

ELECTRICAL ENGINEERING (ELECENG)

Electrical Engineering Courses

ELECENG 101 Fundamentals of Electrical Engineering

3 cr. Undergraduate.

Principles of electrical engineering including intro to fundamental electrical quantities and circuit analysis. Lab with reinforcing experiments, introduction to electrical test equipment, computer simulation techniques, and team project.

Prerequisites: concurrent enrollment in MATH 105 or MATH 108.

Course Rules: Counts as repeat of ELECENG 299 with same topic. Not open to students who have completed ELECENG 301.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 140 Intro to Embedded Computing I: Digital Logic and Microprocessors

3 cr. Undergraduate.

Explores the foundations of computing and programming in terms of the bits and gates that carry out computations. A module on Matlab is included.

Prerequisites: MATH 115(C).

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 150 Electronic Technology in the World Around Us

3 cr. Undergraduate.

An introductory course that explains the modern technology affecting our everyday life. Topics include: digital communication, satellites, television, stereo system, computer, radar, microwaves, lasers.

Prerequisites: none.

General Education Requirements: NS

Last Taught: Fall 2019, Spring 2019, Fall 2018, Spring 2018.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 201 Foundations of Electrical Engineering

3 cr. Undergraduate.

Background of electrical engineering, basic electrical laws and quantities, experimental explorations, discussion of recent electrical devices and technologies.

Prerequisites: MATH 115(C).

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 234 Analytical Methods in Engineering

4 cr. Undergraduate.

Mathematical techniques for linear systems. Solutions of ordinary differential equations by classical and transform techniques. Elementary aspects of linear algebra. Complex Numbers.

Prerequisites: a grade of C or better in MATH 232(P).

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 240 Intro to Embedded Computing II: C Programming for Embedded Applications

4 cr. Undergraduate.

C programming, basics including variables, functions, Input/Output, pointers and computer-memory. In lab, students complete programming assignments using industrial computers. Builds on knowledge of computer hardware and operation developed in ELECENG 140/MECHENG 140.

Prerequisites: ELECENG 140(P).

Course Rules: A MATLAB module is included. ELECENG 240 and MECHENG 240 are jointly offered and count as repeats of one another.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 299 Topics in Electrical Engineering:

1-3 cr. Undergraduate.

Work on new material in electrical engineering. Section title and credits announced whenever course is offered.

Prerequisites: specific courses dependent on topic.

Course Rules: May be retaken with change in topic to max of 6 cr max.

Last Taught: Fall 2011, Fall 2010, Fall 2005, Fall 1998.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 301 Electrical Circuits and Electronics I

3 cr. Undergraduate.

Circuit laws and analysis, resistive circuits, inductors and capacitor circuits, AC circuits and ideal Op-Amp circuits, basic diode and transistor devices and circuits.

Prerequisites: ELECENG 101(P) or ELECENG 201(P) or PHYSICS 210(C) or PHYSICS 220(C) and MATH 231(C).

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 305 Electrical Circuits II

4 cr. Undergraduate.

Transformers, transient response, network functions, s-domain, response, filters, fourier analysis, two-ports.

Prerequisites: ELECENG 234(P) and ELECENG 301(P).

Course Rules: 3 hr lec/2 hr lab.

Last Taught: Spring 2025, Fall 2024, Fall 2023, Spring 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 306 Introduction to Electrical Engineering

4 cr. Undergraduate.

An introduction to electrical circuits with laboratory. Topics include dc and ac circuits, signal transients, motors, transformers and operational amplifiers.

Prerequisites: PHYSICS 210(P); ELECENG 234(P).

Last Taught: Spring 2016, Fall 2015, Spring 2015, Fall 2014.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 310 Signals and Systems

3 cr. Undergraduate.

Analysis techniques for signals and systems in both continuous and discrete time. Signal representation, including fourier and laplace transforms; system definitions and properties.

Prerequisites: ELECENG 234(P) and ELECENG 301(P); or graduate standing; or special student.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 330 Electrical Circuits and Electronics II

4 cr. Undergraduate.

Phasor analysis, Transformer, Filter, Resonance, Non-ideal Op-amps, BJT, and MOSFET-based amplifiers.

Prerequisites: ELECENG 301(P).**Course Rules:** Counts as repeat of ELECENG 331.**Last Taught:** Spring 2025, Fall 2024, Spring 2024, Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 335 Electronics II**

4 cr. Undergraduate.

CMOS Logic Gates, Differential and multistage amplifiers, IC techniques, frequency response.

Prerequisites: ELECENG 330(P) and ELECENG 310(C).**Course Rules:** Counts as repeat of ELECENG 332.**Last Taught:** Fall 2024, Spring 2024, Fall 2023, Spring 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 340 Embedded Systems I: C and C++ Programming for Embedded Applications**

3 cr. Undergraduate.

Engineering real-world embedded microcontroller computer applications incorporating digital I/O, analog I/O, precision timing, serial communications; project design and execution in industry; C and PLC programming and algorithm development.

Prerequisites: ELECENG 240(P).**Course Rules:** ELECENG 340 and MECHENG 340 are jointly offered and count as repeats of one another.**Last Taught:** Fall 2024, Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 354 Digital Logic**

3 cr. Undergraduate.

Number systems and binary codes; Boolean Algebra and basic results; switching functions; minimization techniques; analysis and design of combinational and sequential logic circuits.

Prerequisites: COMPSCI 240(P) or COMPSCI 250(P).**Last Taught:** Fall 2022, Spring 2022, Fall 2021, Spring 2021.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 361 Electromagnetic Fields**

3 cr. Undergraduate.

Principles of electrostatics and electromagnetics; laws of fields; resistance, inductance, and capacitance; dielectrics; energy storage; Maxwell's field equation.

Prerequisites: PHYSICS 210(P) and PHYSICS 215(P) or PHYSICS 220(P); ELECENG 234(P), and MATH 233(P).**Last Taught:** Fall 2024, Spring 2024, Fall 2023, Spring 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 362 Electromechanical Energy Conversion**

4 cr. Undergraduate.

Principles of electrical and electromechanical energy conversion; transformers, polyphase induction and synchronous machines, d.c. machines, single phase motors, including design parameters and testing.

Prerequisites: ELECENG 234(P) and ELECENG 301(P); or graduate standing. Special students must satisfy course prerequisites.**Course Rules:** 3 hr lec recitation and 2 hr lab per week.**Last Taught:** Spring 2025, Fall 2024, Spring 2024, Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 367 Introduction to Microprocessors**

4 cr. Undergraduate.

Fundamentals of microprocessors, including assembly language programming, hardware design, interfacing peripherals and programmable I/O devices, and social/ethical issues in engineering design and practice. Lab.

Prerequisites: COMPSCI 240(P) or COMPSCI 250(P); and a grade of C or better in ELECENG 354(P).**Last Taught:** Spring 2023, Fall 2022, Spring 2022, Fall 2021.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 410 Digital Signal Processing**

3 cr. Undergraduate/Graduate.

Spectral computation including DFT and FFT, sampling of continuous signals, digital filter design including FIR and IIR filters.

Prerequisites: junior standing and ELECENG 310(P).**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 410G Digital Signal Processing**

3 cr. Undergraduate/Graduate.

Spectral computation including DFT and FFT, sampling of continuous signals, digital filter design including FIR and IIR filters.

Prerequisites: junior standing and ELECENG 310(P).**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 411 Machine Learning and Applications**

3 cr. Undergraduate/Graduate.

Important topics and application in machine learning, including deep learning. Provides hands-on experience with machine learning software and libraries.

Prerequisites: completion of one of the following: COMPSCI 202(P), COMPSCI 241(P), or COMPSCI 250(P); or consent of instructor.**Course Rules:** COMPSCI 411 and ELECENG 411 are jointly offered and count as repeats of one another.**Last Taught:** Spring 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 411G Machine Learning and Applications**

3 cr. Undergraduate/Graduate.

Important topics and application in machine learning, including deep learning. Provides hands-on experience with machine learning software and libraries.

Prerequisites: completion of one of the following: COMPSCI 202(P), COMPSCI 241(P), or COMPSCI 250(P); or consent of instructor.**Course Rules:** COMPSCI 411 and ELECENG 411 are jointly offered and count as repeats of one another.**Last Taught:** Spring 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 420 Random Signals and Systems**

3 cr. Undergraduate/Graduate.

Fundamental probability and random process theory, power spectral density. Linear systems and random signals, auto- and cross-correlation, optimum MSE filter design.

Prerequisites: junior standing and ELECENG 310(P); or graduate standing.**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>

ELECENG 420G Random Signals and Systems

3 cr. Undergraduate/Graduate.

Fundamental probability and random process theory, power spectral density. Linear systems and random signals, auto- and cross-correlation, optimum MSE filter design.

Prerequisites: junior standing and ELECENG 310(P); or graduate standing.

Last Taught: Spring 2025.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 421 Communication Systems

3 cr. Undergraduate/Graduate.

Basic concepts of information; modulation, transmission and demodulation; presentation of information; practical communication systems.

Prerequisites: junior standing and ELECENG 335(C).

Last Taught: Spring 2025, Spring 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 421G Communication Systems

3 cr. Undergraduate/Graduate.

Basic concepts of information; modulation, transmission and demodulation; presentation of information; practical communication systems.

Prerequisites: junior standing and ELECENG 335(C).

Last Taught: Spring 2025, Spring 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 430 Energy Modeling

3 cr. Undergraduate/Graduate.

Electrical/thermal energy modeling through lectures and hands-on classroom work along with use of energy modeling software.

Prerequisites: junior standing or consent of instructor.

Course Rules: ELECENG 430 and MECHENG 430 are jointly offered and count as repeats of one another.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 430G Energy Modeling

3 cr. Undergraduate/Graduate.

Electrical/thermal energy modeling through lectures and hands-on classroom work along with use of energy modeling software.

Prerequisites: junior standing or consent of instructor.

Course Rules: ELECENG 430 and MECHENG 430 are jointly offered and count as repeats of one another.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 436 Introduction to Medical Instrumentation

3 cr. Undergraduate/Graduate.

Biopotential signals and electrodes; Biopotential Amplifiers and Signal Processing; Sensors, Detectors, and Sources; Electrical Safety; Specifications; Error Analysis; Device Approval Process.

Prerequisites: junior standing and ELECENG 305(P) or equivalent.

Last Taught: Spring 2024, Fall 2018.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 436G Introduction to Medical Instrumentation

3 cr. Undergraduate/Graduate.

Biopotential signals and electrodes; Biopotential Amplifiers and Signal Processing; Sensors, Detectors, and Sources; Electrical Safety; Specifications; Error Analysis; Device Approval Process.

Prerequisites: junior standing and ELECENG 305(P) or equivalent.

Last Taught: Spring 2024, Fall 2018.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 437 Introduction to Biomedical Imaging

3 cr. Undergraduate/Graduate.

Biomedical imaging modalities and underlying principles: X-radiography, computerized tomography, Radon transforms; image reconstruction techniques; ultrasonic imaging; nuclear medicine; magnetic resonance imaging; experimental techniques.

Prerequisites: senior standing; completion of BME 310(P) or ELECENG 310(P).

Course Rules: BME 437/ELECENG 437 are jointly offered and count as repeats of one another.

Last Taught: Fall 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 437G Introduction to Biomedical Imaging

3 cr. Undergraduate/Graduate.

Biomedical imaging modalities and underlying principles: X-radiography, computerized tomography, Radon transforms; image reconstruction techniques; ultrasonic imaging; nuclear medicine; magnetic resonance imaging; experimental techniques.

Prerequisites: senior standing; completion of BME 310(P) or ELECENG 310(P).

Course Rules: BME 437/ELECENG 437 are jointly offered and count as repeats of one another.

Last Taught: Fall 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 439 Introduction to Biomedical Optics

3 cr. Undergraduate/Graduate.

Tissue Optical Properties, Light Transport, Fourier Transforms in Spatial Domain, Wave theory, Spectroscopy, Optical imaging, Laser-Tissue interaction, Photoconversion, Photodynamic Therapy, Microscopy, Fluorescence imaging, and OCT.

Prerequisites: senior standing; ELECENG 310(P) or BME 310 (P).

Course Rules: BME 439/ELECENG 439 are jointly offered and count as repeats of each other.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 439G Introduction to Biomedical Optics

3 cr. Undergraduate/Graduate.

Tissue Optical Properties, Light Transport, Fourier Transforms in Spatial Domain, Wave theory, Spectroscopy, Optical imaging, Laser-Tissue interaction, Photoconversion, Photodynamic Therapy, Microscopy, Fluorescence imaging, and OCT.

Prerequisites: senior standing; ELECENG 310(P) or BME 310 (P).

Course Rules: BME 439/ELECENG 439 are jointly offered and count as repeats of each other.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 440 Embedded Systems II: Advanced Embedded Systems

3 cr. Undergraduate.

Real time operating systems for embedded microcontroller systems; implementation of multitasking, synchronization and protection; major project.

Prerequisites: ELECENG 340(P).

Course Rules: ELECENG 440 and MECHENG 440 are jointly offered and count as repeats of one another.

Last Taught: Spring 2025, Fall 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 451 Introduction to VLSI Design

3 cr. Undergraduate/Graduate.

Introduction to design of VLSI circuits. Ic fundamentals including: energy band diagrams, transistor optimization, design approaches including both customs and semi-custom.

Prerequisites: junior standing and ELECENG 330(P).**Last Taught:** Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 451G Introduction to VLSI Design**

3 cr. Undergraduate/Graduate.

Introduction to design of VLSI circuits. Ic fundamentals including: energy band diagrams, transistor optimization, design approaches including both customs and semi-custom.

Prerequisites: junior standing and ELECENG 330(P).**Last Taught:** Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 457 Digital Logic Laboratory**

3 cr. Undergraduate/Graduate.

Digital design using a hardware description language and FPGAs. Topics include VHDL, design methodologies, finite state machines, multiple clock domains, timing analysis, simulation and verification.

Prerequisites: junior standing and ELECENG 140(P).**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 457G Digital Logic Laboratory**

3 cr. Undergraduate/Graduate.

Digital design using a hardware description language and FPGAs. Topics include VHDL, design methodologies, finite state machines, multiple clock domains, timing analysis, simulation and verification.

Prerequisites: junior standing and ELECENG 140(P).**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 458 Computer Architecture**

3 cr. Undergraduate/Graduate.

Processor organization, memory hierarchy, pipelining, computer architectures exploiting instruction/data/thread level parallelism, warehouse scale computers.

Prerequisites: sophomore standing and a grade of C or better in COMPSCI 337(P) or ELECENG 240(P); and a grade of C or better in COMPSCI 351(P).**Course Rules:** COMPSCI 458 and ELECENG 458 are jointly offered and count as repeats of one another.**Last Taught:** Spring 2021, Fall 2020.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 458G Computer Architecture**

3 cr. Undergraduate/Graduate.

Processor organization, memory hierarchy, pipelining, computer architectures exploiting instruction/data/thread level parallelism, warehouse scale computers.

Prerequisites: sophomore standing and a grade of C or better in COMPSCI 337(P) or ELECENG 240(P); and a grade of C or better in COMPSCI 351(P).**Course Rules:** COMPSCI 458 and ELECENG 458 are jointly offered and count as repeats of one another.**Last Taught:** Spring 2021, Fall 2020.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 461 Microwave Engineering**

3 cr. Undergraduate/Graduate.

Review from electromagnetics, transmission lines and waveguides; impedance matching, passive components, stripline and microstrip line circuits, dielectric waveguide, laboratory experiments, industrial and biomedical applications.

Prerequisites: junior standing and ELECENG 361(P) or equivalent.**Last Taught:** Spring 2021.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 461G Microwave Engineering**

3 cr. Undergraduate/Graduate.

Review from electromagnetics, transmission lines and waveguides; impedance matching, passive components, stripline and microstrip line circuits, dielectric waveguide, laboratory experiments, industrial and biomedical applications.

Prerequisites: junior standing and ELECENG 361(P) or equivalent.**Last Taught:** Spring 2021.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 464 Fundamentals of Photonics**

3 cr. Undergraduate/Graduate.

Fundamentals of ray, electromagnetic, and beam optics; polarization and polarization-based devices; optics of layered media; and guided-wave optics, including optical fibers.

Prerequisites: junior standing and ELECENG 361(P); or graduate standing.**Last Taught:** Fall 2022.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 464G Fundamentals of Photonics**

3 cr. Undergraduate/Graduate.

Fundamentals of ray, electromagnetic, and beam optics; polarization and polarization-based devices; optics of layered media; and guided-wave optics, including optical fibers.

Prerequisites: junior standing and ELECENG 361(P); or graduate standing.**Last Taught:** Fall 2022.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 465 Broadband Optical Networks**

3 cr. Undergraduate/Graduate.

Multichannel lightwave systems based on wavelength-division, time-division, and subcarrier multiplexing; optical devices and coding techniques for implementing optical networks.

Prerequisites: junior standing, ELECENG 305(P), and ELECENG 361(P); or graduate standing.**Course Rules:** Counts as repeat of ELECENG 490 with the same topic.**Last Taught:** Spring 2018, Spring 2013.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 465G Broadband Optical Networks**

3 cr. Undergraduate/Graduate.

Multichannel lightwave systems based on wavelength-division, time-division, and subcarrier multiplexing; optical devices and coding techniques for implementing optical networks.

Prerequisites: junior standing, ELECENG 305(P), and ELECENG 361(P); or graduate standing.**Course Rules:** Counts as repeat of ELECENG 490 with the same topic.**Last Taught:** Spring 2018, Spring 2013.**Current Offerings:** <https://catalog.uwm.edu/course-search/>

ELECENG 471 Electric Power Systems

3 cr. Undergraduate/Graduate.

Elements of a typical power system. Per-unit quantities; load flow study; economic dispatch; symmetrical components; fault study; system protection; stability.

Prerequisites: junior standing and ELECENG 362(C).**Last Taught:** Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 471G Electric Power Systems**

3 cr. Undergraduate/Graduate.

Elements of a typical power system. Per-unit quantities; load flow study; economic dispatch; symmetrical components; fault study; system protection; stability.

Prerequisites: junior standing and ELECENG 362(C).**Last Taught:** Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 474 Introduction to Control Systems**

4 cr. Undergraduate/Graduate.

Modeling of continuous systems; stability considerations, analysis and design of feedback control systems in time and frequency domains.

Prerequisites: junior standing; ELECENG 310(P), and COMPSC 240(P); or graduate standing.**Last Taught:** Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 474G Introduction to Control Systems**

4 cr. Undergraduate/Graduate.

Modeling of continuous systems; stability considerations, analysis and design of feedback control systems in time and frequency domains.

Prerequisites: junior standing; ELECENG 310(P), and COMPSC 240(P); or graduate standing.**Last Taught:** Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 481 Electronic Materials**

3 cr. Undergraduate/Graduate.

Modern principles of semiconductor fabrication, crystals, electrical and thermal conductivity phenomena, band gap and structure, doping effects, dielectric and optical properties, semiconductor homo and hetero-junctions, solar cells, thermo-electric materials; with projects.

Prerequisites: junior standing and PHYSICS 210(P) or PHYSICS 220(P); or consent of instructor.**Course Rules:** MATLENG 481 and ELECENG 481 are jointly offered; they count as repeats of one another.**Last Taught:** Spring 2025, Spring 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 481G Electronic Materials**

3 cr. Undergraduate/Graduate.

Modern principles of semiconductor fabrication, crystals, electrical and thermal conductivity phenomena, band gap and structure, doping effects, dielectric and optical properties, semiconductor homo and hetero-junctions, solar cells, thermo-electric materials; with projects.

Prerequisites: junior standing and PHYSICS 210(P) or PHYSICS 220(P); or consent of instructor.**Course Rules:** MATLENG 481 and ELECENG 481 are jointly offered; they count as repeats of one another.**Last Taught:** Spring 2025, Spring 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 490 Topics in Electrical Engineering:**

1-3 cr. Undergraduate/Graduate.

Specific topics, credits, and any additional prerequisites will be announced in the Schedule of Classes each time the course is offered.

Prerequisites: junior standing.**Course Rules:** May be retaken with change in topic to max of 9 cr.**Last Taught:** Spring 2025, Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 490G Topics in Electrical Engineering:**

1-3 cr. Undergraduate/Graduate.

Specific topics, credits, and any additional prerequisites will be announced in the Schedule of Classes each time the course is offered.

Prerequisites: junior standing.**Course Rules:** May be retaken with change in topic to max of 9 cr.**Last Taught:** Spring 2025, Fall 2024.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 541 Integrated Circuits and Systems**

3 cr. Undergraduate/Graduate.

Differential and operational amplifier circuits. Linear integrated circuits: comparators, regulators, amplifiers and phase locked loops. Digital integrated circuits: mos shift registers, ram, a-to-d converters.

Prerequisites: junior standing and ELECENG 330(P); or graduate standing.**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 541G Integrated Circuits and Systems**

3 cr. Undergraduate/Graduate.

Differential and operational amplifier circuits. Linear integrated circuits: comparators, regulators, amplifiers and phase locked loops. Digital integrated circuits: mos shift registers, ram, a-to-d converters.

Prerequisites: junior standing and ELECENG 330(P); or graduate standing.**Last Taught:** Spring 2025.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 565 Optical Communication**

3 cr. Undergraduate/Graduate.

Overview of communication systems, light and electromagnetic waves, optical fibers, lasers, led, photodetectors, receivers, optical fiber communication systems.

Prerequisites: senior standing, ELECENG 361(P), and ELECENG 330(P) or ELECENG 465(P); or graduate standing.**Last Taught:** Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>**ELECENG 565G Optical Communication**

3 cr. Undergraduate/Graduate.

Overview of communication systems, light and electromagnetic waves, optical fibers, lasers, led, photodetectors, receivers, optical fiber communication systems.

Prerequisites: senior standing, ELECENG 361(P), and ELECENG 330(P) or ELECENG 465(P); or graduate standing.**Last Taught:** Fall 2023.**Current Offerings:** <https://catalog.uwm.edu/course-search/>

ELECENG 572 Power Electronics

3 cr. Undergraduate/Graduate.

Power diodes and transistors; static converters; D.C. power supplies; power transistor circuits; SCR's; classical and modern forced-commutation inverters; choppers; cycloconverters, applications in power.

Prerequisites: senior standing and ELECENG 335(C); or graduate standing.

Last Taught: Fall 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 572G Power Electronics

3 cr. Undergraduate/Graduate.

Power diodes and transistors; static converters; D.C. power supplies; power transistor circuits; SCR's; classical and modern forced-commutation inverters; choppers; cycloconverters, applications in power.

Prerequisites: senior standing and ELECENG 335(C); or graduate standing.

Last Taught: Fall 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 574 Intermediate Control Systems

3 cr. Undergraduate/Graduate.

State space; frequency domain methods of modelling, analysis and design of control systems; digital control; and multivariate systems.

Prerequisites: senior standing and MECHENG 474(P) or ELECENG 474(P); or graduate standing.

Course Rules: ELECENG 574 and MECHENG 574 are jointly offered and count as repeats of each other. Not open for cr to students who have cr in ELECENG 503 or MECHENG 478.

Last Taught: Spring 2020.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 574G Intermediate Control Systems

3 cr. Undergraduate/Graduate.

State space; frequency domain methods of modelling, analysis and design of control systems; digital control; and multivariate systems.

Prerequisites: senior standing and MECHENG 474(P) or ELECENG 474(P); or graduate standing.

Course Rules: ELECENG 574 and MECHENG 574 are jointly offered and count as repeats of each other. Not open for cr to students who have cr in ELECENG 503 or MECHENG 478.

Last Taught: Spring 2020.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 575 Analysis of Electric Machines and Motor Drives

3 cr. Undergraduate/Graduate.

Reference frame analysis, computer simulation, permanent magnet synchronous machines, induction machines, power electronic inverters, pulswidth modulation, vector control.

Prerequisites: junior standing, ELECENG 330(P) and ELECENG 362(P).

Last Taught: Spring 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 575G Analysis of Electric Machines and Motor Drives

3 cr. Undergraduate/Graduate.

Reference frame analysis, computer simulation, permanent magnet synchronous machines, induction machines, power electronic inverters, pulswidth modulation, vector control.

Prerequisites: junior standing, ELECENG 330(P) and ELECENG 362(P).

Last Taught: Spring 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 595 Capstone Design Project

5 cr. Undergraduate.

Team project in simulated industrial environment. Each team develops solutions to complex real world design problems and reports results in professional writing and oral presentation.

Prerequisites: senior standing; ELECENG 335(P) and ELECENG 367(P).

Course Rules: Counts as repeat of ELECENG 355.

Last Taught: Spring 2022, Fall 2021, Spring 2021, Fall 2020.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 596 Capstone Design I

3 cr. Undergraduate.

Introduction to a real-world design process and team project in a simulated industrial environment. Each team develops solutions to complex real-world design problems and reports results in a professional oral slide presentation.

Prerequisites: ELECENG 240(P) and ELECENG 330(P); and one of the following: ELECENG 305(P), ELECENG 335(P), ELECENG 340(P), ELECENG 361(P), or ELECENG 362(P).

Course Rules: Counts as a repeat of ELECENG 595.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 597 Capstone Design II

2 cr. Undergraduate.

Introduction to a real-world design process and team project in a simulated industrial environment. Each team realizes and demonstrates a project prototype and reports results in a professionally written report.

Prerequisites: senior standing and ELECENG 596(P).

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 599 Senior Thesis

1-3 cr. Undergraduate.

Independent research under the direction of a faculty member; submission of a written thesis is required. 3 cr total required.

Prerequisites: senior standing and consent of instructor.

Course Rules: May be retaken to max of 3 cr.

Last Taught: Fall 2020, Fall 2014, Spring 2014, Spring 1997.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 699 Independent Study

1-3 cr. Undergraduate/Graduate.

Prerequisites: junior standing and consent of instructor; or graduate standing and consent of instructor.

Course Rules: May be retaken to max of 6 cr toward the undergraduate degree.

Last Taught: Spring 2025, Fall 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 699G Independent Study

1-3 cr. Undergraduate/Graduate.

Prerequisites: junior standing and consent of instructor; or graduate standing and consent of instructor.

Course Rules: May be retaken to max of 6 cr toward the undergraduate degree.

Last Taught: Spring 2025, Fall 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 700 CEAS Graduate Seminar

1-3 cr. Graduate.

Seminar in professional ethics, oral and written communication, contemporary social issues, career development, time management, and laboratory safety.

Prerequisites: graduate standing.

Course Rules: CV ENG 700, COMPSCI 700, ELECENG 700, IND ENG 700, MATLENG 700 and MECHENG 700 are jointly offered and count as repeats of one another

Last Taught: Fall 2020, Spring 2020, Fall 2019, Spring 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 701 Advanced Linear System Analysis

3 cr. Graduate.

Theory and analysis of linear dynamic systems; discrete and continuous state models; linear algebra for dynamic systems; state transition matrix, numerical methods; and applications.

Prerequisites: graduate standing.

Course Rules: ELECENG 701 and MECHENG 701 are jointly offered and count as repeats of one another.

Last Taught: Spring 2025, Fall 2022, Fall 2020, Fall 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 710 Artificial Intelligence

3 cr. Graduate.

AI programming, search techniques game playing, knowledge representation, knowledge acquisition, expert systems, selected topics from learning. Natural language understanding, vision and robotics.

Prerequisites: graduate standing, COMPSCI 351 or COMPST 751, and COMPSCI 535(P).

Course Rules: COMPSCI 710 and ELECENG 710 are jointly offered and count as repeats of one another.

Last Taught: Spring 2025, Fall 2019, Spring 2016, Fall 2014.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 711 Introduction to Machine Learning

3 cr. Graduate.

Introduction to machine learning techniques and applications, including optimal classification, regression, support vector machines, boosting, deep learning, and clustering.

Prerequisites: graduate standing.

Course Rules: COMPSCI 711 and ELECENG 711 are jointly offered and count as repeats of one another.

Last Taught: Spring 2022, Spring 2021, Spring 2020, Spring 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 712 Image Processing

3 cr. Graduate.

This course covers the materials required to process and enhance photographic images, remote sensor multispectral scanner data and others. Topics include transform techniques, recorders, discriminate function, and associated hardware.

Prerequisites: graduate standing.

Course Rules: COMPSCI 712 and ELECENG 712 are jointly offered and count as repeats of one another.

Last Taught: Spring 2024, Fall 2021, Fall 2020, Fall 2019.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 716 Tomography: Imaging and Image Reconstruction

3 cr. Graduate.

In-depth examination of the fundamentals of tomographic imaging and tomographic image reconstruction algorithms.

Prerequisites: graduate standing, ELECENG 410(P) and ELECENG 420(P).

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 717 Tomography: Image Quality and Artifact Correction

3 cr. Graduate.

In depth study of the factors affecting tomographic image quality. State-of-the-art techniques and practices for artifact correction.

Prerequisites: graduate standing and ELECENG 716(P).

Last Taught: Spring 2014.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 718 Nonlinear Control Systems

3 cr. Graduate.

Advanced concepts and methodologies in modeling and design of nonlinear control systems. Lyapunov theory; describing functions; variable structure control.

Prerequisites: graduate standing, ELECENG 474(P) or MECHENG 474(P) or equivalent; ELECENG 701(P) or MECHENG 701(P); or consent of instructor.

Course Rules: ELECENG 718 and MECHENG 718 are jointly offered and count as repeats of one another. Not open for credit to students with credit in MECHENG 778.

Last Taught: Fall 2021, Fall 2016, Fall 2010, Spring 2007.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 721 Digital Communications

3 cr. Graduate.

Fundamentals of design and analysis of digital communication systems in the presence of noise; application of satellite, phone, and computer communication systems.

Prerequisites: graduate standing and ELECENG 421(P); or graduate standing.

Last Taught: Spring 2011, Fall 2009, Fall 2007, Fall 2004.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 733 Sensors and Systems

3 cr. Graduate.

Physical principles and working of sensors, interfacing, and sensor networks.

Prerequisites: graduate standing and ELECENG 305(P) or consent of instructor.

Course Rules: BME 733, ELECENG 733, and MECHENG 733 are jointly offered and count as repeats of one another.

Last Taught: Fall 2024, Fall 2023, Fall 2022, Fall 2021.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 737 Medical Imaging Signals and Systems

3 cr. Graduate.

Medical imaging physics; physical parameters of imaging systems; imaging system models; physical measurements; image reconstruction; image characteristics; biomedical applications.

Prerequisites: graduate standing, ELECENG 310(P) and PHYSICS 210(P); or consent of instructor.

Last Taught: Fall 2009.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 741 Electromagnetic Fields and Waves

3 cr. Graduate.

Propagation, radiation and scattering of electromagnetic waves and their applications in electrical engineering.

Prerequisites: graduate standing and ELECENG 361(P) or equivalent.

Last Taught: Fall 2019, Fall 2013, Fall 2010, Fall 2009.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 742 Electromagnetic Wave Theory

3 cr. Graduate.

Electromagnetics of layered media and open waveguides; surface waves, radiation modes, and plasmons; asymptotic methods; Dyadic green's functions; integral equation methods

Prerequisites: graduate standing and ELECENG 361(P).

Last Taught: Spring 2018, Fall 2015, Spring 2012, Spring 2010.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 755 Information and Coding Theory

3 cr. Graduate.

Information measures, entropy, source coding, channon's theorems, channel capacity, error correcting codes, linear codes, convolutional codes, arithmetic codes, encoding and decoding algorithms.

Prerequisites: graduate standing.

Course Rules: COMPSCI 755 and ELECENG 755 are jointly offered and count as repeats of one another.

Last Taught: Fall 2019, Fall 2018, Fall 2017, Fall 2016.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 758 Advanced Computer Architecture

3 cr. Graduate.

Advanced topics in computer architecture including pipeline processing, multiple and parallel processing systems, performance enhancement issues and vlsi computing structures.

Prerequisites: graduate standing and COMPSCI 458(NP) or ELECENG 458(NP).

Course Rules: COMPSCI 758 and ELECENG 758 are jointly offered and count as repeats of one another.

Last Taught: Fall 2013.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 760 Computer Systems Performance Evaluation

3 cr. Graduate.

Performance measurement and tools, workload characterization, markov models, queueing theory, simulation, benchmarks, data analysis, parallel systems performance analysis.

Prerequisites: graduate standing, COMPSC 458(P) or ELECENG 458(P).

Course Rules: COMPSCI 760 and ELECENG 760 are jointly offered and count as repeats of one another.

Last Taught: Fall 2017, Fall 2016, Fall 2014, Spring 2013.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 762 Fault-Tolerant Computing

3 cr. Graduate.

Faults in digital circuits, fault detection, fault location, system reconfiguration or repair, system recovery, design for testability, self-checking circuits, fault-tolerant interconnection networks, systems level fault-diagnosis, fault-tolerant software.

Prerequisites: graduate standing and ELECENG 354(P).

Course Rules: Not open to students with cr for COMPSCI 762.

Last Taught: Spring 2002, Spring 2000, Spring 1992, Spring 1991.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 765 Introduction to Fourier Optics and Optical Signal Processing

3 cr. Graduate.

Two dimensional linear systems, scalar diffraction theory, imaging properties of lenses, optical imaging systems, spatial filtering, wavefront reconstruction.

Prerequisites: graduate standing, ELECENG 310(P) and ELECENG 361(P).

Last Taught: Spring 2020, Spring 2019, Spring 2018, Fall 2015.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 766 Introduction to Nonlinear Optics

3 cr. Graduate.

Characteristics and efficiency of various nonlinear optical processes that find applications in communications, signal processing and computing. Topics include optical switching devices, mixers and solitons.

Prerequisites: graduate standing and ELECENG 361(P).

Last Taught: Spring 2014, Fall 2011, Fall 2009, Spring 2003.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 781 Advanced Synchronous Machinery

3 cr. Graduate.

Machine construction, direct and quadrature axis reactances, steady state performance, unbalanced operating conditions, transient performance, motor starting, standards.

Prerequisites: graduate standing and ELECENG 362(P).

Last Taught: Fall 2023, Fall 2020, Spring 2019, Fall 2017.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 810 Foundations for Advanced Machine Learning and Signal Processing

3 cr. Graduate.

Detection, estimation, optimal filtering, monte carlo methods, Markov decision processes, machine learning and signal processing applications.

Prerequisites: graduate standing and ELECENG 420(P).

Last Taught: Fall 2024, Spring 2015, Fall 2011, Spring 2010.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 811 Advanced Machine Learning

3 cr. Graduate.

Advanced topics and applications in machine learning, including deep learning, recurrent neural networks, EM algorithm and clustering, reinforcement learning, Markov models and MCMC, and variational inference.

Prerequisites: ELECENG 711(P) or ELECENG 420(P) and COMPSCI 411(P); or consent of instructor.

Course Rules: COMPSCI 811 and ELECENG 811 are jointly offered and count as repeats of one another; they also count as a repeat of COMPSCI 890 or ELECENG 890 with similar topic 'Advanced Machine Learning'.

Last Taught: Fall 2023, Spring 2022.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 816 Optimal Control Theory

3 cr. Graduate.

Analysis and synthesis of discrete and continuous optimal control systems; linear quadratic regulators; dynamic programming and variational methods; applications.

Prerequisites: graduate standing, ELECENG 474(P) or MECHENG 474(P) or equivalent, and ELECENG 701(P) or MECHENG 701(P); or consent of instructor.

Course Rules: ELECENG 816 and MECHENG 816 are jointly offered and count as repeats of one another.

Last Taught: Spring 2017, Spring 2011, Fall 2008, Spring 2006.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 819 Adaptive Control Theory

3 cr. Graduate.

Adaptive control systems including mathematical foundations, estimation, model reference adaptive control, self tuning regulators, numerical methods, applications.

Prerequisites: graduate standing, ELECENG 474(P) or MECHENG 474(P), and ELECENG 701(P) or MECHENG 701(P); or consent of instructor.

Course Rules: ELECENG 819 and MECHENG 819 are jointly offered and count as repeats of one another.

Last Taught: Fall 2018, Spring 2014, Spring 2009, Fall 2007.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 872 Computer Analysis of Electric Power Systems

3 cr. Graduate.

Graph theory, matrix algebra and numerical analysis applied to computer solution of power system problems; mathematical models; algorithms and solution techniques for load flow and fault studies.

Prerequisites: graduate standing and ELECENG 471(P).

Last Taught: Fall 2009, Spring 2007, Spring 2004, Spring 2001.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 880 Bioengineering Seminar

1 cr. Graduate.

Presentations by bioengineering affiliated faculty, invited speakers, and graduate students.

Prerequisites: graduate standing.

Course Rules: CIV ENG 880, COMPSCI 880, ELECENG 880, IND ENG 880, MATLENG 880, and MECHENG 880 are jointly offered and count as repeats of one another. May be repeated to 3 cr max.

Last Taught: Fall 2018, Spring 2018, Fall 2017, Spring 2017.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 888 Candidate for Degree

0 cr. Graduate.

Available for graduate students who must meet minimum credit load requirement.

Prerequisites: graduate standing.

Course Rules: Fee for 1 cr assessed; unit does not count towards credit load for Fin Aid. Repeatable. Satisfactory/Unsatisfactory only.

Last Taught: Summer 2024, Fall 2019, Summer 2019, Summer 2018.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 890 Special Topics:

3 cr. Graduate.

Lectures on special topics in electrical engineering.

Prerequisites: graduate standing.

Course Rules: May be repeated with change in topic to 9 cr max. Variable content course. Specific topics and any additional prerequisites will be announced in the schedule of classes each time the course is offered.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 990 Masters Thesis

1-9 cr. Graduate.

Prerequisites: graduate standing and consent of instructor.

Course Rules: Repeatable.

Last Taught: Spring 2025, Fall 2024, Spring 2024, Fall 2023.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 998 Doctoral Thesis

1-12 cr. Graduate.

Prerequisites: graduate standing and consent of instructor and graduate program committee.

Course Rules: Repeatable.

Last Taught: Spring 2025, Fall 2024, Summer 2024, Spring 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>

ELECENG 999 Advanced Independent Study

1-3 cr. Graduate.

Prerequisites: graduate standing and consent of instructor.

Course Rules: Repeatable to 15 cr max.

Last Taught: Spring 2025, Fall 2024, Summer 2024, Spring 2024.

Current Offerings: <https://catalog.uwm.edu/course-search/>