topics of mathematics in preparation for individual research. Course is repeatable.

MATH 289 Colloquium in Mathematics (1) Prerequisite(s): graduate standing. Specialized discussions by staff, students and visiting scientists on current research topics in Mathematics. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

MATH 290 Directed Studies (1-6) Prerequisite(s): consent of instructor. Research and special studies in mathematics. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

MATH 291 Individual Study in Coordinated Areas (1-6) Individual study, 3-18 hours. Prerequisite(s): graduate standing in Mathematics or consent of instructor. Designed to advise and assist candidates with exam preparation Graded Satisfactory (S) or No Credit (NC). Course is repeatable prior to successful completion of the qualifying examination for M.A. and M.S. students to a maximum of 6 units and for Ph.D. students to a maximum of 12 units.

MATH 297 Directed Research (1-6) Outside research, 3-18 hours. Prerequisite(s): consent of department. Directed research in mathematics. Graded Satisfactory (S) or No Credit (NC). Course is repeatable more than once per quarter if studying with two or more faculty members.

MATH 299 Research for Thesis or Dissertation (1-12) Thesis, 3-36 hours. Prerequisite(s): consent of department. Original research in an area selected for the advanced degree. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Professional Courses

MATH 302 Apprentice Teaching (2-4) Lecture, 0-1 hour; seminar, 2-4 hours; consultation, 1-2 hours. Prerequisite(s): graduate standing. Modern trends in mathematical pedagogy at the college level. Covers instructional methods and classroom section activities most suitable for teaching Mathematics. Designed for new graduate students in the Mathematics Department. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

MATH 401 Professional Development in Mathematics (2) Lecture, 1 hour; consultation, 1 hour. Prerequisite(s): graduate standing in Mathematics. Includes professional and research ethics, scientific writing and publications, oral presentation skills, career options in academia, and nonacademic careers. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Mechanical Engineering

Subject abbreviation: ME
The Marian and Rosemary Bourns College of Engineering

Guillermo Aguilar, Ph.D. Chair
Department Office, A342 Bourns Hall
(951) 827-5830; me.ucr.edu

Professors
Reza Abbaspour, Ph.D. Distinguished Professor
Guillermo Aguilar, Ph.D.
Cengiz Ozkan, Ph.D.
Marko Princevac, Ph.D.
Thomas Stahovich, Ph.D.
Kambiz Vafai, Ph.D. Distinguished Professor
Akula Venkatram, Ph.D.
Guanshui Xu, Ph.D.

Associate Professors
Haejeong Jung, Ph.D.
Lorenzo Mangolini, Ph.D.
Masauni, P. Rao, Ph.D.

Assistant Professors

Sinisa Coh, Ph.D.
Shane Cybart, Ph.D.
Elisa Franco, Ph.D.
P. Alex Greaney, Ph.D.
Sandeep Kumar, Ph.D.
Chen Li, Ph.D.
Monica Martinez, Ph.D.
Suveen Mathaudhu, Ph.D.
Fabio Pasqualetti, Ph.D.
Hideaki Tsutsui, Ph.D.
Richard Wilson, Ph.D.

Adjunct Professors
Chris Dames, Ph.D.
Santiago Camacho-Lopez, Ph.D.
Carlos Coimbra, Ph.D.
Javier Garay, Ph.D.

Cooperating Faculty
Bahman Avarri, Ph.D. (Bioengineering)
Matthew Barth, Ph.D. (Electrical and Computer Engineering)
Bir Bhanu, Ph.D. (Electrical and Computer Engineering)
Mihr Ozkan, Ph.D. (Electrical and Computer Engineering)
Wei Ren, Ph.D. (Electrical and Computer Engineering)

Major
The design and production of machines requires a broad-based education. The Mechanical Engineering degree program has been structured to provide the necessary background in chemistry, physics, and advanced math to achieve success in the advanced engineering subjects. In addition, students are taught the basics of Mechanical Engineering while learning about the latest developments and experimental techniques.

The Mechanical Engineering program objectives are to produce mechanical engineers who:

- have the knowledge and skills to adapt to the changing engineering environment in industry
- are able to pursue and succeed in graduate studies

- have the educational breadth and the intellectual discipline required to enter professional careers outside engineering, such as business and law

- have an ability to work in multi-disciplinary teams

- engage in a lifetime of learning

The Mechanical Engineering B.S. degree program at UCR is accredited by the Engineering Accreditation Commission of ABET, abet.org. For more details see me.ucr.edu.

All undergraduates in the College of Engineering must see an advisor at least annually. Visit student.engr.ucr.edu for details.

University Requirements
See Undergraduate Studies section.

College Requirements
See The Marian and Rosemary Bourns College of Engineering, Colleges and Programs section. The Mechanical Engineering major uses the following major requirements to satisfy the college’s Natural Sciences and Mathematics breadth requirement.

Mathematics / Mechanical Engineering / 350

1. BIOL 005A, BIOL 05LA
2. MATH 008B or MATH 009A
3. PHYS 040A, PHYS 040B, PHYS 040C

Major Requirements

1. Lower-division requirements (73 units)

   a) BIOL 005A, BIOL 05LA
   b) CHEM 001A, CHEM 001B, CHEM 01LA, CHEM 01LB
   c) EE 001A, EE 01LA
   d) MATH 008B or MATH 009A, MATH 009B, MATH 009C, MATH 010A, MATH 010B, MATH 046
   e) ME 002, ME 009, ME 010, ME 01B
   f) PHYS 040A, PHYS 040B, PHYS 040C

2. Upper-division requirements (77 units)

   a) ME 100A, ME 103, ME 110, ME 113, ME 114, ME 116A, ME 118, ME 120, ME 135, ME 170A, ME 170B, ME 174, ME 175A, ME 175B, ME 175C

   b) STAT 100A
   c) Choose one Focus Area:
      (1) Materials and Structures
         Sixteen (16) units of technical electives chosen from ME 100B, ME 116B, ME 121, ME 122, ME 153, ME 156, ME 180, ME 197
      (2) Energy and Environment
         Sixteen (16) units of technical electives chosen from ME 100B, ME 116B, ME 117, ME 136, ME 137, ME 198, ME 197
      (3) Design and Manufacturing
         Sixteen (16) units of technical electives chosen from ME 121, ME 122, ME 130, ME 131, ME 133, ME 140, ME 153, ME 156, ME 176, ME 180, ME 197
      (4) General Mechanical Engineering
         Sixteen (16) units of technical electives chosen from the following list, in consultation with an advisor: ME 100B, ME 116B, ME 117, ME 121, ME 122, ME 130, ME 131, ME 133, ME 136, ME 137, ME 138, ME 140, ME 153, ME 156, ME 176, ME 180, ME 197

Visit the Student Affairs Office in the College of Engineering or student.engr.ucr.edu for a sample program.

Graduate Program
The Department of Mechanical Engineering offers graduate educational programs leading to M.S. and Ph.D. degrees in Mechanical Engineering. Broad areas of research include:

1) mechanics and materials, 2) fluids and thermal sciences and 3) information computation and design. Specific research focus areas include the following:

- 2. Fluids and Thermal Sciences:
  - Heat transfer
  - Fluid mechanics
  - Thermal management

- 3. Information Computation and Design:
  - Control systems
  - Computational methods
  - Design and optimization
Air quality, small and large-scale pollutant dispersion in urban flows, turbulent combustion and wildland fire behavior, engine emissions and nanoparticle science, thermal and electrical properties of nanowires and nanotubes, direct energy conversion, porous media and multiphase transport, bioheat transfer, biomedical optics, and medical laser applications.

• Wafer fab processing, thin film mechanics and nanotechnology, bio-inspired materials, mechanical behavior of thin films and other small-featured structures, mechanics of interfaces and surfaces, mechanical properties of carbon nanotubes and ferroelectric/piezoelectric materials, sensing and imaging, mechanics of geophysical materials, advanced material synthesis, composites, MEME, BioMEMS, biomedical devices, and processing of nanocrystalline materials.

• Artificial intelligence, computer-aided design or manufacturing, process planning, sensor networks, and distributed computing and control.

Visit me.ucr.edu/programs/gradindex.html for detailed information on the research programs of individual faculty members.

Combined B.S. + M.S. Five-Year Program The college offers a combined B.S. + M.S. program in Mechanical Engineering designed to lead to a Bachelor of Science degree as well as a Master of Science degree in five years. Applicants for this program must have a high school GPA above 3.6, a combined SAT Reasoning score above 1950 (or ACT plus Writing equivalent), complete the Entry Level Writing Requirement before matriculation, and have sufficient mathematics preparation to enroll in calculus in their first quarter as freshmen. Eight units of technical electives will count in both programs, reducing the total number of units required for the MS degree.

Interested students who are entering their junior year should check with their academic advisor for information on eligibility and other details.

Admission In addition to the following requirements, all applicants must meet the general requirements for graduate study at UCR. Applicants for the MS degree must formally apply for admission to the graduate program committee. It is held every other quarter, and requires a written and oral preliminary examination. Students must be eligible to complete a thesis. An acceptable M.S. thesis must be submitted. The M.S. thesis may be based on:

1. A research or advanced design project, either analytical, computational or experimental;
2. An extensive report consisting of theoretical, computational or experimental contribution to mechanical engineering.

The student's M.S. Thesis Committee is responsible for approving the thesis. The thesis must be formulated by the student and his/her faculty advisor within the first quarter after admission to the Ph.D. program and must be approved by the student's Ph.D. advisor and Ph.D. Examination Committee. It is understood that changes to this may occur as the student's research progresses. These changes should be documented after consultation with the Ph.D. advisor and Ph.D. Examination Committee.

Core Course Work Before the oral defense of the dissertation proposal at least 24 units of course work must be completed. This is excluding seminar and research credits. Of these a minimum of eight graduate units must be in Mechanical Engineering courses (ME 200 or higher, including ME 250, ME 290, ME 297, ME 298I, and ME 299). To meet this requirement by the end of the first year students must take at least eight units of course work per quarter. Typically students also enroll in ME 250 and ME 297 units their first year. The student may be advised to take additional courses prior to advancement to candidacy.

Seminar Requirement The student must also complete 6 units of ME 250 (seminar) prior to graduation. One unit of ME 250 is offered each quarter. These units do not have to be completed before the dissertation proposal defense.

Research Units At least 36 units of directed or thesis research credits (ME 297 or ME 299) must be taken prior to graduation.

Courses taken as part of the Ph.D. requirement during the spring quarter of every year.

Normative Time to Degree Two years

Doctoral Degree

The Department of Mechanical Engineering offers the Ph.D. degree in Mechanical Engineering.

Admission An M.S. or equivalent degree in engineering or physical sciences or mathematics is normally required for admission to the Ph.D. program, although applicants with exceptional undergraduate or research record may be admitted directly into the Ph.D. program without an M.S. degree. Applicants for the Ph.D. degree must also meet the same requirements as for the master’s programs. Students in the M.S. program of Mechanical Engineering who desire to pursue the Ph.D. degree must formally apply for admission to the Ph.D. program.

The procedure for satisfying the requirements for the Ph.D. degree in Mechanical Engineering at UCR consists of four principal parts:

1. Successful completion of an approved program of course work below.
2. Passing a written and oral preliminary examination.
4. Defense and approval of the dissertation.

Course Work A course work plan should be formulated by the student and his/her faculty advisor within the first quarter after admission to the Ph.D. program and must be approved by the student’s Ph.D. advisor and Ph.D. Examination Committee. It is understood that changes to this may occur as the student’s research progresses. These changes should be documented after consultation with the Ph.D. advisor and Ph.D. Examination Committee.

• Artificial intelligence, computer-aided design or manufacturing, process planning, sensor networks, and distributed computing and control.

• Wafer fab processing, thin film mechanics and nanotechnology, bio-inspired materials, mechanical behavior of thin films and other small-featured structures, mechanics of interfaces and surfaces, mechanical properties of carbon nanotubes and ferroelectric/piezoelectric materials, sensing and imaging, mechanics of geophysical materials, advanced material synthesis, composites, MEME, BioMEMS, biomedical devices, and processing of nanocrystalline materials.

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in Mechanical Engineering at UCR can be used to satisfy the course requirements for an M.S. in Mechanical Engineering at UCR and vice versa.

Normative Time to Degree Five years

Refer to the department’s graduate program guidelines for further details

Written and Oral Preliminary Examination The examination aims to screen candidates for pursuing doctoral studies. It is administered by the graduate program committee and is composed of two sessions:
Session 1: Written Examination
Session 2: Oral Examination

Normally, both sessions are completed within a four-week period. The written examination is designed to test understanding of graduate-level mechanical engineering concepts and methods. It covers three subject areas to be selected by the student among the following: materials structure & properties, control systems, engineering analysis, fluid mechanics, heat transfer, thermodynamics, solid mechanics. Students are strongly encouraged to complete the relevant graduate-level course work for the selected subject areas. For details, consult the departmental guidelines. The oral examination assesses the student’s ability to conduct independent research. Consult departmental guidelines for details. The preliminary examination is normally offered once every year at the beginning of the summer session.

Dissertation and Final Oral Examination After successfully completing the preliminary examination, the student, with advice from the advisor, recommends a qualifying committee and prepares a dissertation proposal. The dissertation proposal consists of a written document and an oral presentation or defense. Typically, the student submits a dissertation proposal to the qualifying committee within one year after successfully completing the preliminary examination and completion of the required 24 units of graduate core courses. The qualifying committee chair normally schedules an oral defense within one month of the written proposal submission. The presentation is given only to the qualifying committee members. The student is advanced to candidacy after successfully completing this examination and all coursework.

After completing the dissertation research, a written draft copy of the completed dissertation must be submitted to the dissertation committee for review, evaluation, and determination of whether the draft thesis is ready for oral defense. Once a draft has been approved for defense, an oral defense of the dissertation is scheduled and is open to the entire academic community. This defense consists of a presentation, followed by a question-and-answer period conducted by the dissertation committee and the audience. After successfully defending the dissertation, the candidate must submit final copies of the dissertation that comply with the format requirements set forth by the Graduate Division. Copies are given to the department and the dissertation advisor, in addition to those required by the Graduate Division. Consult departmental guidelines for appointments to qualifying and dissertation committees.

Refer to the department’s graduate program guidelines for further details.

Lower-Division Courses

ME 001A Introduction to Mechanical Engineering (1) Laboratory, 3 hours. Prerequisite(s): none. An introduction to mechanical engineering as a field of study and as a profession. Orients students to the curriculum, faculty, and resources in the Department of Mechanical Engineering. Graded Satisfactory (S) or No Credit (NC). Credit is awarded for only one of ENGR 010 or ME 001A.

ME 001B Introduction to Mechanical Engineering (1) Laboratory, 3 hours. Prerequisite(s): none. An introduction to mechanical-engineering and computer-aided design. Students design, analyze, prototype, and test a mechanical device using modern methods. Graded Satisfactory (S) or No Credit (NC).

ME 001C Introduction to Mechanical Engineering (1) Laboratory, 3 hours. Prerequisite(s): MATH 008B or MATH 009A or MATH 09HA. An introduction to engineering problem solving and computing using EXCEL and MATLAB. Topics include functions, scalar and array operations, graphics, linear algebra, and symbolic mathematical operations with applications in mechanical engineering.

ME 002 Introduction to Mechanical Engineering (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 005 or equivalent. An introduction to the field of mechanical engineering. Topics include the mechanical engineering profession, machine components; forces in structures and fluids; materials and stresses; thermal and energy systems; machine motion; and machine design.

ME 003 How Things Work: The Principles Behind Technology (4) Lecture, 3 hours; discussion, 1 hour. Introduces the basic physical principles of engineering systems from everyday life such as automobiles, computers, and household appliances. Topics include conservation laws and the physics and chemistry of engineering systems. Does not confer credit towards a degree in the Bourns College of Engineering.

ME 004 Energy and the Environment (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): none. Covers energy conservation, energy sources, market dynamics, and climate change. Addresses cultural, political, and social trends and their impact on the ecosystem. Discusses renewable and nonrenewable energy sources. Technical background not required. Does not confer credit towards a degree in the Bourns College of Engineering.

ME 005 The Science of Mythbusting (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): none. Introduces to the scientific method for non-science majors. Explores the application of scientific concepts to test the validity of myths and events from news stories, movies, and other popular media. Provides critical reasoning skills necessary to interpret advertiser’s product claims, critique information on the World Wide Web, and understand new technologies. Students may petition for Satisfactory/No Credit (S/N/C).

ME 009 Engineering Graphics and Design (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 002 (may be taken concurrently). Covers graphical concepts and projective geometry relating to spatial visualization and communication in design. Includes technical sketching, computer-aided design with solid modeling, geometric dimensioning and tolerancing, and an introduction to the engineering design process.

ME 010 Statics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 009C, PHYS 040A. Covers equilibrium of coplanar force systems; analysis of frames and trusses, noncoplanar force systems; friction; and distributed loads.

ME 018 Introduction to Engineering Computation (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 002. An introduction to the use of MATLAB in engineering computation. Covers scripts and functions, programming, input/output, two- and three-dimensional graphics, and elementary numerical analysis.

Upper-Division Courses

ME 100A Thermodynamics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 010A, ME 018, PHYS 040B. Introduces basic concepts and applications of thermodynamics relevant to mechanical engineering. Topics include work and energy, the first law of thermodynamics, properties of pure substances, system and control volume analysis, the Carnot cycle, heat and refrigeration cycles, the second law of thermodynamics, entropy, and reversible and irreversible processes. Credit is awarded for only one of CHE 100 or ME 100A.

ME 100B Thermodynamics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A. Topics include the second law of thermodynamics, entropy function, entropy production, analysis of cycles, vapor power systems, gas power systems, refrigeration and heat pump systems, equations of state, thermodynamic property relations, ideal gas mixtures and psychrometrics, multicomponent systems, combustion, and reacting mixtures.

ME 103 Dynamics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 046, ME 010 with a grade of “C-” or better, ME 018. Topics include vector representation of kinematics and kinetics of particles; Newton’s laws of motion; force-mass-acceleration, work-energy, and impulse-momentum methods; kinetics of systems of particles; and kinematics and kinetics of rigid bodies.

ME 110 Mechanics of Materials (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CS 030 or ME 018, MATH 046, ME 010 with a grade of “C-” or better. Topics include mechanics of deformable bodies subjected to axial, torsional, shear, and bending loads; combined stresses; and their applications to the design of structures.

ME 113 Fluid Mechanics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 046, PHYS 040B, ME 010 with a grade of “C-” or better, ME 018. Introduces principles of fluid mechanics relevant to mechanical engineering. Topics include shear stresses and viscosity, fluid statics, pressure, forces on submerged surfaces, Bernoulli and mechanical energy equations, control volume approach, mass conservation, momentum and energy equations, the differential approach, turbulent flow in pipes, and lift and drag. Credit is awarded for only one of CHE 114 or ME 113.

ME 114 Introduction to Materials Science and Engineering (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): CHEM 001B, PHYS 040C; upper-division standing. Covers materials classification, atomic structure and interatomic bonding, crystal structure of metals, imperfections in solids, diffusion, mechanical properties of engineering materials, strengthening mechanisms, basic concepts of fracture and fatigue, phase diagrams, ceramics, polymers, and composites.

ME 116A Heat Transfer (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 046, ME 113 (ME 113 may be taken concurrently). Introduces the analysis of steady and transient heat conduction, fin and heat generating systems, two-dimensional conduction, internal and external forced convection, natural convection, radiation heat transfer, heat exchangers, and
mass transfer. Credit is awarded for only one of CHE 116 or ME 116A.

ME 116B Heat Transfer (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 116A. Covers analytical and numerical methods in heat transfer and fluid mechanics. Topics include heat conduction and convection, gaseous radiation, boiling and condensation, general aspects of phase change, mass transfer principles, multimode heat transfer and the simulation of thermal fields, and the heat transfer process.

ME 117 Combustion and Energy Systems (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A, ME 113, ME 116A. Covers mixed and diffusion flames; fuel-air thermochromy; combustion-driven engine design and operation; engine cycle analysis; fluid mechanics in engine components; pollutant formation, and gas turbines.

ME 118 Mechanical Engineering Modeling and Analysis (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): MATH 046, ME 018. Introduces data analysis and modeling used in engineering through the software package MATLAB. Numerical methods include descriptive and inferential statistics, sampling and bootstrapping, fitting linear and nonlinear models to observed data, interpolation, numerical differentiation and integration, and solution of systems of ordinary differential equations. Final project involves the development and evaluation of a model for an engineering system. Credit is awarded for only one of ENGR 118 or ME 118.

ME 120 Linear Systems and Controls (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 001A, EE 011A, ME 103. Introduces the modeling and analysis of dynamic systems, emphasizing the common features of mechanical, hydraulic, pneumatic, thermal, electrical, and electromechanical systems. Controls are introduced through state equations, equilibrium, linearization, stability, and time and frequency domain analysis.

ME 121 Feedback Control (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 118, ME 120. Introduces students to the analysis and design of feedback control systems using classical control methods. Topics include control system terminology, block diagrams, analysis and design of control systems in the time and frequency domains, closed-loop stability, root locus, Bode plots, and an introduction to analysis in state-space.

ME 122 Vibrations (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 103. Covers free and forced vibration of discrete systems with and without damping resonance, matrix method for multiple degree-of-freedom systems; normal modes, coupling, and normal coordinates; and use of energy methods.

ME 130 Kinematic and Dynamic Analysis of Mechanisms (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 009, ME 103. Explores the kinematic analysis of planar mechanisms including linkages, cams, and gear trains. Introduces concepts of multibody dynamics.

ME 131 Design of Mechanisms (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 130. Involves design of planar, spherical, and spatial mechanisms using both exact and approximate graphical and analytical techniques. Requires a computer-aided design project.

ME 133 Introduction to Mechatronics (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 120. Introduces hardware/software integration into control systems that interface with the physical world. Topics include sensors, actuators, software, control algorithms, signal processing, control theory, and computer-aided design tools.

ME 135 Transport Phenomena (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A, ME 113, ME 116A. Introduces new concepts of thermodynamics, fluid mechanics, and heat transfer: sychrometry, combustion, one-dimensional compressible flow, and turbomachinery. Integrates the most important concepts of transport of momentum, heat, and mass.

ME 136 Environmental Impacts of Energy Production and Conversion (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A, ME 113, ME 116A. Covers the environmental impacts of energy production and consumption. Topics include pollution associated with fossil fuel combustion, environmental impacts of energy use, and solid waste and pollution control technologies.

ME 137 Environmental Fluid Mechanics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A, ME 113. Covers the application of fluid mechanics to flows in the atmosphere and oceans. Topics include hydrostatic balance, Coriolis effects, geostrophic balance, boundary layers, turbulence, tracer and heat transport.

ME 138 Transport Phenomena in Living Systems (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIEn 105 or ME 113, MATH 040B. An introduction to the transport processes that govern complex biological systems. Emphasizes how these concepts can explain and predict life processes.

ME 140 Ship Theory (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 018, ME 103, ME 113. Covers ship hull form, static and dynamic stability, ship response to waves, grounding and flooding, numerical integration of complex three-dimensional curved surfaces and mathematical modeling of curved surfaces. Explores engineering approximations necessary for applications of fundamental principles to complex engineering systems such as ships.

ME 144 Introduction to Robotics (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 132. Covers basic robot components from encoders to microprocessors. Kinematic and dynamic analysis of manipulators. Addresses open- and closed-loop control strategies, task planning, contact and noncontact sensors, robotic image understanding, and robotic programming languages. Experiments and projects include robot arm programming, color vision, and mobile robots. Cross-listed with EE 144.

ME 145 Robotic Planning and Kinematics (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 120. Covers motion planning and kinematics with an emphasis in geometric reasoning, programming, and matrix computations. Motion planning includes configuration spaces, sensor-based planning, decoupling, and sampling for path planning and optimal control algorithms. Kinematics includes reference frames, rotations and displacements, and kinematic motion models. Cross-listed with EE 145.

ME 153 Finite Element Methods (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 118. Covers weak form formulation, the Galerkin method and its computational implementation, mesh generation, data visualization, and as well as numerical methods for solving practical problems. Introduces the theory and experimental techniques for testing the mechanical behavior of materials and structures. Covers the fundamental mechanisms of deformation and failure of metals, ceramics, polymers, composite materials, and electronic materials as well as structural design and materials selection.

ME 170A Experimental Techniques (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): EE 001A, EE 011A, ME 118 (ME 118 may be taken concurrently). Covers the principles and practice of measurement and control, and the design and implementation of experiments. Topics include dimensional analysis, error analysis, signal-to-noise problems, filtering, data acquisition and data reduction, and statistical analysis. Includes experiments on the use of electronic devices and sensors, and practice in technical report writing.

ME 170B Experimental Techniques (4) Laboratory, 6 hours; discussion, 2 hours. Prerequisite(s): ME 103, ME 110, ME 113, ME 116A, ME 170A. Analysis and verification of engineering theory using laboratory measurements in advanced, project-oriented experiments involving fluid flow, heat transfer, structural dynamics, thermodynamic systems, and electromechanical systems.

ME 174 Machine Design (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 009, ME 103 (can be taken concurrently), ME 110, ME 114. An introduction to the fundamentals of design. Topics include deflection and stiffness, static failure, and fatigue failure.

ME 175A Professional Topics in Engineering (2) Lecture, 2 hours. Prerequisite(s): senior standing in Mechanical Engineering major. ME 009. Topics include technical communication, team work, project management, engineering economics, professional ethics, and computer-aided design. Satisfaction (S) or No Credit (NC) grading is not available.

ME 175B Mechanical Engineering Design (3) Lecture, 2 hours; laboratory, 3 hours. Prerequisite(s): senior standing in Mechanical Engineering. ME 113, ME 116A, ME 170A, ME 174, ME 175A (may be taken concurrently). Outlines the defining of a design problem and the conception and detail of the design solution. Explores design theory, design for safety, reliability, manufacture and assembly. Graded In Progress (IP) until ME 175B and ME 175C are completed, at which time a final, letter grade is assigned.

ME 175C Mechanical Engineering Design (3) Lecture, 1 hour; discussion, 3 hours. Prerequisite(s): senior standing in Mechanical Engineering. ME 175B. Students create, test, and evaluate a prototype based on the project design generated in ME 175B. Lecture topics include prototyping techniques, design verification, and technical topics in design. Satisfaction (S) or No Credit (NC) grading is not available.

ME 175D Technological Entrepreneurship (4) Lecture, 2 hours; workshop, 2 hours. Prerequisite(s): senior standing in Mechanical Engineering. Introduces concepts of business and management required to convert a technology into a viable business. Topics include technological assessment, market analysis, strategy, decision making, legal and intellectual property issues in business, financial analysis, business ethics and communication. Satisfaction (S) or No Credit (NC) grading is not available.

ME 176 Sustainable Product Design (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 103, ME 110, ME 113, ME 116A. Introduces the principles of sustainable product design. Topics include life cycle design; design for reliability, maintainability, and recycling/reuse/renovation; materials selection, and manufacturing processes. Includes project in which students analyze the environmental impact of a product and redesign it to reduce the impact. Credit is awarded for only one of ME 176 or ME 210.

ME 180 Optics and Lasers in Engineering (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): senior standing; ME 010, ME 110, ME 170A. Focuses
on principles of optics and lasers, wave equations, interferometry, diffraction, laser-material interactions. Applications in analytical characterization including confocal microscopy, Raman spectroscopy, mechan- ical deformation analysis, scanning probe microscopy, ultraviolet-visible spectrophotometry, photolumi- nescence, optical detectors, and lasers in materials processing.

ME 190 Special Studies (1-5) Individual study. 3-15 hours. Prerequisite(s): consent of instructor, depart- ment chair, and Mechanical Engineering Undergraduate Program Committee chair. Individual study to meet special curricular needs. Requires a final written report. Course is repeatable to a maximum of 9 units.

ME 197 Research for Undergraduates (1-4) Outside research, 3-12 hours. Prerequisite(s): consent of instructor and Mechanical Engineering Undergraduate Program Committee chair. Directed research in a particular subject relevant to mechanical engineering. Requires a final written technical report. Course is repeatable to a maximum of 8 units.

**Graduate Courses**

ME 200 Methods of Engineering Analysis (4) Lecture, 4 hours. Prerequisite(s): graduate standing in engi- neering or consent of instructor. Topics include linear algebra theory, vector spaces, eigenvalue problems, complex analysis, integration, experimental education. Original course topics are variable and unique from other departmental course offerings, designed to highlight the student facilitators’ expertise while working closely with a faculty mentor. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 8 units.

ME 201 Computational Methods in Engineering (4) Lecture, 4 hours. Prerequisite(s): graduate standing or consent of instructor. Explores numerical methods with computer applications. Topics include solution of nonlinear algebraic equations, solution of systems of linear equations, error analysis, integration, graphical and computer applications. Topics include solution of differential equations, model fitting, Fast Fourier Transform and applications, and numerical solution of ordinary and partial differential equations.

ME 202 Spectral Computational Methods (4) Lecture, 3 hours; consultation, 1 hour. Prerequisite(s): ME 200 or equivalent; ME 240A is recommended. Introduces data analysis, including discrete Fourier transforms, sampling theorem, and power spectra. Reviews Sturm-Liouville eigenfunction expansions, Gibbs pheno- menon, convergence theorems, and Chebyshev transforms. Additional topics include Galerkin, tau, collocation, and pseudospectral methods, aliasing, time-advancement, and numerical stability. Explores applications to integer and non-integer Fourier transforms, computer flows, reactions, flows, and complex geometries. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Course is repeatable as content changes.

ME 203 Design and Analysis of Engineering Experi- ments (4) Lecture, 3 hours; discussion, 1 hour. Prereq- uisite(s): graduate standing or consent of instructor. ME 203 online section; enrollment in the Online Master-in-Science in Engineering program. Introduces research methods in engineering. Topics include design of experiments, basic statistical tools, data analysis in the time-domain and frequency domain, machine learning and pattern recognition approaches, and computational tools. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

ME 210 Sustainable Product Design (4) Lecture, 3 hours; consultation, 1 hour. Prerequisite(s); graduate standing or consent of instructor. ME 210 online section; enrollment in the Online Master-in-Science in Engineering program. Introduces the principles of sustainable product design. Topics include life cycle design; design for reliability, maintainability, and recycling/reuse/renamufacture; materials selection; and manufacturing processes. Includes project in which students analyze the environmental impact of a product and redesign it to reduce the impact. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Credit is awarded for only one of ME 176 or ME 210.

ME 220 Optimal Control and Estimation (4) Lecture, 4 hours; term paper, 1 hour. Prerequisite(s): ME 120, ME 121 or equivalent; or consent of instructor. Introduces optimization with applications to incompressible Navier-Stokes equations. Topics include numerical optimization; asymptotic properties of optimal controllers; optimal tracking; an introduction to Receding Horizon control; derivation of the Kalman filter; Extended Kalman Filter; and Un- scented Kalman filter. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Course is repeatable with EE 223.

ME 222 Advanced Robotics (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 236/ME 236; ME 120 or equivalent. Topics include robot navigation; description of robot sensors and their characteristics; sensor data processing; feature extraction; and match- ing. Topics include: online mapping; map-based localization; simultaneous localization and mapping; image-based motion estimation; and motion planning. Cross-listed with EE 245.

ME 223 Secure and Reliable Control Systems (4) Lecture, 4 hours. Prerequisite(s): graduate standing or consent of instructor. ME 223 online section; enrollment in the Online Master-in-Science in Engineering program. An introductory study of fault-tolerant and secure control systems. Topics include models and dynamical systems; linear system theory; detectability of attacks and failures; model-based fault detection; analytical redundancy; unknown-input observers; statistical methods for fault detection; graphical mod- els and structured system theory; and fault-tolerant control. Letter Grade or S/NC; no petition required.

ME 230 Computer-Aided Engineering Design (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): graduate standing or consent of instructor. ME 230 online section; enrollment in the Online Master-in-Science in Engineering program. Introduces funda- mentals of interactive computer graphics, three-di- mensional representations and surfaces, Bezier parameterizations, and optimization methods. Demonstrates applications of computer graphics and computational geometry to mechanical system simula- tions, computer-aided design, and engineering design.

ME 231 Pen-Based Computing (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing or consent of instructor; computer programming experience. Introduces computational techniques for pen-based interfaces. Covers fundamental issues such as ink segmentation, sketch parsing, and shape recognition. Explores the topic of sketch understand- ing, including reasoning about context and correcting errors. Also addresses issues related to building prac- tical pen-based systems. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Cross-listed with CS 233.

ME 232 Computational Design Tools (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing or consent of instructor. An introduction to the theoretical foundations and practical application of computational techniques for engineering design. Topics include geometric modeling, numerical optimi- zation, and artificial intelligence techniques. Includes programming projects in which both symbolic and numerical computational techniques are used to solve engineering problems. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

ME 233 Artificial Intelligence for Design (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Explores the appli- cation of artificial intelligence to engineering design. Topics include the use of search, knowledge-based systems, machine learning, and qualitative physical reasoning for design automation. Addresses the theory behind these techniques and issues related to their practical application. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Course is repeatable as content changes.

ME 235 Linear System Theory (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 132. Provides a review of linear algebra. Topics include the mathhe- matical description of linear systems; the solution of state-space equations; controllability and observability; canonical and minimal realization; and state feedback, pole placement, observer design, and compensator design. Cross-listed with EE 235.

ME 236 State and Parameter Estimation Theory (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 237. Covers auto-regressive moving average (ARMA) models; state estimation and parameter identification (including least square and maximum likelihood for- mulations); observability theory; synthesis of optimum inputs; Kalman-prediction (filtering and smoothing); state estimates and frequency response; online estimation; colored noise; and nonlinear filtering algorithms. Cross-listed with EE 236.

ME 237 Nonlinear Systems and Control (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 235/ME 235. Explores nonlinear systems and control. Topics include nonlinear differential equations, second order nonlinear systems, equilibrium and phase portrait, limit cycle, harmonic analysis and describing function, Lyapunov stability theory; and the algebraic Ricatti equations. Introduces the concepts of inputs; Kalman-prediction (filtering and smoothing); state estimates and frequency response; online estimation; colored noise; and nonlinear filtering algorithms. Cross-listed with EE 237.

ME 238 Linear Multivariable Control (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): EE 235/ME 235. Investigates multivariable feedback systems, stability, performance, uncertainty, and robustness. Topics include analysis and synthesis via matrix factorization; Q-parameterization and all stabilizing controllers, frequency domain methods; and H(infinity) design and structured singular value analysis. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Cross-listed with EE 238.

ME 239 Optimal Control (4) Lecture, 3 hours; dis- cussion, 1 hour. Prerequisite(s): EE 215, EE 235/ME 236. Presents the theory of stochastic optimal control systems and methods for their design and analysis. Covers principles of optimization; Lagrange’s equation; linear-quadratic-Gaussian control; certainty-equiv- alence; the minimum principle; the Hamilton-Jac- obi-Bellman equation; and the algebraic Ricatti equation. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Cross-listed with EE 239.

ME 240A Fundamentals of Fluid Mechanics (4) Lecture, 4 hours. Prerequisite(s): graduate standing or consent of instructor. ME 240A online section; enrollment in the Online Master-in-Science in Engineering program. Introduction to fluid mechanics. Explores equations of motion, stress tensor, the Navier-Stokes equations, boundary conditions, exact solutions, vorticity, and boundary layers.

ME 240B Fundamentals of Fluid Mechanics (4) Lecture, 4 hours. Prerequisite(s): ME 240A or consent of instructor. Covers inviscid flow, the Euler and Bernoulli
equations, potential flow, and wing theory and introduces stability theory and turbulence.

**ME 241A Fundamentals of Heat and Mass Transfer** (4) Lecture, 4 hours. Prerequisite(s): ME 240A or consent of instructor. Introduces in-depth derivations of equations and principles governing heat and mass transfer with an emphasis on formulation of problems. Topics include equations involved in conduction, convection, radiation, and mass conservation, and the analytical and numerical solution of transport problems. Mechanical Engineering graduate students receive a letter grade; other students receive a letter grade or Satisfactory (S) or No Credit (NC) grade.

**ME 241B Transport Through Porous Media** (4) Lecture, 4 hours. Prerequisite(s): standing; other students receive a letter grade or Satisfactory (S) or No Credit (NC) grade.

**ME 241C Electronic Cooling and Thermal Issues in Microelectronics** (4) Lecture, 4 hours. Prerequisite(s): standing; faculty, and invited speakers. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade.

**ME 242 Turbulence in Fluids** (4) Lecture, 4 hours. Prerequisite(s): ME 240A or consent of instructor. An introduction to the application of fundamental conservation laws of mechanics (mass, momentum, and energy) to the modeling of complex turbulent natural and human-made flows. Covers passive, active, and hybrid thermal management techniques, or numerical and advanced thermal management concepts such as single-phase, phase change and heat pipes. Mechanical Engineering graduate students receive a letter grade; other students receive a letter grade or Satisfactory (S) or No Credit (NC) grade.

**ME 243 Advanced Mechanical Engineering Thermodynamics** (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A or equivalent. Introduces the fundamental statistical foundations of classical thermodynamics, energy and materials of entropy, temperature, pressure, chemical potential, and the free energies. Applications include chemical equilibrium and reactions, phase equilibrium and transitions including vapor-liquid and solid-solid, fluctuations, and thermodynamics of nanoscale systems. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 244 Nanoscale Heat Transfer and Energy Conversion** (4) Lecture, 4 hours. Prerequisite(s): at least two of EE 201/ME 207, EE 202/ME 217, ME 100A, ME 116A, or equivalents. Explores fundamental processes of energy transport and conversion at short length and time scales. Introduces classical and quantum-mechanical size effects on electronic, phonon, and photons. Topics include modes of energy storage, coupling between energy carriers, and electrical and thermal transport using the Boltzmann transport equation and/or kinetic theory. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 245 Radiative Heat Transfer** (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 116A or ME 116B or consent of instructor. Offers in-depth study of topics related to radiative heat transfer. Builds upon curriculum of radiation presented at the undergraduate level. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 246 Computational Fluid Dynamics with Applications** (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): ME 240A or consent of instructor. Introduces finite difference, finite volume, and finite element; spectral methods, governing equations for nonreacting and reacting flows; and stability and convergence for steady and unsteady problems. Students use commercial computational fluid dynamics (CFD) software for the course project.

**ME 248 Internal Combustion Engines** (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): ME 100A; graduate standing. Covers engine types and their operation. Also addresses engine design and operating parameters, thermodynamics of fuel-air mixture, engine cycles, spark ignition and compressed ignition engines, and emissions. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 250 Seminar in Mechanical Engineering (1 or 2) Seminar, 1-2 hours. Prerequisite(s): standing; seminar in selected topics in mechanical engineering presented by graduate students, staff, faculty, and invited speakers. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. Course is repeatable.

**ME 255 Transport Processes in the Atmospheric Boundary Layer** (4) Lecture, 4 hours. Prerequisite(s): ME 100A or CHE 100, ME 113 or CHE 114, and ME 116A or CHE 116; or consent of instructor. Examines heat, mass, and momentum transport in areas of the atmospheric boundary layer using current understanding of remote sensing. Topics include surface energy balance, Monin-Obukhov similarity theory, and dispersion of pollutants in the atmospheric boundary layer. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 261 Theory of Elasticity** (4) Lecture, 4 hours. Prerequisite(s): ME 110 or consent of instructor. Introduces the theory of elasticity. Topics include stress, strain, equations of motion, and constitutive equations. Topics include typical boundary value problems of classical elasticity, problems of plane strain and plane stress, and variational principles.

**ME 266 Mechanics and Physics of Materials** (4) Lecture, 4 hours. Prerequisite(s): standing; or consent of instructor. Introduces the structure and properties of materials. Topics include the static and dynamic analysis of mechanical and multiphysical systems and techniques of automatic mesh generation.

**ME 270 Introduction to Microelectromechanical Systems** (4) Lecture, 4 hours. Prerequisite(s): ME 110, ME 114, or equivalents; B+ or better for MSE 238 online section; enrollment in the Online Master-in-Science in Engineering program. An introduction to the design and fabrication of microelectromechanical systems (MEMS). Topics include micromachining processes; material properties; transduction; applications in mechanical, thermal, optical, radiation, and biological sensors and actuators; microfluidic devices; BioMEMS and applications; packaging and reliability concepts; and mechanical techniques for MEMS. Cross-listed with MSE 238.

**ME 271 Therapeutic Biomedical Microdevices** (4) Lecture, 4 hours. Prerequisite(s): ME 270/ME 238 or equivalent or consent of instructor. An introduction to the application of micro device technology toward biomedical therapeutics. Topics include emerging micro device fabrication techniques, bio-compatibility requirements, and applications in areas such as cardiovascular intervention, minimally-invasive drug delivery, neuroprosthetic interfaces, and cellular engineering. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor.

**ME 272 Nanoscale Science and Engineering** (4) Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): standing; or consent of instructor. Explores physical principles and designs of nanoscale sensors. Topics include macroscopic and microscopic physical phenomena and properties; signal processing; mechanical transducers; thermal transducers; electrical transducers; magnetic transducers; optical transducers; chemical and biological transducers; and applications such as lab-on-a-chip, medical diagnosis and power MEMS.

**ME 274 Plasma-aided Manufacturing and Materials Processing** (4) Lecture, 4 hours. Prerequisite(s): ME 243 or equivalent; or consent of instructor. An overview of the Title Master-in-Science in Engineering program. Covers the fundamentals of gaseous plasmas and the physics of both equilibrium and non-equilibrium plasmas. Covers the basic techniques for plasma diagnostics. Discusses the use of plasmas as a materials processing medium for a variety of manufacturing processes. Advanced topics such as the processing of nanostructured materials using plasmas are included.

**ME 278 Imperfections in Solids** (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): standing; or consent of instructor. Explores physical principles and designs of chemical and electrical Engineering or Computer Science or Electrical Engineering or Materials Science and Engineering or Mechanical Engineering. Covers fundamentals of crystal structures and crystal defects, including the generation of point defects; nuclear and electronic processes; perfect and partial dislocations; twins, stacking faults, and transformations; mechanics of semiconductor and metallic thin films and multilayered structures. Cross-listed with MSE 218.

**ME 290 Directed Studies** (1-6) Individual study, 3-18 hours. Prerequisite(s): standing; consent of instructor and graduate advisor. Individual study, directed by a faculty member, of selected topics in mechanical engineering. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 9 units.

**ME 297 Directed Research** (1-6) Outside research, 3-18 hours. Prerequisite(s): standing; consent of instructor. Research conducted under the supervision of a faculty member on selected problems in mechanical engineering. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 9 units.

**ME 298-B Individual Internship** (1-12) F, W, Summer Internship, 2-24 hours; written work, 1-12 hours. Prerequisite(s): standing; consent of instructor. An individual apprenticeship in Mechanical Engineering with an approved professional individual
Mechanisms of Gene Expression & Regulation Studies Designated Emphasis / Media & cultural Studies 356

Mechanisms of Gene Expression and Regulation Studies Designated Emphasis

Subject abbreviation: GERS
School of Medicine

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Frances Sladek (Cell Biology and Neuroscience)
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Yinsheng Wang (Chemistry)
Thomas Girke (Institute for Integrative Genome Biology)
Xinpeng Cui (Statistics)
Katherine Borkovich (Microbiology)
James Borneman (Microbiology)
Jason Stajich (Microbiology)
Shou-Wei Ding (Microbiology)

Designated Emphasis Requirements

The Designate Emphasis is an interdisciplinary graduate program of study to enhance student training in the field through a focused coursework across at least two departments. The program is optional and the courses used for the DE may not be counted toward MS or PhD requirements.

1. Three (3) courses (12 units) with a focus in basic principles of genetics gene regulation (epigenetics, non coding RNA) and bioinformatics will be selected from:
   - MCBL 221 - Microbial Genetics
   - CMBD 203 - Advanced Advanced Genetics
   - GEN 203 - Advanced Genetic Analysis of Model Organisms
   - GEN 241 - Advances in Genomics
   - GEN 242 - Data Analysis in Genome Biology
   - GEN 206 - Gene Silencing
   - GEN 220 - Computational Analysis of High Throughput Biological Data
   - BPSC/BIOL 148 - Quantitative Genetics
   - EEOB 214 - Evolutionary Genetics
   - EEOB 216 - Theory of Evolution
   - ENTX 204 - Genome Maintenance and Stability
   - STAT 100A Introduction to Statistics
   - BPSC 234 – Statistical Genomics
   - STAT 110 - Biostatistical Methods in Life Sciences
   - CS234: Computational Methods for Biomolecular Data
   - CS238: Algorithmic Techniques in Computational Biology

Students must select courses with relevant content in consultation with the Designated Emphasis Advisory Committee comprising of three participating faculty including student's major professor. Students must select courses from at least two different departments. Undergraduate course taken to fulfill the requirement must be accompanied by a 292 course taken in the same quarter with extra work agreed upon by professor and student.

2. BMSC 222 (2 units): Special Topics in Biomedical Sciences with emphasis in Gene expression and regulation. The course will address the research pertaining to the student's interest and prepare trainees in applying the knowledge of basic principles in regulation of gene expression and bioinformatics data analysis of next generation sequencing approaches. Graded Satisfactory (S) or No Credit (NC)

3. Research Project: students will write a review article on a selected genetics/ bioinformatics/ regulation of gene expression topic. The review will be evaluated by the Designated Emphasis Advisory Committee. It is the committee's expectation that student will fulfill this component by submitting the review article for the journal publication in a pubmed indexed journal. Successful completion of this review is required for the Designated Emphasis completion.

All requirements for the Designated Emphasis must be satisfied no later than one calendar year from the quarter in which candidate advances to candidacy in their PhD field; a minimum GPA of 3.0 is required for the Designated Emphasis completion.

Media and Cultural Studies

Subject abbreviation: MCS
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Erika Suderburg, M.F.A
Sherry Vint, Ph.D.

Associate Professors
Derek Burrell, Ph.D.
Amalia Cabezas, Ph.D. (Gender and Sexuality Studies)
Michelle Dixon, Ph.D.
Keith Harris, Ph.D.
Tabassum “Ruhul” Khan, Ph.D.
Jodi Kim, Ph.D.
Timothy Labor, Ph.D.
Judith Rodenbeck, Ph.D.
Richard Rodriguez, Ph.D.
Freya Schiwy, Ph.D.
Sarita Say, Ph.D.
Setsu Shigematsu, Ph.D.
Wendy Wei Lin Su, Ph.D.

Assistant Professor
Laura Harris, Ph.D. (on leave)
Gloria Kim Ph.D.

Major
The Media and Cultural Studies minor provides an interdisciplinary examination of film, video, television multimedia, visual and digital cultures with a primary emphasis on history and theory, and a secondary focus on creative intervention in media environments through production.

The Media and Cultural Studies focuses an interdisciplinary lens on the analysis of the dynamic relationship between media and society with special emphasis on race, gender, class, sexuality, and ethnicity as well as political economy and globalization. Our students critically engage in major debates about social and environmental justice within both global and local contexts. They also learn through practicing creative interventions in media ecologies, for example, creative, documentary, and ethnographic video; photography; multimedia and digital production; and journalism. Media literacies are essential for the making of engaged global citizens, capable of moving flexibly between the applied and the critical, the professional and the scholarly, the empirical and the theoretical.

University Requirements
See Undergraduate Studies section.

College Requirements
See College of Humanities, Arts, and Social Sciences; Colleges and Programs section.

Major Requirements
1. Lower-division requirements (5 lower-