ELECTRICAL ENGINEERING (ELECENG)

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: MATH 116(C).
Course Rules: Counts as repeat of ELECENG 299 with same topic. Not open to students who have completed ELECENG 301.
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
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, Fall 2018, Fall 2018.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 234 Analytical Methods in Engineering
4 cr. Undergraduate.
Prerequisites: Grade of C or better in Math 232(P).
Last Taught: Summer 2021, Spring 2021, Fall 2020, Summer 2020.
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 w/chg 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 I
3 cr. Undergraduate.
Circuit laws and analysis, resistive circuits, energy storage, AC circuits and power, three-phase circuits, computer-aided analysis.
Prerequisites: Physics 210(C) or 220(C).
Last Taught: Summer 2021, Spring 2021, Fall 2020, Spring 2020.
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. 3 hr Lec/2 hr Lab.
Prerequisites: C or better in ElecEng 234(P); ElecEng 301(P).
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
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 305(C).
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 330 Electronics I
4 cr. Undergraduate.
Op-amps, diodes, bipolar junction transistors, mos field effect circuit applications.
Prerequisites: ElecEng 305(C).
Course Rules: Counts as repeat of ElecEng 331.
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 335 Digital Logic
4 cr. Undergraduate.
CMOS Logic Gates, Differential and multistage amplifiers, IC techniques, frequency response.
Prerequisites: ElecEng 330(P), 310(C).
Course Rules: Counts as repeat of ElecEng 332.
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 336 Electromagnetic Fields
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 250(201)(P).
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
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: Grade of C or better in Math 233(P).
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
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; with lab (3 hr lec recitation & 2 hr lab per week).  
Prerequisites: ElecEng 305(P) & ElecEng 361(P).  
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.  
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 250(201)(P), & C or better in ElecEng 354(P).  
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.  
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: jr st; ElecEng 310(P).  
Last Taught: Spring 2021.  
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: jr st; ElecEng 310(P).  
Last Taught: Spring 2021.  
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.  
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.  
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: jr st; ElecEng 310(P), or grad st.  
General Education Requirements: QLB  
Last Taught: Spring 2021, Fall 2020.  
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: jr st; ElecEng 310(P), or grad st.  
General Education Requirements: QLB  
Last Taught: Spring 2021, Fall 2020.  
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: jr st; ElecEng 335(C).  
Last Taught: Spring 2021.  
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: jr st; ElecEng 335(C).  
Last Taught: Spring 2021.  
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: jr st; or cons instr.  
Course Rules: Jointly offered with and counts are repeat of MechEng 430.  
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: jr st; or cons instr.  
Course Rules: Jointly offered with and counts are repeat of MechEng 430.  
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: jr st; ElecEng 305(P) or equiv.  
Last Taught: Fall 2018, Spring 2016.  
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: jr st, ElecEng 305(P) or equiv.
Last Taught: Fall 2018, Spring 2016.
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, computed 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, computed 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.
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.
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 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: jr st, ElecEng 330(P), 354(P).
Last Taught: Fall 2019.
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: jr st, ElecEng 330(P), 354(P).
Last Taught: Fall 2019.
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: jr st, ElecEng 354(P).
Last Taught: Spring 2021.
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: jr st, ElecEng 354(P).
Last Taught: Spring 2021.
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 241(P) or COMPSCI 251(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 241(P) or COMPSCI 251(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: jr st; ElecEng 361(P) or equiv.
Current Offerings: fall 2016, fall 2015.
Course Rules: MechEng 472 & ElecEng 472 are jointly offered; they count as repeats of one another.
Last Taught: Fall 2018, Fall 2015.
Current Offerings:

ELECENG 462 Antenna Theory
3 cr. Undergraduate/Graduate.
Analysis and design of antennas: antenna fundamentals; wire antennas; dipole, monopole, and loop antennas; antenna arrays; aperture antennas; horn, slot, and parabolic dish antennas.
Prerequisites: jr st; ElecEng 361(P).

ELECENG 462G Antenna Theory
3 cr. Undergraduate/Graduate.
Analysis and design of antennas: antenna fundamentals; wire antennas; dipole, monopole, and loop antennas; antenna arrays; aperture antennas; horn, slot, and parabolic dish antennas.
Prerequisites: jr st; ElecEng 361(P).

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: jr st & ElecEng 361(P); or grad st.
Current Offerings: fall 2018, fall 2015.

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: jr st & ElecEng 361(P); or grad st.
Current Offerings: fall 2018, fall 2015.

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: jr st; ElecEng 305(P) & 361(P); or grad st.
Course Rules: Counts as repeat of ElecEng 490(690) w/same topic.
Current Offerings:

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: jr st; ElecEng 305(P) & 361(P); or grad st.
Course Rules: Counts as repeat of ElecEng 490(690) w/same topic.
Current Offerings:

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: jr st; ElecEng 362(C).
Last Taught: Fall 2020.
Current Offerings:

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: jr st; ElecEng 362(C).
Last Taught: Fall 2020.
Current Offerings:

ELECENG 472 Introduction to Wind Energy
3 cr. Undergraduate/Graduate.
Principles of wind turbines; wind characteristics; rotor dynamics of wind turbines; turbine design and integration; controls and electrical systems; grid connection.
Prerequisites: jr st; or cons instr.
Course Rules: MechEng 472 & ElecEng 472 are jointly offered; they count as repeats of one another.
Last Taught: Fall 2016, Fall 2015.
Current Offerings:

ELECENG 472G Introduction to Wind Energy
3 cr. Undergraduate/Graduate.
Principles of wind turbines; wind characteristics; rotor dynamics of wind turbines; turbine design and integration; controls and electrical systems; grid connection.
Prerequisites: jr st; or cons instr.
Course Rules: MechEng 472 & ElecEng 472 are jointly offered; they count as repeats of one another.
Last Taught: Fall 2016, Fall 2015.
Current Offerings:
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: jr st; ElecEng 310(P), CompSci 240 (P); or grad st.
Last Taught: Fall 2020.
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: jr st; ElecEng 310(P), CompSci 240 (P); or grad st.
Last Taught: Fall 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 481 Electronic Materials
3 cr. Undergraduate/Graduate.
Electronic conduction in materials. Electronic phenomena in metals,
semiconductors, and insulators. Materials production, characterization,
and application to micro-electronic devices, with particular emphasis on
thin film technology.
Prerequisites: jr st; MatlEng 201(P) or cons instr.
Course Rules: MatlEng 481 and ElecEng 481 are jointly offered; they
count as repeats of one another.
Last Taught: Spring 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 481G Electronic Materials
3 cr. Undergraduate/Graduate.
Electronic conduction in materials. Electronic phenomena in metals,
semiconductors, and insulators. Materials production, characterization,
and application to micro-electronic devices, with particular emphasis on
thin film technology.
Prerequisites: jr st; MatlEng 201(P) or cons instr.
Course Rules: MatlEng 481 and ElecEng 481 are jointly offered; they
count as repeats of one another.
Last Taught: Spring 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 482 Introduction to Nanoelectronics
3 cr. Undergraduate/Graduate.
Wave properties of electrons, diffraction, Schrödinger’s equation,
quantum confinement, band theory, tunnel junctions, Coulomb blockade,
quantum dots and wires, quantum conductance and ballistic transport.
Prerequisites: jr st; ElecEng 330(C), ElecEng 361(C).
Last Taught: Fall 2016, Fall 2011.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 482G Introduction to Nanoelectronics
3 cr. Undergraduate/Graduate.
Wave properties of electrons, diffraction, Schrödinger’s equation,
quantum confinement, band theory, tunnel junctions, Coulomb blockade,
quantum dots and wires, quantum conductance and ballistic transport.
Prerequisites: jr st; ElecEng 330(C), ElecEng 361(C).
Last Taught: Fall 2016, Fall 2011.
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: jr st.
Course Rules: May be retaken w/chg in topic to max of 9 cr.
Last Taught: Spring 2020, Fall 2019.
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: jr st.
Course Rules: May be retaken w/chg in topic to max of 9 cr.
Last Taught: Spring 2020, Fall 2019.
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: jr st; ElecEng 330(P).
Last Taught: Spring 2021.
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: jr st; ElecEng 330(P).
Last Taught: Spring 2021.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 545 FPGA Embedded CPUs & Firmware Development
3 cr. Undergraduate/Graduate.
Use of modern embedded system central processor units (CPUs)
with integrated field-programmable gate arrays (FPGAs). Design and
implementation of firmware for these devices.
Prerequisites: jr st; ElecEng 367(P) & 457(P).
Course Rules: Jointly offered with & counts as repeat of ElecEng 545.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 545G FPGA Embedded CPUs & Firmware Development
3 cr. Undergraduate/Graduate.
Use of modern embedded system central processor units (CPUs)
with integrated field-programmable gate arrays (FPGAs). Design and
implementation of firmware for these devices.
Prerequisites: jr st; ElecEng 367(P) & 457(P).
Course Rules: Jointly offered with & counts as repeat of ElecEng 545.
Current Offerings: https://catalog.uwm.edu/course-search/
ELECENG 562 Telecommunication Circuits
3 cr. Undergraduate/Graduate.
Radio frequency communication systems, terrestrial and satellite communication systems, mixers, oscillators, filters, design considerations for receivers and transmitters.
Prerequisites: sr st; ElecEng 330(P).
Last Taught: Fall 2011, Spring 2010.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 562G Telecommunication Circuits
3 cr. Undergraduate/Graduate.
Radio frequency communication systems, terrestrial and satellite communication systems, mixers, oscillators, filters, design considerations for receivers and transmitters.
Prerequisites: sr st; ElecEng 330(P).
Last Taught: Fall 2011, Spring 2010.
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: sr st; ElecEng 361(P), & 330(P) or 465(P).
Last Taught: Fall 2019.
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: sr st; ElecEng 361(P), & 330(P) or 465(P).
Last Taught: Fall 2019.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 568 Applications of Digital Signal Processing
3 cr. Undergraduate/Graduate.
Introduction to the use of modern digital signal processor (DSP) units in DSP applications such as digital filtering and speech signal processing.
Prerequisites: ElecEng 310(P), 367(P).
Course Rules: Counts as repeat of ElecEng 490 and 890 w/similar topic;
Last Taught: Spring 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 568G Applications of Digital Signal Processing
3 cr. Undergraduate/Graduate.
Introduction to the use of modern digital signal processor (DSP) units in DSP applications such as digital filtering and speech signal processing.
Prerequisites: ElecEng 310(P), 367(P).
Course Rules: Counts as repeat of ElecEng 490 and 890 w/similar topic;
Last Taught: Spring 2020.
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: sr st; ElecEng 335(C).
Last Taught: Fall 2020.
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: sr st; ElecEng 335(C).
Last Taught: Fall 2020.
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: sr st; MechEng 474(P) or ElecEng 474(402(P); or grad st.
Course Rules: ElecEng 574(503) & MechEng 574(478) are jointly offered & count as repeats of each other. Not open for cr to students who have cr in ElecEng 503(ER) or MechEng 478(ER).
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: sr st; MechEng 474(P) or ElecEng 474(402(P); or grad st.
Course Rules: ElecEng 574(503) & MechEng 574(478) are jointly offered & count as repeats of each other. Not open for cr to students who have cr in ElecEng 503(ER) or MechEng 478(ER).
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, pulsewidth modulation, vector control.
Prerequisites: jr st, ElecEng 330(P) & 362(P).
Last Taught: Spring 2021.
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, pulsewidth modulation, vector control.
Prerequisites: jr st, ElecEng 330(P) & 362(P).
Last Taught: Spring 2021.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 588 Fundamentals of Nanotechnology
3 cr. Undergraduate/Graduate.
Nanofabrication, self-assembly, principles of scanning tunneling/atomic force microscopy, operators, energy quantization; density of states, quantum dots, nanowires, carbon nanotubes; electronic properties and applications.
Prerequisites: jr st; non-ElecEng majors; ElecEng 361(P) or equiv.
Last Taught: Fall 2014, Fall 2012.
Current Offerings: https://catalog.uwm.edu/course-search/
ELECENG 588G Fundamentals of Nanotechnology
3 cr. Undergraduate/Graduate.
Nanofabrication, self-assembly, principles of scanning tunneling/atomic force microscopy, operators, energy quantization; density of states, quantum dots, nanowires, carbon nanotubes: electronic properties and applications.
Prerequisites: jr st; non-ElecEng majors; ElecEng 361(P) or equiv.
Last Taught: Fall 2014, Fall 2012.
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: sr st; ELECENG 335(P) and ELECENG 367(P).
Course Rules: Counts as repeat of ELECENG 355.
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
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 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 330(P), ELECENG 367(P), and ELECENG 335(C).
Course Rules: Counts as a repeat of ELECENG 595.
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 simulated industrial environment. Each team develops a prototype project.
Prerequisites: senior standing, ELECENG 335(P), and ELECENG 596(P).
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: sr st & cons instr.
Course Rules: May be retaken to max of 3 cr.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 699 Independent Study
1-3 cr. Undergraduate/Graduate.
Prerequisites: jr st; cons instr.
Course Rules: May be retaken to max of 6 cr toward the undergraduate degree.
Last Taught: Summer 2021, Spring 2021.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 699G Independent Study
1-3 cr. Undergraduate/Graduate.
Prerequisites: jr st; cons instr.
Course Rules: May be retaken to max of 6 cr toward the undergraduate degree.
Last Taught: Summer 2021, Spring 2021.
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: grad st
Course Rules: Civ Eng 700, CompSci 700, ElecEng 700, Ind Eng 700, MatlEng 700 & 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: grad st.
Course Rules: ElecEng 701 & MechEng 701 are jointly offered and count as repeats of one another.
Last Taught: Fall 2020, Fall 2019, Fall 2018, Fall 2016.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 710 Artificial Intelligence
3 cr. Graduate.
Programming, search techniques game playing, knowledge representation, knowledge acquisition, expert systems. Selected topics from learning. Natural language understanding, vision and robotics.
Prerequisites: grad st; CompSci 252 & 535.
Course Rules: Not open to students who have cr in CompSci 710.
Last Taught: Fall 2019, Spring 2016, Fall 2014, Fall 2012.
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: grad st
Course Rules: Not open to students who have cr in Compsci 711 which is identical to ElecEng 711.
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 multispatial scanner data and others. Topics include transform techniques, recorders, discriminate function, and associated hardware.
Prerequisites: grad st
Last Taught: Fall 2020, Fall 2019, Fall 2018, Fall 2017.
Current Offerings: https://catalog.uwm.edu/course-search/
ELECENG 713 Computer Vision
3 cr. Graduate.
Fundamental issues and current research in computer vision. Topics in early or low-level vision, intermediate vision or perceptual organization, and high-level vision or object recognition.
Prerequisites: grad st; ElecEng 410(P) or cons instr.
Course Rules: Jointly offered w/ and counts as a repeat of CompSci 713.
Last Taught: Fall 2005.
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: grad st; ElecEng 410 (P) & 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: grad st; 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: grad st; ElecEng or MechEng474(P) or equiv; ElecEng or MechEng 701(P); or cons instr.
Course Rules: ElecEng 718 & MechEng718 are jointly offered and count as repeats of one another. Not open for credit to students w/ cr in MechEng 778.
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: grad st, ElecEng 421 or cons instr.
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: grad st; ElecEng 305 or cons. instr.; Jointly offered with & counts as repeat of BME 733 & MechEng 733.
Last Taught: Fall 2020, Fall 2019, Fall 2018, Fall 2017.
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: grad st; ElecEng 310(P) and Physics 210(P), or cons instr.
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: grad st; Eleceng 361 or equiv.
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: Grad st; ElecEng 361(P).
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 755 Information and Coding Theory
3 cr. Graduate.
Information measures, entropy, source coding, shannon's theorems, channel capacity, error correcting codes, linear codes, convolutional codes, arithmetic codes, encoding and decoding algorithms.
Prerequisites: grad st.
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: grad st; CompSci 458 or ElecEng 458.
Course Rules: Not open for cr to students with cr in CompSci 758, which is identical to ElecEng 758.
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, queuing theory, simulation, benchmarks, data analysis, parallel systems performance analysis.
Prerequisites: grad st; & CompSci 458(P) or ElecEng 458(P).
Course Rules: Not open to students who have cr in CompSci 760, which is the same as ElecEng 760.
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: grad st; ElecEng 354.
Course Rules: Not open to students with cr in CompSci 762, which is identical to ElecEng 762.
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: grad st; ElecEng 310(P) & 361(P)
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: grad st; ElecEng 361(P).
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: ElecEng 362.
Last Taught: Fall 2020, Spring 2019, Fall 2017, Spring 2016.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 810 Advanced Digital Signal Processing
3 cr. Graduate.
Prediction and optimum filters; lattice structures; adaptive filters; deconvolution techniques, spectrum estimation, applications.
Prerequisites: grad st; ElecEng 410(P).
Last Taught: Spring 2015, Fall 2011, Spring 2010, Fall 2008.
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'.
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: grad st; ElecEng or MechEng474(P) or equiv; ElecEng or MechEng 701(P); or cons instr.
Course Rules: ElecEng 816 & MechEng 816 are jointly offered and count as repeats of one another.
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: grad st; ElecEng or MechEng474(P) or equiv; ElecEng or MechEng 701(P); or cons instr.
Course Rules: ElecEng 819 & MechEng 819 are jointly offered and count as repeats of one another.
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: grad st & ElecEng 471.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 877 Computer Applications 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: grad st & ElecEng 471.
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: grad st
Course Rules: MechEng 880, ElecEng 880, CompSci 880, MatlEng 880, IndEng 880 & Civ Eng 880 are jointly offered and count as repeats of one another. May be repeated to 3 cr. max.
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.
Current Offerings: https://catalog.uwm.edu/course-search/
ELECENG 890 Special Topics:
3 cr. Graduate.
Lectures on special topics in electrical engineering. Variable content course. Specific topics and any additional prerequisites will be announced in the schedule of classes each time the course is offered.
Prerequisites: grad st.
Course Rules: May be repeated w/ chg in topic to 9 cr max.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 990 Masters Thesis
1-9 cr. Graduate.
Prerequisites: grad st; cons instr.
Last Taught: Summer 2021, Spring 2021, Fall 2020, Summer 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 998 Doctoral Thesis
1-12 cr. Graduate.
Prerequisites: grad st; cons instr & grad prog comm.
Last Taught: Summer 2021, Spring 2021, Fall 2020, Summer 2020.
Current Offerings: https://catalog.uwm.edu/course-search/

ELECENG 999 Advanced Independent Study
1-3 cr. Graduate.
Prerequisites: grad st & cons instr.
Last Taught: Spring 2021, Fall 2020, Spring 2020, Fall 2019.
Current Offerings: https://catalog.uwm.edu/course-search/