

# ENES - ENGINEERING SCIENCE

## ENES401 Entrepreneurial Design Realization (3 Credits)

The vision for this course, and an aspect that makes it unique, is to expose students to the opportunities and challenges of bringing a product design to reality (entrepreneurship). The emphasis is on environmentally and socially sustainable projects. The end-product of this course will be full-scale implementations or complete design "packages" that can be taken to potential stakeholders.

**Cross-listed with:** ENME401.

**Restriction:** Must have senior standing and permission of instructor.

**Credit Only Granted for:** ENME401, ENME489B or ENES401.

**Formerly:** ENME489B.

## ENES424 Engineering Leadership Capstone: Inclusive Leadership in Addressing Organizational & Societal Challenges (3 Credits)

The Minor in Global Engineering Leadership is designed to bring together one's understanding of leadership, organizations, culture, and global studies and apply this synthesized learning to a capstone project. The project will provide real-world application of global leadership principles to address an organizational or societal need. Students will utilize an inclusive leadership and global mindset to propose a big idea which brings about a positive organizational or societal change.

**Prerequisite:** ENES472 and ENES317.

**Restriction:** Must be in the Global Engineering Leadership minor (#EN09).

## ENES428 Engineering Research for Exchange Students (3-12 Credits)

Directed research within the Clark School of Engineering for international exchange students.

**Restriction:** Available only to visiting exchange students taking part in an Engineering exchange program.

**Repeatable to:** 24 credits.

## ENES440 Science, Technology, Ethics, and Policy: Minor Program Capstone (3 Credits)

Capstone research seminar for students in the Science, Technology, Ethics, and Policy Minor program.

**Prerequisite:** ENES240 and 2 courses from the STEP minor elective list.

**Restriction:** Must be in the Science, Technology, Ethics, and Policy minor.

**Additional Information:** This is the culminating course the STEP minor program.

## ENES442 Creating Historic Woodwinds (3 Credits)

In this class, students will learn the art of woodworking and blend techniques of modern and historic instrument-making methods. Using wood lathes, metalworking tools, 3d scanners and selective laser sintering 3d printers. Student teams will first train to acquire the skills needed to use fabrication equipment. Each mixed team will then share their individual discipline's skills to help contribute to the creation of a completed musical instrument. Along the way, we'll explore the historical and cultural context of instrument making and the musical period.

**Cross-listed with:** MUSC442.

**Credit Only Granted for:** MUSC442 or ENES442.

## ENES458 Topics in International Engineering (1-4 Credits)

A variety of topics related to engineering in a global context are discussed including cultural aspects, cross-cultural communication, international standards and law, and engineering and technology issues, business behavior, attitudes and values of selected countries and regions.

**Prerequisite:** ENES100.

**Repeatable to:** 12 credits if content differs.

## ENES459 Study Abroad Special Topics in Engineering IV (1-6 Credits)

Special topics course in engineering science taken as part of an approved study abroad program.

**Repeatable to:** 15 credits if content differs.

## ENES460 Fundamentals of Technology Start-Up Ventures (3 Credits)

Fundamental aspects of creating, organizing, funding, managing, and growing a technology startup venture. This multidisciplinary course will draw on management, business, legal, financial, as well as technical, concepts. Students form teams and develop a business plan for a technology company, based on each team's own business idea and then present the plan to a panel of outside experts.

**Restriction:** Permission of ENGR-Maryland Technology Enterprise Institute.

**Credit Only Granted for:** ENES460, BMGT461, SMLP470 or HLMN470.

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

## ENES461 Advanced Entrepreneurial Opportunity Analysis in Technology Ventures (3 Credits)

Explores the factors that influence entrepreneurial opportunity analysis in technology-based ventures. Uses a cognitive theoretical framework to examine the integration of motivation, emotions and information processing modes to make complex entrepreneurial decisions in technology venture environments.

**Credit Only Granted for:** ENES210 or ENES461.

## ENES462 Marketing High-Technology Products and Innovations (3 Credits)

Examines the opportunities and challenges of marketing high-technology products in turbulent environments requiring rapid decision making with incomplete information. Explores how innovations are introduced at frequent intervals, research-and-development spending is vital, and there are high mortality rates for both products and businesses.

**Restriction:** Permission of ENGR-Maryland Technology Enterprise Institute.

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

## ENES463 Strategies for Managing Innovation (3 Credits)

Emphasizes how the technology entrepreneur can use strategic management of innovation and technology to enhance firm performance. Examines the process of technological change, the ways that firms come up with innovations, the strategies that firms use to benefit from innovation, and the process of formulating technology strategy. Provides frameworks for analyzing key aspects of these industries and teaches students how to apply these frameworks.

**Restriction:** Permission of ENGR-Maryland Technology Enterprise Institute.

**Credit Only Granted for:** ENES463, BMGT467, SMLP473 or HLMN472.

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

## ENES464 International Entrepreneurship and Innovation (3 Credits)

Focuses on the need for every entrepreneur and innovator to understand the global market in today's hypercompetitive world, and to appreciate how to compete effectively in domestic markets by managing international competitors, suppliers, and influences. Explore how the distinction between foreign and domestic markets is becoming less pronounced. Develop skills to identify and manage opportunities on a global basis.

**Restriction:** Permission of ENGR-Maryland Technology Enterprise Institute.

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

**ENES466 Leading and Financing the Technology Venture (3 Credits)**

Focuses on the challenges of leading and financing new technology ventures. Leadership topics include team selection and formation, aligning rewards with relative contributions of team members, and how early decisions can enable or prevent founders from achieving results that align with their individual motivations for becoming an entrepreneur. Essential tools and methods for building a strong financial foundation for a new technology venture are examined. Includes important accounting principles as well as methods for keeping financial control of the technology venture. Insights are shared on navigating the multitude of financial barriers that may block your entrepreneurial success, as well as how to grow the technology venture from concept through launch.

**Restriction:** Permission of ENGR-Maryland Technology Enterprise Institute.

**Credit Only Granted for:** ENES466, BMGT365, SMLP471 or HLMN471.

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

**ENES467 Engineering for Social Change (3 Credits)**

Critical analysis of issues at the intersection of engineering, philanthropy and social change. How engineering design, products and processes have created social change in the past and will do so in the future through both intended and unintended consequences. Topics covered include energy, sustainability and climate change, autonomy, the digital future, low cost engineering, manufacturing, philanthropy, ethics and the impact of electronics on society, among others. Faculty and external experts will engage with students on these topics. Students will broadly engage with organizations involved in using technology for positive social impact.

**Cross-listed with:** ENME467.

**Restriction:** Junior standing or higher.

**Credit Only Granted for:** ENES467 or ENME467.

**Additional Information:** Students in the Mechanical Engineering (ENME) major should register for ENME467, all other majors should register under ENES467.

**ENES471 Legal Aspects of Entrepreneurship (3 Credits)**

Explores critical legal and business issues entrepreneurs face as they build and launch a new venture. Examines real world scenarios, and addresses the legal issues at all of the important junctures along the path to success. Significant attention placed on new venture formation, intellectual property management, and financing arrangements.

**Restriction:** Must be in the Minor in Technology Entrepreneurship & Corporate Innovation (#EN06).

**Additional Information:** Course may not be used to fulfill any BMGT major or minor program requirement.

**ENES472 Leading Global Teams and Engaging Across Cultures in Business, Engineering, and Technology (3 Credits)**

Develop global leadership capacities and an understanding of the cultural aspects pertaining to industry and international business. In a globalized world, the ability to work, lead and communicate in culturally diverse settings has become a core component to leadership. Through real-world examples, research, and simulations, students will increase their self-awareness and understanding of culture and how culture influences attitudes, behaviors, and practices at the individual, organizational, or societal levels. Students will develop the skills necessary to navigate, negotiate, and lead cross-cultural engagements and teams. The course content is relevant and applicable to anyone interested in developing cross-cultural leadership competencies and cultivating a global mindset.

**Restriction:** Sophomore standing or higher; must be a minor in Global Engineering Leadership (#EN09), Global Poverty (#AG06), Global Terrorism Studies (#BS07), or International Development and Conflict Management (#BS02).

**Credit Only Granted for:** ENES472, SLLC471, or SLLC473.

**Additional Information:** Students not meeting restriction requirements should add themselves to the course holdfile. Restrictions DO NOT apply to winter and summer terms.

**ENES474 Global Perspectives of Engineering (3 Credits)**

Faculty supervised research on aspects of engineering in a foreign country including leading fields of research, key world markets, and the culture of the engineering workplace. Students will produce a comprehensive report exhibiting their expertise in their chosen country and the field of engineering within.

**Prerequisite:** ENES100; or permission of ENGR-A. James Clark School of Engineering.

**Restriction:** Must be in the International Engineering Minor.

**Credit Only Granted for:** ENES458M or ENES474.

**Formerly:** ENES458M.

**ENES475 Leadership in Times of Crisis: Pandemics, Disasters, and Humanitarian Crises (3 Credits)**

Students are provided with immersive opportunities to learn from industry professionals about crisis prevention and response by examining leadership throughout the crisis cycle: from identification, prevention, and preparation, to response, recovery, and rebuilding. The course brings together the study and practice of leadership with promising practices in disaster preparedness and data informed decision-making. This course will examine how leadership has been enacted to help local, national, and global communities navigate through pandemics, disasters, and other humanitarian crises. Students will develop capacities for informed leadership in times of crisis and develop an understanding for applying these skills in a variety of settings.

**Restriction:** Must have earned a minimum of 60 credits.

**Credit Only Granted for:** ENES275 or ENES475.

**ENES478 Topics in Engineering Education (1 Credit)**

Topics related to teaching engineering courses, particularly project-based courses. Topics can include learning styles, student development theory, multicultural issues in teaching, facilitating team experiences, assessment, and academic integrity.

**Restriction:** Must be in the Engineering Teaching Fellow program.

**Repeatable to:** 3 credits if content differs.

**ENES480 Engineering Honors Seminar I (1 Credit)**

Introduction to engineering leadership, professionalism, and ethics. Discussions of leadership style, elements of success, professional communication, codes of ethics, handling of ethical dilemmas, and the characteristics of a professional.

**Restriction:** Must be in College of Engineering Honors; and junior standing or higher.

**ENES481 Engineering Honors Seminar II (1 Credit)**

Introduction to engineering creativity and innovation in engineering. Application of methods of creativity to topics in communication, conducting research, and leadership.

**Restriction:** Must be in College of Engineering Honors; and junior standing or higher.

**ENES489 Special Topics in Engineering (3-6 Credits)**

Special topics in engineering.

**Prerequisite:** Permission of ENGR-A. James Clark School of Engineering.

**Repeatable to:** 6 credits if content differs.

**ENES490 QUEST Capstone Professional Practicum (4 Credits)**

The capstone course for the QUEST Honors Program provides students with an opportunity to learn in multidisciplinary teams of business, engineering, and science students in a real-world setting. Companies engage teams of QUEST students with real organizational challenges and dedicate resources to help students address these problems. Student teams must enhance their skills in quality management, process improvement, and systems design and will apply these to add value to a client. In the process, students will improve their teamwork skills.

**Prerequisite:** BMGT390, ENES390 or ENED390.

**Cross-listed with:** ENED490.

**Credit Only Granted for:** BMGT490, ENES490 or ENED490.

**Formerly:** ENES490.

**ENES491 Scoping Experiential Learning Projects (3 Credits)**

QUEST students cultivate relationships with new and current corporate partners and prepare project scopes for QUEST's introductory course, BMGT/ENES 190H, and capstone course, BMGT/ENES 490H. Requires independent work communicating with clients and class visits to a variety of potential project sites.

**Prerequisite:** BMGT190 or ENES190.

**Cross-listed with:** BMGT491.

**Restriction:** Restricted to QUEST Program (TQMP) students.

**Credit Only Granted for:** BMGT491 or ENES491.

**ENES498 Special Topics in Entrepreneurship (3 Credits)**

This entrepreneurship seminar and case study-based course will explore technology entrepreneurship with a focus on leadership, marketing, team-building, and management of new technology ventures and assumes baseline knowledge of entrepreneurship. Students will learn skills needed to succeed as a technology entrepreneur and how to apply best practices for planning, launching, and growing new companies. This course is a requirement of the Hinman CEOs program.

**Restriction:** Must be in Hinman CEOs Program.

**Repeatable to:** 12 credits if content differs.

**ENES499 Senior Projects in Engineering (3 Credits)**

Students will work in large teams to solve a multidisciplinary research/design problem. The course will begin with students identifying opportunities, brainstorming project concepts to address these opportunities, applying lean startup and design thinking strategies, and then selecting/proposing a project for the semester. Acceptable projects will require the multidisciplinary design, construction and testing of a project within limited budget and time constraints.

**Prerequisite:** Permission of ENGR-A. James Clark School of Engineering; and completion of all 1XX and 2xx level (lower-division) technical courses in engineering major with a C- or better.

**Restriction:** Must be in a major in ENGR-A. James Clark School of Engineering.

**Repeatable to:** 6 credits if content differs.

**ENES601 Future Faculty Program Seminar I (1 Credit)**

Introduction to and development of skills necessary to obtain and succeed in a university faculty position. Emphasis on technical writing and effective presentations. Discussion of research diversification, networking, ethics and professionalism.

**Restriction:** Must be in the Clark School Future Faculty Program.

**ENES602 Future Faculty Program Seminar II (1 Credit)**

Effective teaching techniques. Basic principles of education and learning. Developing a course; promoting active learning, problem solving and critical thinking; designing exam and assignments; and communicating effectively with students.

**Restriction:** Must be in the Clark School Future Faculty Program.

**ENES603 Future Faculty Program Seminar III (1 Credit)**

Developing a successful faculty research program. Establishing and maintaining a research group. Finding funding opportunities and writing grant proposals. Mentoring graduate students. Faculty position application process. Preparing research and teaching statements.

**Restriction:** Must be in the Clark School Future Faculty Program.

**ENES604 Future Faculty Program Teaching Practicum (1 Credit)**

Graduate students will co-teach a course under supervision of a faculty mentor. Graduate students will be involved in all aspects of the course including development of syllabus, presenting lectures, writing and grading examinations, and evaluating the students in the course.

**Prerequisite:** ENES602.

**Restriction:** Must be a graduate student in the Clark School Future Faculty Program; and students for whom English is not the native language must pass the Maryland English Institute ITA Evaluation prior to enrolling in this course.

**ENES658 Special Topics in Engineering in a Global Context (1-3 Credits)**

Advanced topics in engineering in a global context.

**Restriction:** Graduate standing or permission of instructor.

**Repeatable to:** 12 credits if content differs.

**ENES660 Fundamentals of Product Management (3 Credits)**

Provides a comprehensive survey of product management and its growing role in producing technology-driven products that customers love. Guides students through the product lifecycle and market lifecycle, diving into the competencies needed at each stage. Topics include startup and corporate strategy, product strategy, vision setting and evangelism, development lifecycle approaches based on customer involvement and product stage, the various types of innovation at each stage of the lifecycle, and how the product manager leads the team through it all. Learn the basics of customer discovery, product discovery, product delivery, and the core-context model for managing products through maturity.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES662 Innovative Ideas and Concept Development (3 Credits)**

Enables aspiring entrepreneurs to understand the content, methods, and models for new venture opportunity assessment and analysis. Focuses on how to identify and analyze entrepreneurial opportunities for technology-based ventures by first understanding the personal self and decision-making factors. Explores how to evaluate new venture opportunities and challenges within industries and markets.

**Restriction:** Must be in the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES663 Strategies for Managing Innovation (3 Credits)**

Emphasizes how innovative leaders can use strategic management of innovation and technology to enhance firm performance. It helps students to understand the process of technological change; the ways that firms come up with innovations; the strategies that firms use to benefit from innovation; and the process of formulating technology strategy. It provides frameworks for analyzing key aspects of these industries and teaches students how to apply these frameworks.

**Restriction:** Must be in the Product Management or the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies programs; or permission of Maryland Technology Enterprise Institute.

**ENES664 Business Modeling and Customer Validation (3 Credits)**

Focuses on how to create and deliver value for customers and extract value for the new venture. Develop business models that encompass the product or service, customers, and the economic engine to meet the venture's financial and growth objectives. Introduces a structured way to think about, analyze, and develop a sound business model that is customer validated.

**Restriction:** Must be in the Product Management or the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies programs; or permission of Maryland Technology Enterprise Institute.

**ENES665 Innovative Thinking (3 Credits)**

Introduces students to new and powerful tools to boost their creative problem solving skills. Participants re-discover their communication and teaming skills. Students unlock their creativity potential, and explore win-win approaches to define and solve problems of different kinds. Students are also introduced to topics related to intellectual property.

**Restriction:** Must be in the Product Management or the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies programs; or permission of Maryland Technology Enterprise Institute.

**ENES666 Creative Design, Prototyping, and Testing (3 Credits)**

Transition from creative, innovative, design thinking methods to prototyping and concept testing of products and services. Learn how to translate ideas into marketable offerings to create real value for customers and the new venture. Emphasis is placed on an integrated and interdisciplinary approach to engineering design, concurrent engineering, design for manufacturing, industrial design, and the business of new product development. Topics include design methods, modeling and simulation, material and manufacturing process selection, platform and modular design, mass customization, planning and scheduling, and business issues, teamwork, group dynamics, creativity, and innovation.

**Restriction:** Must be in the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES667 Market Development and Commercialization (3 Credits)**

Provides an orientation to key marketing concepts critical to marketing technology-based products and services. Learn to identify market opportunities, understand customer preferences, evaluate market acceptance, and devise the appropriate going to market strategies for the new venture.

**Restriction:** Must be in the Product Management or the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies programs; or permission of Maryland Technology Enterprise Institute.

**ENES668 Corporate Technology Entrepreneurship (3 Credits)**

Focuses on the role of entrepreneurial individuals inside of existing technology organizations. Explores developing and leading innovation inside the firm. Discusses stages of innovation in the corporate entrepreneurship process and dynamics of organizational structure, politics, decisions, financing, and personal styles.

**Credit Only Granted for:** ENPM 808N or ENES 668.

**Formerly:** ENPM 808N.

**ENES670 Financial Management and New Venture Financing (3 Credits)**

Provides the essential tools and skills to build a strong financial foundation for a new technology venture. Examines accounting principles as well as methods for keeping firm financial control of the venture. Discusses navigating the multitude of financial barriers that may block entrepreneurial success, as well as how to raise the right amount of capital at the right time from the right source.

**Restriction:** Must be in the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES671 Legal Aspects of Entrepreneurship (3 Credits)**

Explores critical legal and business issues entrepreneurs face as they build and launch a new venture. Examines real world scenarios, and addresses the legal issues at all of the important junctures along the path to success. Significant attention placed on new venture formation, intellectual property management, and financing arrangements.

**Restriction:** Must be in the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES672 Launching Technology Startup Ventures (6 Credits)**

Explores the processes and skills needed to launch and manage technology startup ventures. Learn how to apply best practices for planning, launching, and leading new companies. Discusses a wide range of issues of importance and concern to entrepreneurs, to include how to navigate uncertainty.

**Restriction:** Must be in the Technology Entrepreneurship and Corporate Innovation Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.



**ENES673 Financing the Product Life Cycle (3 Credits)**

Provides the essential tools and skills to build a strong financial foundation for designing, developing, and managing new products within established companies and organizations. Examines accounting principles as well as methods for managing the financials of the product. Discusses navigating the multitude of financial barriers that may block success, as well as how to raise the right amount of capital at the right time from the right source, with an emphasis on internal company financing.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES674 Managing Product Development and Operations (3 Credits)**

Explores the evolution of modern management methods for operations and product development. Evaluates production and operation methods from inception to factory-based models of productivity, through the quality and lean movements, to the explosion of productivity with modern approaches. Focuses on how to effectively run large-scale agile teams with agile engineering at its core.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES676 Negotiation and Problem-Solving (3 Credits)**

Explores key negotiation techniques, how to apply these techniques, and their application to real-world scenarios. Establishes an understanding of deal-making, and creates a foundation for exploring the concepts of agreements, contracts, conflicts, and how the resulting transactions formed the foundation for modern scaled economies. Examines reputation effects, customer lifetime value, the basics of civil and criminal law, and how these have formed to constrain our interactions in modern society.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES677 Data Analysis and Decision Making (3 Credits)**

Provides a comprehensive understanding of making decisions under uncertainty for products, portfolios, and programs across various industries and environments. Focuses on the use of Bayesian methods for informing decisions on products and programs when directing experiments. Examines the testing of product ideas throughout the lifecycle, from customer discover, to product discovery, to product design and optimization, to channel testing and marketing for growth.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.

**ENES680 Building and Leading Innovative Organizations (3 Credits)**

Focuses on building a product enterprise through lean product portfolio management. Defines the conceptual groundwork that enables achieving the vision of a customer-centric value creation business model centered around lean principles. Explains the details of building a scaled product enterprise and explores alignment of organizational support functions with a product framework that lays the pathway for a sustainable value maximizing enterprise at scale.

**Restriction:** Must be in the Product Management Master of Professional Studies program; or permission of Maryland Technology Enterprise Institute.