

# ENES - ENGINEERING SCIENCE

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## ENES100 Introduction to Engineering Design (3 Credits)

Students work as teams to design and build a product using computer software for word-processing, spreadsheet, CAD, and communication skills.

**Prerequisite:** Must have math eligibility for MATH140 or higher.

## ENES102 Mechanics I (3 Credits)

The equilibrium of stationary bodies under the influence of various kinds of forces. Forces, moments, couples, equilibrium, trusses, frames and machines, centroids, moment of inertia, beams, friction, stress/strain, material properties. Vector and scalar methods are used to solve problems.

**Prerequisite:** Minimum grade of C- or better in MATH140.

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

## ENES106 Achieving Success in Mathematics (3 Credits)

An exploration of the skills and habits needed to successfully complete introductory mathematics courses.

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

## ENES107 Achieving College Excellence (1-3 Credits)

An exploration of the skills and habits needed to successfully complete the introductory chemistry course for engineering students. Course will also include strategies for a successful first year experience.

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

## ENES108 Achieving College Success: First Year Transition (1 Credit)

An exploration of the skills and habits needed to successfully complete the first year of study for Science, Technology, Engineering, and Mathematics (STEM) majors. This course is an extension of the college success seminars taught during the Summer Bridge Program.

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

**Repeatable to:** 2 credits if content differs.

## ENES113 Virtus Living and Learning Community Seminar I (1 Credit)

The seminar focuses on personal and professional development related to the field of engineering with a strong emphasis on clarifying career goals and decisions. Additional topics include an introduction to basic tools, undergraduate research opportunities, and campus and engineering resources.

**Restriction:** Must be in first year Virtus program.

## ENES114 Virtus Seminar II (1 Credit)

Focus on personal and professional development with engineering with a strong emphasis on career development. Learn to employ strategies and skills for academic and professional success.

**Prerequisite:** ENES113.

**Restriction:** Students must be participants in the Virtus Living and Learning Community.

## ENES115 FLEXUS Living and Learning Community Seminar I (1 Credit)

The seminar focuses on personal and professional development related to the field of engineering with a strong emphasis on clarifying career goals and decisions. Additional topics include an introduction to campus and engineering resources, basic tools, and undergraduate research opportunities. Students will discuss issues of concern through a variety of book readings, self-reflections, and panel discussions with practicing women engineers.

**Restriction:** Must be a first year FLEXUS Participant.

## ENES116 FLEXUS Living and Learning Community Seminar II (1 Credit)

The seminar focuses on personal and professional development by enhancing technical ability, understanding educational options through minors and student projects in engineering, identifying and employing strategies and skills for academic and professional success, and developing career commitment through networking and mentoring. Students develop professional portfolios in preparation for a future internship or job.

**Prerequisite:** ENES115.

**Restriction:** Must be in the Flexus Living-Learning Program.

## ENES122 Mechanics I and the Strong Light Works of Artists and Engineers (4 Credits)

The equilibrium of stationary bodies under the influence of various kinds of forces. Forces, moments, couples, equilibrium, trusses, frames and machines, centroids, moment of inertia, beams, friction, stress/strain, material properties. Vector and scalar methods are used to solve problems. Beyond mechanics, the course explores engineering as both a technical and creative discipline, examining how history's greatest engineering achievements balance engineering analysis, constraints, aesthetic aspirations, and cultural considerations.

**Prerequisite:** Minimum grade of C- in MATH140.

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

**Credit Only Granted for:** ENES102 or ENES122.

**Additional Information:** This course will include a short-term study abroad component and will require applications to be submitted through Education Abroad.

## ENES138 Exploring Engineering Design Through Dialogue (1 Credit)

Through deliberate reflections on past and current successes and failures in engineering design, you will develop skills for engaging in processes and practices that can transform your collaborations on teams and approach to engineering. This course engages students in facilitated dialogue in order to strengthen the engineering design process and outcomes.

**Restriction:** Must be a student in the A. James Clark School of Engineering or in the Global Engineering Leadership minor.

**Credit Only Granted for:** ENES338K, CHSE338K, or ENES138.

**Formerly:** ENES338K.

## ENES140 Discovering New Ventures (3 Credits)

Students explore dynamic company startup topics by working in teams to design a new venture. This multi-disciplinary course helps students to learn the basic business, strategy, and leadership skills needed to launch new ventures. Topics include learning how to assess the feasibility of a startup venture, as well as how to apply best practices for planning, launching, and managing new companies. Students discuss a wide range of issues of importance and concern to entrepreneurs and learn to recognize opportunities, assess the skills and talents of successful entrepreneurs, and learn models that help them navigate uncertainty.

**Additional Information:** This course may count as an elective for a student at the University of Maryland, depending on the student's specific degree program. It cannot be counted towards the requirements for the Smith School of Business Entrepreneurship Fellow Program.

**ENES181 Engineering & The Grand Challenges (1 Credit)**

Introduction to the various fields of engineering and the necessary context for students to fully engage in selected National Academy of Engineering's Grand Challenges such as economical solar energy, carbon sequestration, access to clean water, engineering better medicines, restoring urban infrastructure and personalized learning. The lectures and activities will provide an introduction to the engineering disciplines, NAE Grand Challenges, STEM cultures, and research.

**Restriction:** Must be in a major in ENGR-A. James Clark School of Engineering; and must be a new freshman or transfer student.

**ENES192 Engineering For Us All (3 Credits)**

Students are challenged to uncover hidden valuable connections among a variety of disciplines, while creatively seeking and solving problems as a team. Students learn and practice skills for how groups function and identify innovation while addressing the tensions between our inherent drives to seek and solve, to share, and to sell.

**Prerequisite:** MATH107.

**Additional Information:** Recommended for non-engineering majors.

**ENES193 Engineering Design Principles and Practices (1 Credit)**

Introduces students to engineering design practices by challenging them to modify an existing product or design to meet additional specifications and constraints. Using a combination of computational modeling, CAD tools, and rapid prototyping techniques, students will iteratively develop, test, and refine their designs. Teams will justify design choices based on data, performance criteria, and real-world considerations. By the end of the course, students will have built and tested a functional prototype, critically evaluated both their design product and design process, and recommended areas for future improvements to both product and process.

**Prerequisite:** Minimum grade of C- in ENES192.

**Credit Only Granted for:** ENES100 or (ENES192 and ENES193).

**ENES197 The Fault in Our Data: What Counts and Who's Counting (3 Credits)**

Quantitative data and analysis are key to understanding the shape of the world. In this course, we will use the tools of computational analysis to load, interrogate, visualize, and model datasets from dozens of data points to hundreds of thousands. We'll look at how computational methods can tell us when a movie is sexist, how wealth inequality can form, and how rumors spread like diseases. Then, you will find datasets of interest, write code to make sense of them, and share your findings with the world. No prior programming experience is required.

**Prerequisite:** MATH113 or equivalent.

**Recommended:** MATH115.

**ENES200 Technology and Consequences: Engineering, Ethics and Humanity (3 Credits)**

What makes a technology socially responsible? At UMD, the Fearless Ideas campaign asks us to aim our enthusiasm for technology at big real problems. At the same time, we are coming to appreciate the increasingly complex nature of technological systems as they become integrated into all forms of infrastructure, we realize they may be unpredictable, interdependent on social and biological systems, and have unintended consequences. In this midst of this complexity, people make decisions with far reaching impacts. How then do we follow our passion for technology and innovation but also stay skeptical in a way that allows us to consider the potential and shortcomings of technology? Designed for both engineering and non-engineering students wishing to explore and assess the impact of engineering technology on society and the role of society in generating that technology.

**Credit Only Granted for:** ENEE200 or ENES200.

**ENES210 Entrepreneurial Opportunity Analysis and Decision-Making in 21st Century Technology Ventures (3 Credits)**

This multi-disciplinary course helps students learn the principles of entrepreneurial opportunity analysis and decision-making in an increasingly dynamic and technically-inclined society. Emphasis is placed on how aspiring technology entrepreneurs can develop their entrepreneurial perspectives to develop winning entrepreneurial plans for their future ventures.

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

**ENES213 Virtus Living and Learning Community Seminar III (1 Credit)**

The seminar focuses on personal, academic and professional success by cultivating leadership skills, developing academic and technical ability and encouraging self awareness, identifying and employing strategies for academic and professional success, further enhancing career development through networking and mentoring and developing awareness of diversity issues.

**Prerequisite:** ENES113 and ENES114.

**Restriction:** Must be a participant in the second year of the Virtus living-learning program.

**ENES214 Virtus Seminar IV (1 Credit)**

Students continue to develop their leadership and mentoring skills, participate in networking opportunities and explore their interest in special engineering topics.

**Prerequisite:** Students must have completed ENES213.

**Restriction:** Students must be participants in the Virtus Living and Learning Community.

**ENES215 FLEXUS Living and Learning Community Seminar III (1 Credit)**

The seminar focuses on personal, academic and professional success by cultivating leadership skills, developing self-confidence and self-efficacy in academic and technical ability and encouraging self awareness, identifying and employing strategies for academic and professional success, further enhancing career development through networking, mentoring and role modeling, and developing awareness of diversity issues, specifically gender diversity.

**Prerequisite:** ENES115 and ENES116.

**Restriction:** Must be a second year FLEXUS participant.

**ENES216 FLEXUS Living and Learning Community Seminar IV (1 Credit)**

The seminar focuses on gender diversity and its cross-sections with culture. Students continue to enhance their leadership and mentoring skills, participate in networking opportunities with women in leadership roles and careers in engineering, and engage in opportunities for outreach and service-learning. Students will also complete a culminating semester project.

**Prerequisite:** ENES115, ENES116, and ENES215.

**Restriction:** Restricted to second year FLEXUS participants.

**ENES220 Mechanics II (3 Credits)**

Stress and deformation of solids-rods, beams, shafts, columns, tanks, and other structural, machine and vehicle members. Topics include stress transformation using Mohr's circle; shear and moment diagrams; derivation of elastic curves; and Euler's buckling formula. Design problems related to this material are given in lab.

**Prerequisite:** Minimum grade of C- in ENES102; and (MATH141 and PHYS161).

**Restriction:** Must be in a major in ENGR-A. James Clark School of Engineering; and must not be in Engineering: Electrical program.

**ENES221 Dynamics (3 Credits)**

Systems of heavy particles and rigid bodies at rest and in motion. Force-acceleration, work-energy and impulse-momentum relationships. Motion of one body relative to another in a plane and in space.

**Prerequisite:** Minimum grade of C- in ENES102; and (MATH141 and PHYS161).

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

**ENES232 Thermodynamics (3 Credits)**

Introduction to thermodynamics. Thermodynamic properties of matter. First and second laws of thermodynamics, cycles, reactions, and mixtures.

**Prerequisite:** Minimum grade of C- in PHYS161, MATH141, CHEM135, and (ENES102 or ENAE222).

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

**Credit Only Granted for:** BIOE232, CHBE301, or ENES232.

**ENES240 Ethical, Policy and Social Implications of Science and Technology (3 Credits)**

Asks students to think about how society should manage complexity, transformation, and uncertainty with an eye on developing a broader sense of ethics and social responsibility. Introduces analytical frameworks, concepts, and data collection techniques that interdisciplinary scholars use to map relationships among science, technology and society and generate important questions about the future of society.

**Cross-listed with:** PLCY240.

**Credit Only Granted for:** ENES240 or PLCY240.

**ENES250 Why Do Things Fail? (3 Credits)**

What brought down two brand new Boeing 737's in the span of two months? Was the Challenger spacecraft disaster preventable? Why did Hurricane Katrina have such devastating results for New Orleans? What went wrong during the design phase of the Hyatt Regency skywalks that caused their collapse within months of their opening? What have we learned from past disasters? What are the ethical implications for engineers and managers alike? To answer the question "Why do things fail?" we must look beyond the specific conditions that cause a single point or a single component to fail. In this course, we will, of course, study how individual components fail, but a much greater emphasis will be placed on the myriad of other reasons why things fail. We will learn how to design structures with specific performance goals in mind, we will predict their failure points, then we will build them, test them, and compare our results with our predictions.

**ENES256 Partnering With Artificial Intelligences To Reimagine Our Future (3 Credits)**

How can we effectively and responsibly partner with artificial intelligences to tackle previously unthinkable problems--and reimagine what's possible for our future? In this course we will explore what it means to think, create, and collaborate in a world where artificial intelligences are not just tools, but teammates. As AIs become increasingly capable partners in thinking, designing, and decision-making, new futures become imaginable--and attainable. We'll examine key cognitive processes such as reasoning, memory, perception, and creativity in both humans and machines. Students will gain hands-on experience working with generative AI tools and autonomous agents on real-world challenges. Along the way, we'll critically assess the risks, ethics, and design choices involved in these hybrid systems--and imagine how human-AI partnerships might shape the future of knowledge, innovation, and society.

**ENES259 Study Abroad Special Topics in Engineering II (1-6 Credits)**

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

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

**ENES260 AI4ALL: Introduction to Machine Learning for All Engineers (3 Credits)**

This introductory course covers a wide range of topics, from the fundamentals of linear algebra and programming to advanced topics such as backpropagation in neural networks and hardware considerations for Large Language Models. This course will explore how professionals use Machine Learning (ML) to solve real-world engineering problems and even implement models in a team-based project. This course also delves into unsupervised algorithms for dimensionality reduction, defensive strategies against adversarial attacks on ML, ethical considerations of the open internet, and copyright.

**Prerequisite:** Minimum grade of C- in MATH140.

**Recommended:** Some programming experience is recommended, especially in Python.

**Restriction:** Permission of Department (Keystone).

**ENES269 Topics in Grand Challenges for Engineering in a Global Context (3 Credits)**

Special topics course that explores the grand engineering challenges facing the world from a technical, cultural, political, and economic perspective, as well as solutions developed through innovation and technology. Topics can include energy, environment, urban infrastructure, health, safety and security, and engineering the tools of discovery.

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

**Additional Information:** Course includes a study abroad component. No engineering background is required.

**ENES275 How Do You Navigate Leadership in Times of Crisis? (3 Credits)**

Students take part in immersive opportunities to learn from industry professionals about crisis prevention and response. The course introduces students to the study and practice of leadership with promising practices in disaster preparedness and data informed decision-making. Global communities need those who can lead during times of crisis and understand when and how to use data to inform decisions in times of crisis. 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.

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

**ENES300 Unveiling Hidden Barriers: How the World is Engineered for Some, and Not for Others (3 Credits)**

By unveiling hidden barriers in technical design, students will use a multidisciplinary approach to envision and propose more inclusive, equitable, and community-responsive design. Through a systems-thinking lens and case studies from both the U.S. and global contexts, students will analyze how historical, political, and social forces shape design processes, determine access and benefit, and often reproduce inequities. Students will engage with case studies and real world application within STEM education; artificial intelligence; transportation infrastructure; safety & compliance; urban design; data, information technology & cybersecurity; and agriculture & food sciences.

**Restriction:** Must be in the A. James Clark School of Engineering; or must have permission from the A. James Clark School of Engineering.

**ENES317 Introduction to Leadership in Engineering, Science, and Technology (3 Credits)**

Develop a comprehensive overview and introduction to leadership and organizational development. Students will reflect on their own leadership experiences, develop a strong foundational knowledge of leadership theory, and advance their capacities in effectively leading teams. Students will connect leadership theory to practice by engaging in case study analysis and critique leadership practices enacted within engineering and technology settings. Students will complete self-assessments to better understand their own leadership strengths and refine their approaches to leadership by incorporating theories covered in this course.

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

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

**ENES332 Thermodynamics and the Technologies that Transform Civilization (4 Credits)**

Explores the foundations of classical thermodynamics, including the thermodynamic properties of matter and the first and second laws as applied to processes and cycles. Students examine the historical evolution of thermodynamics from early steam engine to modern energy systems. Students explore both the technological progress enabled by thermodynamics and the broader cultural, societal, and environmental consequences of technological innovations.

**Prerequisite:** Minimum grade of C- in PHYS161, MATH141, CHEM135, and (ENES102 or ENAE222); or permission of Keystone program.

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

**Credit Only Granted for:** BIOE232, CHBE301, or ENES232.

**Additional Information:** This is an approved Education Abroad course.

**ENES338 Navigating Difference through Intergroup Dialogue (1 Credit)**

The goal of intergroup dialogue is for students to develop comfort with, and skill for, discourse on controversial, difficult, and divisive topics in an effort to foster positive, meaningful, and sustained cross-group relationships. Whereas in debate, students learn to listen to gain advantage, in intergroup dialogue, students learn to listen to gain understanding. In so doing, students develop increased capacity for interaction across difference, heightened intergroup awareness and sensitivity, and greater commitment to community engagement.

**Prerequisite:** Completion of on-line enrollment form.

**Cross-listed with:** WEID139.

**Repeatable to:** 6 credits.

**Credit Only Granted for:** CHSE338, EDHI338, ENES338 or WEID139.

**Formerly:** CHSE338.

**ENES340 Engineering and Social Justice (3 Credits)**

Students will explore the relationships between engineering and social justice through personal reflection and historical and contemporary case studies. Students will explore their own social locations, privileges, alliances, and resistances to social justice through critical engagement of interdisciplinary readings that challenge engineering mindsets and ideologies. Students will work to understand what constitutes social justice in different areas of social life and the role that engineers, and engineering might play. Students will gain an understanding of why and how engineering has been aligned and divergent from social justice issues and causes.

**Prerequisite:** ENEE200.

**ENES359T Education, Technology and Society: Ecuador in Context (3 Credits)**

Set in the UNESCO World Heritage site of Cuenca, Ecuador, students in this short-term study abroad course use theory from Science and Technology Studies (STS) to explore, discuss and critique the design, development and implementation of technology-based social programs in Ecuador. The program looks at education and technology throughout multiple lenses and contexts. Collaboration with the University of Cuenca, participating students have the opportunity for both university and field-based research and practice. UMD students work alongside students and faculty from the leaders and practitioners from UCuenca, government agencies, nongovernmental organizations, small business and local communities.

**Recommended:** 1 course from (ENES240, ENES200, or ENEE200).

**Cross-listed with:** CPSS370, LACS370.

**Restriction:** Minimum cumulative GPA of 2.5.

**Credit Only Granted for:** ENES259T, ENES359T, CPSP279T, LASC269T, CPSS370, or LACS370.

**Formerly:** ENES259T.

**ENES388 Engineering Honors Seminar (1 Credit)****ENES389 Selected Topics (3 Credits)**

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

**ENES390 Designing Innovative Systems (3 Credits)**

The QUEST systems thinking course challenges students to analyze how processes interact in larger systems. Students will learn how to use process improvement tools and a systems thinking approach to solve problems and design innovative solutions. By drawing upon their multidisciplinary backgrounds, students will be able to understand and reframe problems from multiple perspectives to uncover new solutions.

**Prerequisite:** ENES190, BMGT190, ENED290 or BMGT290.

**Cross-listed with:** ENED390.

**Restriction:** Must be in the QUEST program.

**Credit Only Granted for:** BMGT390, ENES390 or ENED390.

**Formerly:** ENES390.

**ENES401 Entrepreneurial Design Realization for Projects of Impact (3 Credits)**

The purpose of the course is to produce socially or environmentally responsible impacts through the development and implementation of real-world products or processes. Students must produce tangible deliverables that go out into the public domain. These can include physical builds and implementations, process or curriculum plans, or design packages that can be taken to potential licensors or funders (including prototypes, market assessment, and manufacturing approach).

These deliverables should include the necessary documentation and structure for the continuation and expansion of impact that extends beyond the timeframe and scope of the semester's work. Students will be exposed to the opportunities and challenges of bringing an environmentally or socially responsible product designs to reality.

**Cross-listed with:** ENME401.

**Restriction:** Must have senior standing.

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

**Additional Information:** Students in Mechanical Engineering (ENME) major should register for ENME401; all other majors should register under ENES401.

**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.

**ENES434 Creating Historic Woodwinds (3 Credits)**

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:** MUSC434.

**Restriction:** Permission of the School of Music.

**Credit Only Granted for:** ENES434 or MUSC434.

**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:** Students must receive a B- or better in ENES240 and take 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.

**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.

**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.

**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.

**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.