Mechanical Engineering

Purpose and Goals

As one of the broadest engineering branches, mechanical engineering includes design, analysis, and manufacturing associated with: (1) energy; and (2) structures and motion in mechanical systems. Mechanical Engineers design machines, processes, and systems utilizing mechanical and thermal power. The work of Mechanical Engineers include, but is not limited to, the following areas: machinery design and construction, design and analysis of thermal systems, manufacturing, instrumentation and controls, fluid and solid mechanics, plant engineering, materials specification and evaluation, research and development, and technical sales. Many Mechanical Engineers are promoted to management and administrative positions.

Because of the global consequences of many engineering endeavors, and because of the continually changing technological climate, the Department emphasizes an integrated curriculum that overlaps other engineering branches and the physical sciences. Graduates of the mechanical engineering curriculum will be prepared to be technical leaders in tomorrow’s society.

The goal of the Mechanical Engineering Program is to produce industrial, scientific, and technological leaders capable of systematically identifying, addressing, and solving technical problems whose solutions will benefit society. Specific educational objectives of the Mechanical Engineering Program are to produce graduates who will:

1. Have successful careers in engineering and related fields;
2. Advance their careers through increasing levels of responsibilities and leadership;
3. Successfully pursue graduate or advanced professional degrees and continuing professional development; and
4. Actively participate in professional and community services.

Eligibility to Take Upper Division College Courses

The Roy G. Perry College of Engineering requires an eligibility standard for the students to take upper division college courses. Students must have completed or be currently enrolled in all lower division (1000 and 2000 level) courses in English, Mathematics, Science, and Engineering to be eligible to enroll in upper division (3000 or 4000 level) courses in the Roy G. Perry College of Engineering. Students in the Mechanical Engineering Program must complete a prescribed list of courses in the following with a minimum Grade Point Average (GPA) of 2.5 to be eligible to enroll in upper division (3000 or 4000 level) courses in the College. Students transferring to the Roy G. Perry College of Engineering with 60 or more semester hours from another institution will be allowed a period of one semester to comply.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1034</td>
<td>Chemistry for Engineers</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1021</td>
<td>Inorganic Chemistry Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 1143</td>
<td>Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2513</td>
<td>University Physics I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; PHYS 2511</td>
<td>and University Physics Lab I</td>
<td></td>
</tr>
<tr>
<td>MATH 1124</td>
<td>Calculus with Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>GNEG 1121</td>
<td>Engineering Lab II for Mathematics</td>
<td>1</td>
</tr>
<tr>
<td>MATH 2024</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>GNEG 2021</td>
<td>Engr Lab III for Math</td>
<td>1</td>
</tr>
<tr>
<td>MCEG 1011</td>
<td>Intro Engr Cs Tech</td>
<td>1</td>
</tr>
<tr>
<td>MCEG 1021</td>
<td>Introduction to Mechanical Engineering Drawing and Design Lab I</td>
<td>1</td>
</tr>
<tr>
<td>ELEG 1043</td>
<td>Computer Applications in Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Admission Requirements

Table 1. First-time Freshmen Requirements for Direct Admission to the Mechanical Engineering Program

<table>
<thead>
<tr>
<th>Academic Major</th>
<th>Meet PVAMU Admission Standards</th>
<th>High School GPA</th>
<th>SAT/ACT</th>
<th>High School Rank</th>
<th>THEA Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
<td>Yes</td>
<td>3.00</td>
<td>New SAT: 950/18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Transfer Students Requirements for Direct Admission to the Mechanical Engineering Program

<table>
<thead>
<tr>
<th>Academic Major</th>
<th>Meet PVAMU Admission Standards</th>
<th>Transfer Grades</th>
<th>Transfer GPA (Math; Science and Engineering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
<td>Yes</td>
<td>&quot;C&quot; or Greater</td>
<td>2.50</td>
</tr>
</tbody>
</table>
These tables represent a summary of admission requirements. For more detailed requirements see the section in the catalog pertaining to the College of Engineering Admission.

**Accreditation Status**

The Mechanical Engineering program is accredited by the Engineering Accreditation Commission of ABET, [http://www.abet.org](http://www.abet.org).

**Bachelor of Science in Mechanical Engineering Degree Program Requirements**

<table>
<thead>
<tr>
<th>Core Curriculum</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>College and Support Area Requirements</strong></td>
<td></td>
</tr>
<tr>
<td>MATH 1124</td>
<td>Calculus with Analytic Geometry I</td>
</tr>
<tr>
<td>MATH 2024</td>
<td>Calculus with Analytic Geometry II</td>
</tr>
<tr>
<td>MATH 3023</td>
<td>Probability and Statistics</td>
</tr>
<tr>
<td>MATH 4173</td>
<td>Advanced Math for Engineers</td>
</tr>
<tr>
<td>GNEG 1121</td>
<td>Engineering Lab II for Mathematics</td>
</tr>
<tr>
<td>GNEG 2021</td>
<td>Engr Lab III for Math</td>
</tr>
<tr>
<td>CHEM 1021</td>
<td>Inorganic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHEM 1034</td>
<td>Chemistry for Engineers</td>
</tr>
<tr>
<td>PHYS 2511</td>
<td>University Physics Lab I</td>
</tr>
<tr>
<td>PHYS 2521</td>
<td>University Physics Lab II</td>
</tr>
<tr>
<td>CVEG 2043</td>
<td>Engineering Mechanics I</td>
</tr>
<tr>
<td>CVEG 2053</td>
<td>Engineering Mechanics II</td>
</tr>
<tr>
<td>ELEG 2053</td>
<td>Introduction to Electrical Engineering</td>
</tr>
<tr>
<td>MCEG 1011</td>
<td>Intro Engr Cs Tech</td>
</tr>
<tr>
<td>MCEG 1021</td>
<td>Introduction to Mechanical Engineering Drawing and Design Lab I</td>
</tr>
<tr>
<td>MCEG 2013</td>
<td>Thermodynamics I</td>
</tr>
<tr>
<td>GNEG 3061</td>
<td>Introduction to Engineering Project Management</td>
</tr>
<tr>
<td>MCEG 4472</td>
<td>Senior Design and Professionalism I</td>
</tr>
<tr>
<td>MCEG 4482</td>
<td>Senior Design and Professionalism II</td>
</tr>
<tr>
<td><strong>Major Requirements</strong></td>
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</tr>
<tr>
<td>MCEG 2023</td>
<td>Materials Science and Engineering</td>
</tr>
<tr>
<td>MCEG 3011</td>
<td>Measurement and Instrumentation Laboratory</td>
</tr>
<tr>
<td>MCEG 3013</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>MCEG 3023</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>MCEG 3021 &amp; MCEG 3021</td>
<td>and Thermal Science Laboratory</td>
</tr>
<tr>
<td>MCEG 3033</td>
<td>Manufacturing Processes</td>
</tr>
<tr>
<td>MCEG 3031 &amp; MCEG 3031</td>
<td>and Manufacturing Processes Laboratory</td>
</tr>
<tr>
<td>MCEG 3043</td>
<td>Machine Design I</td>
</tr>
<tr>
<td>MCEG 3053</td>
<td>Kinematic Design and Analysis</td>
</tr>
<tr>
<td>MCEG 3063</td>
<td>Fluid Mechanics</td>
</tr>
<tr>
<td>MCEG 4043</td>
<td>Machine Design II</td>
</tr>
<tr>
<td>MCEG 4063</td>
<td>Dynamic Systems and Controls</td>
</tr>
<tr>
<td>MCEG 4093</td>
<td>Finite Element Analysis and Design</td>
</tr>
<tr>
<td>CVEG 2063</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td><strong>Technical Electives</strong></td>
<td></td>
</tr>
<tr>
<td>Total Hours</td>
<td>126</td>
</tr>
</tbody>
</table>

1 All Mechanical Engineering Core Curriculum requirements are shown in the suggested degree program.

**Mechanical Engineering Suggested Technical Electives**

Technical electives must be 3000 level or above. At least one technical elective must be taken in the department. Internship and co-op courses are not suitable for technical electives.
MCEG 3073  Automatic Controls  3
MCEG 3193  Introduction to Robotics  3
MCEG 4123  Energy System Design  3
MCEG 4163  Special Topics  3
MCEG 4183  Gas Dynamics  3
CHEG 4133  Process Modeling and Simulation  3
CHEG 4153  Bioengineering  3
CHEG 4163  Engineering Optimization  3
CVEG 3073  Structural Analysis  3
CVEG 3043  Environmental Engineering  3
CVEG 4063  Water Resources Engineering  3
CVEG 4093  Systems Engineering  3
ELEG 3033  Physical Principles of Solid State Devices  3
ELEG 3063  Logic Circuits  3
MATH 3073  Linear Algebra  3
MATH 4063  Numerical Analysis  3

Technical Electives through Five-Year BS/MS Degree Plan Option

Students may, upon approval to the Five-Year BS/MS Degree Plan Option (see College of Engineering Academic Programs and Degree Plans), apply up to six semester-credit hours of graduate courses toward technical electives requirements.

Requirements For Mechanical Engineering as a Minor Field

Students must complete the following 18 SCH of courses to satisfy the Minor requirements.

MCEG 3023  Thermodynamics II  3
MCEG 3033  Manufacturing Processes  3
MCEG 3043  Machine Design I  3
MCEG 3063  Fluid Mechanics  3
Two Approved 3000 or 4000 Level MCEG Courses  6
Total Hours  18

Professional and Honor Societies

American Society of Mechanical Engineers (ASME). The Department sponsors the student chapter of American Society of Mechanical Engineers, the national professional society for mechanical engineering that seeks to develop professional integrity, ethics, and organization skills among the mechanical engineering students on the campus.

Pi Tau Sigma National Honor Society. The Mechanical Engineering Department has a chapter of Pi Tau Sigma, the National Mechanical Engineering Honor Society to recognize and honor outstanding mechanical engineering students on the campus.

Courses

MCEG 1011 Intro Engr Cs Tech: 1 semester hour.
Introduction to basic engineering, computer science and technology concepts. Students will become aware of the various disciplines of engineering, computer science and technology, ethical responsibilities in these fields, creativity and design.
Co-requisite: MCEG 1021 (http://catalog.pvamu.edu/search/?P=MCEG%201021).  

MCEG 1021 Introduction to Mechanical Engineering Drawing and Design Lab I: 1 semester hour.
Introduction to 3D modeling, technical sketching, multi-views and visualization, geometric dimensioning and tolerancing, and working drawings and assembly.

MCEG 2013 Thermodynamics I: 3 semester hours.
First Law, transformation of energy, theoretical limitations, Second Law, absolute temperature, entropy, and available energy, properties of gases, liquids, and vapors, and irreversibility.
Prerequisites: MATH 2024 (http://catalog.pvamu.edu/search/?P=MATH%202024/) and PHYS 2513 (http://catalog.pvamu.edu/search/?P=PHYS%202513).
MCEG 2023 Materials Science and Engineering: 3 semester hours.
Science concepts of crystal structures, atomic scale defects, bonding, phase diagrams and solidification. Relationship between microstructure and thermal, mechanical, optical, electrical and magnetic properties of materials. 
Prerequisites: CHEM 1033 (http://catalog.pvamu.edu/search/?P=CHEM%201033/) or CHEM 1034 (http://catalog.pvamu.edu/search/?P=CHEM %201034/) or CHEM 1043 (http://catalog.pvamu.edu/search/?P=CHEM%201043/).

MCEG 2053 Engineering Mechanics II: 3 semester hours.
Kinematics and kinetics of particles and of rigid bodies as applied to engineering problems; Newton's laws of motion; work and energy; impulse and momentum; translations; rotation; plane motion; motion about a point; general motions; and periodic motions. 
Prerequisites: CVEG 2043 (http://catalog.pvamu.edu/search/?P=CVEG%202043/).

MCEG 3011 Measurement and Instrumentation Laboratory: 1 semester hour.
The scope of this course includes fundamentals in measurement theory, statistical analysis of experimental data, uncertainty, accuracy assessments, and calibration techniques. The course includes the use and applications of instruments for measuring area, pressure, time, speed, temperature, strain, hardness, and deflection. 
Prerequisites: PHYS 2513 (http://catalog.pvamu.edu/search/?P=PHYS%202513/) and PHYS 2511 (http://catalog.pvamu.edu/search/?P=PHYS %202511/) and PHYS 2521 (http://catalog.pvamu.edu/search/?P=PHYS%202521/).

MCEG 3030 Heat Transfer: 3 semester hours.
Study of the fundamental modes of heat transfer, conduction, convection, and thermal radiation, separately and in combination. Theoretical, numerical, and design methods of analysis of steady, transient, single, and multidimensional problems will be emphasized. 
Prerequisites: MATH 2043 (http://catalog.pvamu.edu/search/?P=MATH%202043/) and MCEG 3063 (http://catalog.pvamu.edu/search/?P=MCEG %203063/).

MCEG 3021 Thermal Science Laboratory: 1 semester hour.
This course includes experimental investigation of the performance of various thermal systems, such as engines, combustion unit, heat exchangers, nozzles, boilers and turbo machinery. 
Prerequisites: MCEG 3011 (http://catalog.pvamu.edu/search/?P=MCEG%203011/) and MCEG 3013 (http://catalog.pvamu.edu/search/?P=MCEG %203013/) (may be taken concurrently) and ELEG 1043 (http://catalog.pvamu.edu/search/?P=ELEG%201043/) (may be taken concurrently).

MCEG 3023 Thermodynamics II: 3 semester hours.
Continuation of Thermodynamics I, including various power cycles, refrigeration cycles, fluid flow, combustion process, and advanced concepts of gas dynamic, such as shock waves. 
Prerequisites: MCEG 2013 (http://catalog.pvamu.edu/search/?P=MCEG%202013/) and MATH 2024 (http://catalog.pvamu.edu/search/?P=MATH %202024/).

MCEG 3031 Manufacturing Processes Laboratory: 1 semester hour.
This lab includes experiments for metal identification, machinability of materials, effects of factors on surface roughness measurement, material removal rates, and cutting tool force analysis. It also includes illustrations of casting, forging, rolling, and powder metallurgy. Student will be required to design a structure part and perform manufacturing operations. 
Co-requisite: MCEG 3033 (http://catalog.pvamu.edu/search/?P=MCEG%203033/).

MCEG 3033 Manufacturing Processes: 3 semester hours.
This course provides the concepts for the conversion of materials into products. It includes measurement and quality assurance, and processes of casting, forming, material removal, and joining. In addition, it involves the study of computer numerical control machines, manufacturing systems, and automation. 
Prerequisites: MCEG 2023 (http://catalog.pvamu.edu/search/?P=MCEG%202023/).

MCEG 3043 Machine Design I: 3 semester hours.
Fundamentals of mechanical design methodology, design of machine elements for static and fatigue failure, individual projects and classroom discussions of various design solutions. 
Prerequisites: CVEG 2063 (http://catalog.pvamu.edu/search/?P=CVEG%202063/) and MCEG 1021 (http://catalog.pvamu.edu/search/?P=MCEG %201021/).

MCEG 3053 Kinematic Design and Analysis: 3 semester hours.
This course includes the theory and application for the kinematic design of mechanisms. The students will be required to use computers to model, analyze, and synthesize mechanical systems. 
Prerequisites: MCEG 1021 (http://catalog.pvamu.edu/search/?P=MCEG%201021/) and MCEG 2053 (http://catalog.pvamu.edu/search/?P=MCEG %202053/).

MCEG 3063 Fluid Mechanics: 3 semester hours.
The fundamental conservation laws in fluid statics and dynamics are derived and solved analytically and numerically. Other topics include: analysis of viscous and inviscid flow; laminar and turbulent flows in pipes and on external surfaces; open channel flow; hydraulic machinery; and introduction to compressible flow. Direct applications to problems encountered in practice and in engineering design will be covered. Problem solving and design application will be emphasized. 
Prerequisites: MCEG 2013 (http://catalog.pvamu.edu/search/?P=MCEG%202013/) and MATH 2043 (http://catalog.pvamu.edu/search/?P=MATH %202043/) (may be taken concurrently) and MCEG 2053 (http://catalog.pvamu.edu/search/?P=MCEG%202053/) (may be taken concurrently).
MCEG 3073 Automatic Controls: 3 semester hours.
Analysis and synthesis of continuous time control systems, transfer function, block diagrams, stability, root locus, state space representation, and design considerations for feedback control system.
Prerequisites: MATH 4173 (http://catalog.pvamu.edu/search/?P=MATH%204173/) (may be taken concurrently).

MCEG 3123 Renewable Energy and Energy Sustainability: 3 semester hours.
The topics of various types of renewable energies, energy conversion, utilization and storage technologies, such as wind, solar, biomass, fuel cells and hybrid systems. For each source, the physical and technological principles are explained and the economics, environmental impacts and future prospects are examined. The course explores the main factors likely to influence the long-term evolution of the world's energy systems and the technologies and policies that could be adopted to create more sustainable energy systems.
Prerequisites: CHEG 3113 (http://catalog.pvamu.edu/search/?P=CHEG%203113/).

MCEG 3156 Mechanical Engineering Internship I: 6 semester hours.
An internship program of work experience with an approved engineering firm.

MCEG 3193 Introduction to Robotics: 3 semester hours.
Fundamental topics in Robotics covering configuration (forward and reverse) kinematics, motion kinematics, force/torque relations and trajectory planning. Rudiments of dynamics and position control are also introduced.
Prerequisites: MATH 4173 (http://catalog.pvamu.edu/search/?P=MATH%204173/) (may be taken concurrently).

MCEG 4043 Machine Design II: 3 semester hours.
This is a design course featuring a design project using strength of materials, kinematics of machines, machine element design (e.g. gears and shafts), and CAD.
Prerequisites: MCEG 3043 (http://catalog.pvamu.edu/search/?P=MCEG%203043/) and MCEG 3053 (http://catalog.pvamu.edu/search/?P=MCEG%203053/) (may be taken concurrently).

MCEG 4063 Dynamic Systems and Controls: 3 semester hours.
The scope of this course includes mathematical modeling, analysis, and feedback control of dynamic systems. Topics include free and force vibrations of single and multiple degrees of freedom systems. Transient, steady-state, and stability of linear feedback control systems will be studied in the course.
Prerequisites: MCEG 2053 (http://catalog.pvamu.edu/search/?P=MCEG%202053/) and MATH 2043 (http://catalog.pvamu.edu/search/?P=MATH%202043/).

MCEG 4093 Finite Element Analysis and Design: 3 semester hours.
An introduction to finite element analysis as a modern computational tool to solve boundary value problems. Applications will be in structural mechanics, fluid flow, and heat transfer. Design and computer projects included.
Prerequisites: CVEG 2063 (http://catalog.pvamu.edu/search/?P=CVEG%202063/) and MCEG 3013 (http://catalog.pvamu.edu/search/?P=MCEG%203013/) (may be taken concurrently).

MCEG 4113 Modeling and Simulation of Engineering Systems: 3 semester hours.
Concepts, models, notations, and methods to effectively and efficiently design and implement complex engineering systems. Provides a hands-on approach to mathematical modeling and computer simulations across physical domains. Both constrained and unconstrained systems are considered with examples of analytical and numerical solutions for system modeling and model validation.
Prerequisites: ELEG 1043 (http://catalog.pvamu.edu/search/?P=ELEG%201043/) and CVEG 2053 (http://catalog.pvamu.edu/search/?P=CVEG%202053/) and (MCEG 3063 (http://catalog.pvamu.edu/search/?P=MCEG%203063/) or CVEG 3063 (http://catalog.pvamu.edu/search/?P=CVEG%203063/)).

MCEG 4123 Energy System Design: 3 semester hours.
A design course emphasizing heat exchangers, heat pipes, heat reclamation devices, piping systems, and solar heating and cooling systems.
Prerequisites: MCEG 3013 (http://catalog.pvamu.edu/search/?P=MCEG%203013/) (may be taken concurrently) and MCEG 3023 (http://catalog.pvamu.edu/search/?P=MCEG%203023/) (may be taken concurrently).

MCEG 4156 Mechanical Engineering Internship II: 6 semester hours.
Continuation of MCEG 3156 (http://catalog.pvamu.edu/search/?P=MCEG%203156/).

MCEG 4163 Special Topics: 3 semester hours.
Selected current and emerging topics in mechanical engineering depending on need determined by the department.

MCEG 4183 Gas Dynamics: 3 semester hours.
Fundamentals in compressible fluid flow, one dimensional and two dimensional flows, subsonic and supersonic flow. Topics include isentropic flow, normal and oblique shock, Prandtl-Meyer Flow, flow with friction and heat transfer, and various engineering applications.
Prerequisites: MCEG 3023 (http://catalog.pvamu.edu/search/?P=MCEG%203023/) (may be taken concurrently) and MCEG 3063 (http://catalog.pvamu.edu/search/?P=MCEG%203063/).
MCEG 4472 Senior Design and Professionalism-I: 2 semester hours.
This is the first course of a two-semester capstone experience (MCEG 4482) must immediately follow MCEG 4472 or sequence must restart with MCEG 4472 involving engineering design of an industrial or advanced team project. Elements of ethics and professionalism in engineering practice are integrated into the project experience. The project will include application of relevant engineering codes and standards, as well as realistic constraints. Design achievements are demonstrated with written reports, and oral presentation, and professional standards and ethics examinations.
Prerequisites: MCEG 3043 and MCEG 3011 (http://catalog.pvamu.edu/search/?P=MCEG%203011/) and MCEG 3023 (http://catalog.pvamu.edu/search/?P=MCEG%203023/).
Co-requisite: MCEG 3013 (http://catalog.pvamu.edu/search/?P=MCEG%203013/).

MCEG 4482 Senior Design and Professionalism II: 2 semester hours.
A continuation of MCEG 4472 with required design modifications of the team projects necessary to produce a working prototype of the designs initiated in Senior Design and Professionalism I. Design project deliverables include an oral presentation, a final written report and demonstration of prototype, or model of the design. Elements of professionalism reinforce the importance of professional engineering ethics, corporate culture, life-long learning, and globalization.
Prerequisites: MCEG 4472.

MCEG 4993 Independent Study: 1-3 semester hour.
Readings, research, and/or field work on selected topics.

MCEG 5023 Advanced Thermodynamics: 3 semester hours.
Theories of thermodynamics and their application to the more involved problems in engineering practice or design. Topics include advanced power cycles, superconductivity, thermodynamic relations, chemical thermodynamics and phase equilibrium.

MCEG 5033 Advanced Machine Design: 3 semester hours.
A systematic approach to machine design is studied in detail. Topics include systematic steps for planning and design, methods for developing and evaluating solutions, conceptual design, embodiment design, and product life cycle.

MCEG 5043 Turbomachinery: 3 semester hours.
This course in an introduction to Turbomachinery and its applications in engineering science. Fluid mechanics and thermodynamics applied to turbomachines: dimensionless performance characteristics; momentum and energy equations; thermodynamics and efficiencies; cascade aerodynamics; compressors and turbines; reaction and stage loading; radial equilibrium; radial flow machines; application of generalized performance to choice of compressors; and mechanical details and auxiliary systems.

MCEG 5163 Advanced Engineering Fluid Dynamics: 3 semester hours.
A comprehensive study of fluid mechanics and dynamics is considered. This includes Potential flow, Stokes flow, Oseen flow, other inviscid flow, Eckman Row, and other viscous flows such as Boundary Layer Analysis. An introduction to perturbation to theory will also be given.

MCEG 5183 Computer Integrated Manufacturing: 3 semester hours.
A total integration of manufacturing, management, strategic planning, finance, and the effective use of computer technology in the control of the production process.

MCEG 5223 Advanced Heat Transfer: 3 semester hours.
An advanced study of heat and mass diffusion, convection, conjugate heat transfer, heat exchangers two-phase heat transfer, micro-scale heat and mass transfer, and thermal radiation. Lumped, integral, differential, and numerical analysis will be included and a term project will be required.

MCEG 5233 Robotics: 3 semester hours.
Topics in Robotics covering configuration (forward and reverse) kinematics, Jacobians (velocities and static forces), force/torque relations, trajectory planning, dynamics and position control.

MCEG 5243 Dynamics of Engineering Systems: 3 semester hours.
Modeling and manipulation of dynamic engineering systems, basic component models, system models, state-space equations, analysis of linear systems, and nonlinear simulation.

MCEG 5253 Advanced Engineering Materials: 3 semester hours.
Qualitative and quantitative relationships between microstructure and mechanical properties. Studies of dislocation theory, elasticity, plasticity, brittle and ductile fracture, fatigue and creep, design criteria and statistical aspects of failure.

MCEG 5263 Nanotechnology & Nanomaterials: 3 semester hours.
Fundamentals to develop new materials, devices, and systems at the atomic and meso scale and to employ them to achieve novel properties. Carbon nanotubes, nanophysics, nanomaterials, nanomechanics, nanoelectronics, nanoscale heat transfer and fluid mechanics, nanobiotechnology, and MEMS and NEMS.

MCEG 5333 Computational Fluid Dynamics: 3 semester hours.
Potential flow theory. Application of numerical methods and the digital computer to inviscid flow analysis. Application of vortex lattice, panel element, and boundary element methods to incompressible and compressible three dimensional aerodynamic flow problems. Wings and Wing-body analysis and incorporation of boundary integration for complete modeling.