# SCHOOL OF ENGINEERING AND TECHNOLOGY

**V. Trent Montgomery, Ph.D., P.E.**
**Dean**
**Room 226 ETB**

## MISSION

The School of Engineering and Technology operates in the traditional land-grant concept with emphasis on instructional, research, and extension programs. The School strives to provide an integrated academic program for students who have aspirations for modern day careers in engineering, engineering technology, industrial technology, or related scientific disciplines. The mission is accomplished through the integration of general and professional studies in each engineering or technology discipline.

## OBJECTIVES

1. To provide course work that provides a bridge between mathematics, basic sciences, social sciences, and current practices in engineering, engineering technology, and industrial technology.

2. To provide course work that provides a fundamental understanding of engineering, engineering technology, and industrial technology, and their impact on the individual, the society, and the environment.

3**.** To provide course work that provides a mastery of technical knowledge, basic sciences, and social sciences, and their use in the solution of individual, societal, and environmental problems.

## DEPARTMENT OF CIVIL ENGINEERING
**Pabitra K. Saha, Ph.D., P.E., Chair**
**Room 305 ETB**

## DEPARTMENT OF ELECTRICAL ENGINEERING
**Kaveh Heidary, Ph.D., Chair**
**Room 214 ETB**

## DEPARTMENT OF MECHANICAL ENGINEERING
**Mohamed A. Seif, Ph.D., P.E., Acting Chair**
**Room 307 ETB**

### MASTER OF ENGINEERING in MATERIEL ENGINEERING

The Departments of Civil, Electrical, and Mechanical Engineering collectively offer a graduate program leading to the Master of Engineering (M.Eng) degree in Materiel Engineering. Materiel is defined as the equipment, apparatus, and supplies used by an organization. Materiel engineering involves the design, production, test and evaluation, distribution, operation and support, and ultimate disposition of man-made equipment, apparatus, and supplies, and, as such, is highly interdisciplinary.

### OBJECTIVE

The general objective of this program from AAMU is to provide a curriculum of the highest quality for post-baccalaureate learning opportunities in this highly important area. Specific objectives are as follows:

- Provide students with a solid foundation in Materiel Engineering, as well advanced studies in areas of Civil, Electrical, or Mechanical Engineering
- Provide a continuum of study leading to a graduate degree for qualified students at AAMU completing a baccalaureate in engineering
- Provide a program of study that also accommodates the needs and limitations of mature adults engaged in full-time employment
- Accommodate the admission of persons holding bachelor's degrees in non-engineering areas, using selected background courses
- Respond to the anticipated requirement of making the master's degree, or the equivalent, as an entry-level qualification for attaining professional licensure.

### ADMISSION REQUIREMENTS

This program is intended for individuals holding a bachelor's degree from a regionally accredited institution in any area of engineering or a closely related discipline. To formally pursue the Master of Engineering degree, the student must apply to the Graduate School of AAMU for Regular Admission, meeting the requirements for either Unconditional or Conditional Status. To take individual courses without seeking the graduate degree, persons may be admitted in a Non-Degree Graduate Status.

**Regular Graduate Admission** Applicants for admission to the Graduate School of AAMU must provide transcripts from each post-secondary school attended, as well as a transcript of the

Graduate Record Examination (GRE). They must also provide two letters of recommendation and submit details of any professional work experience. Students from non-English speaking countries are required to have a minimum score of 500 on the Test of English as a Foreign Language (TOEFL).

Unconditional Admission. To be admitted with Regular Status to the Master of Engineering program, an applicant must have

- Earned a bachelor's degree in an engineering program that had ABET accreditation at the time of graduation,
- Earned an overall Grade Point Average (GPA) of at least 3.00 on a scale of 4.00, or have passed the National Council of Examiners for Engineering and Surveying (NCEES) Fundamentals of Engineering Examination, and
- Minimum GRE scores of 600 on the quantitative portion and 1000 on the combined verbal and quantitative portions.

Conditional Admission. Applicants who do not meet one, but no more, of the three above-listed requirements for unconditional admission may be admitted on a conditional basis under the following conditions:

- GPA or GRE Deficiency. Persons with a bachelor's degree in engineering may receive Conditional Admission provided their GPA is at least 2.5 on all undergraduate engineering courses attempted. This condition also holds for individuals with a GRE deficiency, including those who have not taken the GRE.
- Degrees in Other Fields. Individuals with a bachelor's degree in physics, mathematics, computer science, chemistry, or other fields closely related to engineering may receive Conditional Admission provided they have completed the following:
    - Mathematics through Differential Equations
    - Series in General Chemistry
    - Series in Calculus-based Physics
    - Introductory Computer Programming
    - Other courses prescribed by the advising engineering department, including specific topics stated as prerequisites for intended graduate courses.

  Persons not meeting these minimum preparatory studies are advised to register as undergraduate students while completing this background.

Under Conditional Admission, a student may complete up to 15 semester hours credits recommended by the department advisor. A student in Conditional Admission is required to earn a minimum of 'B' grade in these courses to progress to Regular Admission; otherwise, the student will be dismissed from the School of Graduate Studies.

**Non-Degree Graduate Status** Professionals in the community may desire to take certain courses for graduate credit without the full formalities of applying for the graduate program. The AAMU School of Graduate Studies provides for the admission of such persons in a non-degree graduate status. To qualify for this admission, individuals must be a graduate of a regionally accredited institution in the United States with a 2.5 or higher undergraduate GPA. They must also have the prerequisites for any course pursued at AAMU.

To pursue graduate engineering courses using the non-degree graduate status, an application must first be submitted to the School of Engineering and Technology. This is to ensure that the

applicant has the required background for the desired course(s). If approved, the application will then be passed on to the School of Graduate Studies for processing.

Up to nine semester hours of graduate credit may be earned while in the non-degree status. Later, if the individual applies for and receives regular admission to the program, applicable credits earned with a grade of 'B' or better may be applied to meeting the program requirements.

**DEGREE COMPLETION REQUIREMENTS**

**Academic Credit**: A minimum of 30 semester hours credit in graduate-level courses will be required. These are distributed as follows:

| | |
|---|---|
| Core Courses | 12 s.h. |
| Discipline Specialization Courses | 9 s.h. |
| Approved Electives | 6 s.h. |
| Master's Project | 3 s.h. |
| Total Academic Credit | 30 s.h |

**1. Core Courses**:

| | |
|---|---|
| GEN- 601 Life-Cycle Design Engineering | 3 s.h. |
| GEN -602 Product Assurance Engineering | 3 s.h. |
| GEN -603 Analysis and Simulation Methods | 3 s.h. |
| GEN -604 Test and Evaluation Engineering | 3 s.h. |

**2. Discipline Specialization Courses**: The discipline specialization allows the student to further develop his/her ability in a narrow area of engineering. Each specialization must have a minimum of three courses. The primary specializations and the cognizant departments are as follows:

- Civil Engineering: Environmental Systems, Structural Systems, Transportation Systems
- Electrical Engineering: Control Systems, Electrical Power Systems, Micro/ Nanoelectronics, Sensor Systems, Software Engineering, Telecommunication Systems
- Mechanical Engineering: Aerospace Systems, Manufacturing Systems, Systems Engineering, Thermal Energy Systems

The student will select courses for his/her specialization from an approved list. Department Advisors may approve other specializations. GEN-590 and GEN-600 may be used as discipline specialization courses. Advisors may also approve appropriate courses from other AAMU departments or courses taken elsewhere.

**3. Approved Elective Courses**: To allow additional diversity, approved elective courses may be included to complete the course requirements, the number of such electives depending on the number of courses taken in the specialization. These electives may be drawn from other specialty areas or may include approved graduate courses from other AAMU departments or elsewhere as approved by the advisor. In certain cases and as appropriate, advanced courses needed as prerequisites to other program courses may be included.

**4. Master's Project**: The Master's Project is a significant completion requirement. For this, the student registers in GEN-690 Materiel Engineering Project.

The activity is initiated by a seminar covering the requirements, with an emphasis on reports typical in the engineering profession. The project subject, which must be approved by the student's department advisor, must relate one or more topics from core courses with a detailed topic from a specialty course, providing a state-of-the-art treatment based on available literature. The student then acts independently in developing the report.

Information sources would include journals, trade publications, and government and industry reports. Other than the assessment of this existing information, no original research is required. Source information must be referenced in a professional style. The final report will be reviewed by the department advisor, with a Pass/Fail/Incomplete grade.

**Transfer Credit.** With the approval of the department advisor, graduate credit may be transferred into this program from study at AAMU and/or other colleges and universities. This would be limited to 12 semester hours if the credit has not been used in completing a graduate program, and 6 semester hours if previously used in completing a graduate degree. All such courses must have been completed with a grade of "B" or better and must have been taken while the student was in a graduate status.

## COURSE DESCRIPTIONS

### Materiel Engineering

*GEN 590 Special Topics* – 3 hrs. This course focuses on topics based on modern trends in materiel engineering. The specifics of each course will be identified prior to it being offered.

*GEN 600 Special Topics* – 3 hrs. This course focuses on topics based on modern trends in materiel engineering. The specifics of each course will be identified prior to it being offered..

*GEN 601 Life-Cycle Design Engineering* **–** 3 hrs. This course is intended to provide insight and experience in theory and in practice in dealing with product complexity associated with such design processes. Topics include contemporary techniques such as product realization process, robust design, design for six-sigma, and design for manufacturability. Also considered are systems architectural principles; system optimization; standardization; and case studies in real-life product design projects. **Prerequisite**: bachelor's degree in engineering or admission to Materiel Engineering graduate program.

*GEN 602 Product Assurance Engineering* **–** 3 hrs. This course involves techniques for establishing product specifications, process controls for quality assurance, compatibility analysis, and product reliability and maintainability. Topics include system reliability; confidence intervals-limits; normal and exponential distribution; failure analysis; the Weibull model in life testing; quality control; aging and system reliability; and case studies. **Prerequisite**: bachelor's degree in engineering or admission to Materiel Engineering graduate program; basic knowledge of statistics.

*GEN 603 Analysis and Simulation Methods* **–** 3 hrs. The course centers on stochastic search methods for system optimization and the analysis and construction of Monte Carlo simulations. The focus is on issues in algorithm design and mathematical modeling, together with implications for practical implementation. Finite-element analysis is also given major consideration. **Prerequisite**: bachelor's degree in engineering or admission to Materiel Engineering graduate program; capability in computer programming.

*GEN 604 Test and Evaluation Engineering* – 3 hrs, lecture and laboratory. This course provides an intensive introduction to test methods and evaluation techniques; statistical considerations in measurement uncertainties; experiment planning, designing, debugging, and execution; instrumentation for data acquisition; signal processing; techniques for data analysis and evaluation; methods for hardware verification and validation. **Prerequisite**: bachelor's degree in engineering or admission to Materiel Engineering graduate program; basic knowledge of statistics and electronic instrumentation.

*GEN 690 Materiel Engineering Project* – 3 hrs. The activity is initiated by a seminar covering the requirements, with an emphasis on reports typical in the engineering profession. The project subject must relate one or more topics from core courses with a detailed topic from a specialty course, providing a state-of-the-art treatment based on available literature. **Prerequisite**: at least 18 graduate semester hours in materiel engineering program.

The following courses are offered by the three AAMU Engineering Departments for use in fulfilling the Discipline Specialization and/or Approved Elective requirements. Many of these courses are co-listed as undergraduate (400-level) and graduate (500-level). Graduate students taking co-listed courses will be required to complete additional assignments.

Co-listed courses may be used in a graduate program only if the student has not completed the same, or a highly similar, course at the undergraduate level within the past four years (the typical half-life of advanced engineering subjects). If a co-listed course is required in an AAMU undergraduate curriculum, except with approval by the cognizant Graduate Advisor the corresponding 500-level course cannot be used in a Discipline Specialization; these courses, however, may be used in the Approved Electives. Such courses are marked with an asterisk (*).

**Civil Engineering**

CE 501 *Structural Steel Design* - 3 hrs. Same as CE 401*. Introduction to the design of steel structures to include behavior of members and their connections. Theoretical and practical basis for proportioning members are addressed. **Prerequisite:** undergraduate course in structural analysis

CE 502 *Reinforced Concrete Design* - 3 hrs. Same as CE 402*. A study of the theory and design of reinforced concrete members. Design considerations for concrete bridges and buildings are included. **Prerequisite:** undergraduate course in structural analysis

CE 504 *Hydraulic Engineering and Design* - 3 hrs. Same as CE 404*. A study of the similitude, and flow measurement; open channel flow, pipe flow and their applications; and design of various elements of hydraulic structures. **Prerequisites:** undergraduate course in fluid mechanics

CE 506 *Computer Analysis of Structures* - 3 hrs. Same as CE 406. Focus on flexibility and stiffness methods of analysis. Development of matrix methods for both trusses and rigid frames and use of the computer in structural analysis, including finite element method are included. **Prerequisites:** undergraduate course in structures; good knowledge of computer programming

CE 508 *Foundation Design* - 3 hrs. Same as CE 408*. The study of shallow and deep foundation elements, determination of bearing capacity of spread footings, mat and pile foundations. This course also includes instruction on drilled caissons and piers as well as lateral earth pressure and the design of retaining structures. **Prerequisite:** undergraduate course or experience in soil mechanics

CE 509 *Public Health Engineering* - 3 hrs. Same as CE 409. A study of the engineering aspects involved in the control of the environment for the protection of health and the promotion of the comfort of man. Discussion will include communicable disease control, air pollution, refuse disposal, industrial hygiene, and radiological health hazards. **Prerequisite:** undergraduate course or experience in environment analysis

CE 510 *Transportation Engineering and Design* - 3 hrs. Same as CE 410*. A study of engineering and design basics for highway transportation; elements of highway transportation and their characteristics; drivers; vehicles, volume, density, speed, and travel time; design for safety, service, and economy; highway alignment, cross section and geometric design elements. **Prerequisite:** undergraduate course or experience in transportation systems

CE 511 *Urban Transportation Planning* - 3 hrs. Same as CE 411. A study of functions and elements of urban transportation including modeling trip generation, trip attraction, modal split and network assignment; integrated models, and computer applications. **Prerequisites:** undergraduate course or experience in transportation systems

CE 512 *Pavement Systems* - 3 hrs. Same as CE 412. A study of the design of highway and airport pavement systems; subgrades, subbases and bases; flexible and rigid pavements; drainage and earthwork; pavement evaluation and maintenance. **Prerequisites:** undergraduate course or experience in transportation systems

CE 513 *Construction Management* - 3 hrs. Same as CE 413 An introduction to construction project planning and scheduling by network diagrams. Estimating and project control fundamentals. Various equipment and productivity are included. **Prerequisite:** undergraduate studies or experience in construction

CE 514 *Design of Timber Structures* - 3 hrs. Same as CE 414. A study of wood as an engineering design material. Beams, columns, plywood design, and glued laminated structural members as used in actual design and construction are covered. **Prerequisite:** undergraduate course in structural analysis

CE 550 *Hydraulics of Open Channel Flow* - 3 hrs. Same as CE 450. A study of the mechanics of fluid flow in open channels, as an extension of basic engineering hydraulics and experimental concepts applied to the theory, design, and shape optimization of open channels. Classification of flow, channel cross section, hydraulic jump, stilling basins, specific energy, culvert hydraulics, and the use of design charts and tables are included. **Prerequisite:** undergraduate course in hydrogeology

CE 555 *Wastewater Treatment* - 3 hrs. Same as CE 455. An introduction to wastewater characteristics and treatment processes; biological mechanism, reactors, waste treatment, and kinetics. The engineering design of physical processes such as sedimentation, thickening, and filtration, as well as chemical processes, processing of sludge and advanced wastewater treatment processes are included. A field trip to wastewater treatment plant is required. **Prerequisites:** undergraduate course in hydrogeology

CE 556 *Solid Waste Disposal* - 3 hrs. Same as CE 456. An introduction to the problem of solid waste management, types and quantities of wastes, collection and transportation of wastes, composting, landfill and incineration, and recycling of wastes and resource recovery. **Prerequisite:** undergraduate course or experience in environmental analysis

CE 557 *Hazardous Waste Management* - 3 hrs. Same as CE 457. An introduction to the transportation, storage, and disposal of hazardous wastes. Legal aspects of hazardous materials, cleanup of hazardous material spills, and the impact of hazardous materials on the environment are all covered. **Prerequisite:** undergraduate course or experience in environmental analysis

## Electrical Engineering

EE 502 *Electrical Machines* -3 hrs. Same as EE 402. A study of energy conversion; D.C. machines, motors, generators, principles of operation, characteristics, and applications; transformers and induction machines, principles of operation, characteristics, and applications; and synchronous machines, alternators, synchronous motors, principles of operation, characteristics, and applications. **Prerequisite:** undergraduate course in electromagnetic theory

EE 503 *Feedback System Analysis and Design* - 3 hrs. Same as EE 403*. A study of open and closed loop systems; time domain analysis; transfer functions, poles, and zeros; frequency response, Bode plots; root locus methods; system stability, Routh-Hurwitz criterion, Nyquist criterion; system compensation and design; state space methods, state equations, state transition matrix, and system response. **Prerequisite:** undergraduate course in electrical signal analysis

EE 504 *Communication Theory* -3 hrs. Same as EE 404*. A study of communication signals and systems; AM and FM methods; pulse code modulation; multiplexing, and digital communications. **Prerequisite:** undergraduate course in electrical signal analysis

EE 510 *Microwave Engineering* - 3 hrs. Same as EE 410*. A review of electromagnetic theory, transmission lines and waveguides, circuit theory for waveguide systems, impedance matching and transformation, passive microwave devices, electromagnetic resonators, and periodic structures and filters. **Prerequisite:** undergraduate course in electromagnetic theory

EE 520 *Power Systems I* - 3 hrs. Same as EE 420. Fundamental concepts of power system analysis, transmission line parameters, basic system models, steady state performance, network

calculations, power flow solutions, symmetrical components, fault studies, operating strategies and control. **Prerequisite:** undergraduate course or experience in energy conversion

EE 521 *Power Systems II* - 3 hrs. Same as EE 421. Generating station characteristics, transmission line calculations, load studies and economic operations, and stability. **Prerequisite:** EE 520 or extensive experience in power systems

EE 524 *Advanced Digital Systems* - 3 hrs. Same as EE 424. A course designed to provide digital system design experience using the Verilog hardware description language (Verilog HDL). The history of descriptive hardware design and features of hardware description languages are explained along with design and simulation examples. With the use of the industry standard simulation and synthesis tools, designs will be constructed, synthesized, and configured in Field Programmable Gate Arrays (FPGA) or other Programmable Logic Devices. **Prerequisite:** undergraduate course or experience with microprocessors

EE 525 *High Performance Computing and Networks* -3 hrs. This course introduces students to the cutting edge of high performance computing, examining both parallel and distributed architectures and the networks that interconnect them. The course covers a number of topics, ranging from computing and network architecture, design of software applications, to hands-on supercomputing. **Prerequisite:** undergraduate course or experience with numerical techniques and UNIX systems.

EE 531 *Advanced Semiconductor Engineering* – 3 hrs. Same as EE 431*. Principles of device electronics, physics of band models, Schottky barriers, bipolar and unipolar devices, conduction phenomena, SRH generation-recombination statistics, role of defects and noise. The course provides an introduction to wide-bandgap semiconductors and devices. **Prerequisite:** undergraduate course or experience in semiconductor engineering

EE 541 *Digital Signal Processing* - 3 hrs. Same as EE 441. A review of discrete time signals and systems; sampling of continuous time signals, sampling theorem; discrete time Fourier transforms; Z-transforms; region of convergence; applications; discrete Fourier transforms; fast Fourier transforms; design of digital filters, IIR filters, FIR filters, and computer-aided design. **Prerequisite:** undergraduate course or experience in signal processing

EE 545 *Advanced Electromagnetic Theory* - 3 hrs. Same as EE 445. Solution of Laplace's equation in two dimensions, circular harmonics, cylindrical harmonics, method of finite differences; wave propagation, perfect dielectrics, conductors, lossy dielectrics, transmission line analogy, Smith chart solutions; and computer applications. **Prerequisite:** undergraduate course in electromagnetic theory

EE 551 *Integrated Circuit Fabrication* - 3 hrs. Same as EE 451*. Introduction to principles of monolithic IC fabrication including bipolar and MOS transistor processing. The course includes active and passive device and process design, simulation, cleanroom procedures, in-process and final test and evaluation techniques, yield, chip assembly and packaging. **Prerequisite:** undergraduate course or experience in semiconductor devices

EE 552 *Semiconductor Instrumentation* - 3 hrs. Same as EE 452*. Basic principles of semiconductor testing and evaluation. Various tools and techniques will be introduced for test and evaluation of semiconductor materials, devices and integrated circuits. **Prerequisite:** undergraduate course or experience in semiconductor devices

EE 555 *Optimal Control Theory* - 3 hrs. Same as EE 455. A review of state space methods; optimal control problems, performance criterion, minimum time problems, minimum energy problems, and minimum fuel problems; optimization, using calculus of variations, Lagrange, Meyer, and Bolza problems, Lagrange equations, solution, applications; Pontryagin's maximum principle, formulation, co-state variables, solution; dynamic programming, principle of optimality, discrete control processes; Hamilton-Jacobi approach, closed loop control law, matrix Riccati equation, applications; and stability in the sense of Lyapunov. **Prerequisite**: undergraduate course in control theory

EE 556 *Nonlinear Control Systems* - 3 hrs. Same as EE 456. A study of nonlinearities, classification, saturation, dead zone, hysteresis; phase plane formulation, phase portraits; description of function approach, limit cycles, and relay servomechanisms. **Prerequisite:** undergraduate course in control theory

## Mechanical Engineering

ME 511 *Power Plant Performance* - 3 hrs. Same as ME 411*. A study of the fundamentals of aerothermodynamics of propulsion systems, cycle analysis, ideal Bryton air cycle, and real turbojet and turbofan performance. Basic sizing techniques, economy parameters, performance simulation, and prediction will be covered. Introduction to power plant/airframe integration will be introduced. **Prerequisites:** undergraduate course in thermodynamics and power generation

ME 512 *Analysis and Synthesis of Gas Turbines and Components* - 3 hrs. Same as ME 412*. A review of aerothermodynamics of propulsion systems, characterization of power plant utilization, and operation cycle analysis. On-off design performance, component characterization, component design, component matching, optimization, and introduction to power plant integration systems in a fixed or moving architecture are also covered. **Prerequisite:** ME 511 or the equivalent

ME 513 *Rocket Propulsion* - 3 hrs. Same as ME 413*. A study of propulsion system requirements for terrestrial and interplanetary flight. Basic principles and performance of both solid and liquid chemical rocket propulsion systems, elements of nuclear rockets, nuclear-electrical power systems, and electrical propulsion systems are addressed. **Prerequisites:** undergraduate courses in thermodynamics and fluid mechanics

ME 514 *Gas Turbine Engine Design and Manufacture* - 3 hrs. Same as ME 414 A study of synthesis of gas turbine design under the constraints of power plant system integration or airframe integration. Definitions of system requirements, preliminary configuration analysis and engine sizing; inlet preliminary design; compressor, combustor, turbine and nozzle design; co-generation and heat recovery considered for stationary power plants.; engine on and off design performance simulation; installed thrust and system interference effects; noise sources and noise control are covered. **Prerequisites:** undergraduate courses in heat and mass transfer and machine dynamics

ME 515 *Heating, Ventilating, Air Conditioning, Refrigeration* - 3 hrs. Same as ME 415. A study of refrigeration cycles, psychrometrics, thermal comfort, ventilation, duct design, equipment sizing, energy recovery, and solar design concepts. **Prerequisites:** undergraduate courses in thermodynamics and heat and mass transfer

ME 516 *Gas Dynamics* - 3 hrs. Same as ME 416*. A study of the fundamental theory of one-dimensional gas dynamics: Isentropic flow, flow in converging-diverging nozzles, shock propagation, normal and oblique shock theory, Prandtl-Meyer expansions, Fanno line flow, and measurement methods. **Prerequisites:** undergraduate courses in thermodynamics and fluid mechanics

ME 532 *Design for Manufacture and Reliability* - 3 hrs. Same as ME 432*. A study of the design synthesis and methods; strength design of mechanical structures and components; optimization and reliability principles; and computer-aided design techniques. Emphasis is on modeling synergistic processes for manufacture. **Prerequisites:** undergraduate course in machine dynamics or consent of instructor**.**

ME 571 *Systems Engineering* - 3 hrs. Same as ME 471. The systems engineering process is defined and investigated in this course. Among the topics introduced and studied are conceptual, preliminary, and detail design concepts using modern tools such as CAD, optimization, and systems test and evaluation in completing designs built for increased reliability, maintainability, and supportability. Environmental and social impact and life-cycle costs are also introduced. **Prerequisites:** undergraduate courses in advanced engineering mathematics.

ME 572 *Economic Evaluation of Design* - 3 hrs. Same as ME 472*. The concepts of life-cycle costs and optimization of alternatives are investigated. The formal study of decision-making and economic theory are applied to engineering projects. Case studies are used. **Prerequisites:** undergraduate course in machine dynamics or consent of instructor

ME 573 *Logistics* - 3 hrs. A study of the initial distribution and the subsequent sustaining life-cycle maintenance and support of a system of products throughout the consumer use phase. Systems design will be re-evaluated with emphasis placed on maintenance and support, taking into consideration reliability, maintainability, human factors, and life-cycle cost factors. **Prerequisite:** undergraduate course or experience in system design

ME 581 *Quality and Reliability Assurance* - 3 hrs. Same as ME 481*. An introduction to probability and statistics. Quantitative techniques for establishing product specifications and process controls for quality assurance, ISO 9000; the role of reliability in manufacturing operations; and so forth, are covered. **Prerequisite:** undergraduate course or experience in system design

ME 582 *Operations Planning and Scheduling* - 3 hrs. Same as ME 482*. Analysis and design of production and control systems for both intermittent and continuous manufacturing, inventory effects on production, and production control techniques review of Just In Time manufacturing. Emphasis is given to extending concurrent engineering techniques and methods for manufacturing and product development. **Prerequisite:** undergraduate course or experience in concurrent engineering