined as the synergistic integration of mechanical engineering with electronic and intelligent computer control in the design and manufacture of industrial products and processes. This course covers topics such as actuators and drive systems, sensors, programmable controllers, microcontroller programming and interfacing, and automation systems integration. (Cross-listed with ME-451)
**Course Descriptions**

**BEGR-452. NANOTECHNOLOGY**  
**Credits:** 3 (Two hours of lecture and three hours of lab per week)  
**Fees:** Lab Fee - $104  
This course explores the fundamentals of nanotechnology and its applications for colloidal suspension, Electrotherapeutic deposition and nano-sensing by understanding materials properties, micro-machining, sensor and actuator principles. Two hours of lecture and three hours of lab per week. (Cross-listed with ME-452)

**BEGR-465. BIOCHEMISTRY**  
**Credits:** 3 (Three hours of lecture per week)  
An introduction to metabolism and how it is studied together with an introduction to the physical and chemical properties of macromolecules and their precursors. The goal is to learn enough biochemistry and metabolism to figure out how to identify target pathways and how they might be engineered to produce desired products or to engineer organisms with desired capabilities. (Cross-listed with CHM-365)

**BEGR-474. IMAGING IN BIOMEDICINE**  
**Credits:** 3 (Three hours of lecture and three hours of lab per week)  
**Fees:** Lab Fee - $104  
Biological and medicinal imaging techniques. This course will cover different aspects of imaging important to biomedicine including optical, scanning probe, ultrasound, X-ray and nuclear radiation techniques. The course will have lectures to cover the theory and practical applications of imaging. Some of the lectures and assignments will be in our imaging laboratories both at Wilkes and/or at our partner institutions.

**BEGR-477. CELLULAR BIOPHYSICS**  
**Credits:** 3 (Three hours of lecture per week)  
Cells are complex micron-sized machines that may best be understood by reverse systems engineering, which means that the understanding originated from detailed analysis of cellular functions and how they were optimized. This course focuses on a quantitative understanding of cellular processes. It is designed for students who feel comfortable with and are interested in analytical and quantitative approaches to cell biology and cell physiology.

**BEGR-488. BIOMEDICAL DEVICES AND DESIGN**  
**Credits:** 3 (Two hours of lecture and one hour of lab per week)  
**Fees:** Lab Fee - $104  
This course discusses the design development and evaluation of medical devices. The goal is to develop the thinking and research tools that will enable students to understand medical devices as products as commercially available technological solutions to medical needs. This total understanding is based upon the coordinate separated understandings of: 1) underlying medical science and clinical practice; 2) underlying technologies and the potential choices between available technologies; 3) engineering design; and 4) technological and business direction of companies.

**BEGR-498. BIOMECHANICS – MUSCULAR-SKELETON MECHANICS**  
**Credits:** 3 (Three hours of lecture and three hours of lab per week)  
**Fees:** Lab Fee - $104  
Instruction will be given towards the mechanical structure of humans and vertebrates, including the concerted motion of bone, muscles and joints as well as the stress and strain of human movements and motion. One example practical outcome of the course is towards the design of prosthetics.

**BEGR-599. THESIS/PROJECT**  
**Credits:** 3-6 (Three to six credits of research, proposal writing, presentation, and thesis per week)  
Students have the option of selecting up to six credits- hours of thesis or three credit hour of project under guidance of a thesis/project advisor. The thesis will have a committee of three members; at least two members (including the advisor) must be Wilkes faculty members. The thesis/project should be presented in an open forum.

**EE. ELECTRICAL ENGINEERING**

**EE-403. COMPUTATIONAL TECHNIQUES IN ELECTRICAL ENGINEERING**  
**Credits:** 3  
**Fees:** $100  
Application of MATLAB, LabVIEW, and PSPICE to solve problems in electrical engineering topics. Software design, implementation methodologies, software engineering, and procedural and data abstraction. Implementation methodology is based on object-oriented programming techniques using LabWINDOWS CVI (compiler). Students work on real-world design problems of increasing complexity. These will include graphical user interfaces (GUIs), event models, exception handling and multithreading. One Hour lecture and three hour lab per week Lab fee: $100.

**EE-405. ADVANCED LABORATORY EXPERIENCE FOR GRADUATE STUDENTS**  
**Credits:** 3  
Laboratory and related analytical experience in different disciplines within electrical engineering, including but not limited to, electrical measurements, mechatronics, digital design, electromagnetics, and communications systems. Real-world design problems will be assigned. Three hour lab per week. Lab fee: $100.

**EE-410. LINEAR SYSTEM THEORY**  
**Credits:** 3  
Linear spaces and linear operators; input-output systems and state variables; linear dynamical equations and impulse response matrices; controllability, observability and their applications to minimal realizations; state feedback controllers and observers; multivariable systems.

**EE-414. MODERN CONTROL SYSTEMS**  
**Credits:** 3  

**Pre-Requisites**  
Graduate standing

**GRADUATE STUDENTS**

**EE-403. COMPUTATIONAL TECHNIQUES IN ELECTRICAL ENGINEERING**  
**Credits:** 3  
**Fees:** $100  
Application of MATLAB, LabVIEW, and PSPICE to solve problems in electrical engineering topics. Software design, implementation methodologies, software engineering, and procedural and data abstraction. Implementation methodology is based on object-oriented programming techniques using LabWINDOWS CVI (compiler). Students work on real-world design problems of increasing complexity. These will include graphical user interfaces (GUIs), event models, exception handling and multithreading. One Hour lecture and three hour lab per week Lab fee: $100.

**EE-405. ADVANCED LABORATORY EXPERIENCE FOR GRADUATE STUDENTS**  
**Credits:** 3  
Laboratory and related analytical experience in different disciplines within electrical engineering, including but not limited to, electrical measurements, mechatronics, digital design, electromagnetics, and communications systems. Real-world design problems will be assigned. Three hour lab per week. Lab fee: $100.

**EE-410. LINEAR SYSTEM THEORY**  
**Credits:** 3  
Linear spaces and linear operators; input-output systems and state variables; linear dynamical equations and impulse response matrices; controllability, observability and their applications to minimal realizations; state feedback controllers and observers; multivariable systems.

**EE-414. MODERN CONTROL SYSTEMS**  
**Credits:** 3  

**Pre-Requisites**  
Graduate standing
EE-415. DIGITAL CONTROL SYSTEMS DESIGN  
Credits: 3  
Review of design and compensation of control systems. State space analysis of continuous-time and discrete-time systems; discrete-time observations, control and feedback; digital regulators design; digital tracking systems design; controlling continuous-time systems.  

Pre-Requisites  
EE-414  

EE-416. ROBOT VISION  
Credits: 3  
Image formation and image sensing; binary images; geometrical and topological properties; reflectance map; photometric stereo, shape, and shading; motion field and optical flow; extended Gaussian images; picking parts out of bin.  

Pre-Requisites  
First course in Robotics  

EE-418. CONTROLS AND KINEMATICS IN NAVIGATION  
Credits: 3  

Pre-Requisites  
EE-318, EE-460  

EE-421. POWER SYSTEM ANALYSIS  
Credits: 3  
Review of power generation schemes. Transmission line calculations and power system representation; network solution by matrix transformations; symmetrical components; symmetrical and unsymmetrical fault analysis of power systems; load flow analysis.  

Pre-Requisites  
EE-321  

EE-425. POWER ELECTRONICS  
Credits: 3  
SCR characteristics; turn-on and turn-off mechanisms; SCR connections; power and switching devices, including UJT, triac and special devices; AC power control: full-wave control, half-wave control, and phase control; line-commutated converters and inverters; chopper circuits; applications.  

Pre-Requisites  
EE-252, EE-321  

EE-432. ELECTROMAGNETIC FIELDS AND WAVES  
Credits: 3  
Maxwell's equations; energy and momentum in the electromagnetic field; plane, cylindrical, and spherical waves; boundary conditions; cylindrical waveguides; cavity resonators; scattering by a sphere and other geometries.  

Pre-Requisites  
EE-337  

EE-435. MICROSTRIP CIRCUIT DESIGN  
Credits: 3  
A review of TEM mode transmission line theory. Static TEM parameters and design; discontinuities in microstrip and coupled microstrip lines; design examples of passive microstrip elements; narrowband and wideband microwave amplifiers.  

Pre-Requisites  
EE-335/EE 337  

EE-436. ANTENNA THEORY AND DESIGN  
Credits: 3  
Electromagnetic vector potentials; Green's functions; radiating systems; image theory; reciprocity; directional arrays; linear and broadband antennas; moment method; aperture antennas; microstrip antennas, and antenna synthesis.  

Pre-Requisites  
EE-337  

EE-441. DIGITAL SYSTEMS DESIGN  
Credits: 3  
Advanced topics in digital design; combinational and sequential circuit modeling, fault modeling, digital design testing and testability, design to test principles, and basic concepts in fault tolerant design.  

Pre-Requisites  
EE-241  

EE-442. MICROCOMPUTER OPERATION AND DESIGN  
Credits: 3  
Fees: $100  
Microprocessor architecture, microcomputer design, and peripheral interfacing. Microprogramming, software systems, and representative applications. Associated laboratory experiments consider topics such as bus structure, programming, data conversion, interfacing, data acquisition, and computer control. Two hour lecture and one two-hour laboratory a week. (same as CS-429)  

Pre-Requisites  
EE-345  

EE-444. OPERATING SYSTEM PRINCIPLES  
Credits: 3  
Analysis of the computer operating systems including Batch, Timesharing, and Realtime systems. Topics include sequential and concurrent processes, processor and storage management, resource protection, processor multiplexing, and handling of interrupts from peripheral devices. (same as CS-445)  

Pre-Requisites  
EE-327  

EE-445. COMPUTER ORGANIZATION  
Credits: 3  
Number representation, digital storage devices and computational units, bus structures; execution sequences and assembly language concepts; control units with horizontal and vertical microcoding; addressing principles and sequencing; microprocessors; basic input and output devices; interrupts; survey of RISC principles including pipelined execution. (same as CS-445)  

Pre-Requisites  
EE-241
Course Descriptions

**EE-446. COMPUTER ARCHITECTURE**
**Credits:** 3  
A study of the design, organization, and architecture of computers, ranging from the microprocessors to the latest 'supercomputers.' (same as CS-430)

**Pre-Requisites**  
EE-242 or EE-342

**EE-451. OPTO-ELECTRONICS**
**Credits:** 3  
Electromagnetic theory; propagation of rays; propagation of optical beams in homogeneous and guiding media; optical resonators; interaction of radiation and atomic systems; theory of laser oscillators; some specific laser systems; second-harmonic generation and parametric oscillation; electronic modulation of lasers; optical radiation interaction of light and sound; propagation, modulation, and oscillation in optical dielectric waveguides; laser applications; fiber optics and couplers.

**Pre-Requisites**  
EE-337

**EE-460. STOCHASTIC PROCESSES IN ENGINEERING**
**Credits:** 3  
Review of probability. Random variables and random processes; functions of one and two random variables; expectations; moments and characteristic functions; correlation and power spectra; stationary and nonstationary processes, harmonic analysis of random processes.

**EE-461. DIGITAL COMMUNICATIONS**
**Credits:** 3  
Sampling theory; analog pulse modulation; time-division multiplexing; baseband digital transmission; bandlimited digital PAM systems; synchronization techniques; PCM, PCM with noise, DPCM and DM; digital multiplexing; error correction and detection; linear block codes; convolutional codes; bandpass digital transmission; coherent and noncoherent binary systems; quadrature carrier and Mary systems; information theory.

**Pre-Requisites**  
EE-361, EE-460

**EE-465. DIGITAL SIGNAL PROCESSING**
**Credits:** 3  
Z transforms; Fourier transforms; discrete Fourier transforms; sampling theorem; analog filter approximations; digital filter realizations and topological properties; analysis and design of recursive (IIR) filters and non-recursive (FIR) filters; fast Fourier transforms.

**Pre-Requisites**  
EE-252

**EE-471. ADVANCED SOLID STATE DEVICES**
**Credits:** 3  
Review of semiconductor fundamentals. Physics, fabrication technologies, and operational characteristics of a variety of solid-state structures including p-n junctions, bipolar transistors, thyristors, metal semiconductor contacts, JFET and MESFET, MIS and CCD, MOSFET, microwave and photonic devices including IMPATT, BARITT, TED, LED, semiconductor lasers, photodetectors, and solar cells.

**Pre-Requisites**  
EE-271

**EE-474. INTEGRATED CIRCUIT DESIGN**
**Credits:** 3  
Model calculations, transfer characteristics and use of SPICE for MOS devices and circuits; basic logical units; integrated systems fabrication including scaling, channel properties, yield statistics, design rules and choice of technology; data and control flow including clocks, registers and PLA’s; design implementation from circuit topology to patterning geometry and wafer fabrication; CAD; overview of LSI and VLSI systems; architecture and design of system controllers; system timing (SPICE); physical aspects of computational systems; ASICs memories and other logical circuits.

**Pre-Requisites**  
EE-241, EE-271

**EE-481. ADVANCED MICROELECTRONICS LAB**
**Credits:** 3  
**Fees:** $100  
Theoretical and practical aspects of techniques utilized in the fabrication of semiconductor devices. Techniques of wet chemistry; deposition and diffusion; advanced concepts of contamination control; defect-free processing and gathering; complete characterization including junction penetration, resistivity, and oxide thickness. Switching speed, junction characteristics, leakage and gain, ion implantation, and method of fabrication. Extensive use of process simulation programs such as SUPREM.

**Pre-Requisites**  
EE-271

**EE-482. ADVANCED COMMUNICATION AND ANTENNA LAB**
**Credits:** 3  
**Fees:** $100  
Characterization and measurement of microwave devices and systems; emphasis on antenna design and testing; utilization of the network analyzer and spectrum analyzer; antenna pattern measurements; communication link design; computer-aided design of active and passive microwave circuits; touchstone, optical signal generation and modulation.

**Pre-Requisites**  
EE-335

**EE-498. TOPICS IN ELECTRICAL ENGINEERING**
**Credits:** 3  
Three credits  
Selected topics in electrical engineering. These may include one or more of the following: control systems, information theory, signals and noise measurements, communication systems, navigational systems, network design and synthesis, solid state, quantum electronics, magnetic and non-linear circuits, digital and analog systems, computer systems, medical engineering, power systems and generation. May be repeated for credit.

**EE-510. OPTIMAL FILTERING THEORY**
**Credits:** 3  
Review of stochastic processes; stochastic integrals and differential equations; Wiener filtering; discrete Kalman filter; applications and additional topics on discrete Kalman filtering; continuous Kalman filter; discrete smoothing and prediction; additional topics on Kalman filtering.

**Pre-Requisites**  
EE-410, EE-460
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE-514</td>
<td>OPTIMAL CONTROL THEORY</td>
<td>3</td>
<td>The calculus of variations and the minimum principle; optimal control of discrete-time systems; optimal control of continuous-time systems; dynamic programming; models of dynamic systems; optimal estimation; stochastic neighboring optimal control.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-410</td>
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<tr>
<td>EE-516</td>
<td>ROBOTICS AND ARTIFICIAL INTELLIGENCE</td>
<td>3</td>
<td>Prospects for knowledge-based robots; robots and artificial intelligence; expert systems and knowledge-based languages; production-rule expert systems; search techniques; heuristic graph searching; AND/OR graphs; first order predicate logic; future prospects for knowledge-based robots.</td>
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<tr>
<td>Pre-Requisites</td>
<td>First course in Robotics</td>
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<tr>
<td>EE-521</td>
<td>COMPUTER AIDED ANALYSIS OF POWER SYSTEMS</td>
<td>3</td>
<td>Bus impedance and bus admittance matrices; sparsity programming and triangular factorization. Load-flow studies; Gauss, Gauss-Seidel, Newton-Raphson methods. Approximate, fast and special-purpose load-flow studies. Optimal dispatch: equal incremental cost rule; gradient dispatch; optimal reactive power dispatch methods.</td>
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<td>Pre-Requisites</td>
<td>EE-421</td>
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<tr>
<td>EE-535</td>
<td>MICROWAVE CIRCUITS</td>
<td>3</td>
<td>Microwave networks; S-parameters and stability considerations; characterization of transmission line structures and discontinuities; models of microwave solid state devices; measurement techniques for modeling; design synthesis; optimization and analysis of microwave integrated circuits; numerical methods.</td>
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<td>Pre-Requisites</td>
<td>EE-435</td>
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<tr>
<td>EE-541</td>
<td>MICROPROCESSOR-BASED SYSTEMS DESIGN</td>
<td>3</td>
<td>Brief review of directions in microprocessor development: single chip microcomputers, Reduced Instruction Set Computers (RISCs), and Multiple Data Stream processors; hardware and software aspects of the design of microprocessor-based systems; architecture and design of multiple computer and parallel processing systems; cache memory techniques and issues; bus standards and interfacing.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-342</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-460</td>
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<tr>
<td>EE-561</td>
<td>COMPUTER COMMUNICATION NETWORKS</td>
<td>3</td>
<td>Data/computer communication network structures; the structure and function of network protocols; data link control procedures; multiple-access protocols; wideband data transmission media; functions and characteristics of devices used in computer communications; analysis of data/computer networks.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-461</td>
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<tr>
<td>EE-562</td>
<td>OPTICAL COMMUNICATION</td>
<td>3</td>
<td>Structure and waveguiding fundamentals of optical fibers; signal degradation in optical fibers; optical sources and their characteristics; power launching and coupling; photodetectors; optical receiver operation; coherent and non-coherent detection; analysis and design of optical transmission links.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-432, EE-461</td>
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<tr>
<td>EE-565</td>
<td>DIGITAL IMAGE PROCESSING</td>
<td>3</td>
<td>Scenes, images and digital pictures; linear operations on pictures; discrete picture transforms; random variables and random fields; visual perception. Sampling using array of points and orthonormal functions; quantization; Karhunen-Loeve, Fourier, Hadamard, and cosine compression; predictive block truncation, error-free compression; rate-distortion function. Enhancement: gray scale modification, sharpening and smoothing; restoration: inverse least-squares and recursive filtering, constrained deconvolution.</td>
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<td>Pre-Requisites</td>
<td>EE-460</td>
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<tr>
<td>EE-568</td>
<td>MODERN NAVIGATION SYSTEMS</td>
<td>3</td>
<td>Overview of electronic navigation systems: Global Positioning Systems (GPS); application and status; concept and operation; accuracy and propagation consideration; GPS receiver; signal structure, integration principles for navigation systems; Kalman filtering; differential GPS.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-418, EE-460</td>
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<tr>
<td>EE-571</td>
<td>MODERN SOLID STATE DEVICES AND DESIGN</td>
<td>3</td>
<td>Semiconductor fundamentals at an advanced level. Silicon and GaAs, MOS devices; processing details; performance limitations; process design for given device specifications; limitations due to fabrication techniques; quantum phenomena in a variety of modern high performance devices; microwave semiconductor devices; integrated circuit design; VLSI design; computer aids for process and circuit design.</td>
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<tr>
<td>Pre-Requisites</td>
<td>EE-471</td>
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</tbody>
</table>
Course Descriptions

EE-590. PROJECT/THESIS
Credits: 1-6
One to six credits. Students have the option to select a 6-credit or a 3-credit project to meet the degree requirement. Topics will touch on one or more of the following areas: Communications, Navigational Systems; Computers, Digital Systems; Microelectronics; Microwaves and Antennas; Power, Control Systems; and Software Engineering. Three faculty members constitute a Faculty Committee with the Project/Thesis Advisor as Chair. The project/thesis shall be presented in an open forum.

EE-598. ADVANCED TOPICS IN ELECTRICAL ENGINEERING
Credits: 3
Three credits. Advanced topics in electrical engineering. These may include one or more of the following: control systems; navigational systems; information theory; signals and noise measurements; communication systems; network design and synthesis; solid state; quantum electronics; magnetic and non-linear circuits; digital and analog systems; computer systems; medical engineering; power systems and generation. May be repeated for credit.

EGM. ENGINEERING MANAGEMENT

EGM-510. ENGINEERING PROJECT DECISION PROCESSES
Credits: 3
Projects are assessed with respect to uncertainty (revenues, expenses, product/process performance) and risk. Cash flows are evaluated to estimate present values and quantify risks associated with various decision alternatives. Topics include depreciation strategies, make/purchase/rent choices, break-even and benefit/cost assessments, and decision analysis with imperfect information. Required of all students. Three hours lecture per week.

EGM-515. QUALITY PROCESSES FOR DESIGN AND PRODUCTION
Credits: 3
Applicable quality techniques are presented within the context of research, new product development, plant operations, product support, and risk reduction. Students will learn how to articulate objectives, identify desired outcomes and establish suitable metrics for performance management. Required of all students. Three hours lecture per week.

EGM-516. MANAGEMENT SCIENCE
Credits: 3
Students learn how to structure complex problems, analyze available options, obtain information from data, and how to formulate analytical models for making optimal decisions. Topics may include (but are not limited to) regression and correlation analysis, time series analysis, forecasting models, and quality and productivity management. Course activities may include case analyses, research, application of advanced techniques, or and/or utilization of various information technologies. Required of all students. Three lecture hours per week.

EGM-520. OPERATIONS ANALYSIS AND RESOURCE ALLOCATION
Credits: 3
Students will assess production flows and space/equipment/resource utilization for purposes of reducing production bottlenecks while maintaining/increasing facility utilization. Various quantitative analysis and optimization methodologies will be covered for solving linear and nonlinear optimization problems. Simulation and graphical approaches will be utilized to assess solution performance. Required of all students. Three hours lecture per week.

EGM-525. PROJECT ANALYSIS AND RESOURCE ALLOCATION
Credits: 3
A study of critical issues in the management of engineering projects including proposal development, mobilization, scope change, completion and termination. Performance metrics are considered in planning and tracking project cost, schedule, and resource requirements with CPM/PERT algorithms. Case discussions and a term project are included in the course. Required of all students. Three hours lecture per week.

EGM-530. STOCHASTIC MODELS IN ENGINEERING MANAGEMENT
Credits: 3
A review of engineering analytical methods and their application in strategic decision environments. Required case studies will require techniques such as Monte Carlo simulation, risk assessment, and failure modeling as the suitability and application of several engineering analytical approaches to operational analysis of business/industry decision processes. Required of all students. Three hours lecture per week.

EGM-534. MATERIAL & INTELLECTUAL PROPERTY
Credits: 3
A study of the history, fundamental strategies and issues relating to generating and protecting intellectual and material property rights. Topics include the subjects of and the present legal processes to protect trademarks, copyrights, patents, trade secrets, software and other intellectual property rights. Three lecture hours per week.

EGM-536. PRODUCT DESIGN & DEVELOPMENT
Credits: 3
This course focuses on the integration of the design, manufacturing, the ability to coordinate multiple interdisciplinary tasks and marketing functions in the process of creating new products. The course is intended to provide students with the necessary set of tools and methods for new product design and development. Several design frameworks are discussed in order to achieve a common objective. This course will reinforcement students specific knowledge from other courses through practice and reflection in an project-oriented setting. Three lecture hours per week.

EGM-538. AUTOMATION PRODUCTION AND SYSTEMS
Credits: 3
This course focuses on the use of a quantitative approach to simulate, analyze and optimize all engineering aspects of automated production systems. Several modeling frameworks are discussed, such as automata, State-charts, cutting-edge technologies and Petri nets. Solving automation problems is of critical importance to decrease the cost of production systems and increase the throughput and flexibility. This course aims to give the student a basic knowledge of the important results of current research on discrete event systems and how these results can be applied to production systems. Three lecture hours per week.
EGM-540. LEAN SIX SIGMA & LEAN MANUFACTURING
Credits: 3
This course focuses on developing the knowledge and skills of a typical industry based Six Sigma Green Belt candidate. The course includes the descriptive statistics and project management skills necessary to Define, Measure, Analyze, Improve and Control processes. Lecture topics include Six Sigma problem-solving techniques, continuous improvement, mistake proofing, Lean Six Sigma, Lean manufacturing, determining the cost of quality and more. Three lecture hours per week.

EGM-544. EMERGING TECHNOLOGIES
Credits: 3
This course aims to develop students’ skills in monitoring emerging new technologies, innovation forecast and technology assessment, with an introduction of data mining tools and exploration of emerging technologies. Students will study new developments in emerging technologies, how to track pertinent developments, and discover what is going on in the research world. The course focuses on developing the capability to be a technology manager and a critical well-informed consumer of such technology. Three lecture hours per week.

EGM-545. APPLIED ENGINEERING ANALYSIS
Credits: 3
This course is intended for all engineering students and it provides a strong background in mathematical modeling of various systems relevant to mechanical, electrical and management problems. Typical topics covered include (but are not limited to) linear algebra, matrix and vector mechanics, eigenvalue problems, ordinary differential equations, Fourier analysis, partial differential equations and optimization. Three lecture hours per week.

EGM-580. GRADUATE PROJECT CONTINUUM
Credits: 1-3
One - Three CreditsEGM students may elect a three-credit-hour industry-based project option. The student, working with industry, will select a project topic derived from an existing need/interest in industry under the guidance of a faculty project advisor selected by mutual agreement of the student and faculty member. When the project is completed and approved by the Project Advisor, bound copies of the approved report will be filed in the department office and in Farley Library for record. A grade will be awarded each semester the student is enrolled in EGM-580. At project completion, a completion grade will be awarded by converting one credit-hour of EGM-580 to one credit-hour of EGM-581 (Graduate Project Completion). EGM-580 credit does not apply toward meeting degree requirements until a grade for EGM-581 is recorded. Only two hours of credit for EGM-580 may apply toward degree requirements (although the student may enroll in a total of more than two credit hours of continuum if project completion extends to additional semesters).

EGM-581. GRADUATE PROJECT COMPLETION
Credits: 1
One CreditRecorded with grade by converting one credit-hour of EGM-580. Occurs upon completion of the graduate project, receipt of Project Advisor approval, and submittal of approved copies to the department office and Farley Library for binding and record.

EGM-590. THESIS CONTINUUM
Credits: 1-6
One -Six CreditsStudents may elect the six-credit-hour thesis option under the guidance of a Thesis Advisor who chairs the Thesis Committee. The Committee is comprised of three members; at least two members (including the Advisor) must be Wilkes faculty members. When the thesis is complete and has been defended with Committee approval in an open forum, bound copies of the approved thesis will be filed in the department office and in Farley Library for record. A continuum grade will be awarded each semester the student is enrolled in Continuum. A completion grade will be awarded by converting one credit-hour of EGM-590 Graduate Thesis Continuum to one credit-hour of EGM-591 Graduate Thesis Completion. EGM-590 credit does not apply toward meeting degree completion until a grade for EGM-591 is recorded. Only five hours of credit for EGM-590 may apply toward Engineering Management degree requirements (although the student may enroll in a total of more than five hours of continuum if thesis completion extends to additional semesters).

EGM-591. GRADUATE PROJECT COMPLETION
Credits: 1
One CreditRecorded with grade by converting one credit-hour of EGM-590. Occurs after successful defense of the Graduate Thesis before a Thesis Committee in an open forum, and after approved copies have been submitted to the department office and Farley Library for binding and record.

ME. MECHANICAL ENGINEERING

ME-401. APPLIED ENGINEERING ANALYSIS
Credits: 3
This course is intended for physical science and engineering students. Topics include inner product spaces, operator algebra, eigenvalue problems, Fourier series, Sturm-Liouville theory, and partial differential equations. Cross list MTH-461

ME-402. ENGINEERING COMPUTATIONAL ANALYSIS
Credits: 3
This course introduces applications of Matrix algebra (Review only), solution of linear simultaneous equations, solving linear system of equations by iteration methods, roots of algebraic and transcendental equations, interpolation, methods of finding polynomial roots, Eigen values & eigenvectors, numerical integration, numerical differentiation, numerical solution of initial value problems, boundary value problems.

ME-411. PRODUCT DEVELOPMENT
Credits: 3
This course introduces organizational issues and decision-making for capital investments in new technologies. The commercialization process is traced from research and development and marketing activities through the implementation phase involving the manufacturing function. Term project is a commercialization plan for a new manufacturing technology.

ME-418. QUALITY CONTROL ENGINEERING
Credits: 3
This course addresses quality control in the manufacturing environment, statistical methods used in quality assurance, statistical process control.
ME-425. ENERGY SYSTEMS  
Credits: 3  
This course introduces fundamental principles of energy transmission and energy conversion. Comprehension of the physical systems in which the conversion of energy is accomplished. Primary factors necessary in the design and performance analysis of energy systems three credits.

ME-427. TRANSPORT PHENOMENA  
Credits: 3  
This course introduces theory and applications of heat, mass, and momentum transport. The fluid dynamics topics such as conservation laws, laminar and turbulent flow, Navier Stokes equations of motion and other related topics will be covered. Topics include free and forced convection, boiling and condensation, and the analogy between heat and mass transport. Practical problems of engineering applications in different areas will be discussed.

ME-432. VIBRATION OF DYNAMIC SYSTEMS  
Credits: 3  
This course is an introductory course in mechanical vibration dealing with free and forced vibration of single and multi-degree of freedom for linear systems.

ME-436. SOLID MECHANICS  
Credits: 3  
This course is an introduction to continuum mechanics, variational methods, including vectors and tensors, state of stress and compatibility equation, plain stress and strain. Energy Principles and virtual work will be discussed.

ME-438. MACHINE DESIGN  
Credits: 3  
This course introduces design of machine elements and deals with theories of deformation, failure, and fatigue A study of shaft design, fasteners, welds, gears, bailed roller bearings, belts, chains, clutches, and brakes.

ME-439. CLASSICAL MECHANICS  
Credits: 3  
This course is an introduction to classical mechanics. Topics covered include: Newtonian mechanics, oscillations, Lagrangian and Hamilton’s principle, Dynamics of a systems of particles and rigid bodies.

ME-442. MATERIAL SCIENCE  
Credits: 3  
This course introduces advance materials for engineers, emphasizing the fundamentals of manufacturing/structure/property/function relation and applications. Topics include materials selection for machine design components in micro and nano-scales, biomaterials, nano-composites, and optimized materials for nano-sensors & actuator systems.

ME-451. MECHATRONICS  
Credits: 3  
This course is a multidiscipline technical area defined as the synergistic integration of mechanical engineering with electronic and intelligent computer control in the design and manufacture of industrial products and processes. This course covers topics such as actuators and drive systems, sensors, programmable controllers, microcontroller programming and interfacing, and automation systems integration.

ME-452. NANO-TECHNOLOGY  
Credits: 3  
This course explores the fundamentals of Nanotechnology and its applications for colloidal suspension, Electrophoretic deposition and nano sensing by understanding materials properties, micro-machining, sensor and actuator principles. Two hours lecture and three hours lab per week.

ME-454. CONTROL SYSTEMS  
Credits: 3  

ME-498. ADVANCED TOPICS IN MECHANICAL ENGINEERING  
Credits: 1-3  
This course includes selected topics in the field of mechanical engineering. These may include one or more of the following: control systems, automation, robotics, manufacturing systems, solid mechanics, energy systems, fluid flow, acoustics, computer systems, bio-mechanics.

ME-501. GRADUATE EDUCATION CONTINUUM  
Credits: 1-9  
Recorded with grade for one credit-hour. Occurs as a continuum bases till successful completion of thesis or project.

ME-599. THESIS/PROJECT  
Credits: 3-6  
Students have the option of selecting up to six credits- hours of thesis or three credit hour of project under guidance of a thesis/project advisor. The thesis will have a committee of three members; at least two members (including the adviser) must be Wilkes faculty members. The thesis/project should be presented in an open forum.