Graduate Concentrations in Mechanical Engineering

Requirements

A graduate concentration requires completion of 12 credits (4 courses) through a combination of courses from the associated approved lists of Core and Supporting courses as shown in Tables 1 through 4. A maximum of one course (or 3 credits) may be transferred from outside of UMaine toward fulfilling the requirements of a graduate concentration.

It is important to note that pursuing a concentration is not mandatory, rather an option that MEE graduate students can pursue based on their areas of interest and future career goals.

PhD[a] and MS[a] (Thesis)

Students are required to complete a minimum of two (2) Core courses and a maximum of two (2) Supporting courses associated with the selected concentration area. It is acceptable for all four courses to be from the list of Core courses. A minimum grade of B- is required in each course.

MS[a] (Non-Thesis)

Students are required to complete a minimum of three (3) Core courses and a maximum of one (1) Supporting course associated with the selected concentration area. It is acceptable for all four courses to be from the list of Core courses. A minimum grade of B- is required in each course.

Switching Between Thesis and Non-Thesis Options

If a student chooses to switch from thesis to non-thesis option of the MS degree program or vice versa, they will be subject to the requirements for the latter option in completing a concentration.

Eligibility Criteria

Graduate students matriculated in mechanical engineering MS or PhD program are eligible to pursue each concentration as long as the prerequisites for each course in the sequence are met.

Educational Objectives (for each separate concentration)

- Introduce fundamental concepts and theories.
- Develop skills necessary for modeling, analysis, and design of components and systems.
- Establish suitability of products and systems for intended applications.

Timeframe for Concentration Completion

The flexibility built into each concentration will ensure that regular course offerings and rotation schedules will allow successful completion of each concentration in one to two years.

Coordinators

- Aerospace – Dr. Wilhelm "Alex" Friess and Dr. Masoud Rais-Rohani
- Offshore Wind Energy – Dr. Andrew Goupee and Dr. Richard Kimball
- Robotics and Mechatronics – Dr. Babak Hejrati
- Smart Manufacturing – Dr. Bashir Khoda

[a] For MS students, a maximum of one course can be at 400-level. For PhD students, all courses must be at 500- or 600-level.

Graduate Concentrations in Mechanical Engineering

Aerospace

Aerospace serves as an engine for innovation in transportation with continuing advances in both aeronautics and astronautics. UMaine has multiple faculty with background and expertise in Aerospace Engineering. The lists of Core and Supporting courses for Aerospace concentration are given in Table 1. We are looking to develop and offer more courses to support both the undergraduate and graduate concentrations in aerospace. Currently, three major areas in aerospace engineering, i.e., fluid dynamics, structures, and design, are covered.

Table 1. Aerospace

Core Courses	*Supporting Courses*
MEE 448 Aircraft Design	MEE 450 Intro to Composite Materials
MEE 452/552 Aircraft and Automobile Structures	MEE 459/559 Engineering Optimization
MEE 462 Dynamics of Fluid Flows	MEE 480 Wind Energy Engineering
MEE 463 Applied Computational Fluid Dynamics	MEE 483 Turbo Machine Design
MEE 560 Comp. Methods in Fluid Mechanics	MEE 490/590 Modern Control Theory and Applications
MEE 562 Advanced Fluid Mechanics	MEE 546 Finite Elements in Solid Mechanics
MEE 564 Fluid Structure Interaction	MEE 573 Advanced Vibrations I

*MEE 348 Intro to Flight does not satisfy the requirements for Aerospace graduate concentration.

Offshore Wind Energy

Wind energy, including floating offshore wind turbines in deep waters, is a major source of renewable energy in the world. UMaine has multiple faculty with background and expertise in Ocean Engineering and Wind Energy. The University has extensive research programs and capabilities in floating offshore wind energy, including the Alfond Wind-Wave Ocean Engineering Lab at the Advanced Structures and Composites Center. The lists of Core and Supporting courses for Offshore Wind Energy concentration are given in Table 2.

Table 2. Offshore Wind Energy

Core Courses	*Supporting Courses*
CIE 551 Water Wave Mechanics	CIE 558 Coastal Engineering
MEE/CIE 480 Wind Energy Engineering	CIE 564 Deep Foundations
MEE 489/565 Offshore Floating System Design	CIE 559 Marine Turbulence
MEE 564 Fluid Structure Interaction	EET 460 Renewable Energy and Electricity Production
	MEE 463 Applied Computational Fluid Dynamics
	MEE 490/590 Modern Control Theory and Applications
	MEE 560 Computational Methods in Fluid Mechanics
	MEE 562 Advanced Fluid Mechanics
	MEE 573 Advanced Vibrations I

Robotics and Mechatronics

Advances in robotics and mechatronics have had a profound impact in many areas, including manufacturing, healthcare, shipping, space exploration, and autonomous systems. By completing this concentration, students will gain the necessary knowledge in mechanical engineering, electrical engineering, and computer science to pursue a career in this area. With expertise at UMaine in engineering and computer science, students will be able to take courses from multiple departments, as noted in Table 3, for completing this concentration.

Table 3. Robotics and Mechatronics

Core Courses	*Supporting Courses*
ECE 471 Embedded Systems	COS 570 Topics in Artificial Intelligence
ECE 533 Advanced Robotics	COS 598 Machine Learning & Computer Vision
MEE 444/551 Robot Dynamics and Control	ECE 417 Introduction to Robotics
MEE 490/590 Modern Control Theory and Appl.	ECE 477 Hardware Application using C
	ECE 478 Industrial Computer Control
	ECE 571 Advanced Microprocessor-Based Design
	ECE 573 Microprogramming
	ECE 584 Estimation Theory
	ECE 590 Neural Networks
	MEE 459/559 Engineering Optimization

Smart Manufacturing

Smart manufacturing aims to convert data, acquired across the product life cycle, into manufacturing intelligence to improve manufacturing. The emergence of cyber-physical systems and related innovations, including digital twin / digital thread, can be leveraged and effectively integrated into support of data-driven manufacturing or industry 4.0. The systematic computational analysis of manufacturing data can lead to more informed decisions, which in turn can enhance the effectiveness of modern manufacturing. This concentration is supported by the list of courses shown in Table 4.

Table 4. Smart Manufacturing

Core Courses	*Supporting Courses*
COS 570 Topics in Artificial Intelligence	COS 554 Algorithms
MEE 430 Digital Manufacturing	ECE 533 Advanced Robotics
MEE 591 Robot Dynamics and Control	ECE 590 Neural Networks
MET 440 Lean Six Sigma	INV 510 Fundamentals and Systems of Innovation
SIE 516 Virtual Reality: Research and Appl.	INV 511 Advanced Innovation Methods
	MEE 441/541 Manufacturing and Testing of Composites
	MEE 459/559 Engineering Optimization
	MEE 546 Finite Elements in Solid Mechanics
	MEE 558 Mechanical Behavior of Materials
	MEE 646 Advanced Finite Elements in Solid Mechanics

Note: The tabulated courses are regularly offered and enable students to complete each concentration as part of an MS or a PhD degree program in Mechanical Engineering. As more related courses are developed in future, the lists in Tables 1 through 4 will be updated.