ENGINEERING & DESIGN

Martin Weiser, Chair
department page (https://www.ewu.edu/cstem/engineering/)
319E CEB
509.359.2815

Undergraduate Degrees

BS—Applied Technology (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/technology-applied-technology-option-bs/)
BS—Construction Management Technology (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/technology-construction-management-option-bs/)
BS—Manufacturing Technology, DFM Option (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/technology-design-option-bs/)
BS—Manufacturing Technology, Process Option (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/technology-manufacturing-option-bs/)
BS—Electrical Engineering (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/electrical-bs/)
BS—Mechanical Engineering (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/mechanical-bs/)
BS—Mechanical Engineering Technology (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/mechanical-engineering-technology-bs/)
Minor—Applied Technology (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/applied-technology-minor/)
Minor—Construction Management (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/construction-management-minor/)
Minor—Geotechnical Engineering (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/geotech-minor/)
Minor—Manufacturing (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/manufacturing-minor/)
Minor—Mechanical Engineering (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/mechanical-minor/)
Certificate—Cisco Network I (http://catalog.ewu.edu/science-technology-engineering-mathematics/engineering/cisco-cert/)

Pre Engineering Info (p. 1)

Required courses in these programs of study may have prerequisites. Reference the course description section for clarification.

Faculty


Undergraduate Programs

Students studying in the Department of Engineering & Design (APTC, CMTC, DESN, DNTC, EENG, MNTC, MENG, METC, TECH) may select from a broad number of disciplines that include Electrical Engineering, Mechanical Engineering, Mechanical Engineering Technology, Visual Communication Design, Construction, Design and Manufacturing. The primary goal of the Department of Engineering & Design is to provide students with the technical background required for careers in business and industry. Coursework within each program offers experiences in many areas of engineering and design that enhance the preparation of our graduates.

General Admissions Information for Engineering & Design

Students entering the Bachelor of Science degree in the Engineering programs as juniors should have completed one year of physics as well as most of their mathematics. Failure to complete the mathematics and physics requirements before the junior year likely will delay graduation.

Faculty and Facilities

The Department of Engineering & Design faculty, facilities and equipment reflect a commitment to maintaining program relevance. Computer-assisted drafting and manufacturing, networking, signal processing, microprocessors, power systems, digital communication, electronics, integrated circuits design, graphic design/web design, robotics, thermodynamics, fluid dynamics, heat transfer and materials processing laboratories and a variety of other engineering/engineering technology laboratories are constantly being updated with new equipment. Articulation and research with industry have resulted in programs that address the latest trends in industry. These efforts have consistently offered graduates excellent job placement and employment opportunities.

Engineering & Design Departmental Scholarship Information

The department awards two scholarships annually: the M. W. Consulting Engineering Scholarship and Aaron G. Mertens memorial scholarship. These scholarships are awarded to our majors based on academic qualifications and need.

Graduate Program

Engineering & Design offers courses that students may use as part of a degree in communications, multimedia programming and other interdisciplinary areas. These programs are listed in their respective graduate catalog sections.

Department Overload Policy

Engineering & Design undergraduate students who wish to enroll in more than 18 credit hours during a quarter must obtain overload permission from their general or department advisor. Requests for 19 or more credit hours are generally approved only for those with a GPA ≥3.0 in their major courses. The normal limit is 20 credits except in exceptional cases. Additional per credit fees are assessed for students enrolled in more than 18 credits per quarter.
Pre-Construction Management Technology

Eligible to declare a pre-major: Running Start, Freshman, Sophomores, Transfer Students <90 credits, Changing Majors <90 credits, Double Majors <90 credits.

Eligible to declare a major: Juniors, Transfer Students ≥90 credits, Changing Majors ≥90 credits, Double Majors ≥90 credits, Post Baccalaureate.

Threshold: when student has completed the following they can declare major and be assigned to a departmental advisor.

Must be completed with a grade ≥C.

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<td>PHYS 131</td>
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<td>MECHANICS LABORATORY (≥C)</td>
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Pre-Manufacturing Technology, DFM Option

Eligible to declare a pre-major: Running Start, Freshman, Sophomores, Transfer Students <90 credits, Changing Majors <90 credits, Double Majors <90 credits.

Eligible to declare a major: Juniors, Transfer Students ≥90 credits, Changing Majors ≥90 credits, Double Majors ≥90 credits, Post Baccalaureate.

Threshold: when student has completed the following they can declare major and be assigned to a departmental advisor.

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Pre-Manufacturing Technology, Process Option

Eligible to declare a pre-major: Running Start, Freshman, Sophomores, Transfer Students <90 credits, Changing Majors <90 credits, Double Majors <90 credits.

Eligible to declare a major: Juniors, Transfer Students ≥90 credits, Changing Majors ≥90 credits, Double Majors ≥90 credits, Post Baccalaureate.

Threshold: when student has completed the following they can declare major and be assigned to a departmental advisor.

Must be completed with a grade ≥C.

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<tr>
<td>PHYS 100</td>
<td>PHYSICAL SCIENCE I (≥C)</td>
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Pre-Mechanical Engineering

Declaring this major will guide you through the courses that must be completed to apply for the Mechanical Engineering major.

This is a competitive application process based upon your average GPA in the required courses. Students who apply with an average GPA in the required courses ≥3.3 or greater will be accepted while those with lower GPAs will be accepted if space is available. Acceptance into the Mechanical Engineering major is required for students to enroll in some of the 300 level and all of the 400 level Mechanical Engineering courses.

Must be completed with a grade ≥C unless otherwise noted.

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<td>&amp; MATH 163</td>
<td>and CALCULUS III</td>
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<td>PHYS 151</td>
<td>GENERAL PHYSICS I</td>
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<td>&amp; PHYS 152</td>
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<td>MENG 240</td>
<td>STATICS</td>
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Pre-Mechanical Engineering Technology

Declaring this major will guide you through the courses that must be completed to apply for the Mechanical Engineering Technology major.

This is a competitive application process based upon your average GPA in the required courses. Students who apply with an average GPA in the required courses ≥3.0 will be accepted while those with lower GPAs will be accepted if space is available. Acceptance into the Mechanical Engineering Technology major is required for students to enroll in some of the 300 level and all of the 400 level Mechanical Engineering Technology courses.

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Applied Technology Courses
APTC 301. INTRODUCTION TO ROUTING AND SWITCHING. 4 Credits.
Notes: this class prepares students to take the following exam(s): Interconnecting Cisco Networking Devices, Part 1 (ICND1).
Pre-requisites: a two year A.A.S or A.A.T Transfer Degree in IT or equivalent or permission of instructor.
This course provides students the knowledge and skills related to network fundamentals, LAN switching technologies, routing technologies, infrastructure services and infrastructure maintenance.

APTC 302. NETWORK SERVER CONFIGURATION. 4 Credits.
Notes: preparation for DCICN and DCICT Cisco exams.
Pre-requisites: APTC 301 zC or passing score for Cisco CCENT exam (within three years of the quarter of the class offering.)
This course provides students the knowledge of data center infrastructure, data center networking concepts and data center storage networking. Students will also learn about fundamental data center technologies including unified computing, data center network virtualization, Cisco data center networking technologies, data center automation and orchestration and Application Centric Infrastructure.

APTC 303. NETWORK ADMINISTRATION. 4 Credits.
Notes: preparation to take the following exam(s): Interconnecting Cisco Networking Devices: Accelerated (CCNAX).
Pre-requisites: APTC 301 zC.
This course provides students with the knowledge and skills related to network fundamentals, LAN switching technologies, IPv4 and IPv6 routing technologies, WAN technologies, infrastructure security and infrastructure management.

APTC 401. NETWORK DIAGNOSIS AND MAINTENANCE I. 4 Credits.
Notes: preparation for the DCICN, DCII, and DCVAI Cisco exams.
Pre-requisites: APTC 302 zC.
This course provides students the knowledge of implementing Cisco data center technologies including unified computing, unified computing maintenance and operations, automation, unified computing security and unified computing storage. Knowledge of implementing Cisco data center infrastructure including key protocols, routing and switching protocols, maintenance, management, operations, security and storage is included.

APTC 402. NETWORK DIAGNOSIS AND MAINTENANCE II. 4 Credits.
Notes: preparation to take the following exam(s): Designing Cisco Data Center Infrastructure (DCID) and Troubleshooting Cisco Data Center Infrastructure (DCIT).
Pre-requisites: APTC 401 zC.
This course provides students the knowledge of Cisco data center infrastructure design pertaining to deployment requirements and options for network connectivity, infrastructure, storage network, compute connectivity and compute resource parameters. A focus on troubleshooting of Cisco data center infrastructure is included.

APTC 403. ADVANCED ROUTING AND SWITCHING. 4 Credits.
Notes: preparation for the ROUTE, SWITCH, and TSHOOT Cisco exams.
Pre-requisites: APTC 303 zC.
This course enables students to learn advanced IP addressing and routing in implementing scalable and highly secure Cisco routers that are connected to LANs, WANS and IPv6. Students learn how to plan, configure and verify implementation of enterprise switching solutions that use the Cisco Enterprise Campus Architecture. Topics on maintenance and troubleshooting are covered in this course.

APTC 421. NETWORK SECURITY PROTOCOLS. 4 Credits.
Notes: preparation for the IINS Cisco exam.
Pre-requisites: APTC 303 zC.
This course provides students the knowledge of secure network infrastructure, understanding core security concepts, managing secure access, VPN encryption, firewalls, intrusion prevention, web and email content security and endpoint security. A focus on installation, troubleshooting, and monitoring of a secure network utilizing technologies Cisco uses to maintain integrity, confidentiality and availability of data and devices is included.

APTC 490. SENIOR CAPSTONE: PRODUCTION LAB. 4 Credits.
Cross-listed: TECH 490, CMTC 490, DNTC 490, MNTC 490.
Notes: the course will simulate a real world design team concept by utilizing a design group that contains members of different program majors.
Pre-requisites: senior standing.
Satisfies: a university graduation requirement–senior capstone.
The course simulates the real world situation that graduates face. Students will work in teams to apply techniques of production management, product design/development, plant layout, scheduling, cost accounting, assembly, inspection and quality control to produce a product. Learning to deal with the team dynamics is a valuable learning process. Each student team produces a new product and a final written report to demonstrate how the process and goals of the course have been realized.

APTC 491. SENIOR PROJECT. 4-6 Credits.
Cross-listed: TECH 491, CMTC 491, DNTC 491, MNTC 491.
Pre-requisites: senior standing.
Independent and/or group study and implementation of a design and development project. (variable time).

APTC 495. INTERNSHIP. 1-15 Credits.
Cross-listed: TECH 495, CMTC 495, DNTC 495, MNTC 495.
Notes: Graded Pass/Fail. This course may be repeated.
Pre-requisites: junior or senior status and permission of the instructor, department chair and dean.
A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.

APTC 496. EXPERIMENTAL COURSE. 1-6 Credits.
Cross-listed: TECH 496, CMTC 496, DNTC 496, MNTC 496.
Experimental Course.

APTC 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.
Cross-listed: TECH 497, CMTC 497, DNTC 497, MNTC 497.
Workshop, short course, conference, or seminar.

APTC 498. SEMINAR. 1-6 Credits.
Cross-listed: TECH 498, CMTC 498, DNTC 498, MNTC 498.
Seminar.

APTC 499. DIRECTED STUDY. 1-5 Credits.
Cross-listed: TECH 499, CMTC 499, DNTC 499, MNTC 499.
Pre-requisites: permission of the instructor, department chair and college dean.
Designed for students wanting to pursue a subject beyond the scope of regular courses.
Construction Management Technology Courses

CMTC 235. CONSTRUCTION MATERIALS AND TECHNIQUES. 5 Credits.
Pre-requisites: METC 102 ≥C, or two years high school drafting.
This course introduces various materials and techniques used in
construction. Students gain an understanding of the fundamental
principles of structural, physical and long-term performance of some
of these materials through lecture and lab experiments. Students also
gain an understanding of some of the mechanical and non-mechanical
properties of various materials, common construction methods and
knowledge of material properties and applications in construction.

CMTC 305. CONSTRUCTION ESTIMATING. 4 Credits.
Pre-requisites: MATH 107 or MATH 141, CMTC 235; All ≥C.
This course provides students with the ability to estimate construction
costs by reading and interpreting technical drawings. Primary focus is on
calculating materials, labor and equipment cost for both residential and
commercial building projects. Students generate quantity takeoffs for
specific building projects.

CMTC 320. NON-METALLIC PROCESSES. 5 Credits.
Pre-requisites: METC 110; junior/senior status or permission of
instructor.
Survey of non-metallic materials (such as woods, plastics, and ceramics)
and the industrial processes utilized to convert raw materials into
finished products. Course includes characteristics and properties of
non-metallic materials and utilization of industrial tools and processing
equipment.

CMTC 335. ARCHITECTURE. 4 Credits.
Pre-requisites: METC 110, CMTC 354; both ≥C.
Design, layout, and development of residential dwellings and large
structures. (4 hour lecture per week)

CMTC 345. SOILS/SURVEYING. 4 Credits.
Pre-requisites: MATH 141 ≥C.
This course introduces soil mechanics and site surveying. Through
lecture and field work the course examines characteristics and
compositions of soil, soil classification systems and the strength of soil
masses. Students practice fundamentals of construction surveying,
including taping, leveling, angular measurement, traversing, topographic
surveying, building layout and grade staking.

CMTC 354. BUILDING CODES. 4 Credits.
Pre-requisites: ENGL 201 with a grade ≥C.
Building Codes is a comprehensive course pertaining to International
Building Codes (IBC). Emphasis is placed on code requirements for both
commercial and residential applications to include structural, mechanical,
plumbing, fire, fuel gas and private sewage code requirements.

CMTC 490. SENIOR CAPSTONE: PRODUCTION LAB. 4 Credits.
Cross-listed: APTC 490, TECH 490, DNTC 490, MNTC 490.
Notes: the course will simulate a real world design team concept by
utilizing a design group that contains members of different program
majors.
Pre-requisites: senior standing.
Satisfies: a university graduation requirement—senior capstone.
The course simulates the real world situation that graduates face.
Students will work in teams to apply techniques of production
management, product design/development, plant layout, scheduling,
cost accounting, assembly, inspection and quality control to produce a
product. Learning to deal with the team dynamics is a valuable learning
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Pre-requisites: junior or senior status and permission of the instructor,
department chair and dean.
A maximum of 5 credits may be earned toward electives for a Technology
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CMTC 496. EXPERIMENTAL COURSE. 1-6 Credits.
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Experimental Course.

CMTC 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6
Credits.
Cross-listed: APTC 497, TECH 497, DNTC 497, MNTC 497.
Workshop, short course, conference, or seminar.

CMTC 498. SEMINAR. 1-6 Credits.
Cross-listed: APTC 498, TECH 498, DNTC 498, MNTC 498.
Seminar.

CMTC 499. DIRECTED STUDY. 1-5 Credits.
Cross-listed: APTC 499, TECH 499, DNTC 499, MNTC 499.
Pre-requisites: permission of the instructor, department chair and college
dean.
Designed for students wanting to pursue a subject beyond the scope of
regular courses.

Design Courses

DESN 100. DRAWING FOR COMMUNICATION. 5 Credits.
This course covers hand-drawing as a design skill. Emphasis is on
sketching, design drawing, design process and composition studies
for visual presentation and design solutions. Students gain drawing
skills such as basics of drawing techniques, basic shapes, light, texture,
pattern, gesture and perspective drawing to communicate and present
their ideas visually. Students learn and develop critical thinking and
creative problem solving skills using the drawing process.
DESIGN 200. VISUAL THINKING. 5 Credits.
Pre-requisites: ENGL 101.
In this course, students will critically interpret images and decode them much like they would decode a poem. Students will use what they already know to figure out what they don’t. Through hands-on activities, students will practice working with image and text to create compelling and authentic images and messages. Creative exploration and reflection will introduce students to practices with which they may not be familiar or comfortable.

DESIGN 216. DIGITAL FOUNDATIONS. 4 Credits.
Introduction to media design and digital culture using computer software for the creation and manipulation of images and text, file management, and preparation for print, web or multimedia uses.

DESIGN 243. TYPOGRAPHY. 4 Credits.
Pre-requisites: DESN 100 and DESN 216.
An introductory-level course concentrating on the fundamentals of typography with emphasis on letterforms, typographic syntax, type specification, type as image and the use of type in a variety of communicative purposes.

DESIGN 259. HISTORY OF DESIGN. 4 Credits.
This course considers the development of design in the broad sense of the term. Beginning with the Industrial Revolution and continuing forward to the present day, this course explores the components of design that have influenced the direction of design thinking.

DESIGN 263. VISUAL COMMUNICATION DESIGN 1. 4 Credits.
Pre-requisites: DESN 100 and DESN 216.
This course provides an introduction to Visual Communication Design including the theories, principles and practices of visual communication, concept development, design process and design technology.

DESIGN 275. DIGITAL SOUND. 4 Credits.
This course provides a foundation in the techniques of sound design, recording, production and editing for digital media. Students will create and record sound files, apply effects and mix and produce a variety of multimedia audio elements using state-of-the-art digital technology. Applicable uses include websites, games, multimedia products for promotion and learning, entertainment products and virtual worlds.

DESIGN 301. VISUAL STORYTELLING. 5 Credits.
Pre-requisites: DESN 100.
This course will introduce the basics of visual development: from visual storytelling to character design. Students will learn how to create a dialogue between pictures and text through the use of design briefs, research, semiotics, and sequential imagery. They will learn about the history of visual storytelling, practice typographic and pictorial design, and be able to apply what they learn to film, animation/motion design, game design, UX experiences and comics/book illustration projects.

DESIGN 325. EMERGENT DESIGN. 4 Credits.
Pre-requisites: DESN 263.
This course explores benefits and risks of new design technologies. Students learn to recognize emergent design technologies and use them to address design problems and explore ways in which new tools reference past paradigms in order to create forward thinking design solutions. Through hands-on, project-based learning, students investigate the possibilities inherent in these new technologies.

DESIGN 338. USER EXPERIENCE DESIGN 1. 4 Credits.
Pre-requisites: DESN 216.
Students investigate principles of interaction design of web enabled devices and differences and similarities between physical interaction and conceptual interaction through the use of metaphor. Exploring relationships between analog and digital frameworks, students become mindful of the overlapping patterns of interaction between the two systems.

DESIGN 343. TYPOGRAPHY 2. 4 Credits.
Pre-requisites: DESN 243.
Building on the principles and concepts introduced in DESN 243 Typography, this course will review the fundamentals of typography and extend typographic knowledge and skills with emphasis on letterforms, typographic syntax, type specification, and type as image. Projects will include experimental application of type + image to artifacts and multi-page documents.

DESIGN 348. USER EXPERIENCE DESIGN 2. 4 Credits.
Pre-requisites: DESN 338.
Students examine different rhetorical frameworks that inform software user interface/experience (UI/UE) and content design. Supporting theories, such as visual rhetoric, contextual design, information architecture, gestalt, content strategy, and design ethics, are investigated. Students demonstrate their understanding of theoretical principles by creating and redesigning small UI-related deliverables and by practicing rigorous written analysis and critique.

DESIGN 350. DIGITAL PHOTOGRAPHY. 4 Credits.
Pre-requisites: junior standing.
This class will have an experimental and philosophical approach. Students will use digital imaging mediums for effective communication and image design. Working within the medium of digital photography, students will engage in strategies and philosophies of vision, light/shadow, reproduction, editing and presentation.

DESIGN 351. ADVANCED PHOTOGRAPHY. 4 Credits.
Pre-requisites: DESN 350.
An extension of DESN 350 with considerable work in advanced enlarging techniques portraiture with emphasis on lighting, architectural photography, slide making, color transparencies, and color prints.

DESIGN 355. MOTION DESIGN. 4 Credits.
Pre-requisites: DESN 263.
This course explores the principles of design through motion, with an emphasis on effective use of typography, graphical elements, sound and motion within time and space. Students learn how to import projects, create narrative structures, storyboard, output for various devices and problem solve moving image concerns.

DESIGN 360. PUBLICATION DESIGN. 4 Credits.
This course covers principles of design, typography, and the use of graphic files, in both print and digital publication. Professional desktop publishing software and common web design software are used. Emphasis is on skills required for basic literacy as well as the effective design of common formats such as brochures, newsletters, books, and web pages.

DESIGN 363. VISUAL COMMUNICATION DESIGN 2. 4 Credits.
Pre-requisites: DESN 243, DESN 263.
This course focuses on the interaction of type and image in the visual communication design process. An introduction to form and composition will be achieved through a sequence of design projects that emphasize compositional structure. The goal of class projects is the development of complex, cohesive visual systems using traditional production skills, design processes and specialized computer applications.
DESN 365. MOTION DESIGN 2. 4 Credits.  
Pre-requisites: DESN 355.  
This course continues to build upon the knowledge and tools explored in Motion 1. Focusing more on the theory and practice of motion design, students will use advanced motion techniques to further realize and develop their motion design projects. Students will explore pre-visualization techniques, character driven design, data visualization processes, and apply in-depth problem solving skills to create large scale projects.

DESN 366. PRODUCTION DESIGN. 4 Credits.  
Pre-requisites: DESN 263.  
This course provides students with theory, knowledge and skill of production design for both print and web application. Students gain conceptual understanding and practical skill in areas including color management, print production and web graphics such as banners and videos.

DESN 367. WEB DESIGN 1. 4 Credits.  
Pre-requisites: DESN 216.  
This course covers professional web design addressing modern technologies, processes and techniques. Students work with current web technologies, while preparing for future web enabled devices, or the progressive enhancement approach. Technologies will include HTML(5) and CSS(2/3).

DESN 368. WEB DESIGN 2. 4 Credits.  
Pre-requisites: DESN 368.  
This course covers modern user experience (UX) design, rapid prototyping, and modern user interface (UI) patterns. Web programming continues to build upon HTML(5), CSS(2/3), and with the addition of JavaScript frameworks to complement the progressive enhancement process. This course continues the foundations set by DESN 368.

DESN 385. ADVANCED DIGITAL SOUND. 4 Credits.  
Pre-requisites: DESN 275.  
This course provides in-depth experience in digital sound creation and editing techniques, along with related hardware and software. Topics include live and studio recording techniques, multi-track project recording, mixing and mastering, and the design and creation of sound tracks, including music, to support and enhance typical media productions. Collaborative and individual projects will be required.

DESN 396. EXPERIMENTAL COURSE. 1-5 Credits.  
EXPERIMENTAL

DESN 398. SEMINAR. 1-6 Credits.  
Seminar.
DESN 490. SENIOR CAPSTONE. 5 Credits.
*Pre-requisites:* senior standing; DESN 363, DESN 368.
*Satisfies:* a university graduation requirement—senior capstone. This course expands on previous visual communication design knowledge and skills and also emphasizes communication, collaboration and presentation skills. In teams, students work on a comprehensive design project for a community partner which emphasizes design research and the design processes that lead to creative conceptualization and final design solutions. Students are expected to demonstrate sophisticated design decisions and appropriate design solutions.

DESN 491. SENIOR PROJECT. 1-10 Credits.
*Notes:* graded Pass/Fail.
*Pre-requisites:* senior standing; permission of the instructor. Independent and/or group study and production of a design project.

DESN 493. PORTFOLIO. 2 Credits.
*Notes:* may be repeated for credit up to three times.
*Pre-requisites:* DESN 363 and DESN 368.
In this course, students have the opportunity to develop portfolio quality work. Emphasis is placed upon content and concept development, problem solving, formal solutions, statements of objectives and presentation.

DESN 495. INTERNSHIP. 2-6 Credits.
*Notes:* graded Pass/Fail.
*Pre-requisites:* junior standing; permission of instructor, department chair and college dean. An internship is on-the-job-training. It exposes students to the professional environment through outside job opportunities in graphic design studios, advertising agencies, corporate communications departments and other acceptable organizations. Students work under the guidance of art directors, creative directors, senior graphic designers or marketing communication managers and perform creative work that is educational and meaningful for their short-term academic goals as well as their long-range career preparation.

DESN 496. EXPERIMENTAL COURSE. 1-6 Credits.
DESN 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.
DESN 498. SEMINAR. 1-6 Credits.
DESN 499. DIRECTED STUDY. 1-6 Credits.
*Pre-requisites:* permission of instructor, department chair and college dean.

DESN 504. COMMUNICATION TECHNOLOGIES. 4 Credits.
An accelerated coverage of the theory and applications of communication technologies. Emphasis is on competencies and skills required in business and industry including desktop publishing, computer-assisted image generation and manipulation, data translation and communication and presentation media development used in advertising, proposal writing, presentations and publications.

DESN 508. WEB DESIGN. 4 Credits.
*Notes:* offered fall.
This course covers professional web design addressing modern technologies, processes and techniques. Students work with current web technologies, while preparing for future web enabled devices, or the progressive enhancement approach. Technologies will include HTML(5) and CSS(2/3).

DESN 550. DIGITAL FOUNDATIONS. 4 Credits.
*Pre-requisites:* METC 110.
Introduction to media design and digital culture using computer software for the creation and manipulation of images and text, file management, and preparation for print, web or multimedia uses.

**Design Technology Courses**

**DTNC 490. SENIOR CAPSTONE: PRODUCTION LAB. 4 Credits.**
*Cross-listed:* APTC 490, CMTC 490, TECH 490, MNTC 490.
*Notes:* the course will simulate a real world design team concept by utilizing a design group that contains members of different program majors.
*Pre-requisites:* senior standing.
*Satisfies:* a university graduation requirement—senior capstone. The course simulates the real world situation that graduates face. Students will work in teams to apply techniques of production management, product design/development, plant layout, scheduling, cost accounting, assembly, inspection and quality control to produce a product. Learning to deal with the team dynamics is a valuable learning process. Each student team produces a new product and a final written report to demonstrate how the process and goals of the course have been realized.

**DTNC 491. SENIOR PROJECT. 4-6 Credits.**
*Cross-listed:* APTC 491, CMTC 491, TECH 491, MNTC 491.
*Pre-requisites:* senior standing.
Independent and/or group study and implementation of a design and development project. (variable time).

**DTNC 495. INTERNSHIP. 1-15 Credits.**
*Cross-listed:* APTC 495, CMTC 495, TECH 495, MNTC 495.
*Notes:* Graded Pass/Fail. This course may be repeated.
*Pre-requisites:* junior or senior status and permission of the instructor, department chair and dean.
A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.

**DTNC 496. EXPERIMENTAL COURSE. 1-6 Credits.**
*Cross-listed:* APTC 496, CMTC 496, TECH 496, MNTC 496.
Experimental Course.

**DTNC 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.**
*Cross-listed:* APTC 497, CMTC 497, TECH 497, MNTC 497. Workshop, short course, conference, or seminar.

**DTNC 498. SEMINAR. 1-6 Credits.**

**DTNC 499. DIRECTED STUDY. 1-5 Credits.**
*Cross-listed:* APTC 499, CMTC 499, TECH 499, MNTC 499.
*Pre-requisites:* permission of the instructor, department chair and college dean.
Designed for students wanting to pursue a subject beyond the scope of regular courses.

**Electrical Engineering Courses**
EENG 160. DIGITAL CIRCUITS. 4 Credits.
Pre-requisites: MTHD 104 or equivalent.
Fundamentals of digital computer design including appropriate number systems, boolean algebra, and basic digital circuits. Methods introduced will include the use of Karnaugh Maps and the Quine-McKluskey procedure. Computer laboratory work will involve the use of current software for the design, analysis, and simulation of digital circuits.

EENG 209. CIRCUIT THEORY I. 5 Credits.
Pre-requisites: PHYS 153 or permission of the instructor.
This course is intended to provide electrical engineering students with an understanding of electricity and its applications. Topics include AC/DC circuit-analysis methods such as nodal and mesh analysis, superposition, Norton Theorem, Thevenin Theorem and transient analysis.

EENG 210. CIRCUIT THEORY II. 5 Credits.
Pre-requisites: EENG 209 with a minimum grade ≥C.
This course covers circuit analysis using Laplace transform, phasors and AC analysis. It introduces AC Power, three-phase circuits, magnetically coupled circuits and the ideal transformer.

EENG 250. DIGITAL HARDWARE. 2 Credits.
Notes: a continuation of EENG 160.
Pre-requisites: EENG 160 with a minimum grade ≥C.
This course presents logic families, hardware characteristics, noise control and modern programmable logic.

EENG 260. MICROCONTROLLER SYSTEMS. 4 Credits.
Pre-requisites: CSCD 255 and EENG 160, both with a minimum grade ≥C.
This is an introductory course on microprocessor and microcontroller systems organization. It provides low-level programming principles for microcomputer based systems. The course emphasizes assembly and C language programming techniques and laboratory experiments in input/output programming, memory organization, interrupts and interfacing methods.

EENG 320. SIGNALS AND SYSTEMS I. 5 Credits.
Pre-requisites: EENG 210 or concurrent enrollment or permission of the instructor; MATH 163 with a minimum grade ≥C.
This course is an introduction to continuous-time signal analysis. Topics include: generalized functions and the relationship to basic signals including impulses, pulses and unit step; system properties such as linearity, time-invariance and causality; and Fourier analysis.

EENG 321. SIGNALS AND SYSTEMS II. 5 Credits.
Pre-requisites: EENG 320 and MATH 163, both with a minimum grade ≥C.
Introduction to Laplace Transform, Z-transform, the Fourier Series, the Fourier Transform, the Discrete Fourier Transform (DFT), the Discrete-Time Fourier Transform (DTFT) and Sampling Theorem. Introduction to analysis of Linear Time Invariant (LTI) system using above techniques for continuous and discrete time.

EENG 330. MICROELECTRONICS I. 5 Credits.
Pre-requisites: CHEM 171 and CHEM 171L; EENG 209 and MATH 163, both with a minimum grade ≥C and concurrent enrollment in EENG 210. This course introduces the characterization, modeling, and application of semiconductor devices in the context of analog integrated circuits. Emphasis is placed on the development of models for circuit-level behavior of diodes, bipolar transistors, and MOS transistors and applies the models to the analysis and design of linear amplifiers.

EENG 331. MICROELECTRONICS II. 5 Credits.
Pre-requisites: EENG 330 and MATH 163, both with a minimum grade ≥C.
This course is the second in the characterization, modeling and application of semiconductor devices in the context of analog integrated circuits. The emphasis is on the metal-oxide-semiconductor (MOS) transistor. Topics include differential amplifiers, frequency response and feedback effects.

EENG 350. ENERGY SYSTEMS. 5 Credits.
Pre-requisites: EENG 210 and MATH 163, both with a minimum grade ≥C.
This course provides an introduction to the different energy sources, methods of electric energy conversion, the electric power system, transformers and electrical machines.

EENG 360. HARDWARE DESCRIPTION LANGUAGES. 5 Credits.
Pre-requisites: CSCD 255 and EENG 160, both with a minimum grade ≥C.
This course introduces methodologies and computer-aided design (CAD) tools for the design of complex electronic systems. The emphasis is on high-level description languages and their use for specifying, designing, simulating and synthesizing digital very large scale integration (VLSI) circuits in MOS (metal-oxide-semiconductor) technologies. Theoretical knowledge will be complemented by hands-on use of several commercial CAD tools.

EENG 383. APPLIED STOCHASTIC PROCESSES. 4 Credits.
Pre-requisites: MATH 163 or permission of the instructor and must be taken concurrently with EENG 388.
This course provides an introduction to the basic concepts of stochastic processes and their application to engineering problems. Topics include analysis of continuous and discrete random signals and systems, as well as modern estimation techniques.

EENG 388. STOCHASTIC PROCESSES LAB. 1 Credit.
Pre-requisites: MATH 163 or permission of the instructor and must be taken concurrently with EENG 383.
This laboratory course introduces basic concepts of stochastic processes and their application to engineering problems.

EENG 399. DIRECTED STUDY. 1-5 Credits.
Directed Studies.

EENG 401. ENGINEERING APPLIED ELECTROMAGNETICS. 5 Credits.
Pre-requisites: MATH 241, MATH 347; EENG 210 and EENG 320 both with a minimum grade ≥C.
This course provides students with the technical basis to analyze electromagnetic applications systems. Topics include waves and phasors, vector analysis, electrostatics, magnetostatics, Maxwell’s equations for time-varying fields and plane wave propagation.

EENG 415. INTRODUCTION TO COMPUTER COMMUNICATION NETWORKS. 5 Credits.
Pre-requisites: junior standing.
Fundamentals of data communication, telephone cellular computer networks, layered network architecture, OSI model, data link layer functions and protocols including ARQ, network layer functions and protocols including IP, transport layer functions and protocols including TCP. Basic MATLAB programming experience is necessary for this course.
EENG 420. DIGITAL SIGNAL PROCESSING. 5 Credits.
Pre-requisites: EENG 321.
This course provides an introduction to digital signal processing. Convolution, time invariance and stability of discrete-time systems are presented. In addition, various signal processing techniques such as Z-transform, discrete Fourier transform (DFT) and fast Fourier transform (FFT) are studied. Time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters are introduced.

EENG 425. PRINCIPLES OF DIGITAL IMAGE PROCESSING. 5 Credits.
Pre-requisites: EENG 321.
Image representation, color spaces, image filtering and enhancement, image transforms and image/video coding.

EENG 430. CMOS DIGITAL INTEGRATED CIRCUITS DESIGN. 5 Credits.
Pre-requisites: EENG 160; EENG 331.
This course provides students with the theoretical and practical knowledge required for analyzing and designing digital integrated circuits and systems in complementary metal-oxide-semiconductor (CMOS) technology. Lab includes hands-on use of a variety of state-of-the-art computer-aided design (CAD) tools and design techniques.

EENG 435. ANALOG INTEGRATED CIRCUITS DESIGN. 5 Credits.
Pre-requisites: EENG 331.
This course provides students with the theoretical and practical knowledge required for analyzing and designing analog integrated circuits and systems in complementary metal-oxide-semiconductor (CMOS) technology. Topics include operational amplifier design, biasing and reference circuits, stability, and selected applications of analog circuits (e.g. filters, comparators, data converters, transceiver blocks).

EENG 440. DIGITAL COMMUNICATION SYSTEMS. 5 Credits.
Pre-requisites: EENG 321, EENG 383.
This course provides students with a solid background in modern digital communication systems. Random processes are applied in the realm of communication theory. Common digital modulation and demodulation techniques are presented. Other topics include bandpass transmission of binary data, coherent/noncoherent communications, intersymbol interference and equalization.

EENG 442. MOBILE COMMUNICATIONS. 5 Credits.
Pre-requisites: EENG 321 and EENG 383.
This course covers antennas and propagation, signal encoding techniques; spread spectrum, coding and error control, cellular and wireless control.

EENG 450. POWER SYSTEMS ANALYSIS. 5 Credits.
Pre-requisites: EENG 350.
The course provides students with the ability to analyze power systems from technical and economic perspectives. It includes symmetrical components, calculation of line parameters, power flow control, representation of transmission lines and power components.

EENG 452. PROTECTIVE RELAYS. 5 Credits.
Pre-requisites: EENG 450.
This course provides students with the technical basis to analyze and design protection for power systems. Topics include per unit and phasors, symmetrical components, relay input sources, protection fundamentals, system grounding principles and protection of power system components.

EENG 460. COMPUTING SYSTEMS: ORGANIZATION AND DESIGN. 5 Credits.
Pre-requisites: CSCD 255, EENG 360.
This course provides the theoretical and practical knowledge required for analyzing and designing complex computing systems. Topics include computer performance, MIPS assembly language, integer and floating point arithmetic, designing a processor, pipelining and memory hierarchies. Assembly programming and design using VHDL are offered in weekly labs.

EENG 461. EMBEDDED SYSTEMS DESIGN. 5 Credits.
Pre-requisites: EENG 260 or permission of the instructor.
This course provides students with theoretical and practical knowledge required for analyzing and designing embedded computing systems. The key challenge of embedded systems is to optimize various design metrics and assess the impact the organization and interfacing of hardware/software components have on system performance. Hands-on experience using hardware interfaced with select microcontroller development boards is offered in weekly labs.

EENG 462. REAL TIME EMBEDDED SYSTEMS. 5 Credits.
Pre-requisites: EENG 461 or permission of the instructor.
This course involves the design and development of real-time software and hardware for embedded systems with an emphasis on Real-Time Operating Systems (RTOS), Networking and Security. Communication and Timeliness can be compromised under these design environments and therefore constitute some of the design challenges. Hands-on experience using microcontroller development boards sensors and actuators, will be offered in weekly labs.

EENG 470. CONTROL SYSTEMS. 5 Credits.
Pre-requisites: EENG 321.
This course reviews basic topics such as transfer function, step response and stability conditions. Other topics include feedback systems, analysis techniques such as root-locus analysis, transient and steady-state response analyses and frequency response analysis are studied. In addition, state-space analysis techniques are explained within the context of state-space system models. Analysis and design of proportional, integral, and derivative (PID), PI and PD controllers are presented.

EENG 471. DIGITAL CONTROL SYSTEMS. 5 Credits.
Pre-requisites: EENG 470.
This course provides students with the technical basis to understand and analyze digital control systems. Topics include frequency response, modeling digital control systems, steady-state error, stability, Z-domain design and state-space models. An introduction to Lyapunov techniques is presented.

EENG 490A. SR CAPSTONE: DESIGN LAB I. 2 Credits.
Pre-requisites: EENG 210, EENG 260, EENG 320, EENG 330 and EENG 350, each with a minimum grade ≥C.
Satisfies: a university graduation requirement—senior capstone.
This course will simulate the industrial environment, where students will have to work in a team to solve a real world problem, from design to implementation. Team dynamics will be strictly monitored and each student's unique skills will be utilized in different stages of the design process. Dealing with problems typical of a team environment will result in an invaluable learning experience both in the professional and civic lives of the students.

EENG 490B. SR CAPSTONE: DESIGN LAB II. 3 Credits.
Pre-requisites: EENG 490A.
Satisfies: a university graduation requirement—senior capstone.
See course description for EENG 490A.
EENG 491. SENIOR PROJECT. 1-6 Credits.  
**Pre-requisites:** permission of instructor.  
Independent and/or group study and implementation of a design and development project. (variable time)

EENG 495. INTERNSHIP. 1-6 Credits.  
**Notes:** graded Pass/Fail.  
**Pre-requisites:** junior or senior status and permission of the instructor, department chair and dean.

EENG 496. EXPERIMENTAL COURSE. 1-5 Credits.  
Seminars.

EENG 499. DIRECTED STUDY. 1-10 Credits.  
**Pre-requisites:** permission of the instructor, department chair and college dean.  
Designed for students wanting to pursue a subject beyond the scope of regular courses.

EENG 599. INDEPENDENT STUDY. 1-5 Credits.  
Independent Study.

**Manufacturing Technology Courses**

MNTC 208. SURVEY OF ELECTRICITY. 4 Credits.  
**Pre-requisites:** MATH 141, PHYS 100 or PHYS 131; all with grades ≥C.  
Introduces the student to direct current, alternating current (including residential wiring), and amplifying devices. (3 hours lecture, 2 hours laboratory per week)

MNTC 301. METALLIC PROCESSES. 5 Credits.  
**Pre-requisites:** MATH 107, MATH 141 or MATH 161; and METC 110; all with grades ≥C.  
Metallic Processes is a comprehensive basic course in technical metals which is designed to survey metalworking materials and processes which have been developed by modern industry. The course provides opportunity to learn the theories and scientific principles basic to the application of metalworking tools and procedures.

MNTC 320. NON-METALLIC PROCESSES. 5 Credits.  
**Pre-requisites:** MATH 141 and METC 110; all with grades ≥C.  
Survey of non-metallic materials (such as woods, plastics, and ceramics) and the industrial processes utilized to convert raw materials into finished products. Course includes characteristics and properties of non-metallic materials and utilization of industrial tools and processing equipment.

MNTC 399. DIRECTED STUDY. 1-5 Credits.  
Directed Study.

MNTC 402. MACHINE TOOL I. 5 Credits.  
**Pre-requisites:** MENG 217 and MNTC 301; both with grades ≥C.  
A comprehensive course in machine tool operations, both conventional and CNC. Course includes cutting operations, precision measurement, set up, and CNC programming. (2 hours lecture, 6 hours laboratory per week).

MNTC 404. COMPUTER NUMERICAL CONTROL. 5 Credits.  
**Pre-requisites:** MNTC 301, MNTC 402, MENG 217; all with grades ≥C.  
This course provides the learner with experience utilizing CNC processes. Programming methods will include manual, CAM software and conversational languages.

MNTC 406. WELDING TECHNOLOGY. 4 Credits.  
**Pre-requisites:** MNTC 301 with a grade ≥C, or permission of instructor.  
Theory and practice of welding ferrous and non-ferrous metals. Practice in oxyacetylene, shielded metal arc and inert gas processes. (2 hours lecture, 4 hours laboratory per week).

MNTC 430. MACHINE TOOL II. 5 Credits.  
**Pre-requisites:** MNTC 301, MNTC 402; all with grades ≥C.  
Application and theory in the design, development and function of tooling, dies, molds, jigs, and fixtures. Laboratory experiences provide a problem solving approach to development of prototypes in both unit and mass production applications. (2 hours lecture, 6 hours laboratory per week).

MNTC 439. TOPICS IN MANUFACTURING. 5 Credits.  
**Notes:** An authorized elective substitution for MNTC 495. This course is only offered during the summer quarter.  
**Pre-requisites:** TECH 331, TECH 462; all with grades ≥C, and junior standing.

This course explores topics in manufacturing that are beyond the scope of the regular program course curriculum. It allows for a more in-depth coverage through lecture, discussion, and explorations of the manufacturing world as students prepare to enter the work force.

MNTC 490. SENIOR CAPSTONE: PRODUCTION LAB. 4 Credits.  
**Cross-listed:** APTC 490, CMTC 490, DNTC 490, TECH 490.  
**Notes:** the course will simulate a real world design team concept by utilizing a design group that contains members of different program majors.  
**Pre-requisites:** senior standing.  
**Satisfies:** a university graduation requirement—senior capstone.

The course simulates the real world situation that graduates face. Students will work in teams to apply techniques of production management, product design/development, plant layout, scheduling, cost accounting, assembly, inspection and quality control to produce a product. Learning to deal with the team dynamics is a valuable learning process. Each student team produces a new product and a final written report to demonstrate how the process and goals of the course have been realized.

MNTC 491. SENIOR PROJECT. 4-6 Credits.  
**Cross-listed:** APTC 491, CMTC 491, DNTC 491, TECH 491.  
**Pre-requisites:** senior standing.  
Independent and/or group study and implementation of a design and development project. (variable time)

MNTC 495. INTERNSHIP. 1-15 Credits.  
**Cross-listed:** APTC 495, CMTC 495, DNTC 495, TECH 495.  
**Notes:** Graded Pass/Fail. This course may be repeated.  
**Pre-requisites:** junior or senior status and permission of the instructor, department chair and dean.

A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.

MNTC 496. EXPERIMENTAL COURSE. 1-6 Credits.  
**Cross-listed:** APTC 496, CMTC 496, DNTC 496, TECH 496.  
Experimental Course.

MNTC 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.  
**Cross-listed:** APTC 497, CMTC 497, DNTC 497, TECH 497.  
Workshop, short course, conference, or seminar.

MNTC 498. SEMINAR. 1-6 Credits.  
**Cross-listed:** APTC 498, CMTC 498, DNTC 498, TECH 498.  
Seminar.
MENG 201. MATLAB. 4 Credits.
Pre-requisites: MATH 141, MATH 142 or MATH 161 with a grade ≥C. This course introduces the student to the application of basic MATLAB building blocks to engineering problems. Students will get a thorough introduction to data visualization, data analysis, symbolic calculations, numeric computations and other basic skills related to MATLAB.

MENG 207. ELECTRICITY. 3 Credits.
Pre-requisites: MATH 162, PHYS 153 or PHYS 133. This course is intended to provide students with a basic understanding of electricity and its applications. In this course, basic concepts of current, voltage and resistance will be presented as well as basic circuit-analysis methods including inductor and capacitor.

MENG 217. 3D PARAMETRIC COMPUTER AIDED DESIGN. 4 Credits.
Pre-requisites: METC 110 or TECH 110 or High School AUTOCAD or permission of Instructor. This course uses the computer to draft parametric models in three dimensions. File management methods, rapid prototyping and 2D drawing development techniques are discussed. (Four hours per week.)

MENG 240. STATICS. 4 Credits.
Pre-requisites: PHYS 151, PHYS 161, and MATH 161, all with grades ≥C. Fundamentals of applied mechanics, equivalent force systems, equations of equilibrium, structures, three dimensional force systems and friction. (two hours lecture, four hours laboratory per week)

MENG 241. STRENGTH OF MATERIALS. 4 Credits.
Pre-requisites: MENG 240, MATH 162, PHYS 152, and PHYS 162, all with grades ≥C. A study of the internal stresses, internal deformations and deflections of materials. Topics may include: shear and moment diagrams for beams, combined loading on beams, temperature stresses and torsional loading. (four hours lecture per week)

MENG 242. DYNAMICS. 4 Credits.
Pre-requisites: MENG 240 with grade ≥C. Kinematics and kinetics of particles and rigid bodies using vector analysis; force mass acceleration, work and energy, impulse and momentum, translating and rotating coordinate system.

MENG 300. LABORATORY ANALYSIS AND REPORTS. 5 Credits.
Pre-requisites: PHYS 133 or PHYS 153; PHYS 163, MATH 162, ENGL 201, all with ≥C; or permission of instructor. This course examines the different aspects of laboratory analysis and report writing. This includes description of engineering problems, analysis of data including error analysis and data interpretation, instrumentation and measurements. In addition, the application of spreadsheets for solving and analyzing engineering problems, creating technical graphs, trending and curve fitting and project management will be addressed.

MENG 307. INDUSTRIAL CONTROLS AND INSTRUMENTATION. 5 Credits.
Pre-requisites: MENG 207 with a grade ≥C. This course includes principles of instrumentation, sensors, motors and actuators, electrical power systems, relays, and basic control theory. Emphasis will be on discrete control systems and methods.

MENG 353. INDUSTRIAL MATERIALS. 5 Credits.
Pre-requisites: CHEM 121 or CHEM 151, or CHEM 171; ENGL 201; MATH 141, MATH 142 or MATH 161; all ≥C. Students in this course achieve a thorough understanding of engineering materials, their properties, responses and applications. Laboratory work includes destructive and non destructive testing and image analysis of microscopic structure of industrial materials.

MENG 380. THERMODYNAMICS. 5 Credits.
Pre-requisites: PHYS 152 and PHYS 162; MATH 162; MENG 300, may be taken concurrently; all with grades ≥C. Declared Mechanical Engineering Major. This course explores properties of materials, work, heat, conversion of energy, conservation of mass and energy transformation processes. Emphasis is on application of the first and second laws to engineering systems.

MENG 382. FLUID MECHANICS. 5 Credits.
Notes: laboratory work is included.
Pre-requisites: MENG 242; grades ≥C in all of the following, PHYS 152; PHYS 162, MATH 162; MENG 300, may be taken concurrently; and a declared Mechanical Engineering major. This course introduces the student to theory, concepts and applications of fluid mechanics. Topics include static and dynamic forces; conservation of mass, energy and momentum; flow in pipes and ducts; and fan and pump performance.

MENG 385. ROBOTICS AND AUTOMATION. 5 Credits.
Notes: three hours lecture, four hours laboratory per week.
Pre-requisites: MENG 201 or CSCD 255; MENG 207 or MENG 307; all grades ≥C and a declared in Mechanical Engineering or Mechanical Engineering Technology major or permission of instructor. This course covers various electrical and mechanical systems used in robotics and other automated industrial systems. It includes automated equipment programming and industrial planning as applied to automated systems.

MENG 386. ENGINEERING NUMERICAL ANALYSIS. 5 Credits.
Pre-requisites: PHYS 153, PHYS 163; MATH 163; and either MENG 201 or CSCD 255; and a declared Mechanical Engineering major. This course covers a multitude of numerical approximation methods used to solve specific structural engineering problems and highlights the algorithms used in many common scientific software packages.

MENG 398. SEMINAR. 1-5 Credits.
Seminar

MENG 399. DIRECTED STUDY. 1-5 Credits.
Pre-requisites: junior standing; declared Mechanical Engineering major and permission of the instructor, department chair and college dean. Independent Study.

MENG 405. DESIGN OF MACHINE ELEMENTS. 5 Credits.
Pre-requisites: MATH 162 and MENG 241 and MENG 353, with grades ≥C, and a declared Mechanical Engineering major. This course covers the design of machine components and mechanisms and utilizes the concepts of engineering mechanics and strength of materials.
MENG 407. HEATING, VENTILATING AND AIR CONDITIONING. 5 Credits.
Pre-requisites: PHYS 132 or PHYS 152; PHYS 162, MENG 380 or METC 388 (may be taken concurrently), all with grades ≥C, and a declared Mechanical Engineering or Mechanical Engineering Technology major.
The study of the principles of Heating, Ventilating and Air Conditioning (HVAC) including the investigation of the basic calculations to determine heating and cooling loads and the study of the basic equipment design for HVAC.

MENG 412. FUNDAMENTALS OF ENGINEERING. 2 Credits.
Pre-requisites: senior standing; MENG 241 or METC 341; MENG 242 or METC 342; MENG 380 or METC 388; and declared into one of the following: Mechanical Engineering, Mechanical Engineering Technology; or permission of instructor.
This course reviews the fundamentals of engineering. It provides an overview of principles of the practice of engineering and assists students in preparation for the first steps in professional licensure.

MENG 444. HEAT TRANSFER. 5 Credits.
Pre-requisites: MATH 241, MATH 347, MENG 300, MENG 382, MENG 386; all with grades ≥C, and a declared Mechanical Engineering major.
This course provides a detailed calculus-based analysis of the heat transfer through solids, fluids and vacuums. Concepts include conduction, convection, and radiation heat transfer in one and two dimensions for steady and unsteady states.

MENG 452. ENGINEERING ECONOMICS. 2 Credits.
Pre-requisites: MATH 142 or MATH 161, with grades ≥C, and a declared Mechanical Engineering or Mechanical Engineering Technology major; junior standing; or permission of instructor.
This course focuses on the systematic evaluation of the economic benefits and costs of projects involving engineering design and analysis. Engineering economics quantifies the benefits and costs associated with engineering projects to determine whether they make (or save) enough money to warrant their capital investment.

MENG 453. MATERIALS AND DESIGN. 5 Credits.
Pre-requisites: MENG 241 and MENG 353, both with grades ≥C; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
This course expands upon the concepts covered in the Industrial Materials class. Focus is on how materials and the design of products and the processes to make them are interrelated. Students explore processing and properties of materials such as glass, ceramics, polymers and metals other than steel.

MENG 455. COMPOSITE MATERIALS. 5 Credits.
Pre-requisites: MENG 201 and MENG 353, both with grades ≥C; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
This course covers basics of composite materials including manufacturing, design and applications. Students learn anisotropic and heterogeneous material systems; types of composite constituents; physical and mechanical properties; micro, macro and ply mechanics; composite design related to strength and different failure modes; and applications of composite beams, plates and stiffened panels.

MENG 482. ADVANCED FLUID DYNAMICS. 5 Credits.
Pre-requisites: grades ≥C in all of the following, MATH 347, MENG 217, MENG 382; and a declared Mechanical Engineering major.
Students apply fluid principles to various technical situations and utilize advanced methods to derive a solution. Topics covered may include Computational Fluid Dynamics (CFD), turbo machinery, compressible fluid flow, turbulence, thermo-fluid system design, and fan and pump performance.

MENG 485. ADVANCED ROBOTICS AND AUTOMATION. 5 Credits.
Pre-requisites: MENG 385 with a grade ≥B; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
A study of the various electrical and mechanical systems used in advanced robotics and other automated systems. Topics include automated equipment, programming and industrial planning as applied to automated systems, robotic vision, cooperative robotics and service robots.

MENG 486. PROGRAMMABLE LOGIC CONTROLLERS IN AUTOMATION. 5 Credits.
Pre-requisites: MENG 385 with a grade ≥B; and a declared major in Mechanical Engineering or Mechanical Engineering Technology.
A study of Programmable Logic Controllers used in industrial automation and advanced robotics. Course explores automated equipment, ladder logic programming and industrial planning as applied to automated systems.

MENG 487. PROCESS CONTROL. 5 Credits.
Pre-requisites: MENG 385 with a grade ≥B; and a declared major in Mechanical Engineering.
This course includes a study of process control and automation, including basic control concepts, open and closed loop systems, sensors, actuators, control methods. Practical emphasis one the control of flow, temperature, pressure, and level systems with PID control.

MENG 490A. SENIOR CAPSTONE: DESIGN LABORATORY I. 2 Credits.
Pre-requisites: MENG 217, MENG 241, MNTC 301 and ENGL 201, all with a grade ≥C; and senior standing; and a declared Mechanical Engineering major.
Satisfies: a university graduation requirement–senior capstone.
This course simulates the industrial environment, where students work in teams to solve a real world problem from design to implementation. Team dynamics and project constraints are strictly monitored and each student’s unique skills are utilized in different stages of the design process.

MENG 490B. SENIOR CAPSTONE: DESIGN LABORATORY II. 3 Credits.
Pre-requisites: MENG 490A.
Satisfies: a university graduation requirement–senior capstone.
See description for MENG 490A.

MENG 491. SENIOR THESIS. 1-6 Credits.
Pre-requisites: permission of instructor.
Independent and/or group study and implementation of a design and development project. (variable time)

MENG 492. FINITE ELEMENT ANALYSIS. 5 Credits.
Pre-requisites: grades ≥C in all of the following, MATH 347, MENG 217, MENG 241; and a declared Mechanical Engineering major or permission of the instructor.
This course introduces the computational methods to solve engineering problems using the finite element approach. Modeling techniques for different engineering structures such as truss, beams, frames, two and three dimensional solids, and thin-walled structures are introduced in this course. Students solve a wide variety of engineering problems dealing with statics, dynamics, fluid mechanics, heat transfer and design and material selections using the state of art FEA software.
MENG 493. SENIOR SEMINAR. 1 Credit.
Notes: graded Pass/Fail.
Pre-requisites: senior standing or permission of instructor; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
This course provides the students firsthand exposure to the latest technological advances directly from the manufacturer or researcher. This helps students in their lifelong learning and provides an opportunity to inquire about particular topics or fields of interest.

MENG 495. INTERNSHIP. 1-6 Credits.
Notes: Graded Pass/Fail. A minimum of 180 hours of work is required for students to complete the internship experience. Students working part-time over multiple quarters will have the credit hours divided across quarters to match the hours worked in each quarter.
Pre-requisites: junior or senior status and permission of the instructor, department chair and dean; and declared Mechanical Engineering major.
This course gives students applied field experience working in industry. Students will apply engineering principles to solve problems under the supervision of a practicing engineer.

MENG 496. EXPERIMENTAL COURSE. 1-10 Credits.
MENG 499. DIRECTED STUDY. 1-10 Credits.
Pre-requisites: permission of the instructor, department chair and college dean; senior standing; and a declared Mechanical Engineering major.
Designed for students wanting to pursue a subject beyond the scope of regular courses.

Mechanical Engineering Technology Courses

Metc 102. INTRODUCTION TO ENGINEERING GRAPHICS. 4 Credits.
Notes: graded Pass/Fail.
This course offers an introduction to the fundamentals of technical drawing. It emphasizes the technical methods used to describe the size and shape of objects. This course will not satisfy elective requirements for a major or minor in Technology.

Metc 110. ENGINEERING GRAPHICS. 5 Credits.
Notes: two years of high school drafting is highly recommended.
Pre-requisites: Metc 102 or permission of instructor.
A study of the technical portion of the graphics language. This language, technical drawing, is used by engineers to communicate proposed designs and new ideas. Includes the theory and practice of descriptive geometry and the graphic representation of data.

Metc 340. STATICS. 5 Credits.
Pre-requisites: Math 142 or Math 161; Phys 131 or Phys 151; all with grades ≥C.
A study of applied mechanics and the principles of statics dealing with forces and with the effects of forces acting upon rigid bodies at rest.

Metc 341. STRENGTH OF MATERIALS. 4 Credits.
Pre-requisites: Metc 340 or MENG 240, both with grades ≥C.
A study of the relationship that exists between externally applied forces and internally induced stresses in members and parts, including the relationship existing between these same externally applied forces and the resulting deformations. (four hours lecture per week)

Metc 342. DYNAMICS. 4 Credits.
Pre-requisites: Metc 340 or MENG 240 and Math 162; all with grades ≥C.
This course is a study of the motion of rigid bodies and forces affecting their motion. Topics include kinematics and kinetic of motion, curvilinear motion, plane motion, work, energy and power, impulse and momentum. (four hours lecture per week)

Metc 348. ENERGY MANAGEMENT AND UTILIZATION. 5 Credits.
Pre-requisites: Metc 380 or Metc 388, both with grades ≥C.
The study of energy usage and energy management within industrial facilities. The development of energy audit procedures including the energy saving calculations for industrial settings. Students will develop and explore the creation of industrial energy audits through the extensive use of case studies.

Metc 387. FLUID MECHANICS. 5 Credits.
Notes: laboratory work is included.
Pre-requisites: Phys 132 or Phys 152; Phys 162, Math 162; MENG 300 (may be taken concurrently); all with grades ≥C, and a declared Mechanical Engineering Technology major.
This course introduces the student to theory, concepts and applications of fluid mechanics. Topics include static and dynamic forces; conservation of mass, energy and momentum; flow in pipes and ducts; and fan and pump performance.

Metc 388. THERMODYNAMICS AND HEAT TRANSFER. 5 Credits.
Pre-requisites: Phys 132 or Phys 152; Phys 162, Math 162, MENG 300, may be taken concurrently; all with grades ≥C; and a declared Mechanical Engineering Technology major.
This course introduces the student to theory, concepts and applications of thermodynamics and heat transfer. Topics include properties of materials, work, heat, conservation of mass and energy, energy transformation processes, and heat transfer via conduction, convection and radiation.

Metc 399. DIRECTED STUDY. 1-5 Credits.
Directed Study.

Metc 415. DESIGN OF MACHINE ELEMENTS. 5 Credits.
Pre-requisites: Metc 341 or MENG 241; MENG 353, Math 162; all with grades ≥C, and a declared Mechanical Engineering Technology major.
This course covers the design of machine components and mechanisms and utilizes the concepts of engineering mechanics and strength of materials.

Metc 417. ADVANCED PARAMETRIC DESIGN. 5 Credits.
Pre-requisites: MENG 217; Math 162; Metc 341 or MENG 241, all with a grade ≥C; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
Advanced techniques and best practices for parametric design of parts and assemblies. These advanced methodologies include design simulation and analysis including stress analysis, thermal analysis, flow analysis, vibration and motion studies, and design optimization.

Metc 456. ENGINEERING ETHICS, CONTRACTS AND PATENTS. 2 Credits.
Pre-requisites: junior standing, ENGL 201 with a ≥C, and a declared Mechanical Engineering or Mechanical Engineering Technology major.
This course investigates the elements of professional engineering practice including their relationship to the law, to the public and the ethics of the profession. Topics covered range from ethics, contracts, patents, copyrights, sales agreements and engineering specifications to professionalism, licensing, intellectual property, liability, risk, reliability and safety.
METC 468. QUALITY ASSURANCE AND INTRO TO LEAN. 5 Credits.
Pre-requisites: PHYS 132 or PHYS 152; PHYS 162; MATH 162; MENG 300, may be taken concurrently, all with grades ≥C; and a declared Mechanical Engineering or Mechanical Engineering Technology major.
Application and theory of quality control and continuous improvement systems. This includes statistical analysis, design of experiments, development and use of process control charts, sampling processes, time and motion studies, and introduction to other Lean tools.

METC 490A. SENIOR CAPSTONE: DESIGN LABORATORY I. 2 Credits.
Pre-requisites: METC 341 or MENG 241; MENG 217, MATH 162, MNTC 301 and ENGL 201, all with grades ≥C; and senior standing; and a declared Mechanical Engineering Technology major.
Satisfies: a university graduation requirement–senior capstone.
This course simulates the industrial environment, where students work in teams to solve a real world problem from design to implementation. Team dynamics and project constraints are strictly monitored and each student’s unique skills are utilized in different stages of the design process.

METC 490B. SENIOR CAPSTONE: DESIGN LABORATORY II. 3 Credits.
Pre-requisites: METC 490A. Must be a declared Mechanical Engineering Technology major.
Satisfies: a university graduation requirement–senior capstone.
See description for METC 490A.

METC 491. SENIOR PROJECT. 1-10 Credits.
Pre-requisites: senior standing, a declared Mechanical Engineering Technology major and permission of the instructor and chair. Independent and/or group study and implementation of a design and development project. (variable time).

METC 495. INTERNSHIP. 1-5 Credits.
Notes: Graded Pass/Fail. May be repeated for credit. A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.
Pre-requisites: junior or senior status and permission of the instructor, department chair and dean and a declared Mechanical Engineering Technology major.
This course gives students applied field experience working in industry. Students will apply engineering principles to solve problems under the supervision of a practicing engineer. A minimum of 180 hours of work is required for students to complete the internship experience. Students working part-time over multiple quarters will have the credit hours divided across quarters to match the hours worked in each quarter.

METC 499. DIRECTED STUDY. 1-5 Credits.
Pre-requisites: permission of the instructor, department chair and college dean. Designed for students wanting to pursue a subject beyond the scope of regular courses.

TECH 197. WORKSHOP; SHORT COURSE; CONFERENCE; SEMINAR. 1-5 Credits.

TECH 199. DIRECTED STUDY. 1-5 Credits.

TECH 297. WORKSHOP; SHORT COURSE; CONFERENCE; SEMINAR. 1-5 Credits.

TECH 298. SEMINAR. 1-5 Credits.

TECH 330. TECHNOLOGY PROBLEM ANALYSIS AND DESIGN I. 4 Credits.
Pre-requisites: ENGL 201 ≥C.
Development of advanced skills in technical problem analysis, planning, research, solution strategies, critical thinking and presentation. Computer-aided design tools such as CAD, project-planning software, spreadsheets, as well as imaging and publishing software are used. Emphasis is on consideration of interconnected systems.

TECH 331. TECHNOLOGY PROBLEM ANALYSIS AND DESIGN II. 4 Credits.
Pre-requisites: TECH 330 ≥C.
Development of student’s synthesis, design, organizational, and learning skills through examination of current research and/or design topics in Technology.

TECH 393. TECHNOLOGY WORLD CIVILIZATION. 4 Credits.
Cross-listed: HONS 393.
Pre-requisites: ENGL 201 ≥C.
Satisfies: a university graduation requirement–global studies.
Students will investigate the issues surrounding technological change in discrete cultural settings with a historical perspective of the evolution of technology in a global context.

TECH 395. CO-OP FIELDWORK. 1-5 Credits.

TECH 396. EXPERIMENTAL COURSE. 1-6 Credits.

TECH 397. WORKSHOP; SHORT COURSE; CONFERENCE; SEMINAR. 1-5 Credits.

TECH 398. SEMINAR. 4 Credits.

TECH 403. COMPUTER-AIDED DESIGN AND PROJECT MANAGEMENT. 4 Credits.
Pre-requisites: MATH 107, MATH 141, MATH 142 or MATH 161; ≥C.
The application of spreadsheets to solve engineering problems, technical graphs, trending and curve fitting. The introduction to the use of computer-aided scheduling of projects, critical path planning, project tracking and cost collection.

TECH 452. ENGINEERING ECONOMICS. 4 Credits.
Notes: this course cannot be substituted for MENG 452 in degrees that require that class.
Pre-requisites: MATH 107 or MATH 141; ≥C.
This course focuses on the systematic evaluation of the economic benefits and costs of projects involving engineering design and analysis. Engineering economics quantifies the benefits and costs associated with engineering projects to determine whether they make (or save) enough money to warrant their capital investment.

TECH 454. ENVIRONMENTAL ENGINEERING. 4 Credits.
Pre-requisites: PHYS 100, PHYS 110 or PHYS 121; ENGL 201; MATH 107 or MATH 141; all ≥C.
This course explores ways to promote the design and manufacturing of environmentally sound products and processes. Benefits include environmentally-friendly products, more efficient operations and the good will of an informed public that expects a clean, healthy environment.
TECH 456. ENGINEERING ETHICS, CONTRACTS AND PATENTS. 4 Credits.
Pre-requisites: ENGL 201 ≥C.
This course investigates the elements of professional engineering practice including their relationship to the law, to the public and the ethics of the profession. Topics covered range from ethics, contracts, patents, copyrights, sales agreements and engineering specifications to professionalism, licensing, intellectual property, liability, risk, reliability and safety.

TECH 458. QUALITY ASSURANCE. 4 Credits.
Notes: this course cannot be substituted for METC 468 in degrees that require that class.
Pre-requisites: MATH 107 or MATH 141; ≥C.
Application and theory of quality control systems including development and use of process control charts, sampling, time and motion studies, and statistical analysis.

TECH 462. INDUSTRIAL SAFETY ENGINEERING. 4 Credits.
Pre-requisites: junior standing and ENGL 201 ≥C.
Fundamentals of safety, classification of hazards, accident statistics, organization problems, safety codes, machine guarding, mechanical, electrical and chemical hazards, ventilation, respiratory and safety devices. (4 hours lecture per week)

TECH 490. SENIOR CAPSTONE: PRODUCTION LAB. 4 Credits.
Cross-listed: APTC 490, CMTC 490, DNCTC 490, MNTC 490.
Notes: the course will simulate a real world design team concept by utilizing a design group that contains members of different program majors.
Pre-requisites: senior standing.
Satisfies: a university graduation requirement—senior capstone. The course simulates the real world situation that graduates face. Students will work in teams to apply techniques of production management, product design/development, plant layout, scheduling, cost accounting, assembly, inspection and quality control to produce a product. Learning to deal with the team dynamics is a valuable learning process. Each student team produces a new product and a final written report to demonstrate how the process and goals of the course have been realized.

TECH 491. SENIOR PROJECT. 4-6 Credits.
Cross-listed: APTC 491, CMTC 491, DNCTC 491, MNTC 491.
Pre-requisites: senior standing.
Independent and/or group study and implementation of a design and development project. (variable time).

TECH 495. INTERNSHIP. 1-15 Credits.
Cross-listed: APTC 495, CMTC 495, DNCTC 495, MNTC 495.
Notes: Graded Pass/Fail. This course may be repeated.
Pre-requisites: junior or senior status and permission of the instructor, department chair and dean.
A maximum of 5 credits may be earned toward electives for a Technology major. Students considering electives for a Technology minor should consult with their departmental advisor.

TECH 496. EXPERIMENTAL COURSE. 1-6 Credits.
Cross-listed: APTC 496, CMTC 496, DNCTC 496, MNTC 496.
Experimental Course.

TECH 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.
Cross-listed: APTC 497, CMTC 497, DNCTC 497, MNTC 497.
Workshop, short course, conference, or seminar.

TECH 498. SEMINAR. 1-6 Credits.
Cross-listed: APTC 498, CMTC 498, DNCTC 498, MNTC 498.
Seminar.

TECH 499. DIRECTED STUDY. 1-5 Credits.
Cross-listed: APTC 499, CMTC 499, DNCTC 499, MNTC 499.
Pre-requisites: permission of the instructor, department chair and college dean.
Designed for students wanting to pursue a subject beyond the scope of regular courses.

TECH 539. SPECIAL STUDIES TECHNOLOGY. 1-5 Credits.

TECH 595. INTERNSHIP. 1-5 Credits.

TECH 596. EXPERIMENTAL COURSE. 1-5 Credits.

TECH 597. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-6 Credits.
Notes: only one workshop course for up to 3 credits may be used to fulfill graduate degree requirements.

TECH 598. SEMINAR. 1-6 Credits.

TECH 599. INDEPENDENT STUDY. 1-6 Credits.
Notes: may be repeated within the 6 credits allowed to fulfill the student’s goals and needs in specific areas.
Pre-requisites: permission of the instructor, department chair and college dean.

TECH 600. THESIS. 2-6 Credits.
Pre-requisites: permission of the instructor, department chair and college dean.
Independent research study under the direction of a graduate adviser committee.

TECH 601. RESEARCH REPORT. 2-6 Credits.

TECH 695. INTERNSHIP. 1-6 Credits.
Pre-requisites: permission of the instructor, department chair and college dean.

TECH 696. COLLEGE TEACHING INTERNSHIP. 1-5 Credits.
Pre-requisites: permission of the instructor, department chair and college dean.
Teaching a lower-division college course under supervision of a regular faculty member. Includes course planning, arranging bibliographical and instructional aids, conferences with students, experience in classroom instruction and student course evaluation.