MEDC-APPROVED, NON-CREDIT COURSES PROVIDED BY MICHIGAN TECH THROUGH ADVANCED POWER SYSTEMS (APS) LABS

1. Overview

Michigan Technological University and the Michigan Economic Development Corporation (MEDC) are committed to accelerating the long-term upward economic mobility of Michiganders—both employees and employers. This commitment to Michigan involves our organizations collaborating to offer the education, skills, and training for in-demand and high-growth occupations in the automotive industry.

Thus, Michigan Tech, through Advanced Power Systems (APS) LABS, is offering short, non-credit, professional development and learning courses. These hands-on courses, which focus on electrification and mobility, are ideal for those who want to acquire high-tech concepts and expertise for the electric vehicle industry. They are suitable for both current employees striving to improve their skills and prospective employees preparing for new EV and mobility careers.

Please contact Vinicius Vinhaes at vbvinhae@mtu.edu or APS LABS at mobilelab@mtu.edu (906-487-1213) for more information on course registration, cost, and mechanism of delivery.

2. Basic Course Information

Overview: Currently, APS LABS offers several 20-hour professional development/learning courses on various topics connected to electrification and mobility, and one shorter course (16 hours of contact time) on battery voltage and high-voltage safety.

Modality: All courses are offered fully in-person, fully online, or hybrid (a blend of online and in-person). The cost per person varies depending on the modality of the course.

Prerequisites: Those who enroll must have previously earned an undergraduate degree (BS) in Engineering or Technology.

Vendor Content: APS LABS provides the content as well as any required equipment. Depending on the requested modality, the content may be delivered on-site through the APS Mobile Lab or online through the website of our professional development program.

Proof of Completion: Those who successfully finish the course will receive a certificate of completion.

Instructors: Depending on the subject matter, the courses will be taught by various members of the talented, APS LABS instructional team, which consists of Jeffrey Naber, Jeremy Worm, Grant Ovist, and Vinicius Vinhaes.

The APS Mobile Lab surrounded by several test vehicles

3. List of Non-Credit Short Courses

All courses, except for that marked with an asterisk*, contain 20 hours of contact time.

Most courses include a combination of traditional direct learning, theory, group discussions, hands-on experimentation, and practical activities.

Title of Course	Overview / Brief Description
Advanced Digital Signal Processing	The objective of this course is to analyze and apply different signal processing methods, including adaptive filtering and spectral estimation. The content equips participants with practical skills for real-world applications. **The course includes the following topics:** ● techniques for designing and analyzing of digital filters ● FFT, windowing techniques, quantization effects ● physical limitations ● image processing, enhancement, restoration, and coding
Automotive Cybersecurity	The objective of this course is to analyze the fundamentals of cybersecurity and the unique challenges in connected and autonomous vehicles. Participants will gain hands-on experience with the latest tools and techniques used to protect automotive systems against cyber threats. **The course includes the following topics:** ● multiple cybersecurity technologies, processes, and procedures ● threat/ vulnerability analysis and risk assessment ● implementation of robust security protocols and appropriate strategies for mitigating potential cybersecurity issues

An instructor teaches inside the classroom in the APS Mobile Lab.

Title of Course	Overview / Brief Description
Autonomous Vehicles	The objective of this course is to apply autonomous vehicle data sets to develop sensing, perception, and path-planning strategies on simulated autonomous vehicles. **The course includes the following topics:** ● localization, sensor fusion, and motion planning ● autonomy capability, functional safety, and hazard analysis
*Battery and High Voltage Safety**	The objective of this course is to summarize the basic hazards associated with high voltage (both DC and AC) and battery chemistry. This course is ideal for those who are beginning to work on electrified automotive propulsion systems, as well as those who need an introductory or refresher safety course. **The course includes the following topics:** ● basic hazards associated with high voltage and batteries ● the proper use of Personal Protective Equipment (PPE) ● safe operating procedures ● best practices for responding to emergencies

Title of Course	Overview / Brief Description
Design for Six Sigma	The objective of this course is to integrate Six Sigma principles into design processes. It emphasizes tools such as DMAIC (Define, Measure, Analyze, Improve, Control) and DFSS (Design for Six Sigma) for quality improvement and innovation. Participants will learn through practical case studies and projects how to apply these methodologies to achieve operational excellence and enhance product design. **The course includes the following topics**: ● principles of Shewhart, Deming, Taguchi ● meaning of quality ● control charts for variables, individuals, and attributes ● process capability analysis ● variation of assemblies and computer-based workshops
Electric Machines and Power Electronics	The objective of this course is to upskill engineers, technicians, managers, and others to an advanced level of knowledge in Electric Machines and Power Electronics. **The course includes the following topics**: ● detailed operating principals of electric machines and power electronics ● dynamic analysis of electric machines ● reference frame transitions ● reduced order simulation models, digital simulation models ● switching conversions (including dc-dc, ac-dc, and dc-ac) ● the impacts of harmonics, pulse-width modulation, and classical and non-linear control
Electrified Propulsion Systems: Fundamentals	The objective of this course is to provide participants with the basics of propulsion system electrification, including power electronics, electric motors, and control strategies for optimizing energy efficiency and performance. The course, which includes hands-on laboratory sessions and case studies, delivers a comprehensive overview of the latest technologies and trends in the field of electrified propulsion. **The course includes the following topics**: ● electrified vehicle components and architecture ● electrified powertrain systems ● battery basics, Regenerative Braking ● controls and diagnostics ● Control Area Network (CAN) Communications

Title of Course	Overview / Brief Description
Embedded Control System Design	The objective of this course is to analyze the design, analysis, and implementation of embedded control systems, emphasizing real-time constraints and hardware interfacing. Participants will gain hands-on experience, focusing on model-based design techniques to develop reliable embedded control solutions. **The course includes the following topics**: ● model-based embedded control system design ● discrete-event control ● sensors, actuators, electronic control units ● digital controller design ● communications protocols
Instrumentation and Experimental Methods	The objective of this course is to apply advanced techniques for designing experiments, selecting appropriate instrumentation, and analyzing the data with an emphasis on accuracy, reliability, and repeatability. Participants will gain practical experience in using modern data acquisition systems and software, learning how to effectively plan and execute experiments in various engineering contexts. **The course includes the following topics**: ● transducers ● calibration, data acquisition ● signal conditioning ● noise ● specific applications
Nonlinear Control System Analysis and Design	The objectives of this course are to a) investigate nonlinear systems from the perspective of analysis/control system design; and b) to develop and apply control system design approaches for nonlinear systems. **The course includes the following topics**: ● fundamental properties for nonlinear differential equations ● functions, phase plane analysis ● stability/instability theorems ● feedback linearization and sliding mode control

Course participants tear down an electric battery in this hands-on activity.

Title of Course	Overview / Brief Description
Optimization of Control Systems Using MATLAB/Simulink	The objective of this course is to analyze MATLAB/Simulink models for optimizing control systems, focusing on algorithm development, system modeling, and simulation. **The course includes the following topics**: ● algorithm development and implementation ● system modeling and simulation ● controller design and tuning
Using LabVIEW	The objective of this course is to apply (learn how to program) LabVIEW, a popular data acquisition and automation language used by engineers. Participants will learn features including data acquisition, instrument control, and automation. **The course includes the following topics**: ● LabView environment ● construction of graphical user interfaces ● interfaces, loops, debugging ● introduction to data acquisition ● writing data to disk