ENGINEERING EDUCATION

Our Website (http://www.enge.vt.edu)

Overview

The Department of Engineering Education (ENGE) is home to General Engineering (GE) students. The department advises General Engineering (GE) students, teaches the interdisciplinary first-year engineering courses, an interdisciplinary projects course and an interdisciplinary design capstone sequence, and offers a graduate certificate and a Ph.D. in engineering education.

At the undergraduate level, the department provides the foundation for students to begin their engineering journey, preparing them for academic success in one of the degree-granting College of Engineering programs and for success as an engineer. Our Interdisciplinary Projects (https://enge.vt.edu/interdisciplinary-education/interdisciplinaryprojects.html) course helps sophomores and juniors develop a range of workplace skills, practices, and mindsets through mentored participation in interdisciplinary projects on interdisciplinary teams. The two semester Interdisciplinary Design Capstone (https://enge.vt.edu/interdisciplinaryeducation/interdisciplinary-capstone.html) sequence is an in-depth, hands-on educational experience that provides students the ability to create meaning, explore connections, and build knowledge and skills for their academic, professional, civic, and personal lives. Most engineering problems are interdisciplinary in nature and this course sequence provides students the opportunity to work on an interdisciplinary team during their capstone experience. At the graduate level, the department prepares scholars to advance knowledge and address significant challenges facing engineering education in careers including engineering faculty, policy makers, corporate training, university assessment and university administration.

First Year Students and General Engineering

The General Engineering (GE) program of the EngE department serves first-year students in the College of Engineering. Through EngE courses, first-year students participate in problem solving, engineering analysis and design exercises that represent the essence of the engineering profession. The courses emphasize team-based, design-oriented, handson experiences to develop students' concepts of engineering and engineering methods, while reinforcing the role of concurrent required courses (e.g. mathematics, English, physics). The first-year engineering courses also serve as a foundation for subsequent courses in the various engineering curricula. Coverage of engineering ethics instills a sense of the responsibilities of engineers to society. Algorithm development and computer programming develop logical thinking, provide the background for computer use in later courses, and support problem-solving skills. Visualization skills are developed through engineering graphics and modern CAD tools. Through writing and presentations, students begin to hone their professional communication skills, including audience analysis, argument development, effective writing styles, issues in collaborative writing, techniques of oral presentation, print and Webbased research, graphics for written and oral presentations, and editing.

General Engineering students have access to the **Frith First-Year Makerspace** run by the Engineering Education department. The Frith First-Year Makerspace is designed to support the retention and development of young engineers through hands-on learning, peer mentoring, and authentic problem-solving. Part collaboration and innovation space, part fabrication and prototyping space, and part learning laboratory, Frith is integrated into the first-year foundations of engineering courses and enables General Engineering students to learn by dissecting, designing, making, and analyzing engineering products. The Frith Makerspace houses equipment for 3D printing, laser cutting, metalworking, woodshop work, and crafts. https://enge.vt.edu/ undergraduate/frith.html

All College of Engineering students must own a laptop or 2-in-1 tablet meeting the specifications posted at https://eng.vt.edu/admissions/ computer-requirement.html. Students will also be required to acquire the university undergraduate and engineering software bundles allowing them to complete coursework in and out of class.

Process for Declaring a Degree-Granting Engineering Major

The General Engineering program introduces first-year engineering students to foundational concepts and practices in engineering, provides time and support to students as they transition to the College, and provides opportunities to investigate the College's individual degree programs and select an Engineering program best suited to their skills and interests. Upon completion of the Engineering change of major requirements, General Engineering students select a degree program and, if academically eligible, are transferred to the appropriate degreegranting department.

Entry into a degree-granting engineering department requires that students successfully complete all Engineering change of major requirements. Please see the College of Engineering catalog section titled "Required Academic Progress" for details, and visit https://eng.vt.edu/ academics/undergraduate-students/resources-support/change-ofmajor.html for application policies and dates.

Head: E. Berger

Assistant Head for Undergraduate Programs: N.P. Pitterson Assistant Head for Graduate Programs: W.C. Lee Professors: E. Berger, J.M. Case, D.B. Knight, W.C. Lee, V.K. Lohani, H.M. Matusovich, L.D. McNair, and M.C. Paretti Associate Professors: D. Bairaktarova, J.R. Grohs, A.S. Katz, T.W. Knott, N.P. Pitterson, S.L. Rodriguez, and Q. Zhu Assistant Professors: M.V. Huerta, D. Kim, and S. Sajadi Associate Professor of Practice: M.B. James, and N.C.T. Van Tyne Assistant Professor of Practice: N.J. Bedard Collegiate Assistant Professor: B.D. Chambers, T.Clarke Douglas, D.A. Gray, J.D. Ortega Álvarez, M.M. Soledad, and C. Wallwey Senior Instructor: J.L. Lo Advanced Instructor: C.A. Twyman

Instructor: E.H. Dogan

Professor Emeritus: O.H.Griffin

Associate Professor Emeritus: J.B. Connor, R.M. Goff, M.H. Gregg and T.D.L. Walker

Academic and Career Advisors: M. Cheatham, J. Chin, J. Elmore, D. Erb, M. Greene-Havas, A. Mullins, D. Newcomb, J. Newcomer, and A. Noble

E-mail: enge@vt.edu

Undergraduate Course Descriptions (ENGE)

ENGE 1004 - Explore Engineering (1 credit)

Students will participate in a seminar-style experience guided by representatives from different engineering disciplines to learn more about the programs offered by the College of Engineering at Virginia Tech to aid the change of major process.

Instructional Contact Hours: (1 Lec, 1 Crd)

ENGE 1014 - Engineering Success Seminar (1 credit)

Introduction to opportunities and resources available to College of Engineering students during their undergraduate career at VT. Practice in information gathering skills critical for engineering students. Practice in oral, written, and visual communication. Preparation of an academic plan. **Corequisite(s):** ENGE 1215

Instructional Contact Hours: (1 Lec, 1 Crd)

ENGE 1034 - The Connection Project (1 credit)

The Connection Project brings together groups of students to get to know one another while discussing the key components of making meaningful connections. Led by trained, upper-class student facilitators, a group of about 10 students will engage in activities and dialogue that highlight what brings people together, what keeps people apart, and how these things manifest in VT's social culture. Students will develop foundational knowledge of current research on the social, biological, emotional, and cognitive impacts of human connection. Students will also learn about and discuss application of various communication styles and conflict resolution strategies, and further consider how these variations in communication can impact social interactions and connection. **Instructional Contact Hours:** (1 Lec, 1 Crd)

ENGE 1215 - Foundations of Engineering (2 credits)

A first-year sequence to introduce general engineering students to the profession. 1215 (2 credit) Engineering problem-solving, contemporary programming tools, professional practices and expectations (e.g. effective communication, time management, working in teams, ethics), the diversity of fields and majors within engineering, and reflective and corrective practices. 1216 (2 credits): Engineering design, criteria and constraints, data collection and analysis, testing and iteration of design solutions, contemporary CAD tools, professional practices and expectations (e.g. communication, teamwork, ethics), and reflective and corrective practices. Students must complete both ENGE 1215 and ENGE 1216 to earn Pathways credit. 1215: Design Lab/Studio, 1216: Design Lab/Studio. Duplicates ENGE 1414.

Pathway Concept Area(s): 6D Critique & Prac in Design, 10 Ethical Reasoning

Instructional Contact Hours: (3 Lab, 2 Crd)

ENGE 1216 - Foundations of Engineering (2 credits)

A first-year sequence to introduce general engineering students to the profession. 1215 (2 credit) Engineering problem-solving, contemporary programming tools, professional practices and expectations (e.g. effective communication, time management, working in teams, ethics), the diversity of fields and majors within engineering, and reflective and corrective practices. 1216 (2 credits): Engineering design, criteria and constraints, data collection and analysis, testing and iteration of design solutions, contemporary CAD tools, professional practices and expectations (e.g. communication, teamwork, ethics), and reflective and corrective practices. Students must complete both ENGE 1215 and ENGE 1216 to earn Pathways credit. 1215: Design Lab/Studio, 1216: Design Lab/Studio. Duplicates ENGE 1414.

Prerequisite(s): ENGE 1215

Pathway Concept Area(s): 6D Critique & Prac in Design, 10 Ethical Reasoning

Instructional Contact Hours: (3 Lab, 2 Crd)

ENGE 1354 - Introduction to Spatial Visualization (1 credit)

Introduction to spatial visualization. Training to improve threedimensional visualization skills, pictorial sketching, orthographic projection, mental rotation, mental cutting and folding, combining solids. Instructional Contact Hours: (1 Lec, 1 Crd)

ENGE 1414 - Foundations of Engineering Practice (4 credits)

Introduction to the engineering profession for General Engineering students and Transfer Engineering students with significant transfer/ AP credit; engineering problem solving and design, contemporary programming and CAD software tools, and professional practices and expectations (e.g., communication, teamwork, ethics), Reflective and Corrective practices. Design Lab/Studio. Duplicates ENGE 1215-1216. **Pathway Concept Area(s):** 6D Critique & Prac in Design, 10 Ethical Reasoning

Instructional Contact Hours: (6 Lab, 4 Crd)

ENGE 1644 - Global STEM Practice: Leadership and Culture (3 credits) Develop global competencies in science, technology, engineering, and math (STEM) contexts and understand how problems and viable solutions vary across contexts and how intercultural communication and global leadership are important in an interconnected global workforce. Integrates semester-long on-campus module with international module following semester exams (Rising Sophomore Abroad Program). International module engages students in local culture during visits with STEM businesses and universities. Participation in both modules required. Enrollment by application.

Pathway Concept Area(s): 3 Reasoning in Social Sciences, 11 Intercultural&Global Aware.

Instructional Contact Hours: (2 Lec, 1 Lab, 3 Crd)

ENGE 1984 - Special Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 2094 - Createl: Ideation & Innovation (3 credits)

Apply problem solving framing strategies as part of problem solving design processes. Consider cultural, economic, social, and other perspectives in customer discovery and design processes in order to ensure problem/solution fit. Ideate possible solutions or approaches to address open- ended problems using a variety of methods. Engage in iterative critiques of strategies, solutions and prototypes using methods drawn from industrial design, engineering and the arts. Collaborate in interdisciplinary and diverse project teams. Communicate deliverables in multiple formats and for different audiences. Identify and address impacts of designed services and products through global perspectives, such as patterns of inclusion and exclusion and effects on localized ecosystems.

Pathway Concept Area(s): 6D Critique & Prac in Design, 11 Intercultural&Global Aware.

Instructional Contact Hours: (3 Lec, 3 Crd)

ENGE 2524 - Exploring Service Learning Through STEAM/STEM Educational Outreach (3 credits)

Explore volunteerism, traditional service learning, critical service learning, and social change. Develop intercultural competence by examining social identities, power, and privilege with a focus on preK-12 education systems in the United States. Develop Science, Technology, Engineering, Arts, and Math (STEAM) and STEM educational outreach experiences that meet needs identified by community members in teams. Demonstrate career readiness through experiential learning. Pre: Sophomore standing. **Pathway Concept Area(s):** 3 Reasoning in Social Sciences, 7 Identity & Equity in U.S., 11 Intercultural&Global Aware. **Instructional Contact Hours:** (3 Lec, 3 Crd)

ENGE 2524H - Service Learning Edu. Outreach (3 credits)

Pathway Concept Area(s): 3 Reasoning in Social Sciences, 7 Identity & Equity in U.S., 11 Intercultural&Global Aware. Instructional Contact Hours: (3 Lec, 3 Crd)

ENGE 2634 - Introduction to Restricted Research (1 credit)

Introduction to multi-disciplinary, team-based undergraduate engineering research. Emphasis on Department of Defense (DoD) and Intelligence Community missions and projects. Exposure to current restricted research performed around campus. Guest speakers from national labs. Engineering research methods (tools, research integrity/safety/ethics, and communication of results). Deep dive into International Traffic in Arms Regulations-restricted multi-disciplinary DoD engineering problems, potential careers, and security protocols surrounding restricted research and careers.

Instructional Contact Hours: (1 Lec, 1 Crd)

ENGE 2964 - Field Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 2974 - Independent Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 2984 - Special Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ENGE 2984G - Special Study (1-19 credits) Pathway Concept Area(s): 7 Identity & Equity in U.S.

Instructional Contact Hours: Variable credit course

ENGE 2984M - Special Study (1-19 credits) Pathway Concept Area(s): 6A Critique & Practice in Arts Instructional Contact Hours: Variable credit course

ENGE 2994 - Undergraduate Research (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 3604 - Introductory Industry Design Experience (3 credits)

Workplace and industry culture and practice, including folkways, mores, and ethics, centered on engineering design. Interaction with industry professionals. Workplace competencies including effective teamwork, project management, presenting technical information. Training with software, tools and skills used in design practice in industry. **Prerequisite(s):** ENGE 1215 and ENGE 1216 **Instructional Contact Hours:** (3 Lec, 3 Crd)

ENGE 3900 - Bridge Experience (0 credits)

Application of academic knowledge and skills to in a work-based experience aligned with post-graduation goals using research-based learning processes. Satisfactory completion of work-based experience often in the form of internship, undergraduate research, co-op, or study abroad; self-evaluation; reflection; and showcase of learning. Pre: Departmental approval of 3900 plan. Instructional Contact Hours: (0 Crd)

ENGE 3984 - Special Study (1-19 credits)

Instructional Contact Hours: Variable credit course

ENGE 4094 - Startup: Commercialization of Innovation (3 credits)

Work in interdisciplinary teams in an experiential environment replicating modern innovation environments. Engage in real world innovation commercialization opportunities. Individual experiences and projects involving actual inventions, innovations, technologies, intellectual property (e.g. patents) and market opportunities. Integrate design thinking, scientists, entrepreneurs, advisors and other potential collaborators. Create a representation of a plan for a minimum viable product for an innovative product or service based on customer and market feedback.

Pathway Concept Area(s): 3 Reasoning in Social Sciences, 10 Ethical Reasoning

Instructional Contact Hours: (3 Lec, 3 Crd) Course Crosslist: IDS 4094, MGT 4094

ENGE 4104 - Applied Explorations in Innovation (3 credits)

Work in interdisciplinary teams to scope and plan an open-ended design project focused on technology commercialization that addresses a need or problem. Model systems and products computationally and quantitatively to address issues of technical and market feasibility and to predict performance under uncertain conditions. Engage in iterative design process that combines computational and quantitative processes with user-centered design and market analysis. Produce viable design that includes technical specifications, market evaluation, and customer discovery results. Communicate with wide range of audiences. Analyze ethical and intercultural and global impacts of innovation. Pre: 3 credits of foundational quantitative and computational thinking.

Prerequisite(s): STS 2254 and ENGE 2094 and (MGT 4094 or ENGE 4094 or IDS 4094)

Pathway Concept Area(s): 5A Quant & Comp Thnk Adv., 6D Critique & Prac in Design, 10 Ethical Reasoning, 11 Intercultural&Global Aware. Instructional Contact Hours: (3 Lec, 3 Crd)

ENGE 4735 - Interdisciplinary Design Capstone (3 credits)

Team-oriented, open-ended, interdisciplinary design projects focused on industrially relevant problems. A specific, complex engineering design problem taken from problem definition to product implementation and validation. 4735: Focus on problem identification, development of customer needs, project management, solution validation and selection, solution design, engineering teamwork, documentation and communication. 4736: Focus on design implementation, design validation, ethical and societal impacts of engineering design, communication and teamwork. Students majoring in Material Science and Engineering, Mechanical Engineering, Electrical and Computer Engineering, Industrial and Systems Engineering, and Biomedical Engineering must meet prerequisite and corequisite requirements for their respective in-major capstone courses.

Prerequisite(s): (ME 3024 and ME 3034 and ME 3304 and ME 3524 and ME 3534 and ME 3624 and ME 4005 and MSE 2034) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 4414 and MSE 4554) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 4414 and MSE 3304) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 4414 and MSE 3204) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 4554 and MSE 3304) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 4554 and MSE 3204) or (MSE 4644 and MSE 3044 and MSE 3054 and MSE 3884 and MSE 3304 and MSE 3204) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3106) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3106) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3134) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3134) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3204) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3204) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3214) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3214) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3304) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3304) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3544) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3544) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3564) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3564) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3574) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3574) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3614) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3614) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 3704) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 3704) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4205) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4205) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4234) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4234) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4354) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4354) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4424) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4424) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4524) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4524) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4540) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4540) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4580) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4580) or (ECE 2804 and ECE 3004 and ECE 3105 and ECE 4704) or (ECE 2804 and ECE 3004 and ECE 3514 and ECE 4704) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3106) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3106) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3134) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3134) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3204) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3204) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3214) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3214) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3304) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3304) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3544) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3544) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3564) or (ECE 2804 and ECE 3504 and ECE 3514 and ECE 3564) or (ECE 2804 and ECE 3504 and ECE 3105 and ECE 3574) or (ECE 2804 and ECE 3504 E 2514 and ECE 2574) at (ECE 2004 and ECE 2504 and ECI

ENGE 4736 - Interdisciplinary Design Capstone (3 credits)

Team-oriented, open-ended, interdisciplinary design projects focused on industrially relevant problems. A specific, complex engineering design problem taken from problem definition to product implementation and validation. 4735: Focus on problem identification, development of customer needs, project management, solution validation and selection, solution design, engineering teamwork, documentation and communication. 4736: Focus on design implementation, design validation, ethical and societal impacts of engineering design, communication and teamwork. Students majoring in Material Science and Engineering, Mechanical Engineering, Electrical and Computer Engineering must meet prerequisite and corequisite requirements for their respective in-major capstone courses.

Prerequisite(s): ENGE 4735

Corequisite(s): (MSE 4055 for MSE majors) or (ISE 4404 for ISE majors). Pathway Concept Area(s): 1A Discourse Advanced, 10 Ethical Reasoning Instructional Contact Hours: (3 Lec, 3 Crd)

ENGE 4964 - Field Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 4974 - Independent Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 4974H - Independent Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 4984 - Special Study (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 4994 - Undergraduate Research (1-19 credits) Instructional Contact Hours: Variable credit course

ENGE 4994H - Undergraduate Research (1-19 credits) Instructional Contact Hours: Variable credit course