

ENGINEERING PROFESSIONAL DEVELOPMENT (E P D)

E P D 361 – FUNDAMENTALS OF ENGINE THERMODYNAMICS 2 credits.

Theory and application of energy methods in engineering; conservation of mass and energy; energy transfer by heat, work and mass; thermodynamic properties; analysis of open and closed systems; the second law of thermodynamics and entropy; vapor and gas power cycles.

Requisites: Consent of instructor

Repeatable for Credit: No

Last Taught: Summer 2023

Learning Outcomes: 1. Recognize and apply the methodology of thermodynamics

Audience: Undergraduate

2. Use properties to analyze a thermodynamic system undergoing a process or cycle

Audience: Undergraduate

3. Recognize and evaluate closed and open systems

Audience: Undergraduate

4. Analyze and evaluate cycles

Audience: Undergraduate

E P D 398 – TECHNICAL COMMUNICATIONS INTERNSHIP 1 credit.

Internship with local corporation, industry, government agency, or educational unit. Includes classroom components: use and misuse of social media; managing workplace-related conflicts; communicating technical information to colleagues; identifying and resolving engineering ethics challenges; practicing group discussion and presentation skills.

Requisites: INTEREGR 397 and declared in Certificate in Technical Communication

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2026

E P D 416 – ENGINEERING APPLICATIONS OF STATISTICS 3 credits.

Provides knowledge and skills to apply statistics to many types of engineering problems. Focuses on developing statistically-based experimental techniques and tests for measures of validity, application of computer-based statistical tools, and approaches to distillation of data.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Artificial Intelligence for Engineering Data Analytics

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Apply statistical thinking, regression analysis, and descriptive analytics to evaluate data and assess process or product performance

Audience: Graduate

2. Evaluate process performance against output requirements and identify improvement opportunities using process capability evaluation and design of experiments

Audience: Graduate

3. Detect changes in process signals with noise and address factors impacting performance

Audience: Graduate

4. Design and implement experiments to identify and model input-output relationships and optimize performance

Audience: Graduate

5. Build traditional and artificial intelligence (AI) models to enhance process capability and develop actionable plans to drive measurable improvements

Audience: Graduate

E P D 455 – PYTHON FOR APPLICATIONS IN ENGINEERING

1 credit.

Introduction to Python's concepts of objects and reference; classes and nested objects. Elements of object-oriented programming in Python. Container types: lists, dictionaries, and tuples. Installing Python packages and managing environments. Scientific computing with Numpy and SciPy. Applications of Python to Data Analysis. Applications of Python to Machine Learning. Applications of Python to embedded systems/robotics.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Perform computations typically encountered in Engineering (data reading/writing, solving linear systems, perform regressions, etc.) using Python scripts with hundreds to thousands of lines of code

Audience: Graduate

2. Produce a software design solution that can be subsequently implemented in Python to solve a task/practical problem that draws on a computing component

Audience: Graduate

3. Increase their productivity in tasks that require Python programming by taking advantages of 3rd party Python packages

Audience: Graduate

4. Justify the rationale behind using Python in Engineering; explain how this programming language provides support of numerical analysis, statistical analysis, robotics, machine learning, data visualization, computer vision, and AI

Audience: Graduate

E P D 499 – SENIOR INDEPENDENT STUDY

1-3 credits.

Under faculty supervision.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

E P D 518 – QUALITY ENGINEERING AND QUALITY MANAGEMENT

3 credits.

Enhances the learners' basic business and decision-making skills related to quality systems and process improvement.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Work effectively on a team-based experiential project focused on process design, analysis, and resource management and integrating the concepts of continual improvement, customer focus, and teamwork

Audience: Graduate

2. Apply problem solving and management/planning tools for effectively defining problems, feasible alternative solutions, and measurable goals in a real-world environment

Audience: Graduate

3. Demonstrate ability to lead an industry-based team project integrating contemporary change management frameworks and considering organizational culture

Audience: Graduate

4. Describe how and when to use statistical techniques for process improvement and control

Audience: Graduate

5. Understand and identify the impact of organizational and cultural influences on the planning and implementation of change

Audience: Graduate

E P D 522 – GENERATIVE ARTIFICIAL INTELLIGENCE FOR ENGINEERING APPLICATIONS

3 credits.

Comprehensive coverage of AI-powered chatbots, from understanding generative AI fundamentals to developing sophisticated chatbot applications. Hands-on experience with generative AI tools. Explore retrieval-augmented generation (RAG) techniques. Examine critical aspects such as security, privacy, and memory models. Knowledge of Python [such as COMP SCI 220 or E P D 455] strongly recommended.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Artificial Intelligence for Engineering Data Analytics

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Design and develop a fully functional Generative AI-based chatbot application that can be personalized to the user

Audience: Graduate

2. Implement and optimize Retrieval-Augmented Generation (RAG) to enhance chatbot responses

Audience: Graduate

3. Integrate memory management systems to improve context retention in chatbot interactions

Audience: Graduate

4. Utilize agents to perform specialized tasks within the chatbot framework

Audience: Graduate

5. Demonstrate the ability to deploy, test, and maintain chatbot applications in a production environment

Audience: Graduate

E P D 605 – FUNDAMENTALS OF TECHNICAL PROJECT MANAGEMENT

1 credit.

Learn techniques to plan, execute, and deliver projects with desired scope on time and on budget. Document clear project objectives and goals, accurately estimate project time and costs, schedule and allocate time-critical resources, and establish feedback systems for optimal project control. Best paired with a work experience, such as an internship or co-op, where you can apply these project management skills.

Requisites: Junior standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Plan and manage successful engineering projects using appropriate methods, tools, and techniques

Audience: Both Grad & Undergrad

2. Estimate project costs, resources, and schedules

Audience: Both Grad & Undergrad

3. Immediately apply project management principles regarding the five major project stages: initiate, plan, execute, control, and close

Audience: Both Grad & Undergrad

4. Apply or customize the project management framework to engineering organizational needs

Audience: Both Grad & Undergrad

5. Assess and improve the current project management system

Audience: Graduate

E P D 606 – LEADING AND MANAGING TECHNICAL TEAMS

1 credit.

Key team management concepts, principles, and practices. Team dynamics, team roles, leading and facilitating teamwork, and managing team conflict in the context of STEM (science, technology, engineering, and mathematics)-related work.

Requisites: Junior standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Describe team dynamics, roles, and expectations that influence a STEM team's performance

Audience: Both Grad & Undergrad

2. Identify and effectively deploy specific team member strengths relevant for technical projects / deliverables

Audience: Both Grad & Undergrad

3. Plan, lead and facilitate productive team meetings

Audience: Both Grad & Undergrad

4. Identify and manage team conflict more effectively and constructively

Audience: Both Grad & Undergrad

5. Assess and improve their current STEM team leadership methods and practices

Audience: Graduate

E P D 610 – ENGINEERING ANALYSIS FOR DECISION MAKING

3 credits.

Quantitative and qualitative analysis and visualization tools. Structured decision-making methodology for engineering applications such as variations in materials and production, process control, forecasting and executive decision making. Facilitate persuasive problem-solving and decision making in engineering applications. Builds on foundational knowledge of statistics.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Apply foundational quantitative and qualitative analysis tools and data visualization techniques to engineering applications

Audience: Graduate

2. Apply a structured decision-making methodology to identify, evaluate and recommend the most suitable solution to engineering applications

Audience: Graduate

3. Present an analysis and proposed solutions in a structured written and/or presentation format designed to facilitate persuasive problem-solving and decision making in engineering applications

Audience: Graduate

E P D 611 – ENGINEERING ECONOMICS AND MANAGEMENT

3 credits.

Addresses principles and practices of interpreting financial information and performing engineering-related economic analyses. Focuses on the practical use of economic information for decision-making.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Perform financial statement analysis using financial ratios, vertical analysis, and horizontal analysis for comparison within a company and across companies

Audience: Graduate

2. Evaluate advantages and disadvantages of alternative costing methods, including alternative ways of charging overhead to products

Audience: Graduate

3. Apply techniques in using budgeting and performance-evaluation systems to enhance operational control and lead to improved organizational performance

Audience: Graduate

4. Develop skills to evaluate the nuances of financial decision making and capital budgeting using cost data and the time value of money

Audience: Graduate

E P D 612 – TECHNICAL PROJECT MANAGEMENT

3 credits.

Learn key principles and tools of project management applicable to a broad range of engineering projects. Covers techniques for project planning, scheduling, resource allocation, and project tracking, as well as the interface between projects and the organizations within which they are executed.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Assess project goals and desired outcomes to ensure alignment with organizational strategic goals/objectives

Audience: Graduate

2. Apply project management knowledge, skills, tools, and practices to complex workplace challenges and teams

Audience: Graduate

3. Manage constrained resources within a project plan under conditions of change/uncertainty

Audience: Graduate

4. Develop and implement an actionable learning plan for professional and career development of project management competencies

Audience: Graduate

5. Demonstrate the critical role that ethics, culture, and context plays in effective project management

Audience: Graduate

E P D 613 – INTERNATIONAL ENGINEERING STRATEGIES AND PRACTICES

3 credits.

Provides a deeper understanding of various elements of culture related to business, avoiding the pitfalls, and finding the complementary strengths that will benefit the business. International strategy and the managerial implications such as product, country, location, and organization choices for a multinational engineering operation will be assessed, analyzed and applied. Further discussion will be focused on multi-cultural organization issues and exploring best practices.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify and analyze their assumptions, attitudes, and practices that may inhibit effective working relationship with people (peers, clients/customers, suppliers) from differing cultures and create a plan to address opportunities for improvement

Audience: Graduate

2. Identify a set of strategies and best practices to draw from when interacting with individuals of differing cultural backgrounds

Audience: Graduate

3. Lay out a framework for developing and applying an international strategy that creates value for the engineering organization and corporation

Audience: Graduate

4. Apply an analytic process to assess the managerial implications of international strategy, including product, country, location, and organization choices for a multinational engineering operation

Audience: Graduate

E P D 614 – MARKETING FOR TECHNICAL PROFESSIONALS

3 credits.

Role and contribution of marketing and product management to overall operations; target marketing and market segmentation; product lifecycle positioning; develop product and marketing plan as part of balanced marketing effort; technical perspective on social, ethical, environmental, and sustainability of marketing and product management decisions.

Requisites: Graduate/professional standing. Not open to students declared in Business: Marketing, MBA.

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify the role and contribution of marketing and product management to overall business operations and the technical contributions required

Audience: Graduate

2. Describe the structure and content of a Marketing Plan, the elements of the marketing mix, and a balanced marketing effort across the marketing and technical teams

Audience: Graduate

3. Apply target marketing, market segmentation, target market product or service positioning, and how technical information is required to add accuracy and specificity to achieve market success

Audience: Graduate

4. Assist marketing and product management teams on competitive offerings, product comparisons, product life-cycle positioning, and innovation possibilities

Audience: Graduate

5. Develop and present a comprehensive product and marketing plan for a product that delivers a value proposition to the customer

Audience: Graduate

6. Provide the technical perspective on the social, ethical, environmental, and sustainability implications of marketing and product management decisions

Audience: Graduate

E P D 616 – ENGINEERING LAW

2 credits.

Addresses important legal issues especially relevant to the practice of engineering. Gain awareness and ability to properly address patents, trade secrets, contracts, employment and non-disclosure agreements, as well as product and professional liability. Learn to avoid legal problems that often affect engineering projects and organizations.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Apply the basics of patent law including how to obtain patents, how to analyze patent claims, how patents are infringed or infringement can be avoided, how to recognize and capture patentable innovation, how to approach international patents, and the differentiation between trade secrets and patents.

Audience: Graduate

2. Appraise the innovation IP infrastructure at their organization in order to become more effective in interacting with it.

Audience: Graduate

3. Apply the basics of contract law including some key contract terms and often-encountered agreements such as Non-Disclosure Agreements (NDAs) and Employment Agreements.

Audience: Graduate

4. Engage the legal contractual infrastructure within their organization in order to become more effective in proactively interacting with it.

Audience: Graduate

5. Gain an improved ability to avoid legal liabilities by identifying commonly-occurring legal issues that may give rise to liability, and how to address them.

Audience: Graduate

E P D 617 – COMMUNICATING TECHNICAL INFORMATION

3 credits.

Develops skills necessary for engineering professionals to communicate technical and managerial information. Covers approaches for communicating to diverse audiences and for action-oriented purposes. Emphasizes communication problem solving and communication efficiency. Includes individual and collaborative projects using oral, written, and electronic media.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Differentiate and use key aspects of rhetoric and communication ethics

Audience: Graduate

2. Distinguish communication needs in a variety of contexts and for a variety of audiences

Audience: Graduate

3. Write and edit technical documents that reflect the 5 Cs of writing: correctness, clarity, conciseness, coherence, and cogency

Audience: Graduate

4. Craft and deliver technical presentations that are persuasive and easy to understand

Audience: Graduate

5. Collaborate with others to accomplish communication goals

Audience: Graduate

E P D 618 – APPLIED LEADERSHIP AND MANAGEMENT OF ENGINEERING ORGANIZATIONS

3 credits.

Addresses strategies, models, and practices for leading and managing engineering organizations in a context directly relevant to practicing engineers. Engage in self-reflection about styles, beliefs, and past experiences with leadership and management. Course project of direct relevance to student's organization will integrate theory, models, case studies, and real-time experiences from student's workplace. Gain broad exposure to diverse approaches to leadership and management, and a deeper understanding of how to put what is being learned into effective action.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Apply knowledge of individual, team, and organizational dynamics to improve organizational effectiveness through continuous improvement of engineering processes

Audience: Graduate

2. Apply tools and techniques to motivate and develop employees to improve performance

Audience: Graduate

3. Articulate the value and methods to proactively engage human resources for management issues

Audience: Graduate

4. Identify and prioritize key issues in personal and professional life to help navigate changing circumstances and mediate stress

Audience: Graduate

5. Interpret how the business case for diversity, equity, and inclusion (DEI) pertains to effectively managing engineering teams and organizations

Audience: Graduate

E P D 619 – FOSTERING AND LEADING INNOVATION

3 credits.

Learn to develop vision, culture, and practices that value and drive innovation within engineering and technical organizations. Grow your ability to build an enterprise that values, pursues, and delivers innovative technical services and products.

Requisites: Declared in Master of Engineering: Engineering Management, Data Analytics, Engine Systems, Manufacturing Systems Engineering, or Sustainable Systems Engineering

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Evaluate whether a technological solution is a business opportunity.

Audience: Graduate

2. Understand and discuss the process of commercializing technology and the challenges associated with each phase of that process.

Audience: Graduate

3. Identify and develop the skills and resources required for successfully managing technologies and innovative processes.

Audience: Graduate

4. Assess and present the commercial potential of a technological solution.

Audience: Graduate

5. Cultivate the leadership characteristics of technical organizations that successfully foster and sustain a culture of innovation.

Audience: Graduate

E P D 620 – ELECTRIFIED POWERTRAIN SYSTEMS

2 credits.

Micro, mild, full, and plug-in electrical powertrain systems, their components and the interactions between them, with special attention paid to generators, motors, and inverters. Learn about key metrics for sizing and matching components based on performance.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify, and select class of hybrid to match their use case.

Audience: Graduate

2. Distinguish working principles of all components in electrified powertrain systems.

Audience: Graduate

3. Use modeling and simulation to analyze and size components.

Audience: Graduate

4. Construct control systems for electrified powertrain systems.

Audience: Graduate

E P D 621 – BATTERIES FOR XELECTRIFIED VEHICLES

2 credits.

Concepts of vehicle hybridization levels; battery accessories, components, and materials; battery life and management; as well as various failure modes of batteries. Development of equivalent circuit models (ECM) for cells that can be used for real time control and diagnostics.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Identify the basic aspects of lead acid, nickel metal hydride, and lithium ion cells

Audience: Graduate

2. Compare and Contrast how cells are connected to make modules and packs for power and energy applications

Audience: Graduate

3. Value USABC battery test procedures for PHEV targets

Audience: Graduate

4. Describe and evaluate battery management systems

Audience: Graduate

E P D 622 – ENGINE DESIGN I

3 credits.

Provides an understanding of engine applications, customer need assessment, and engineering product planning.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Engine Design

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Estimate engine displacement requirements and assess trade-offs between displacement and supercharging

Audience: Graduate

2. Assess the trade-offs between various engine configurations and relate them to the specific needs of your application

Audience: Graduate

3. Evaluate the work of product planners and market researchers in determining new product opportunities and requirements

Audience: Graduate

4. Comparatively assess the various materials and processing choices for cylinder block and head design and make design decisions based on weight, durability, and cost requirements for particular engine applications

Audience: Graduate

5. Create a design for an overall engine system layout including package dimensions, durability, cost, and installation

Audience: Graduate

6. Evaluate reliability analysis and accelerated testing and the considerations that determine the required durability development effort for a new engine

Audience: Graduate

E P D 623 – ENGINE DESIGN II

3 credits.

Provides an advanced understanding of internal combustion engine design.

Requisites: E P D 622

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify the major steps and resource requirements for a new engine development project

Audience: Graduate

2. Develop a basic engine layout utilizing input from this course and Engine Design I

Audience: Graduate

3. Document the design with sufficient depth (calculation, assumptions, base dimensions) that the concept engine could be assigned to a design team to begin detail design

Audience: Graduate

4. Integrate the learning, knowledge, and skills from the various disciplines of engine development to the total engine design process

Audience: Graduate

5. Develop methods for making the necessary compromises and trade-offs during the concept/initial design layout stages of the engine

Audience: Graduate

E P D 624 – ENGINE PERFORMANCE AND COMBUSTION

3 credits.

Provides a physically based understanding of combustion, efficiency, and exhaust emission formation and control in internal combustion engines.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Explain theoretical and practical limits of maximum engine performance

Audience: Graduate

2. Analyze engine combustion phenomena from a fundamental thermo-chemical perspective, including effects of mixture preparation strategy, in-cylinder gas composition, and in-cylinder charge motion

Audience: Graduate

3. Identify coupling between a single control input and the remainder of the engine system

Audience: Graduate

4. Compare and contrast mixture preparation strategies and alternative energy conversion strategies

Audience: Graduate

E P D 625 – ENGINE GAS DYNAMICS

3 credits.

Provides a physically based understanding of gas dynamics with applications to internal combustion engines.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Analyze the major physical processes that occur in gas dynamic flows within internal combustion engines.

Audience: Graduate

2. Evaluate the performance and design of the principal air-handling systems in engine combustion.

Audience: Graduate

3. Apply control volume analysis to solve fluid mechanics problems, for fluids at rest and in movement

Audience: Graduate

4. Use the equations of fluid mechanics to solve realistic engineering problems involving fluids by making appropriate assumptions

Audience: Graduate

5. Develop a mathematical working knowledge of the common manipulations that are performed for three dimensional time-dependent flows

Audience: Graduate

6. Implement numerical solutions to selected fluid problems

Audience: Graduate

E P D 627 – PERSPECTIVES ON ENGINE MODELING SEMINAR

1 credit.

Problem definition and planning, tool selection, model construction, calibration, application and data presentation in order to integrate the most appropriate modeling tools into an engine design and development project.

Requisites: Graduate/professional standing, declared in Capstone Certificate in Engine Design, or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes: 1. Define an effective framework for using and assessing computer modeling tools and procedures.

Audience: Graduate

2. Select the analytical tools most appropriate for any given engine design/development project.

Audience: Graduate

3. Evaluate the capability, application, and limitations of the various classes of engine analysis tools and describe how experiment and analysis complement those tools.

Audience: Graduate

E P D 628 – ANALYSIS OF TRENDS IN ENGINES

1 credit.

Scientifically-based look at trends in energy availability, emission control and regulation, and technological advances to make an assessment of the future of engines and powertrain systems for vehicles throughout the world. Emphasis on trends for sustainable mobility solutions.

Requisites: Graduate/professional standing, declared in Capstone Certificate in Engine Design, or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2024

Learning Outcomes: 1. Use past and present regulatory drivers to assess the impact of future regulatory trends on engine developments
Audience: Graduate

2. Determine the market-by-market availability and development of non-petroleum fuels and assess how those developments can impact engine design and marketing both at the macro and the micro scale
Audience: Graduate

3. Evaluate technology developments that achieve compliance with regulatory demands and support customer performance and efficiency requirements
Audience: Graduate

4. Formulate a framework for selecting technology related to powertrain architectures, sub-systems, and components for specific applications
Audience: Graduate

5. Evaluate market requirements for powertrain configurations and features, generating a family of engine variants to satisfy customer needs over a range of applications and sectors
Audience: Graduate

6. Generate a coherent powertrain production lifecycle plan that balances the drivers and constraints of the multi-objective criteria covered by the course
Audience: Graduate

E P D 629 – POWERTRAIN SYSTEMS AND CONTROLS

3 credits.

Explore fundamental control concepts for development and analysis, modeling requirements and considerations related to control and diagnostics, and the application of these tools to powertrain systems.

Requisites: Declared in Engineering: Engine Systems ME or Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Develop powertrain system dynamic models.
Audience: Graduate

2. Develop powertrain system controls.
Audience: Graduate

3. Test controls in simulation using MATLAB and Simulink.
Audience: Graduate

E P D 630 – ENGINE DESIGN III

3 credits.

Builds further experience in engine development project organization; materials and processes; and engine validation. Project organization lessons emphasizing the phases of engine development and the importance of a design freeze with increased scrutiny of design modifications as the engine progresses toward production. Additional engine system components and processes such as forging, plastic molding, and billet machining. Reliability validation expanded to component and system-level validation through rig and engine testing. Test plans calibrated to engine volumes and cost in order to develop an appropriate mechanical development and reliability plan.

Requisites: E P D 623

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Create engine development projects and their key design points, incorporating resource estimates and justification.
Audience: Graduate

2. Use flexible tooling approaches for machining major engine components, identifying the advantages and disadvantages and other key variables.
Audience: Graduate

3. Select any component or sub-system within a particular engine and create and justify a design validation test sequence appropriate to the selection for that engine.
Audience: Graduate

E P D 631 – ELECTRIFIED VEHICLE-LEVEL MODELING

2 credits.

Development of hybrid and electric vehicle powertrain and sub-system mathematical models. Simulations of drive cycles for evaluating component, sub-system, or package performance in the vehicle for fuel economy and emissions.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Learning Outcomes: 1. Evaluate vehicle losses, efficiencies, and opportunities for improvements.

Audience: Graduate

2. Analyze opportunities for fuel economy improvement for certain technologies.

Audience: Graduate

3. Defend how government and regulators calculate fuel economy and CO₂ emissions and assess CO₂ credits.

Audience: Graduate

E P D 633 – ENGINE BOOSTING

2 credits.

Application of fundamental fluid dynamics and thermodynamics principles to intake air boosting for internal combustion engines. Turbocharger and Supercharger design and operating principles, applications to engine system design. Includes both simple, single-stage systems, and multi-stage systems (series, series-sequential, parallel-sequential). Pulse conservation and exhaust gas recirculation will be addressed. Includes advanced considerations including the Miller Cycle, turbocompounding, and e-boosting.

Requisites: E P D 625 or concurrent enrollment

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Design a turbocharger compressor for a specific engine and speed range. Demonstrate how the match is impacted by charge air cooling and exhaust gas recirculation

Audience: Graduate

2. Analyze and evaluate a turbocharger match for margin against surge, choke and overspeed.

Audience: Graduate

3. Break down control points for compressor switching and turbine bypass for a given engine and turbocharger maps lay out the operation of a two-stage, series-sequential system.

Audience: Graduate

4. Evaluate the impact of Miller Cycle application at constant BMEP and as a means on increasing BMEP.

Audience: Graduate

E P D 635 – EXHAUST AFTERTREATMENT SYSTEMS

2 credits.

Fundamental development of the science and engineering underlying the design of exhaust aftertreatment (catalyst) systems for automotive (internal combustion engine containing) systems. Emphasis is on gasoline and diesel, spark-ignition and compression-ignition combustion engines, though the same fundamentals may be applied to other fuels or combustion types. Introductory material is included on aspects that are related to emissions, including regulatory standards, gasoline and diesel engine basics, fuels, lubricants, combustion, instrumentation, and formation of pollutants. Several causes of emissions and pollutants are intertwined throughout the various topics and the control and treatment of specific emissions species are discussed by device type.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

Learning Outcomes: 1. Explain the process that drive emissions formation, know what a catalyst is, and be familiar with the ever-changing landscape of regulations.

Audience: Graduate

2. Compare/contrast emissions testing protocols and emissions measurement equipment to be able to choose the ones best suited to their needs

Audience: Graduate

3. Explain the purpose of the Exhaust Aftertreatment System (EAS) and its reliance on On-Board Diagnostics (OBD) for operations and warranty issues

Audience: Graduate

4. Analyze and describe the operations of the Oxidation Catalysts (OCs) and describe the operations of the Three-Way Catalyst (TWC)

Audience: Graduate

5. Analyze and describe the operations of the Particulate Filters

Audience: Graduate

6. Analyze and describe the operations of the Selective Catalytic Reduction (SCR) catalyst and include Ammonia Slip Catalysts

Audience: Graduate

E P D 636 – INTRODUCTION TO POLYMERS

3 credits.

Introduction to the chemistry and physics of polymeric materials. Concepts of polymer synthesis as well as physical properties are introduced, including molecular weight, chain conformation, step growth and chain growth kinetics, basic rheology and viscoelasticity as well as glass transition and crystallinity.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing & Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Explain the common synthetic strategies for the fabrication of polymers.

Audience: Graduate

2. Analyze outcomes of polymer materials based on properties such as viscoelasticity.

Audience: Graduate

3. Evaluate issues in manufacture and processing to make a material or compound.

Audience: Graduate

E P D 637 – POLYMER CHARACTERIZATION

3 credits.

Basic principles used for both quantitative and qualitative characterization of polymeric materials, including both assessment of their synthesis and of their structural features at different length scales. Discussion of techniques such as NMR (Nuclear Magnetic Resonance) and GPC (Gel Permeation Chromatography), thermal characterization, rheological characterization, as well as scattering of various types of electromagnetic radiation. Introduction to characterization methods used in industry and polymer crystallography.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing & Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Analyze the chemical composition of an unknown polymeric sample.

Audience: Graduate

2. Evaluate the molecular weight of an unknown material through multiple methods.

Audience: Graduate

3. Quantify characteristics such as percent crystallinity or orientation in order to relate processing conditions to mechanical properties.

Audience: Graduate

E P D 638 – POLYMER COATINGS AND ADHESIVES

3 credits.

Introduction to coatings and adhesives, with a focus on the polymer science and chemistry underlying these materials. Topics include film formation, adhesion mechanisms, material characterization, application techniques, and the role of additives in common formulations.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing & Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Explain the purpose of additives included in various paints and coatings systems.

Audience: Graduate

2. Design a formulation for an appropriate system for a given type of paint or coating.

Audience: Graduate

3. Design a hypothetical smart coating system.

Audience: Graduate

4. Apply materials requirements to different applications of adhesives.

Audience: Graduate

E P D 639 – PLASTICS RECYCLING AND SUSTAINABILITY

3 credits.

Sustainability and recycling aspects in the life cycles of plastics and polymeric materials. Chemistries that can be used to make polymers from sustainable or renewable sources and biodegradable polymers. Current recycling practices and their limitations including polymer-based materials such as composites and layered packaging. Textile recycling and plastic pollution including microplastics are covered.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing & Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Analyze the life cycle of a plastic product and the related causes of and solutions for recycling and sustainability issues.

Audience: Graduate

2. Assess benefits and costs of sustainability planning in the public and private sectors.

Audience: Graduate

3. Explain the environmental dimensions of the sustainability challenges associated with plastics manufacture, use and disposal.

Audience: Graduate

4. Apply sustainability principles to address the challenges of plastics disposal, especially in developing countries.

Audience: Graduate

E P D 640 – INTRODUCTORY POLYMER RHEOLOGY

3 credits.

Introduction to polymer rheology. Concepts of continuum mechanics are introduced, specifically the fluid dynamics of non-Newtonian and linear viscoelastic fluids. Material functions, constitutive equations and rheometry and experimental methods for measuring material functions (rheometry) are discussed. Knowledge of linear differential equations [such as MATH 319 or 320] and fluid mechanics [such as ME 363] or momentum transfer [such as CBE 320] required.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Polymer Processing & Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. Differentiate between Newtonian and Non-Newtonian Fluids

Audience: Graduate

2. Explain and apply the mathematics of continuum mechanics

Audience: Graduate

3. Apply constitutive equations to analyze non-Newtonian phenomena exhibited by polymeric fluids

Audience: Graduate

4. Analyze real flow processes involving polymer solutions or melts

Audience: Graduate

5. Recommend solutions to problems using data from rheological properties of polymer fluids and melts

Audience: Graduate

E P D 642 – THERMODYNAMICS OF ENGINE SYSTEMS

3 credits.

Use the 1st and 2nd laws of thermodynamics in the analysis of engines. Use ideal gas mixtures, thermodynamics and combustion principles to determine adiabatic flame temperature and chemical equilibrium - with focus on Engine Systems

Requisites: Declared in Engineering: Engine Systems MEng

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Apply thermodynamic equations, equations of state, and the energy equation

Audience: Graduate

2. Calculate thermodynamic properties of reactants and products, enthalpies of reaction, adiabatic flame temperature, and equilibrium species concentration, with application to simple reactions

Audience: Graduate

3. Apply thermodynamic analysis to IC Engines

Audience: Graduate

E P D 645 – ELECTRIC MACHINES FOR TRACTION APPLICATIONS

2 credits.

Reviews the physics of electric machines. Covers electric machine operation used both in motoring and generating modes necessary in traction applications. The fundamentals of brush DC, PM synchronous, reluctance, and induction machines are explored. Begins with the basics of DC machines and extends to the concept of field orientation in AC machines.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Describe the physics of DC and AC machines

Audience: Graduate

2. Develop techniques to control the electromagnetic torque of the machine using our understanding of physics

Audience: Graduate

3. Compare various forms of control of electric machines

Audience: Graduate

4. Apply the knowledge from IEEE publications on this topic

Audience: Graduate

5. Provide specific application examples of motors used in traction applications

Audience: Graduate

E P D 646 – ELECTRIC DRIVES FOR TRACTION APPLICATIONS

2 credits.

Electric drives operation used both in motoring and generating modes necessary in traction applications. The fundamental drives of brush DC, PM synchronous, reluctance, and induction machines are explored. Begins with the basics of drives and extends to the device physics of power electronics used in drives.

Requisites: E P D 645 or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Describe the basics of DC and AC electric drives
Audience: Graduate

2. Develop techniques to control the electromagnetic torque of the machine with drives
Audience: Graduate

3. Compare various forms of control of electric machines
Audience: Graduate

4. Gain background to apply technical publications on this topic
Audience: Graduate

5. Provide specific application examples of drives used in traction applications
Audience: Graduate

E P D 647 – TRENDS IN ELECTRIFICATION SEMINAR

1 credit.

Discussion of major trends in the automotive and transportation industry, focused on electrification for hybrids, fuel cells, and fully electric vehicles.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Powertrain Electrification

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Discuss key electrification trends and developments in the automotive and transportation industries

Audience: Graduate

2. Assess the impact of regulatory trends on electrification developments
Audience: Graduate

3. Evaluate technology developments for compliance with regulations, performance, and energy efficiency requirements
Audience: Graduate

4. Formulate a framework for selecting technology related to powertrain architectures, sub-systems, and components for specific applications
Audience: Graduate

5. Generate a coherent powertrain production lifecycle plan that balances the drivers and constraints of performance and customer demands
Audience: Graduate

E P D 650 – INTRODUCTION TO POLYMERS PROCESSING

3 credits.

Introduction to the principles of polymer processing. Review of the basic techniques primarily in use by industry as well as foundational principles of polymer physics, viscoelasticity and rheology. Focus on understanding how design of process is used to achieve desired structure and properties. Includes introduction to topics such as 3-d printing and recycling of polymer waste in the context of reprocessing such materials.

Requisites: E P D 636 and (E P D 640 or CHEM/M S & E 421, or concurrent enrollment), or declared in Capstone Certificate in Polymer Processing Manufacturing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. State the differences between the various processing techniques used to convert polymers to useful products including those, for example, for automotive, aerospace, energy, consumer, and medical applications.

Audience: Graduate

2. Apply the concepts of transport phenomena (i.e. fluid, heat, and mass transfer) to the design of polymer processing operations and add topics typically not covered in undergraduate courses (e.g. non-Newtonian fluid mechanics, radiation heating, self-diffusion).

Audience: Graduate

3. Describe the connection between polymer molecular structure and polymer flow by using basic concepts in polymer rheology.

Audience: Graduate

4. Analyze the connection between properties of the product (e.g. strength, stiffness, degree of crystallinity, degree of molecular orientation) and processing conditions (e.g. stress generated during flow, heat transfer conditions).

Audience: Graduate

5. Theorize as to requirements for the design of recycling schemes for polymers.

Audience: Graduate

6. Compare what is possible via traditional processing methods vs. modern methods such as 3-D printing.

Audience: Graduate

E P D 654 – TEACHING IN SCIENCE AND ENGINEERING

2-3 credits.

Introduction to teaching and learning in science and engineering at the college level. Includes exploration of the learning process, teaching methodology, assessment strategies, course design, teaching philosophies, and careers in education, science, and engineering.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

E P D 660 – CORE COMPETENCIES OF SUSTAINABILITY

3 credits.

Introduces real-world pragmatic skills and applications in sustainability competencies. Content reaches across engineering expertise, from chemical engineering to buildings to product design and energy. Modules cover ecological footprinting, lifecycle assessment, resource use and integrated engineering practice.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Calculate and analyze carbon and ecological footprints

Audience: Graduate

2. Compare and evaluate different sustainability frameworks

Audience: Graduate

3. Analyze sustainability issues and/or practices using a systems-based approach, utilizing life-cycle thinking and assessment

Audience: Graduate

4. Explain the social, economic, and/or environmental dimensions of the sustainability challenge of resource consumption, and how sustainable development can fuel innovation

Audience: Graduate

5. Characterize sustainability as a global challenge associated with social inequity and requiring engineering/science leadership, multiple perspectives and solutions

Audience: Graduate

6. Synthesize course lessons as they relate to engineering applications and decision making

Audience: Graduate

7. Assess the relevant professional competencies and how sustainability could affect those choices

Audience: Graduate

E P D 669 – SUSTAINABLE SYSTEMS ENGINEERING CAPSTONE

3 credits.

Provides the opportunity to demonstrate ability to think globally, sustainably, and creatively. Gain real-world experience by applying theory, tools, and research to conceptualize, analyze, and design a solution to a real-world problem within a social and environmental context. Showcase the knowledge and analytical skills acquired, and integrate tools, science, and communication to address a community or industry need. Work with an industry mentor and customer throughout your project.

Requisites: Consent of instructor**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2026**Learning Outcomes:** 1. Pose a problem effectively

Audience: Graduate

2. Apply sustainability principles and/or frameworks to address the challenge of the selected problem, and balance structure and flexibility in problem-solving approaches

Audience: Graduate

3. Analyze sustainability issues and/or practices using a systems-based approach, and creatively consider alternative solutions

Audience: Graduate

4. Perform a targeted literature/document review

Audience: Graduate

5. Integrate sustainable engineering knowledge and tools into social contexts

Audience: Graduate

6. Design a solution to the problem statement, and account for the perspectives of various stakeholders

Audience: Graduate

7. Document and present context, proposed solutions, analysis, results and conclusions

Audience: Graduate

E P D 678 – SUPPLY CHAIN MANAGEMENT FOR ENGINEERS

3 credits.

Examines concepts, management techniques, and current trends in the field of supply chain management with emphasis on topics relevant to engineers. Topics include global logistics, logistics engineering techniques, new product introduction process, purchasing strategy, managing transportation providers, distribution center technology and operations, outsourcing supply chain functions, and an introduction to supply chain information systems.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2025**Learning Outcomes:** 1. Analyze supply chain concepts and principles and show fluency in the language used in supply chain management.

Audience: Graduate

2. Apply logistics engineering techniques to plan and optimize transportation routes and costs across multiple modes of transportation using actual data from large businesses.

Audience: Graduate

3. Implement recent technology and business practices adopted by supply chain participants to improve efficiency and environmental sustainability.

Audience: Graduate

4. Design inventory management systems prioritizing manufacturing capacity, inventory investment, and product availability.

Audience: Graduate

5. Demonstrate use of ERP systems to execute supply chain processes including purchasing, receiving, manufacturing planning, inventory control, and logistics functions.

Audience: Graduate

E P D 690 – SPECIAL TOPICS IN ENGINEERING PROFESSIONAL DEVELOPMENT

1-3 credits.

Topics vary.

Requisites: None**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2026**E P D 699 – INDEPENDENT STUDY**

1-3 credits.

Under faculty supervision.

Requisites: Graduate/professional standing**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Fall 2025

E P D 701 – WRITING FOR PROFESSIONALS

1 credit.

Preparation to produce effective written communication that is suitable for inter-professional and inter-disciplinary audiences in a variety of workplaces. Apply these strategies and tools.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2024

Learning Outcomes: 1. Differentiate and use key aspects of rhetoric and communication ethics

Audience: Graduate

2. Distinguish communication needs in a variety of contexts and for a variety of audiences

Audience: Graduate

3. Write and edit technical documents that reflect the 5 Cs of writing: correctness, clarity, conciseness, coherence, and cogency

Audience: Graduate

4. Craft and deliver technical presentations that are persuasive and easy to understand

Audience: Graduate

5. Collaborate with others to accomplish communication goals

Audience: Graduate

E P D 702 – PROFESSIONAL PRESENTATIONS

1 credit.

Sharpen your ability to create, edit, review, and present information in an efficient, clear, and effective way for your audiences. Develop your presentation skills through a series of presentations related to your professional interests and work.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2025

Learning Outcomes: 1. Analyze audience needs in a variety of situations

Audience: Graduate

2. Construct content that is easily understood by stakeholders

Audience: Graduate

3. Craft more effective slides that persuade, engage, and inform their audience

Audience: Graduate

4. Exhibit confidence while presenting

Audience: Graduate

5. Apply the lessons learned from this course to academic work and professional careers

Audience: Graduate

E P D 704 – ORGANIZATIONAL COMMUNICATION AND PROBLEM SOLVING

1 credit.

Improve your problem solving within complex organizations, with a special emphasis on case studies and improving communication, using cross-disciplinary sources.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Foundations of Professional Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Summarize the biases that affect decision making

Audience: Graduate

2. Influence others to make better decisions

Audience: Graduate

3. Design your decisions and solve your problems using a better process based on empirical social science

Audience: Graduate

4. Design your teams and groups to maximize performance and innovation based on principles from social science

Audience: Graduate

5. Apply strategies to increase open communication and strategically use conflict in organizations to increase productivity and decision quality

Audience: Graduate

6. Create environments and situations that nudge ethical decisions in organization

Audience: Graduate

7. Identify blind spots that lead to unethical decisions

Audience: Graduate

E P D 706 – CHANGE MANAGEMENT

1 credit.

Provides emerging and practicing professionals foundational knowledge to develop a change management strategy and implement it using proven processes and tools. Become better prepared to deliver effective organizational performance. Applies contemporary concepts and methods in change management through student-selected projects.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Foundations of Professional Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2026

Learning Outcomes: 1. List and describe and evaluate three change management frameworks

Audience: Graduate

2. Describe elements necessary to successfully initiate organizational change

Audience: Graduate

3. Plan organizational change using components of one or more change management frameworks

Audience: Graduate

4. Identify challenges inherent in change management and leadership and list methods for addressing these challenges

Audience: Graduate

5. Describe approaches for sustaining change and change benefits

Audience: Graduate

6. Apply methods for influencing stakeholders in affecting outcomes of change initiatives

Audience: Graduate

E P D 708 – CREATING BREAKTHROUGH INNOVATIONS

1 credit.

Explore innovation and how design thinking is a driver of innovation. Learn to use various design thinking methods and tools for analysis and decision-making.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Foundations of Professional Development

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2024

Learning Outcomes: 1. Express what innovation is and how innovation is driven by design thinking

Audience: Graduate

2. Plan and conduct design research

Audience: Graduate

3. Synthesize themes, patterns, and insights from qualitative design research data

Audience: Graduate

4. Plan, structure, and facilitate ideation and concepting sessions

Audience: Graduate

5. Use design thinking tools to frame, plan and execute a challenge relevant to their work, community or personal

Audience: Graduate

E P D 710 – FOUNDATIONS OF ENGINEERING LEADERSHIP

2 credits.

Build the foundations for developing, refining, and strengthening your effectiveness as a leader of engineering teams, projects, and organizations. Enhance your understanding of how to match your leadership style to a team's focus, organization, and culture. Grow your understanding of your strengths and weaknesses as a leader using proven assessment tools. Develop a plan for growing your leadership competency.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Develop a clear understanding of strengths and developmental needs as a manager and leader

Audience: Graduate

2. Create a development plan to intentionally grow foundational management and leadership qualities

Audience: Graduate

3. Manage both engineers and engineering processes with confidence

Audience: Graduate

4. Enhance the ability to strategically adapt leadership styles to the unique context of an engineering setting

Audience: Graduate

E P D 712 – ETHICS FOR PROFESSIONALS

1 credit.

Explores how our actions affect others and influence the choices we make within the workplace. Enhance ethical competencies by providing opportunities to discuss challenges to behavior and decision-making in different professional contexts.

Requisites: Graduate/professional standing or declared in Capstone Certificate in Applied Engineering Management

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify when a decision has ethical dimensions, articulate what professional ethical behavior means, and explain why it matters

Audience: Graduate

2. Apply ethical decision-making strategies and relevant codes of ethics to explore, analyze, and effectively resolve workplace and profession-specific ethical challenges

Audience: Graduate

3. Apply behavioral science concepts to explore the role of self-interest in our decision making and to explain why good people sometimes behave unethically

Audience: Graduate

4. Identify and explain the diverse social, global, and cultural frameworks that play a role in some ethical challenges

Audience: Graduate

E P D 720 – ENGINE NOISE AND VIBRATION

2 credits.

Introduces the engineer to fundamental NVH (Noise, Vibration, and Harshness) concepts with an emphasis on how NVH can be integrated throughout the engine development process from initial concept inception through to validation testing for production.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2020

Learning Outcomes: 1. Analyze how changes to emissions and noise legislation can impact the powertrain architecture

Audience: Graduate

2. Identify sources of NVH in the vehicle and be able to cascade vehicle level metrics down to system level targets

Audience: Graduate

3. Quantify fundamental source mechanisms excitation relating to gas pressure torque and inertia loading

Audience: Graduate

4. Analyze key transmission NVH challenges and the impact of changes to the micro/macro geometry of gears

Audience: Graduate

5. Apply the principles of pipe acoustics towards the design of intake and exhaust systems

Audience: Graduate

6. Explain the role of the mounting system and evaluate the ideal mount configuration

Audience: Graduate

E P D 730 – SUSTAINABLE FACILITIES

3 credits.

Explore the environmental impacts of commercial and residential buildings, including energy, water, materials, transportation, waste, human health, and land use. All phases of a building's life cycle will be considered, along with relevant case studies, benchmarking tools, public policies and emerging concepts.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2024

Learning Outcomes: 1. Describe the environmental impacts of residential and commercial buildings

Audience: Graduate

2. Explain the stages of the building life-cycle, identify the decision-makers, and analyze how the environmental impacts and opportunities change in each stage

Audience: Graduate

3. Evaluate improvement strategies appropriate to each life-cycle stage of a building

Audience: Graduate

4. Utilize benchmarking and analysis tools used in the building sector for environmental and energy performance

Audience: Graduate

5. Compare and justify policies used to influence the building sector, and critique their effectiveness

Audience: Graduate

6. Create and deliver a presentation on a selected green building strategy, citing resources and case studies

Audience: Graduate

E P D 731 – ENERGY EFFICIENCY IN BUILDINGS

3 credits.

Core principles of energy use and efficiency in the building sector (residential, commercial, institutional buildings.) Factors that influence energy demand (design, equipment, controls, operation, maintenance). Review of engineering fundamentals of heat transfer, heating and cooling loads, psychometrics. Topics include building envelope principles (climate, orientation, materials, massing), heating and cooling systems, ventilation indoor air quality, plumbing water heating, lighting daylighting, and internal energy uses (plug loads, equipment). Zero energy building concepts, energy modeling, and energy benchmarking are also covered. Applications include existing building operation and improvement, and new building design and planning.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2025

Learning Outcomes: 1. Identify energy end-uses in commercial and residential buildings

Audience: Graduate

2. Describe the purpose and operation of energy-using building systems

Audience: Graduate

3. Create an energy model to simulate building energy performance

Audience: Graduate

4. Calculate the impact of energy efficiency options

Audience: Graduate

5. Use energy benchmarking tools such as Energy Star Target Finder

Audience: Graduate

6. Analyze the causes of and solutions for the sustainability challenge of excessive energy use in commercial and residential buildings

Audience: Graduate

7. Analyze sustainability issues and/or practices using a systems-based approach to identify opportunities for energy efficiency while maintaining human health

Audience: Graduate

E P D/ACCT I S/GEN BUS 781 – FINANCIAL AND BUSINESS ACUMEN

1 credit.

This course is designed with a keen awareness for the needs of the non-financial student or professional. For this class, no previous financial training is required. The intent is to equip you with the essential concepts used to develop financial literacy. Content will cover basic financial terms and reports, analytical tools to help interpret financial data and using financial data in budgets and forecasts.

Requisites: Graduate/professional standing. Not open to students declared in an MBA program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Apply the language and foundational tools of finance to analyze how a company's economic activity is reflected in its financial reports

Audience: Graduate

2. Perform high-level financial statement analysis to identify important information from financial reports

Audience: Graduate

3. Apply basic financial concepts of valuation, capital budgeting, and financial decision making

Audience: Graduate

E P D/GEN BUS/MARKETNG 782 – MARKETING FOR NON-MARKETING PROFESSIONALS

1 credit.

An overview of marketing's role within an organization, the key elements of a marketing plan, and how the plan is implemented. Students will learn about buyer demographic, psychographic and purchasing decision behavior. A thorough understanding of the customer enables students to develop a coordinated marketing mix (product, price promotion and place) that will satisfy the customer better than the competition and at the required margin. Students will leave the course understanding the degree to which all company functions must be coordinated and focused on the customer. This course will not apply toward fulfilling the MBA degree requirements.

Requisites: Graduate/professional standing or declared in graduate Business Exchange program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

Learning Outcomes: 1. Explain how the marketing function impacts an organization's business operations

Audience: Graduate

2. Identify and use marketing terminology and concept

Audience: Graduate

3. Use both demographic and psychographic information to segment markets and select a target market

Audience: Graduate

4. Research and create a basic marketing plan that aligns customer expectations with organizational marketing activities and the organization's resources

Audience: Graduate

5. Coordinate consistency between product, price, promotion, and place (distribution)

Audience: Graduate

6. Relate and utilize the product life cycle concept to product and service offerings

Audience: Graduate

E P D/GEN BUS/M H R 783 – LEADING TEAMS

1 credit.

Students will gain the knowledge and skills to continuously enhance their own team performance and productivity as well as the teams they are involved with. They will also be in a much better position to lead teams effectively.

Requisites: Graduate/professional standing or declared in graduate Business Exchange program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Describe team dynamics, roles, and expectations that influence a STEM team's performance

Audience: Graduate

2. Identify and effectively deploy specific team member strengths relevant for technical projects

Audience: Graduate

3. Plan, lead, and facilitate productive team meetings

Audience: Graduate

4. Identify and manage team conflict more effectively and constructively

Audience: Graduate

5. Assess and improve their current STEM team leadership methods and practices

Audience: Graduate

E P D/GEN BUS/OTM 784 – PROJECT MANAGEMENT ESSENTIALS

1 credit.

Techniques that will help to plan, execute, and deliver projects with desired scope on time and on budget. Learn to document clear project objectives and goals, accurately estimate project time and costs, schedule and allocate time-critical resources, and establish feedback systems for optimal project control.

Requisites: Graduate/professional standing or declared in graduate Business Exchange program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2023

Learning Outcomes: 1. Plan and manage successful engineering projects using appropriate methods, tools, and techniques

Audience: Graduate

2. Estimate project costs, resources, and schedules

Audience: Graduate

3. Immediately apply project management principles regarding the five major project stages: initiate, plan, execute, control, and close

Audience: Graduate

4. Apply or customize the project management framework to engineering organizational needs

Audience: Graduate

5. Assess and improve the current project management system

Audience: Graduate

E P D/GEN BUS/M H R 785 – EFFECTIVE NEGOTIATION STRATEGIES

1 credit.

Improves students' negotiating skills, doing so by providing a theoretical underpinning that will help them to understand the sources of effective and ineffective approaches to negotiations.

Requisites: Graduate/professional standing or declared in graduate Business Exchange program

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2025

Learning Outcomes: 1. Describe game theory and distinguish between distributive and integrative bargaining, recognizing appropriate tactics

Audience: Graduate

2. Identify bargaining styles, set goals, improve relationships, and leverage interests effectively

Audience: Graduate

3. Analyze ethical issues in negotiations and create mutual gain through value creation

Audience: Graduate

4. Demonstrate thorough preparation for negotiations, use individual and team techniques, and evaluate post-negotiation strengths and areas for improvement

Audience: Graduate