MechanicalEngineering

Faculty and Fields of Interest

Di Massa, Diane E.
Assistant Professor. PhD Massachusetts Institute of Technology/Woods Hole Oceanographic Institution, MEng, MS, BS Massachusetts Institute of Technology.*Specializations:* Acoustics/hydroacoustics, flow measurement technology, autonomous vehicles, marine engineering, design.

DiPippo, Ronald
(Associate Dean, College of Engineering) Chancellor Professor. PhD, ScM, ScB Brown University.*Specializations:* Thermodynamics, power plant design, geothermal energy, energy analysis.

El Wakil, Sherif D.
Chancellor Professor. PhD Birmingham University, MS El-Azhar University, BS Cairo University.*Specializations:* Computer-aided manufacturing, design for manufacturing, materials science.

Fowler, Alex J. (Graduate Program Director)
Assistant Professor. PhD Duke University, BA Wesleyan University.*Specializations:* Fluid flow in porous media, heat transfer, thermodynamics, bioengineering.

Hansberry, John W.
Professor. PhD, ScM Brown University, BSME, BA Rice University, Registered Professional Engineer.*Specializations:* Solid mechanics, control theory, machine design, vibration, safety engineering.

Kattan, I. A.
Associate Professor. PhD Tennessee Technological University, MS Oklahoma State University, MS University of Birmingham, England, DiplEngr University of Belgrade, Yugoslavia.*Specializations:* Manufacturing systems design, facility planning and design, quality control, CAD/CAM simulation, and operational research techniques in manufacturing.

Laoulache, Raymond N.
Associate Professor. PhD Brown University, ScM, ScB Northeastern University.*Specializations:* Thermodynamics, multiphase flow, control systems, fluid mechanics, laser doppler anemometry, parallel computing.

Meressi, Tesfay
Associate Professor. PhD, MS, University of California Santa Barbara, BS Addis Ababa University.*Specializations:* Robotics, control theory, machine design.

Rice, John M. (Chairperson, Department of Mechanical Engineering)
PhD University of Rhode Island, MS Stanford University, BA Northeastern University.*Specializations:* Solid mechanics, computer-aided engineering, finite element analysis, composite materials.

Roy, T. K.
Professor. PhD Texas Tech University, MS University of Hawaii, BS Bihar University.*Specializations:* Machine design, solid mechanics, shell dynamics, robotics.

Shen, Thomas B. C.
Professor. PhD Harvard University, MS Brown University, BS Taiwan Provincial Cheng Kung University.*Specializations:* Heat transfer, thermodynamics, fire research, solid waste management.

Srinagesh, K.
Professor. PhD, MS Indian Institute of Science, BS University of Mysore, India.*Specializations:* Manufacturing processes, physical metallurgy, foundry engineering.

Graduate Mechanical Engineering at UMass Dartmouth

Department of Mechanical Engineering
College of Engineering

With a first class entering in Fall 1998, this new MS in Mechanical Engineering builds on a strong undergraduate degree with close linkages to regional industries through faculty consulting and student projects. It is structured as a practice-oriented master's degree. Programs of study are offered in all areas of mechanical engineering including a special thrust in manufacturing. Its primary purpose is to provide additional professional education to mechanical engineers employed in regional industry, business, and government.

The programs offer small classes, close contact with a diverse faculty, and easy access to well-supported research facilities to provide state-of-the-art learning and research experiences.

Courses are scheduled to permit either full-time or part-time study, and are offered at times that are convenient for students employed in industry and government.

Resources

The Mechanical Engineering Department maintains a wide variety of research and educational laboratories in the areas of robotics, controls, bioengineering, and thermal science. Our manufacturing facilities include a fully equipped machine shop for student use, computer controlled CNC machines, and extensive materials testing equipment.

The robotics lab contains twelve instructional Rhino robots and a brand new SCORBOT with a vision system for state-of-the-art applications in research and manufacturing. The controls laboratory houses an instrumented and dynamically controlled marine environment for research aimed at improving urban aquaculture through advanced environmental control facilities for applications in engineering education and research.

We have laser laboratories that include a laser Doppler velocimeter for the non-invasive measurement of fluid velocity, a clinical laser for the study of laser-skin interactions in medical treatment, and an optical properties measurement lab for studying biological tissues. A Ground Source Heat Pump Center houses an 8 ft. by 4 ft. computer monitored earth coupled heat exchanger for studies aimed at improving heat pump technology in the Northeast region. Other heat transfer research equipment includes a cryopump capable of reaching 10K, differential thermal analyzers, and a wind tunnel.

We also provide extensive UNIX and NT based computer facilities for student use.

In addition, the Center for Rehabilitation Engineering, housed in the College of Engineering; the Laboratory for Marine Science, Environment and Technology; and the Advanced Technology Center for Business and Manufacturing (ATC)—described elsewhere in this catalogue—are especially important for advanced students in engineering.

Admission Requirements

Admission to the MS program is competitive. Students possessing a bachelor's or master's degree from a recognized institution and a strong academic background in mechanical engineering or a similar discipline are encouraged to apply for admission. Typically, MS applicants with an undergraduate cumulative grade point average of 3.0 on a 4.0 grading scale for all engineering, math and physics courses will be considered.

Applicants for the MS in Mechanical Engineering must submit the required application materials to the Graduate Office. In addition, Graduate Record Examination scores for the General Test must be submitted by applicants who are not or will not be graduates of the University of Massachusetts Dartmouth or the Massachusetts Maritime Academy.

Graduate Financial Assistance

Inquiries regarding graduate student financial assistance should be made to the Director of the Graduate Program. For information about loans or other assistance, please consult the chapter on "Expenses and Financial Assistance."

Many employers will assist employees in furthering their professional education; contact the personnel office at your place of work.

Course Availability and Offerings

Graduate courses are offered in the evenings to accommodate both full-time and part-time students.

Degree Requirements (MS degree)

Each candidate for the Master of Science Degree must obtain a minimum of 30 graduate credits (Thesis or Project tracks) or 33 graduate credits (Course Work track), maintaining a grade point average of at least 3.0 out of a 4.0 grading scale in course work with no more than two course grades below B-minus before the degree is awarded.

Required Core Courses (9 credits)

MNE 501	Advanced Engineering Math	3
MNE 502	Applied Numerical Methods	3
MNE 503	Continuum Mechanics	3

Elective Courses — 15 credits selected as follows

Six credits — select one course from any two of the following four groups: 6

Group A	MNE 511	Theory of Elasticity (3)
	MNE 512	Plasticity and Metal Forming Theory (3)
Group B	MNE 521	Classical Thermodynamics (3)
Group C	MNE 531	Advanced Dynamics (3)
	MNE 532	Advanced Robotics (3)
Group D	MNE 504	Advanced Mechanics of Fluids (3)
	MNE 542	Convective Heat Transfer (3)

Other nine credits — may be selected from any advisor-approved graduate level courses. No more than six of these credits may be in graduate courses offered outside the Mechanical Engineering Department. Mechanical Engineering graduate electives: 9

MNE 513 Theory of Plates and Shells (3)
MNE 515 Finite Element Analysis (3)
MNE 518 Advanced Physical Metallurgy (3)
MNE 519 Metal Casting Principles (3)
MNE 522 Statistical Thermodynamics (3)
MNE 525 Bioengineering Fundamentals (3)
MNE 530 Simulation Modeling (3)
MNE 533 Manufacturing Automation (3)
MNE 534 Advanced Vibration (3)
MNE 536 Advanced Control Theory (3)
MNE 537 Manufacturing Systems Design (3)
MNE 538 Manufacturing Planning and Control (3)
MNE 539 Engineering Optimization (3)
MNE 541 Conduction Heat Transfer (3)
MNE 543 Radiation Heat Transfer (3)
MNE 551 Compressible Fluid Flow (3)
MNE 552 Computational Fluid Mechanics (3)
MNE 560 Methods Experimental Research (3)
MNE 570 Reading and Research (3)

Additional Requirements — Thesis, Project, or Course Work tracks (6 or 9 credits)

Thesis Option
MNE 580 Masters Thesis 6

Project Option
MNE 590 Masters Project 6

Coursework Option
additional elective courses 9

Contacts

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MechanicalEngineering Courses

MNE 501 three credits
Advanced Engineering Mathematics
Prerequisite: EGR 301 or equivalent
Ordinary differential equations: power series solutions; solutions to Legendre, Bessel, Hermite, associated Legendre, and Mathieu equations. Partial differential equations: separation of variables; transform methods; eigenvalues; Green's function; solutions to elliptic, parabolic and hyperbolic equations.

MNE 502 three credits
Applied Numerical Methods
Prerequisite: EGR 301 or equivalent
An introduction to the tools of numerical analysis used in all areas of engineering study. Solution of linear systems and non-linear systems of equations. Numerical integration of functions ODE's and PDE's: differentiation, error control, stability and accuracy. Extensive programming in C is required.

MNE 503 three credits
Continuum Mechanics
Prerequisites: EGR 301 and MNE 252 or equivalents
A comprehensive study of the fundamental principles of Continuum Mechanics. The following topics are covered: stress, strain, and strain rated tensors; Lagrangian and Eulerian descriptions; conservation laws; constitutive relations; Navier-Cauchy and Navier Stokes equations; Newtonian fluids.

MNE 504 three credits
Advanced Mechanics of Fluids
Prerequisite: MNE 332 or equivalent
Integral Transformation: Divergence Theorem; Stokes Theorem. Reynolds Transport Theorem. Navier-Stokes equations. Kelvin's theorem. Vorticity Transport. Crocco's Theorem. Viscous flow: boundary layers, buoyancy-driven flows.

MNE 511 three credits
Theory of Elasticity
Prerequisite: MNE 503 or equivalent
Basic field equations. Generalized Hooke's law. General concepts of stress and strain. Equilibrium equations. Plane problems. Stress functions. Saint Venant torsion and flexure. Introduction to three-dimensional problems. Thermoelasticity. Anisotropic solutions.

MNE 512 three credits
Plasticity and Metal Forming Theory
Prerequisite: MNE 503 or equivalent
Tresca and von Mises yield criteria and their associated flow rules. Slip-line field theory and Geiringer velocity equations. Upper bound and lower bound theories. Application of the plasticity theories to rigid, perfectly-plastic bodies undergoing large plastic deformation in various metal forming processes such as wire drawing, extrusion, forging, deep drawing, etc.

MNE 513 three credits
Theory of Plates and Shells
Prerequisite: EGR 242, Pre or co-requisite: MNE 503
Basic plate and shell equations; solutions of different shape plates. Application of cylindrical and spherical shell equations. Linear and non-linear situations. Plates on elastic foundations. Numerical solutions of plates and shells. Membrane theory.

MNE 515 three credits
Finite Element Analysis
Prerequisite: MNE 485 or equivalent
A broad study of the principles of Finite Element Analysis. The following topics are covered: energy methods; variational principles; element formulation; coordinate transformation; problems in dynamics, solids, and heat transfer; non-linear problems; numerical errors and convergence; computer modeling.

MNE 518 three credits
Advanced Physical Metallurgy
Prerequisites: EGR 231, EGR 221 or equivalents
Extending understanding of the effect of structure on the properties of metals and alloys. Deviation in various forms from perfect crystallinity will be analyzed. Metallurgical processes of typical ferrous and nonferrous alloys will be explored.

MNE 519 three credits
Metal Casting Principles
Prerequisites: EGR 231, MNE 345, MNE 411 or equivalents
Advanced concepts in solidification of alloys. Mutually dependent topics are: flow of liquid metals, transient heat transfer, phase and state change. Consequence of these in the design of sound castings will be presented.

MNE 521 three credits
Classical Thermodynamics
Prerequisite: EGR 232 or equivalent
An in-depth study of the fundamental principles of classical thermodynamics. The following topics are covered: equilibrium; temperature; equations of state; fundamental equations; First Law for steady, unsteady and continuous systems; Born-Caratheodory formulation of the Second Law; Third Law.

MNE 522 three credits
Statistical Thermodynamics
Prerequisite: EGR 232 or equivalent
The principles of thermodynamics based on a microscopic approach. The following topics are covered: statistical concepts, Kinetic Theory, Gibbsian ensembles, partition function, Liouville's theorem, Boltzmann equation and the Chapman-Enskog solution, calculation of equilibrium and transport properties.

MNE 525 three credits
Bioengineering Fundamentals
Applications of thermodynamics, fluid mechanics, and transport study to biological systems. An introduction to chemical kinetics, intercellular interactions, and basic biomechanics is also included. Emphasis is on engineering with relevance to clinical and research medical applications.

MNE 530 three credits
Simulation Modeling
Prerequisites: Advanced mathematics (EGR 301) and computer programming (EGR 102) or equivalents
Concepts and principles associated with systems simulation and modeling using contemporary software such as Simulation with Arena. Topics include probability and statistics, discrete event simulation, statistical techniques in simulation modeling. Statistical analysis is integrated for the most part into the simulation modeling, reflecting the joint nature of these activities in good simulation studies, and continuous simulation of industrial and manufacturing systems using SIMAN language. The student will work in a team producing a design project relating to these topics.

MNE 531 three credits
Advanced Dynamics
Prerequisites: EGR 242, EGR 301 or equivalents
A course of study of technologically useful topics from dynamics, such as: three dimensional motion of rigid bodies; dynamics of flexible rotors and linkages; balancing of machinery and non-linear forces and stability. Variational methods and numerical techniques will be introduced.

MNE 532 three credits
Advanced Robotics
Prerequisite: MNE 482 or equivalent
Advanced course in kinematics, dynamics and control of robots. Topics covered include: trajectory generation, position and force control of open chain and closed chain manipulators, kinematic redundancy, link flexibility, artificial intelligence and integration of industrial robots in integrated manufacturing systems.

MNE 533 three credits
Manufacturing Automation
Prerequisite: MNE 345 or equivalent
A study of the different components of an automated manufacturing system. Design of

the hardware and software used in the different manufacturing systems. Analysis, modeling, performance and economics of flexible manufacturing systems and flexible manufacturing cells. Design of parts to facilitate automatic assembly.

MNE 534 three credits
Advanced Vibrations
Prerequisites: EGR 242, EGR 301, or equivalent
Vibration of structures and machine components, Free and Forced Vibrations, Damped Vibrations, National Modes, Critical speeds, non-linear systems techniques, phase plane and function description methods.

MNE 536 three credits
Advanced Control Theory
Prerequisite: MNE 466 or equivalent
Advanced course in design of control systems. Topics covered include: input-output and state space description; controllability and observability of multi-input multi-output systems; pole placement; observer design and separation principle; linear quadratic optimal control; non-linear systems and linearization; Lyapunov stability theory; application to electromechnical systems.

MNE 537 three credits
Manufacturing Systems Design
Prerequisite: MNE 345 or equivalent
Advanced topics in manufacturing systems design and analysis with emphasis on modeling and integration methodologies. Specirfic topics include production flow analysis, group technoilogy, manufacturing cell design, facilities location and work design, material handling systems and automated guided vehicles, flexible manufacturing systems, and systems evaluation. Term design projects are required using computer and software tools.

MNE 538 three credits
Manufacturing Planning and Control
Prerequisite: EGR 301 or equivalent
Advanced topics in manufacturing production planning and control with emphasis on design and resource utilization. Specific topics include operations planning and control, linear programming, capacity planning, resource material planning, inventory control, project scheduling, and manufacturing cost analysis. Term design projects are required using computer and software tools.

MNE 539 three credits
Engineering Optimization
Prerequisite: EGR 301 or equivalent
Advanced topics in engineering optimization with emphasis on the algorithm and applications. Specific topics include linear and nonlinear optimization, mathematical modeling, constrained optimality criteria, transformation methods, constrained direct search, quadratic approximation methods for constrained problems, and comparison of constrained optimization methods. Term design projects are required using computer and software tools.

MNE 541 three credits
Heat Conduction
Prerequisite: MNE 411 or equivalent
Basic heat transfer modes. Steady one dimensional problems with or without heat sources, constant or variable properties. Concepts of thermal resistance. Multidimensional heat conduction problems. Transient problems. Numerical treatment of heat conduction problems. Special applications in heat conduction field.

MNE 542 three credits
Convective Heat Transfer
Prerequisite: MNE 411 or equivalent
Boundary layer flow problems: laminar and turbulent plows. Thermal boundary layer plows. Dimensional analysis. Forced convection problems. Free convection problems. Duct flows. Boiling and Condensation. Special convection problems. Heat Exchange Design. Applications.

MNE 543 three credits
Radiation Heat Transfer
Prerequisite: MNE 411 or equivalent
Basic concepts and fundamental relations of thermal radiation. Radiation field; Kirchoff's laws. Radiation density. Radiation pressure. Blackbody radiation. Graybody radiation. Radiative heat exchanges among surfaces, in enclosures. Radiation through weakly absorbing media.

MNE 551 three credits
Compressible Fluid Flow
Prerequisite: MNE 431 or equivalent
Conservation laws. Wave propagation in compressible media. Isentropic flow. Normal and oblique shock waves. Prandt-Meyer flow. Converging-diverging nozzles and supersonic diffuses. Supersonic oblique shock diffuses. Exit flow for underexpanded and overexpanded supersonic nozzles. Fanne line flow. Rayleigh line flow.

MNE 552 three credits
Computational Fluid Mechanics
Prerequisite: MNE 504
Solutions to Navier-Stokes equations. Finite difference methods: Lax-Wendroff, MacCormack, Rusanov, implicit, forward-time and centered-method, leap-frog/Dufort-Frankel, ADI, predictor-corrector methods. Grid generation. Accuracy and convergence.

MNE 560 three credits
Methods of Experimental Research
Prerequisite: Graduate standing
The need and subject matter of research. Laws, truths, analogy and hypothesis. Identifying and clustering parameters. Use of models. Experimental setup. Induction, deduction, statistics, and conclusions. Presentation and use of finding.

MNE 570 three credits
Reading and Research
Prerequisite: Graduate standing and approval of student's graduate committee
Independent study under faculty supervision. Intensive literature search culminating in a technical report. Oral presentation at the option of the faculty.

MNE 580 six credits
Masters Thesis
Prerequisites: Graduate standing, Thesis Option, and approval of the student's Graduate Committee
Thesis research on an experimental or theoretical project in mechanical engineering under a faculty advisor. A formal thesis must be submitted to fulfill the course requirements.

MNE 590 six credits
Masters Project
Prerequisites: Graduate standing, Project Option, and approval of the student's Graduate Committee
Project research in conjunction with industry under a faculty advisor. A formal report must be submitted to fulfill the course requirements.