

MSME with depth in Fluid Mechanics

The primary areas of fluid mechanics research at Michigan State University's Mechanical Engineering program are in developing computational methods for the prediction of complex flows, in devising experimental methods of measurement, and in applying them to improve understanding of fluid-flow phenomena. Theoretical fluid dynamics courses provide a foundation for this research as well as for related studies in areas such as combustion, heat transfer, thermal power engineering, materials processing, bioengineering and in aspects of manufacturing engineering.

MS Track for Fluid Mechanics

The MSME degree program for fluid mechanics is based around two graduate-level foundation courses offered through the Department of Mechanical Engineering (ME). These courses are

ME 830	Fluid Mechanics I	Fall
ME 840	Computational Fluid Mechanics and Heat Transfer	Spring

The ME 830 course is the basic graduate level course in the continuum theory of fluid mechanics that all students should take. In the ME 840 course, the theoretical understanding gained in ME 830 is supplemented with material on numerical methods, discretization of equations, and stability constraints appropriate for developing and using computational methods of solution to fluid mechanics and convective heat transfer problems. Students augment these courses with additional courses in fluid mechanics and satisfy breadth requirements by selecting courses in the areas of Thermal Sciences, Mechanical and Dynamical Systems, and Solid and Structural Mechanics.

Graduate Course and Research Topics

(Profs. Benard, Brereton, Foss, Jaber, Koochesfahani, Naguib, Priezjev, Zhuang)

Experimental Research

Many fluid flow phenomena are too complicated to be understood fully or predicted accurately by either theory or computational methods. Sometimes the boundary conditions of real-world problems cannot be analyzed accurately. Some methods of prediction use models of unknown reliability. Therefore there is a strong interest in carrying out research that would provide experimental solutions to unresolved fluid-flow questions, and in developing new measurement techniques that would provide such information.

Turbulence Research

Fluid turbulence, and in particular its accurate mathematical description, is one of the great remaining unsolved problems of physics. There are needs for detailed measurements of turbulent phenomena, for computer simulations of those phenomena under idealized conditions, and for the continued development of models that would better predict complex fluids flows, reacting flows, and multi-phase flows.

Computational Fluid Dynamics

In computational fluid mechanics, modern research is concerned with algorithms appropriate for accurate solutions in complex discretized domains, numerical approaches to governing equations from multiple, coupled physical disciplines such as fluid mechanics and combustion, acoustics, solid-structure interactions, magnetic fields, etc. There is also interest in predictive modeling of fine scale turbulence in fluid flow, using techniques such as large eddy simulation, and of reacting flows using pdf methods.

Typical 4-semester 'Thesis Option' M.S. Program with depth in Fluid Mechanics

Fall Semester: 9 cr

ME 830 Fluid Mechanics I	3 cr
ME 800 Engineering Analysis	3 cr
Choose one course from:	3 cr
ME 8xx Breadth Course (see list below)	
ME 836 Experimental Methods in Fluid Mechanics (even years)	

Spring Semester: 9 cr

Choose three courses from:	
ME 840 Computational Fluid Mechanics and Heat Transfer	3 cr
ME 8xx Breadth Course (see list below)	3 cr
ME 804 Micro-Scale Fluid Mech. and Heat Transfer (odd years)	3 cr
ME 832 Fluid Mechanics II (even years)	3 cr

Summer: 4 cr

ME 899 Master's Thesis Research	4 cr
or other 400, 800, or 900 level courses inside or outside Mechanical Engineering	

Fall Semester: 8 cr

ME 899 Master's Thesis Research	2 cr
Choose two 3 credit courses from:	
ME 8xx Breadth Course (see list below)	3 cr
ME 834 Fundamentals of Turbulence (odd years)	3 cr
ME 835 Turbulence Modeling and Simulation (even years)	3 cr
ME 836 Experimental Methods in Fluid Mechanics (even years)	3 cr
or other 400, 800, or 900 level courses inside or outside Mechanical Engineering	3 cr
TOTAL 30 credits	

Breadth Course Requirement:

In addition to ME 830, each student must take at least 1 course from 2 of the 3 areas listed below.

Thermal Sciences:

ME 802 Adv. Classical Thermodynamics (Fall)
 ME 812 Conductive Heat Transfer (Fall)
 ME 814 Convective Heat Transfer (Spring)
 ME422 Intro to Combustion (Fall)
 ME 822 Combustion (Spring)
 ME 842 Advanced Turbomachinery (Spring even)

Mechanical and Dynamical Systems:

ME 851 Linear Systems and Control (Spring)
 ME 860 Theory of Vibrations (Fall)

Solid and Structural Mechanics:

ME 820 Continuum Mechanics (Fall)
 ME 828 Adv. Strength of Materials (Spring, odd)