VDEO210 $ (3)
Digital Video Editing
An introductory class covering the fundamental techniques and concepts of nonlinear editing. Students explore the process of video editing from conceptualization to final output. Emphasis on sequencing and continuity, use of visual effects, color correction, audio editing, media management, narration and industry terminology. Lab required. Prerequisites: DGME175, VDEO130. Fall, Spring

VDEO320 $ (3)
Video Compositing
An introductory course covering the essential components in video compositing. Students learn how to create innovative visual effects and motion graphics for video. Emphasis on text animation, keyframing, masks, alpha channels, 3-D compositing, rendering, application integration, advanced visual and artistic effects. Lab required. Prerequisites: DGME215; VDEO210. Spring

VDEO340 $ (3)
Video Shooting
An advanced study in digital video, exploring professional level cameras, lighting, sound and other equipment necessary to make good video, aesthetic issues of creating visual and audio stories, and developing skills and knowledge beyond an introductory level. Lab required. Prerequisites: ART214; JOUR230; VDEO130, 210. Spring

VDEO360 $ (4)
3-D Imaging
A study of basic 3-D modeling principles and techniques. Students learn 3-D modeling terminology and how to create 3-dimensional models using polygonal, nurbs, and subdivision techniques. Students also learn basic lighting and surfacing. Lab required. Prerequisites: ART104; DGME175. Fall

VDEO370 $ (4)
3-D Animation
A study of 3-D animation techniques implementing key frame, forward and inverse kinematics, dynamics, lighting, paint effects, rendering and more. Lab required. Prerequisites: DGME215; VDEO210, 360. Spring

VDEO390 $ (3)
DVD Authoring/Design
A course emphasizing production of interactive DVD. Video, DVD authoring, work flow, story boarding, navigation, menu design, bit budgeting, video and audio encoding, DVD video navigational structures, web linking, proofing, pre-mastering, and recording to DVD-R. Lab required. Prerequisite: DGME347. Spring

VDEO465 $ (3)
Video Documentary
Study and application of documentary storytelling techniques. Students will explore the technical and creative use of digital video cameras in documentary filmmaking. Emphasis on interview techniques, story selection and structure. One lab required. Prerequisites: VDEO130, 210, 340. Fall

ENGGINEERING AND COMPUTER SCIENCE

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Undergraduate Programs

COMPUTING
Two emphases are available in Computing—Computer Science and Software Systems.

Computer Science focuses on a study of computing as well as on its role in an application area. Areas of interest include artificial intelligence, compilers, computer architectures, computer graphics, computer networks, operating systems, program development, and analytical theory. A degree in computing with the Computer Science emphasis prepares students for graduate study, employment in computer systems/networks, administration/development, software development/maintenance, and for careers in education.

Software Systems is an applied study of computing, focusing on the development and maintenance of software in an application area. A minor in an application area is included as part of the degree. Typical minors might include one of the sciences, behavioral science, or business. Supervised “real-world” projects are a requirement for this degree. A degree in Computing with the Software Systems emphasis prepares students for employment in developing and maintaining commercial applications and for graduate studies in applied computing such as software engineering.
BS: Computing
Major requirements—40
Common core—19
CPTR151, 152, 276, 427, 440, 460

Computer Science Emphasis
Required courses—9
CPTR425, 436 or 437, 467
Major electives—12
Chosen from CPTR courses in consultation with an advisor.
A minimum of 12 upper division credits required.
Cognate requirements—26–28
MATH141, 142, 355; STAT340 (14)
ENGR385 (4)
BIOL165; 166 (10)*
or CHEM131, 132 (8)*
or PHYS141, 142 (8)*
or PHYS241, 242, 271, 272 (10)*
* These courses may apply toward the general education natural science requirement

Software Systems Emphasis
Required courses—9
CPTR310, 450, 466
Major electives—12
Chosen from CPTR courses in consultation with an advisor.
A minimum of 12 upper division credits required.
Cognate requirements—36–38
MATH182, 355; STAT340 (9)
CHEM131
PHYS241, 242, 271, 272

Minor in Computing—20
Required courses—12
CPTR125, 151, 152, 276
Minor electives—8
Chosen from CPTR courses in consultation with an advisor.

Notes:
No course grade below a C- may apply to a major or minor in Computing.
A minimum GPA of 2.25 may apply to a major or minor in Computing.
A secondary-education endorsement is available for students seeking either a major or minor in Computing. In such cases, CPTR459 must be taken. Consult the School of Education for further information.

BS in Engineering
Major requirements—66
Common core—30
ENGR120, 125, 180, 185, 225, 275, 285, 310, 491, 492, and INDT450.
Cognates—35
MATH141, 142, 215, 240, 286; STAT340
CHEM131
PHYS241, 242, 271, 272

Electrical and Computer Engineering Emphasis
Required courses—31
CPTR151, 152, 465, ENGR325, 335, 385, 415, 435, and 455.
Major electives—5
Chosen from upper division ENGR and CPTR courses in consultation with an advisor.

Mechanical Engineering Emphasis
Required courses—30
CPTR125, ENGR320, 330, 340, 350, 360, 390, 410, 420, and 440.
Major electives—6
Chosen from upper division ENGR and INDT courses in consultation with an advisor.

Minor in Engineering—20
Required courses—10
ENGR120, 125, 185, 225
Minor Electives—10
Chosen from ENGR and INDT courses in consultation with an engineering advisor.
Cognates: MATH182 or MATH141, 142

Graduate Programs
MS: Software Engineering
Software Engineering is an applied study of computing focusing on the software development process through the application and synthesis of principles from computer science and related fields. Emphasis is placed on practical results balanced by scientific foundation. Supervised “real-world” projects are a requirement for this degree.

Admission requirements. In addition to meeting the general graduate admission requirements on pp. 46–48 of the bulletin, students applying for admission to the MS: Software Engineering program must show evidence that they have taken academic course work and/or demonstrate proficiency in the following areas:
- Calculus
- Computer Organization and Assembler
- Discrete Mathematics
- Elementary Data Structures
- Probability or Statistics
- Programming proficiency in two computer languages (including C or C++)

Degree requirements—32
A minimum of 32 semester credits. At least 23 credits chosen from 500- and 600-level graduate courses. The Comprehensive Examination must be successfully completed prior to graduation. Completion of the following requirements:

ENGINEERING
The engineering program at Andrews University leads to a Bachelor of Science in Engineering degree with emphases in Electrical and Computer Engineering and in Mechanical Engineering. These two emphases build on a strong traditional mathematics, science, and engineering core. The Electrical and Computer Engineering emphasis focuses on the areas of digital systems, communication systems, and computer controlled instrumentation and computer simulation. The Mechanical Engineering emphasis focuses on mechanical design and the electromechanical elements of smart machines.

The mathematics courses listed as cognates for the engineering degree satisfy the requirements for a minor in mathematics. A second major in mathematics requires 6 additional credits in mathematics, and a second major in physics requires 14–17 additional credits in physics. See the mathematics and physics department listings for details.
**Courses (Credits)**

See inside front cover for symbol code.

### COMPUTING AND SOFTWARE ENGINEERING

**CPTR125** $ (3)

*Introduction to Computer Programming*
Programming in a selected language. May be repeated for a total of three unique languages. Satisfies general education requirements for computing majors. Only 3 credits of CPTR125 may apply toward a computing major or minor. *Fall, Spring*

**CPTR151** $ (4)

*Computer Science I*
An introduction to programming methodology using C++, UNIX usage, problem-solving, algorithm development, control structures, arrays, program style, design correctness and documentation techniques, as well as a brief overview of computer systems and computer history. *Fall, Spring*

**CPTR152** $ (3)

*Computer Science II*
A continuation of CPTR151 examines program specifications, design, coding, correctness, and style with additional coverage of pointers and arrays, and an in-depth study of recursion and data structures. Includes files, lists, stacks, queues, trees, graphs, and an overview of computer ethics. Prerequisites: CPTR151. *Fall, Spring*

**CPTR276** $ (3)

*Data Structures and Algorithms*
A study of techniques for the design and analysis of algorithms using appropriate data structures covered in CPTR152. Topics include: asymptotic complexity bounds, graph and tree algorithms, fundamental algorithmic strategies (such as greedy, divide-and-conquer, backtracking, branch-and-bound, heuristics, pattern matching and string/text algorithms), numerical approximation and dynamic programming. Prerequisite: CPTR152. *Fall*

**CPTR295** (1–3)

*Directed Computer Language Study*
Directed study of computer language in consultation with the instructor. Normally, the language is not included in other courses taught by the department. A programming project may be required. Prerequisites: CPTR151 or equivalent.

**CPTR310** (3)

*Database Application Programming*
A study of basic database principles and web applications using technologies such as PHP, MySQL, Three Tier Architectures, scripting languages and data manipulation. Manipulating database using SQL. Sessions authentication and security. Prerequisite: CPTR151.

**CPTR416** $ (3)

*Internet Technologies*
A study of current technologies and their effects, including web server software, e-commerce, various scripting languages, human-computer interfacing, perception, and related issues. Prerequisite: CPTR152. *Spring, Summer*

**CPTR425** $ (3)

*Object-Oriented Design and Programming*
Emphasizes the study of object-oriented analysis and design methodologies and the application of these to the development of advanced software. Includes survey of object-oriented programming languages and environments. Prerequisite: CPTR152. *Fall*

**CPTR427** $ (3)

*Numerical Methods and Analysis*
A study of common numerical techniques applicable on the computer. Includes interpolation, extrapolation, approximation techniques, numerical methods for linear problems, root finding, function fitting, numerical integration, location of extremes, efficiency of numerical algorithms, and minimization of computational error. Prerequisites: CPTR276 and MATH215.

**CPTR436** $ (3)

*Formal Theory of Computation*
Includes post productions, Turing machines, and recursive functions. Recursive and recursively enumerable sets. Undecidability results of computation. Prerequisites: CPTR152 and MATH355. *Spring (odd years)*

**CPTR437** $ Alt (3)

*Operating Systems*
Process management, including asynchronous concurrent processes and deadlock. Virtual storage management and job and process scheduling. Multiprocessing. Disk scheduling and file and database systems. Performance and security. Prerequisite: CPTR276. *Fall*

**CPTR440** $ (3)

*Network Computing and Architecture*
Concepts applicable to constructing a computer network and the application of computing algorithms and solutions using networked computers and devices. Study topics such as physical transmission media, protocols and associated layers, TCP/IP, application programming interfaces and frameworks, sockets, clustering and security. Prerequisite: CPTR152. *Fall*
CPTR459  
**Secondary Methods: Computer Science**
Consider computer science programs in the secondary school and presents information and materials for teaching computer science in secondary school. Topics include organization and maintenance of equipment, publications, legal issues, dealing with diversity of abilities, problem-solving skills, and strategies for debugging programs. Prerequisite: CPTR276.

CPTR460  
**Software Engineering**
Surveys basic software engineering topics associated with the processes, documents, and products of the entire software life cycle. Topics include software evolution, project organization, and management, feasibility studies, product definition, design, implementation, and testing issues, and the role of the software engineer within the life cycle. Prerequisite: CPTR152. Fall

CPTR465  
**Computer Architecture**
Focus on hardware aspects of computing and logical concepts. Includes data representation for numbers and other data types, Boolean algebra, digital logic circuit representations of basic computational building blocks, CPU components, interrupt schemes and buses. Relevance of supporting concepts is discussed, including system software, assemblers, assembly language programming and operating systems. Prerequisite: CPTR152.

CPTR466  
**Software Engineering Group Project**
The implementation of a group project and the study of topics related to the group project, including CASE tools, 4GL's, and graphical user interfaces. Emphasizes written documents and oral presentations associated with group project rather than lecture. Corequisite: CPTR460. Fall

CPTR467  
**Database Concepts and Theory**
Study of issues relevant to abstract and concrete aspects in both the creation of a database management system software and its use. Indexing, buffering and other internal and physical database design issues. Relational model algebra, calculus and query languages (including SQL). Functional dependencies and normalization. Study of and modeling using Entity-Relationship and other relevant paradigms. Common application databases. Introduction to the use of transactions, query optimization and non-relational database models. Design and programming assignment using databases. Prerequisite: CPTR152.

CPTR475  
**Topics in [insert subject]**
Selected topics of current interest in computer science such as Robotics, advanced languages, or others. Repeatable with different subjects.

CPTR485  
**Computer Graphics**
Introduction to computer graphics examining raster and/or vector images, 2D and 3D images, polygons, transformations, segments, widowng, clipping, hidden line removal. Prerequisite: CPTR152. Fall (odd years)

CPTR487  
**Artificial Intelligence**
Provides the conceptual basis for understanding current trends in Artificial Intelligence. Topics include both symbolic and numeric processing, intelligent search methods, problem representation, machine learning, expert systems, and a survey of some social implications of AI. Prerequisite: CPTR152. Fall (even years)

CPTR495  
**Independent Study**
Directed study of material of special interest chosen in consultation with the instructor. No more than 6 credits may be earned in CPTR495. Graded S/U.

CPTR496  
**Special Projects**
Project chosen in consultation with instructor. No more than 6 credits may be earned in CPTR495. Graded S/U.

CPTR536  
**Compiler Construction**
Storage allocation for programs, subroutine linkage, and code generation and optimization. Simple translator written in course. Prerequisites: CPTR276, 425. Spring (odd years)

CPTR548  
**Advanced Database Systems**
Database design and theory. Concurrency, distributed databases, integrity, security, query optimization, transaction processing, object-oriented databases. A survey of the design and implementation tradeoffs considered for these topics in the creation of available database packages. Includes a term project and reading from the literature. Prerequisite: CPTR467 or equivalent. Fall (even years)

CPTR555  
**Advanced Operating Systems**
May include system structures and algorithms, reliability, security, distributed systems, study of operating systems highlighting these concepts, and recently published research in these and other areas. Includes a term project and readings from the literature. Prerequisite: CPTR440. Spring (odd years)

CPTR556  
**Real Time Systems**
A survey of the system architecture and software engineering aspects of real time systems such as operating systems, and process-control software. Includes a term project and readings from current literature. Prerequisite: CPTR276.

CPTR557  
**Advanced Network Computing and Architecture**
A study of the concepts, conceptual design and implementation of the client/server, multi-tier and distributed models of computing. Consider topics such as physical media, protocols and layers, application programming interfaces, clustering, distributed computing and security from the perspective of a programmer using these tools as well as a system programmer and architect that creates and implements such tools, algorithms and models. Prerequisite: CPTR450 or equivalent.

CPTR560  
**Advanced Software Engineering**
A study of applied software product development issues, including requirement analysis, systems and software design method-
ologies, software-project planning models (e.g., COCOMO), implementation, testing and reuse, language, tool and hardware selection, software economics, productivity measurement, risk management, statistical process evaluation, and control. Prerequisites: CPTR460, MATH182 or 141, STAT285. Spring

CPTR561, 562
Software Engineering Group Project I, II
The implementation of a group project and the study of topics related to the group project including CASE tools, 4GL’s, graphical user interfaces. Generally, the project begun in CPTR561 carries over to CPTR562. Corequisites: CPTR460, 560 respectively. Fall, Spring

CPTR568
Advanced Computer Architecture
Functional analysis of computer hardware and supporting software systems. Includes a comparative study of past, present and proposed architectures as well as computer performance analysis and optimization. Additional topics may include parallel architectures and detailed CPU design issues. Prerequisite: CPTR485 or equivalent. Fall

CPTR585
Advanced Computer Graphics
Advanced topics and current research in computer imaging—may include shading, ray tracing, radiosity, color spaces, lighting models, texture mapping, and recently published research in computer imagery. Includes term project and readings from the literature. Prerequisite: CPTR485. Spring (even years)

CPTR587
Advanced Artificial Intelligence
Provides a forum for exploring current topics in machine intelligence through a survey of recent research results, independent readings, and hands-on projects. Typical topics include machine vision, speech recognition, natural language processing, and machine learning systems. Prerequisite: CPTR487. Spring (odd years)

CPTR625
Analysis of Algorithms
Technique for analyzing and designing algorithms, including average/worst case analysis, asymptotics, recurrences, experimental methodology, intractability proofs (i.e., NP-Completeness) and heuristic alternatives. Application of such techniques as divide-and-conquer, graph, greedy, dynamic programming, backtracking, branch-and-bound, and probabilistic algorithms. Prerequisites: CPTR152, MATH315, 355, STAT340.

CPTR637
Formal Methods
A survey of the different paradigms associated with formal methods. Applies formal methods to the specification, verification, and validation of software systems. Case studies are examined and a programming project is included. Prerequisites: CPTR460, MATH215, STAT285. Spring

CPTR660
Thesis/Project Extension
(0)

CPTR689
Topics in ___________
Topics in computer science such as graphics, parallel processors, compiler design and optimization, communications and signal processing, distributed systems, graph theory, artificial intelligence, and formal theory. Repeatable with different topics to 6 credits. Prerequisite: Depends upon topic.

CPTR690
Independent Study
Directed study of material of special interest chosen in consultation with the instructor. May be repeated to 6 credits. Grade S/U.

CPTR698
Master’s Research Project
Special project chosen in consultation with student’s advisor and instructor. To be repeated to 6 credits. Grade S/U.

CPTR699
Master's Thesis
To be repeated to 6 credits. Graded S/U.

ENGINEERING

ENGR120
Introduction to Engineering
$ (2)
Introduces students to the engineering profession. Various engineering disciplines, job functions, engineering designs and engineering ethics will be discussed. Tips on how to succeed in the classroom, advice on how to gain actual, hands-on experience will be discussed. Introduces computer tools such as Mathcad and Microsoft Excel. Fall

ENGR125
Engineering Graphics
(2)
Fundamentals of drawing as applied to mechanical engineering problems. Orthographic projections, auxiliary and sectional views, dimensioning, oblique and isometric views. Sketching and computer-aided drafting. Weekly: 1 lecture and a 3-hour lab. Fall

ENGR135
Descriptive Geometry
(1)
Solution of basic space problems. Determination of distances and angles, intersections of lines and surfaces, intersections of lines and development of surfaces. Prerequisite: ENGR125. Spring

ENGR180
Materials Science
$ (4)
Introduction to the study of materials used in industry. Deals with the fundamentals of structure and classification of materials. A weekly hands-on laboratory helps demonstrate the relationship of properties of materials studied in lecture. Weekly: 3 hours lecture and a 3-hour lab. Prerequisite: CHEM131. Spring

ENGR185
Engineering Statics
(3)
Principles of statics and their application to engineering problems; forces, moments, couples, friction, centroids and moments of inertia. Corequisite: MATH141. Spring

ENGR225
Circuit Analysis
$ (3)
Resistive circuit analysis, network theorems, dependent sources, energy storage elements, 1st and 2nd order circuit transient responses, ac circuit analysis using phasors and impedances, and ac complex power. Weekly: 2 hours lecture and a 3-hour lab. Corequisite: MATH142. Fall
ENGR248  (1–4)
Workshop
Provides flexibility for the occasional workshop where it is appropriate to offer engineering credit. Workshop requirements must be approved by the department.

ENGR275  (3)
Electronics I
Introduction to diodes and transistors and their applications in switching and amplification circuits. Introduction to the basic op-amp circuits and their characteristics. Binary numbers and codes, Boolean algebra, logic circuits, flip-flops and registers. Digital circuit applications. Weekly: 2 hours lecture and a 3-hour lab. Prerequisite: ENGR225. Spring

ENGR285  (3)
Engineering Dynamics
Vectorial kinematics of moving bodies in fixed and moving reference frames. Kinetics of particles, assemblies of particles, and rigid bodies, with emphasis on the concept of momentum. Keplerian motion, elementary vibrations, and conservative dynamic systems. Prerequisites: ENGR185 and MATH142. Spring

ENGR310  (3)
Linear System Analysis
Convolution, analysis and spectra of continuous time domain signals, Fourier and Laplace transforms, discrete time domain signals, and the z-transform. Prerequisite: MATH215; Corequisite: MATH286. Spring

ENGR320  (3)
Manufacturing Processes
Covers traditional manufacturing practices such as machining processes (abrating, coating), and forming processes (cutting, forming, and assembling). Discusses non-traditional processes such as thermal, chemical, and pressure methods and explores special processes involved with specific materials such as plastics, woods, fibers, and other materials. Prerequisite: ENGR180. Fall

ENGR325  $ (4)
Electronics II
Modeling of transistors, biasing of transistors in amplifier circuits, and amplitude and frequency limitations of transistors. Linear and switching electronic circuits with an emphasis on op-amps. Weekly: 3 hours lecture and a 3-hour lab. Prerequisite: ENGR275. Fall

ENGR330  (3)
Thermodynamics
Introduction to the nature of energy and study of energy transport conservation in closed and flowing systems; properties and states of solids, liquids, vapors, and gases; enthalpy; meaning and production of entropy and introduction to cyclic systems. Prerequisite: PHYS242. Fall

ENGR335  (3)
Logic Circuit Design
Modern digital logic families, state machines, design of digital logic circuits in FPGAs, and VHDL specification of logic circuits. Prerequisite: ENGR275. Fall

ENGR340  (3)
Strength of Materials
Study of stresses and strain, deformations and deflections of posts, shafts, beams, columns; combined stresses; elasticity. Prerequisite: ENGR185. Fall

ENGR350  $ (3)
Sensors and Actuators
Study of temperature, mechanical, and optical sensors; sensor signal conditioning; ac, dc, and stepping motors; and the motor control requirements. Weekly: 2 lectures and a 3-hour lab. Prerequisite: ENGR275. Spring

ENGR360  (3)
Fluid Dynamics
Fluid statics and dynamics of fluid motion. Conservation of mass, momentum, and energy in laminar and turbulent flow. Boundary layer flow, lift and drag forces, viscous flow in conduits, open channel flow, flow measurements. Prerequisite: ENGR285 and 330; Corequisite: MATH286. Spring

ENGR380  $ (2)
Programmable Controllers
Introduction to typical programmable logic controllers and their applications. Emphasis on programming and interfacing to electromechanical systems. Weekly: 1-hour lecture and a 3-hour lab. Prerequisite: ENGR275. Spring

ENGR385  $ (4)
Microprocessor Systems
Introduction to computer organization, microprocessors, assembly language programming, memory devices, I/O devices, interfacing with emphasis on control applications. Weekly: 3 hours lecture and a 3-hour lab. Prerequisite: ENGR335 or CPTR276. Spring

ENGR390  (2)
Mechanical Engineering Lab
Mechanical engineering lab work in thermodynamics, heat transfer, fluid mechanics, and material stress and strain. Weekly: Two 3-hour labs. Prerequisites: ENGR330, 340, Corequisites: ENGR350, 360. Spring

ENGR410  $ (4)
Feedback Control Systems
Study of both analog and digital feedback control systems. Performance criteria and design and analysis methods. Weekly: 3 hours lecture and a 3-hour lab. Prerequisites: ENGR275, 285, and 310. Fall

ENGR415  (3)
Virtual Instrumentation
Introduction to virtual instrumentation with emphasis on the sampling requirements and the signal conditioning requirements. Data logging and control applications. Prerequisite: ENGR275 and CPTR125 or 151. Fall

ENGR420  (3)
Machine Design
The design of machine elements and the calculations necessary in determining the size and shape of machine parts. The selection of materials and the application of standard machine components. Includes bearings, gears, clutches, and couplings. Prerequisites: ENGR320, 390. Fall

ENGR435  (3)
Electromagnetic Fields
Study of static and dynamic electric and magnetic fields.
Unbounded and bounded fields, fields in materials, force and torque, energy and potential functions, and Faraday induction. Propagation of electromagnetic energy; plane waves, transmission lines, and waveguides; radiation from dipole antennas; introduction to arrays. Prerequisites: MATH240, 286, PHYS242. Fall

ENGR440
Heat Transfer
Study of steady-state and transient heat conduction, black-body thermal radiation, solar radiation, forced and non-forced convection through ducts and over surfaces, and heat exchangers. Prerequisite: ENGR360. Fall

ENGR455
Communication Systems
Introduction to analog and digital communication systems; including topics in modulation; baseband and bandpass signals; power spectral density and bandwidth; random processes; noise, signal-to-noise ratio, and error probability; and system performance. Weekly: 3 hours lecture and a 3-hour lab. Prerequisites: ENGR310, 325, Corequisite: STAT340. Spring

ENGR465
Operations Analysis and Modeling
The methodology of mathematical modeling and its relation to solving problems in industrial and public systems. Linear programming, scheduling, queuing, simulation, optimization, and decision analysis. Prerequisites: INDT460, STAT340. May not be offered each year. Spring

ENGR470
Finite Element Methods
Introduction of finite element methods for the solution of problems in solid mechanics and heat transfer. Techniques for obtaining approximate numerical solutions to governing differential equations in the problem areas are covered. Industrial software is applied to the analysis and design of a broad range of engineering problems. Prerequisites: ENGR330, 340, MATH286. Spring

ENGR475
Topics in _______
Repeatable in different subjects (prerequisites depend on topic)

ENGR491, 492
Senior Design Project
A significant design project which culminates in a working system or a complete description of a proposed design. Both an oral and written presentation of the results of the project is required. Prerequisite: ENGR385 or 390. Fall, Spring

ENGR495
Independent Study
Individual study, research, or project in some field of engineering under the direction of a member of the engineering faculty. Prerequisite: permission of the person who will direct the study.

ENGR496
Cooperative Work Experience
Work experience in industry directed by an engineering faculty member. 120 hours of work is required per credit. A report must be submitted that summarizes the work experience and indicates the value of the experience to the student. Grade S/U. Repeatable to 4 credits. Prerequisite: junior/senior standing and permission of the person who will direct the study.

ENGINEERING MANAGEMENT

ENGM520
Ergonomics and Work Design
The application of ergonomics and engineering principles to the design analysis and measurement of human work systems. Summer

ENGM555
Facilities Planning
Planning and design of industrial and service facilities: site selection, process layout, materials handling, and storage. Summer

ENGM565
Operations Analysis and Modeling
The development and use of mathematical models to analyze elements of production and service systems: linear programming, probabilistic models, game theory, dynamic programming, queuing theory, and simulation. Prerequisites: INDT460; STAT285; MATH142 or 182. Spring

ENGM570
Project Management
Design and management of engineering projects: proposals, planning, resource requirements, organization, scheduling, and cost and schedule control. Fall

INDT310
Industrial Supervision
Introduction to and an overview of the fundamentals of industrial supervision. Topics include organization, duties, human relations, training, evaluation, promotion, grievances, management-employee relationships. Spring

INDT320
Work Methods and Measurements
Principles and applications of basic methods and techniques for improvement of the man-job-time relationships; job standards, time and motion studies, and work-space design for efficient use of manpower. Spring

INDT410
Project Management
Methodology used successfully to carry out a technical project including proposals, planning, work breakdown, scheduling, creativity, monitoring progress, and documentation. Fall

INDT440
Quality Control
Analysis of the factors affecting product quality during manufacturing. Topics include basic statistics, sampling, control charts, measurements methods, inspection systems, reliability, and motivation programs. If this course is taken to fulfill degree requirements
requirements at the undergraduate level, it cannot also be taken at
the graduate level to fulfill degree requirements for a graduate
degree. Prerequisite: STAT285 or 340. Spring

INDT450 (3)

Industrial Economy
Study of engineering decision methodology and criteria used to
include economic factors in determining the best alternative in the
design and selection of equipment, structures, methods, and
processes. Prerequisite: MATH165 or MATH141. Fall

INDT460 (3)

Production Planning and Control
Planning and coordination of manufacturing facilities and
materials for economic production: forecasting, estimating,
process planning, plant layout, product flow, scheduling,
production controls, materials acquisition and handling, and
inventory. If this course is taken to fulfill degree requirements at
the undergraduate level, it cannot also be taken at the graduate
level to fulfill degree requirements for a graduate degree.
Prerequisites: MATH166 or equivalent, STAT285 or 340. Fall