ELECTRICAL ENGINEERING (EE)

EE-610 eMobility System Analysis & Control 4 Credits
Prerequisites: None
This course will provide system analysis and design methods for electrified road vehicles. Firstly, the components and subsystems of electrified powertrain will be reviewed with real application design, including battery, electric motor and inverter etc. Modeling and simulation methods with MATLAB/Simulink will be covered for students to adopt multi-physical level model skills. With the knowledge of the systems, powertrain design basics will be reviewed, including hybrid/electric powertrain configurations, E/E architecture and energy management strategies. Finally, functional safety topics will be covered, including subjects and work products of road vehicle functional safety standard ISO-26262. System and function analysis methods, such as fault tree analysis (FTA), will be covered as well. Graduate students are required to complete a research project, to be determined and assigned with the approval of the instructor. Students may not receive credit for both EE-410 and EE-610.
Lecture: 4, Lab 0, Other 0

EE-621 Energy Storage Systems with EV Applications 4 Credits
Prerequisites: None
This course introduces the basics of energy storage systems. Several competing energy storage concepts and management systems will be considered with emphasis on rechargeable Li-ion batteries for EV applications. The course will focus on the fundamentals of Li-ion batteries with respect to the physical principles of operation, design, modeling and state estimation, as well as battery management systems. Graduate students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both EE-421 and EE-621.
Lecture: 4, Lab 0, Other 0

EE-624 Power Electronics & Applications 4 Credits
Prerequisites: None
Electrical energy conversion principles, along with several powerelectronic devices and converter topologies are studied. Topics include: characteristics of diodes, thyristors, BJTs, IGBTs, and MOSFETs; transistor gate-drive circuits; operating principles of AC/DC, DC/DC and DC/AC converter circuits; isolation and isolated DC/DC converter circuits; power loss and efficiency calculations; high-frequency magnetic component design, and computer-aided analysis of the dynamic response of the converter circuits. Applications involving the dynamic representation and speed control of electric motors, together with power electronics, are also studied. Graduate students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both EE-424 and EE-624.
Lecture: 3, Lab 2, Other 0

EE-626 Power Electronics for Vehicle Electrification 4 Credits
Prerequisites: None
This is an advanced class in power electronics. Advanced converter topologies, control methods, and analyses used in electric-vehicle and power-system domains will be discussed. topics include state-variable modeling of DC-DC converters for closed-loop control system design, isolated DC-DC converter topologies (half, full, and dual bridges) and resonant DC-DC converter topologies (series, parallel and series-parallel) for wireless power transfer and battery charging, soft-switching concepts and control methods for isolated DC-DC converters, single-phase and three-phase inverter design, inverter control methods including six-step, Sine PWM, Space Vector PWM, and Discontinuous PWM and the design and control of multilevel and modular multilevel inverters.
Lecture: 0, Lab 0, Other 0

EE-6263 Power Electronics for Vehicle Electrification 3 Credits
Prerequisites: None
This is an advanced class in power electronics. Advanced converter topologies, control methods, and analyses used in electric-vehicle and power-system domains will be discussed. topics include state-variable modeling of DC-DC converters for closed-loop control system design, isolated DC-DC converter topologies (half, full, and dual bridges) and resonant DC-DC converter topologies (series, parallel and series-parallel) for wireless power transfer and battery charging, soft-switching concepts and control methods for isolated DC-DC converters, single-phase and three-phase inverter design, inverter control methods including six-step, Sine PWM, Space Vector PWM, and Discontinuous PWM and the design and control of multilevel and modular multilevel inverters. This course is designed for online delivery and available only through Kettering University Online to students in the MS in Engineering: Electrical & Computer Engineering-Advanced Mobility program.
Lecture: 3, Lab 0, Other 0

EE-633 Digital Control Systems 4 Credits
Prerequisites: None
Control of continuous-time processes using computer-based controllers is studied. Topics include design of control algorithms for implementation, modeling of discrete time systems, application of z-transforms, stability analysis, root locus analysis, controller design via conventional techniques, state-space analysis and modeling, and design and implementation of digital controller. Implementation of real-time digital controllers is performed in the laboratory. Graduate students will be assigned an area or topic for a final class project which will be involved in researching an actual digitally controlled application, identifying all sub-systems, study of digital controller, analysis of system performance using topics covered in the class, developing Simulink model for the control system and finally proposing alternative solution for the controller for system response improvement. Students may not receive credit for both EE-433 and EE-633.
Lecture: 3, Lab 2, Other 0

EE-634 Digital Signal Processing 4 Credits
Prerequisites: None
Basic principles, design, and applications of digital signal processing systems are presented. Topics include: review of discrete-time signals and systems, the z-transform, discrete-time Fourier analysis, the Discrete Fourier Transform, the Fast Fourier Transform, digital filter structures, FIR filters, and IIR filters, statistical signal processing. The course includes extensive use of MATLAB and experimental design projects using real-time digital signal processors. Graduate students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both EE-434 and EE-634.
Lecture: 3, Lab 2, Other 0

EE-643 Fundamentals of Power Systems 4 Credits
Prerequisites: None
Basic structure of electrical power systems and characteristics of power transmission lines, transformers and generators are studied. Topics include: conventional and renewable energy resources for power generation, representation of power systems; symmetrical three-phase fault analysis; symmetrical components; unsymmetrical fault computations; and simulation tools and network analyzers. Graduate students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both EE-443 and EE643.
Lecture: 3, Lab 2, Other 0

EE-646 Vector Control of AC Electric Machines 4 Credits
Prerequisites: None
Methods of controlling electric machines and their applications in electric vehicles are discussed. Topics include the theory of permanent-magnet and induction machines; coordinate-frame transformations; analysis and tuning of torque and speed control systems; modeling and dynamics of electric drives and vehicles, power-electronic devices, power-electronic circuits and switching schemes; rotor-flux oriented vector control; regenerative braking; and rotor-flux position-sensing methods. Machine and vehicle models will be developed using MATLAB Simulink. A low-voltage permanent-magnet machine and power-electronic inverter will be analyzed and tested. Students are also required to complete a research project, to be determined and assigned with approval of the instructor. Students may not receive credit for both EE-446 and EE-646.
Lecture: 3, Lab 2, Other 0

EE-682 Robot Dynamics and Control 4 Credits
Prerequisites: None
Review of mathematical principle for robotics including matrix operations and their concepts. Principles of robot analysis, design, and operation are presented. Topics include review of historical robotics evolutions and applications, robot coordinate system placement rules, kinematic model development, kinematic solutions and analysis, trajectory planning and movement optimization, collision avoidance and path planning, feedback control system for robotics, feedforward, study of sensors for robotics applications, vision system types and application for robotics and mobile robots. Graduate students will complete an advanced robotic application project to integrate and highlight the application of course materials. Examples of application area include surgery, space exploration, radioactive material handling, agriculture automation. Students may not receive credit for both EE-482 and EE-682.
Lecture: 4, Lab 0, Other 0

EE-691 Graduate Special Topics in EE 4 Credits
Prerequisites: None
Graduate Level Special Topics in Electrical Engineering.
Lecture: 4, Lab 0, Other 0

EE-695 Graduate Research in Electrical Engineering 8 Credits
Prerequisites: None
This course is directed research towards a master's thesis. Students take the course under the direction of a faculty advisor. This course may be repeated for credit.
Lecture: 0, Lab 0, Other 0

EE-699 Graduate Level Independent Study in Electrical Engineering 4 Credits
Prerequisites: None
Graduate level Independent Study in Electrical Engineering.
Lecture: 0, Lab 0, Other 0