

# Course Bulletin

<b>103583</b>	<b>Chemical Process Principles</b>			
Subject: CHBE	Catalog Nbr: 0010	2017 FALL	Primary	James Van Deventer James.Van_Deventer@tufts.edu
Introduction to chemical and biological process calculations emphasizing unit operations, process stoichiometry, material and energy balances, states of matter, and continuous steady state and transient processes. Introduction to computational tools for process engineering calculations.				

<b>103643</b>	<b>Chemical Engineering Thermodynamics</b>			
Subject: CHBE	Catalog Nbr: 0011	2018 SPRG	Primary	Matthew Panzer Matthew.Panzer@tufts.edu
Thermodynamic concepts - first and second laws, heat, work, energy, entropy, equilibrium, reversibility, equations of state - are introduced in process contexts. Phase equilibria, chemical potential, fugacity, and colligative properties are also discussed.				

<b>103699</b>	<b>Transport Phenomena I</b>			
Subject: CHBE	Catalog Nbr: 0021	2016 FALL	Primary	Ara Philipossian No Email on file.
		2018 SPRG	Primary	Nikhil Nair Nikhil.Nair@tufts.edu
Fundamentals of fluid mechanics and their applications to the design and understanding of flow phenomena in industrial and biological processes. Analysis and design of steady-state and non-steady-state heat conduction and convective heat transfer in industrial and biological processes.				

<b>103757</b>	<b>Transport Phenomena II</b>			
Subject: CHBE	Catalog Nbr: 0022	2016 FALL	Primary	Simon Steel Simon.Steel@tufts.edu
		2018 SPRG	Primary	Derek Mess Derek.Mess@tufts.edu
Principles of heat and mass transfer. Steady-state conduction and diffusion processes. Convective transport of heat and mass in laminar and turbulent flows in conduits and over various surfaces. Applications to design of heat exchangers. Natural convection. Combined heat and mass transfer applications. Recommendations: CHBE 10, 11; MATH 42 (formerly MATH 13).				

<b>103906</b>	<b>Applied Numerical Methods For Chemical &amp; Biological Engineering</b>			
Subject: CHBE	Catalog Nbr: 0039	2017 SPRG	Primary	Emmanouhl Tzanakakis Emmanuel.Tzanakakis@tufts.edu

# Course Bulletin

Numerical analysis methods and their implementation using commercially available software are reviewed. Scientific programming methodology. Application of commercial process simulation software to the analysis of chemical and biological process models.

<b>103945</b>	<b>Chemical And Biological Separations</b>			
Subject:	Catalog Nbr:			
CHBE	0045			
2016 FALL	Primary	Ara Philipossian		No Email on file.
2017 FALL	Primary	Ayse Asatekin		Ayse.Asatekin@tufts.edu
<p>Design and analysis of separation processes. Equilibrium-stage processes, stagewise separation processes, mass transfer operations, and rate-controlled separations. Fundamental study of distillation, extraction, adsorption, membrane separation, and precipitation &amp; crystallization processes.</p> <p>Pre-Requisite: CHBE 22</p>				

<b>103965</b>	<b>Chemical And Biological Engineering Laboratory</b>			
Subject:	Catalog Nbr:			
CHBE	0051			
2017 FALL	Primary	Derek Mess		Derek.Mess@tufts.edu
<p>Laboratory experiments related to fundamental concepts characterizing chemical and biological systems and processes. Experience is gained in planning and executing the experiments and critically analyzing the collected data to achieve a deeper understanding of the underlying concepts. Oral presentations and written reports are an integral part of this laboratory course.</p>				

<b>103986</b>	<b>Chemical And Biological Engineering Laboratory</b>			
Subject:	Catalog Nbr:			
CHBE	0052			
2018 SPRG	Primary	Derek Mess		Derek.Mess@tufts.edu
<p>Open-ended laboratory projects in an area of applied and industrial interest of chemical and biological engineering. Students work in groups and choose one project for the whole term. They are asked to not only analyze the results of a given experiment but also decide what are the important experiments to perform as part of their overall plan to bring their project to a successful conclusion Oral presentations and written reports are an integral part of this laboratory course.</p>				

<b>104016</b>	<b>Various Topics In Computer Science</b>			
Subject:	Catalog Nbr:			
COMP	0009			
<p>Please see departmental website for detailed information. One-half credit.</p> <p>Recommendations: A sincere interest in learning more about computer science and no prior programming experience.</p>				

# Course Bulletin

<b>104031</b>	<b>Product &amp; Process Design</b>			
Subject:	Catalog Nbr:			
CHBE	0060			
2018 SPRG	Primary	Daniel Ryder		daniel.ryder@tufts.edu
<p>This is a capstone design course covering the principles of design and economic evaluation through the preliminary design of a commercial project related to a product or a process. Working in groups on assigned or selected portions of the overall project, students are required to make integrated use of a wide variety of fundamentals and principles gained from previous courses. Computational laboratories are supplemented by lectures. Use of design software.</p>				

<b>104049</b>	<b>Molecular Biotechnology</b>			
Subject:	Catalog Nbr:			
CHBE	0062			
2018 SPRG	Primary	David Kaplan		david.kaplan@tufts.edu
2018 SPRG	Primary	Niall Lennon		No Email on file.
2018 SUMR	Primary	Dana Cairns		Dana.Cairns@tufts.edu
2018 SUMR	Primary	Nina Dinjaski		Nina.Dinjaski@tufts.edu
<p>(Cross-listed as BIO 62 and BME 62.) Overview of key aspects of molecular biology and engineering aspects of biotechnology. Lecture topics include molecular biology, recombinant DNA techniques, immunology, cell biology, protein purification, fermentation, cell culture, combinatorial methods, and bioinformatics. (May be taken at 100 level.) Recommendations: CHEM 1, BIO 13, or permission of instructor.</p>				

<b>104066</b>	<b>Independent Study</b>			
Subject:	Catalog Nbr:			
CHBE	0093			
<p>Guided Individual study of an approved topic. Designed to develop self-teaching skills of the advanced undergraduate. Appraisal of the student's knowledge in the chosen topic based on written and and/ or oral examination. Credit as arranged. Please see departmental website for specific details. Recommendations: Permission of department .</p>				

<b>104086</b>	<b>Independent Study</b>			
Subject:	Catalog Nbr:			
CHBE	0094			
2018 SPRG	Primary	Derek Mess		Derek.Mess@tufts.edu
<p>Guided individual study of an approved topic. Designed to develop self-teaching skills of the advanced undergraduate. Appraisal of the student's knowledge in the chosen topic based on written and/or oral examination. Prerequisite: consent of the department. Course credit as arranged. Please see departmental website for specific details.</p>				

# Course Bulletin

104132		Undergraduate Research		
Subject:	Catalog Nbr:			
CHBE	0095			
2017 FALL	Primary	Jerry Meldon		No Email on file.
2018 SPRG	Primary	Daniel Ryder		daniel.ryder@tufts.edu
2018 SPRG	Primary	David Kaplan		david.kaplan@tufts.edu
2018 SPRG	Primary	Maria Flytzani-Stephanopoulos		mflytzan@tufts.edu
2018 SPRG	Primary	Kyongbum Lee		Kyongbum.Lee@tufts.edu
2018 SPRG	Primary	Christos Georgakis		Christos.Georgakis@tufts.edu
2018 SPRG	Primary	Hyunmin Yi		Hyunmin.Yi@tufts.edu
2018 SPRG	Primary	Matthew Panzer		Matthew.Panzer@tufts.edu
2018 SPRG	Primary	Ayse Asatekin		Ayse.Asatekin@tufts.edu
2018 SPRG	Primary	Darryl Williams		Darryl.Williams@tufts.edu
2018 SPRG	Primary	Nikhil Nair		Nikhil.Nair@tufts.edu
2018 SPRG	Primary	Emmanouhl Tzanakakis		Emmanuel.Tzanakakis@tufts.edu
2018 SPRG	Primary	James Van Deventer		James.Van_Deventer@tufts.edu
2018 SPRG	Primary	Prashant Deshlahra		Prashant.Deshlahra@tufts.edu
Preparation of a report based on personal research, design, or experiment. Please see departmental website for specific details.				

104192		Honors Thesis Research A		
Subject:	Catalog Nbr:			
CHBE	0096			
2017 FALL	Primary	Daniel Ryder		daniel.ryder@tufts.edu
2017 FALL	Primary	David Kaplan		david.kaplan@tufts.edu
2017 FALL	Primary	Jerry Meldon		No Email on file.
2017 FALL	Primary	Maria Flytzani-Stephanopoulos		mflytzan@tufts.edu
2017 FALL	Primary	Kyongbum Lee		Kyongbum.Lee@tufts.edu
2017 FALL	Primary	Christos Georgakis		Christos.Georgakis@tufts.edu
2017 FALL	Primary	Hyunmin Yi		Hyunmin.Yi@tufts.edu
2017 FALL	Primary	Matthew Panzer		Matthew.Panzer@tufts.edu
2017 FALL	Primary	Ayse Asatekin		Ayse.Asatekin@tufts.edu
2017 FALL	Primary	Nikhil Nair		Nikhil.Nair@tufts.edu
2017 FALL	Primary	Emmanouhl Tzanakakis		Emmanuel.Tzanakakis@tufts.edu
2017 FALL	Primary	James Van Deventer		James.Van_Deventer@tufts.edu
2017 FALL	Primary	Prashant Deshlahra		Prashant.Deshlahra@tufts.edu
Supervised research in chemical and biological engineering leading to the completion of the undergraduate honors thesis. Please see the Departmental website for specific program details and qualification requirements.				

# Course Bulletin

<b>104248</b>	<b>Internship In Chemical &amp; Biological Engineering</b>			
Subject:	Catalog Nbr:			
CHBE	0099			
2016 FALL	Primary	Matthew Panzer		Matthew.Panzer@tufts.edu
2017 SUMR	Primary	Christos Georgakis		Christos.Georgakis@tufts.edu
<p>A mentored professional experience in engineering at an off-site organization. The internship must conform to all the requirements of the School of Engineering Internship Program. The department will grant course credit for internships if all of the following conditions are met: 1) The project is approved in advance by the department, 2) a faculty mentor has supervisory and technical control of any work that receives credit, and 3) a written report is submitted that is evaluated by the faculty adviser and the outside institutional supervisor. Recommendations: Junior or senior standing.</p>				

<b>104290</b>	<b>Reactor Design</b>			
Subject:	Catalog Nbr:			
CHBE	0102			
2018 SPRG	Primary	Kyongbum Lee		Kyongbum.Lee@tufts.edu
2018 SPRG	Primary	Simon Steel		Simon.Steel@tufts.edu
<p>Treatment of chemical reaction equilibrium and kinetic fundamentals and application of them to the design of reactors. Topics include interpretation of reaction-rate data, establishment of reaction mechanism and rate-controlling steps, sizing, and optimization of reactors. Use of personal computer software is encouraged.</p>				

<b>104334</b>	<b>Separation Processes</b>			
Subject:	Catalog Nbr:			
CHBE	0104			
<p>Material on mass-transfer separation processes beyond that covered by the undergraduate unit operations course. Computational techniques employing digital computers are emphasized. Recommendations: CHBE 45</p>				

<b>104353</b>	<b>Membrane Separation Processes</b>			
Subject:	Catalog Nbr:			
CHBE	0107			
2017 SPRG	Primary	Jerry Meldon		No Email on file.
<p>Fundamentals of liquid/solid, liquid mixture, and gas mixture separations using synthetic membranes. Processes include microfiltration, ultrafiltration, reverse osmosis, electrodialysis, and gas permeation, with applications to industrial process streams, bioprocessing, water purification, and hazardous waste control; also novel membrane reactors and membrane extraction. Emphasis on application of mass transfer and fluid flow principles; also process configuration selection, to design and scale-up. Recommendations: CHBE 45.</p>				

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<b>104372</b>	<b>Various Topics In Computer Science</b>			
Subject:	Catalog Nbr:			
COMP	0010			
2018 SPRG	Primary	Johannes De Ruiter		jp.deruiter@tufts.edu
Please see departmental website for detailed information. One Credit.				

<b>104399</b>	<b>Process Dynamics And Control</b>			
Subject:	Catalog Nbr:			
CHBE	0109			
2017 FALL	Primary	Christos Georgakis		Christos.Georgakis@tufts.edu
Mathematical modeling of chemical processes with ordinary differential equations. Feedback, feedforward, and environmental control. Block diagrams. Laplace transformation. Linearization techniques. Frequency response. Laboratory exposure to instrumentation.				

<b>104420</b>	<b>Introduction Optimization</b>			
Subject:	Catalog Nbr:			
CHBE	0110			
Intorduction to fundamental method of optimization with application to problems related to chemical and biological systems and processes; nature of optimization problem; one-dimensional and multivaribale unconstrained optimization; linear programming; non-linear programming with constriants; mixed-integer programming; selected applications.				

<b>104459</b>	<b>Thermal-fluid Transport I</b>			
Subject:	Catalog Nbr:			
CHBE	0111			
2017 FALL	Primary	Erica Kemmerling		Erica.Kemmerling@tufts.edu
(Cross-listed as ME 111). Advanced topics in fluid mechanics. Viscous and inviscid flows. Strain rate, vorticity and streamline coordinates. Differential conservation laws for mass, momentum and energy. Dimensional analysis. Lubrication flows. Momentum and thermal laminar boundary layers. Laminar-turbulent transition. Reynolds stress and turbulence modeling. Turbulent boundary layers. Flow modeling. Recommendations: ES 8 - Fluid Mechanics or permission of instructor.				

<b>104481</b>	<b>Thermal-fluid Transport II</b>			
Subject:	Catalog Nbr:			
CHBE	0112			
2018 SPRG	Primary	Marc Hodes		Marc.Hodes@tufts.edu
(Cross-listed as ME 112). Multi-dimensional conduction. Transient conduction including moving boundary problems. External forced and natural convection. Internal forced and natural convection. Developing flows and transition to turbulence. Condensation and boiling heat transfer. Radiation and conjugate heat transfer				

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involving radiation. Temperature and heat flux measurements. Numerical techniques.  
Recommendations: ME 111 Thermal-Fluid Transport I or equivalent.

104507	Introduction To Computer Science			
Subject: COMP	Catalog Nbr: 0011			
2016 FALL	Primary	Christopher Gregg	No Email on file.	
2017 FALL	Primary	Megan Monroe	Megan.Monroe@tufts.edu	
2017 SUMR	Primary	Michael Shah	Michael.Shah@tufts.edu	
2018 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2018 SUMR	Primary	Elena Strange	Elena.Strange@tufts.edu	
<p>The study of computer science centers on two complementary aspects of the discipline. First, computer science is fundamentally concerned with the problem-solving methodologies it derives from its foundational fields: the design principles of engineering, mathematical theory, and scientific empirical study. Second, these methodologies are applied in the complex context of a modern day computing system. In this course we will address both of these important aspects. As a means for developing your design skills, we will discuss the fundamental features of a high level, general purpose programming language — namely C++ — and learn how to use it as a tool for problem solving. We will also consider the performance of solutions, and how to apply both analytical and empirical assessment techniques. Finally, we will explore the Unix operating system as a context for problem solving. (Additional weekly lab time scheduled at first class meeting.) Recommendations: High school algebra. No prior programming experience is necessary.</p>				

104569	Principles Of Polymerization			
Subject: CHBE	Catalog Nbr: 0121			
2017 FALL	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
<p>Synthesis of polymeric materials. Three major types of polymerization--step, chain, and ring-opening--are reviewed with emphasis on reaction mechanisms, kinetics, and thermodynamics of the reactions, and their relationships to molecular weight and molecular structures of macromolecules. Recommendations: Physical and organic chemistry</p>				

104592	Physical Chemistry Of Polymers			
Subject: CHBE	Catalog Nbr: 0122			
2018 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
<p>Physicochemical properties of polymeric materials with emphasis on the relationship between molecular architecture and physical properties. Topics include polymer solution theories, thermal transitions, conformational analysis, polymer microstructure, crystallinity and morphology, the rubbery and glassy states, rheology, and statistical thermodynamics. Recommendations: CHBE 11</p>				

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<b>104621</b>	<b>Data Structures</b>			
Subject:	Catalog Nbr:			
COMP	0015			
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2018 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu	
2018 SUMR	Primary	Partha Biswas	Partha.Biswas@tufts.edu	
<p>A second course in computer science. Data structures and algorithms are studied through major programming projects. Topics include linked lists, trees, graphs, dynamic storage allocation, and recursion.            Recommendations: COMP 11 or permission of Instructor.</p>				

<b>104635</b>	<b>Air Pollution Control</b>			
Subject:	Catalog Nbr:			
CHBE	0136			
<p>(Cross-listed as CHBE136.) A study of health and environmental effects from air pollution, dispersion modeling, air pollution laws and regulations, fate and transport of air pollution, and design of pollution control equipment and processes. Recommendations: (ES 8 &amp; CEE 32) or CHBE 22</p>				

<b>104656</b>	<b>Hazardous Waste Treatment Technologies</b>			
Subject:	Catalog Nbr:			
CHBE	0138			
2017 FALL	Primary	Larry Cohen	larry.cohen@tufts.edu	
<p>(Cross-listed as CEE 138.) Hazardous waste treatment options based on physical, chemical, biological, and thermal processing technologies. Brief review of definitions and appropriate hazardous waste legislation. Introduction to pollution prevention. Traditional end-of-pipe treatment technologies. Applications to include solvent recovery, chemical fixation, land disposal, biodegradation, and special wastes. Incineration and associated environmental discharges constitute a major portion of course. Emerging technologies and evaluation of technical/economic process viability.            Recommendations: Senior standing or consent of instructor.</p>				

<b>104659</b>	<b>Web Programming</b>			
Subject:	Catalog Nbr:			
COMP	0020			
2018 SUMR	Primary	Ming Chow	ming.chow@tufts.edu	
<p>An introduction to techniques, principles, and practices of writing computer programs for the World Wide Web. Server and browser capabilities and limits. Media types, handlers, and limitations. Web programming languages and techniques. Web security, privacy, and commerce. Lectures augmented with programming projects illustrating concepts and current practice.</p>				

<b>104678</b>	<b>Surface And Colloid Chemistry</b>			
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Subject:	Catalog Nbr:			
CHBE	0140			
2017 SPRG	Primary	Simon Steel		Simon.Steel@tufts.edu
2018 SPRG	Primary	Matthew Panzer		Matthew.Panzer@tufts.edu
<p>Emphasis on fundamental concepts: attractive and repulsive forces between particles in a dispersion; stabilization and flocculation of a dispersion, electrokinetic phenomena; surfactants; contact angle and wetting; phenomena at curved interfaces; capillarity; rheology of suspensions; drying of coatings; emulsions. For students in chemical engineering and other disciplines in which surface chemistry plays an important role. Prerequisites: CHBE 21 and CHEM 31</p>				

<b>104699</b>	<b>Biochemical Engineering</b>			
Subject:	Catalog Nbr:			
CHBE	0160			
2016 FALL	Primary	Daniel Ryder		daniel.ryder@tufts.edu
2017 FALL	Primary	Gautham Sridharan		Gautham.Sridharan@tufts.edu
<p>Thermodynamics of biological reactions, principles of fermentation processes, and chemical engineering applications to bioreactor analysis are studied. Recommendations: CHBE 102.</p>				

<b>104720</b>	<b>Game Development</b>			
Subject:	Catalog Nbr:			
COMP	0023			
<p>Principles, design, and development of games. Game structure, engineering, physics, testing, 2D and 3D rendering, user interfaces, sound, and animation. Security of online games. Applications of Economics, Music, and Psychology in crafting games. Projects include writing game design documents, developing an interactive fiction game, and building a functional game in a team. Recommendations: COMP15.</p>				

<b>104760</b>	<b>Protein Purification</b>			
Subject:	Catalog Nbr:			
CHBE	0161			
2018 SPRG	Primary	Hyunmin Yi		Hyunmin.Yi@tufts.edu
<p>Methods of purifying proteins at a large scale for therapeutic or industrial uses. Focus on unit operations found in a typical process flowsheet including centrifugation, membrane filtration, most modes of chromatography, and lyophilization. Topics include introduction to protein chemistry and analytical methods, effects of production host choice, and protein stability. Process economics, GMP operations and validation, and case studies of biotechnology industry separations.</p>				

<b>104783</b>	<b>Molecular Biotechnology</b>			
Subject:	Catalog Nbr:			

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CHBE	0162			
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Niall Lennon	No Email on file.	
2018 SUMR	Primary	Dana Cairns	Dana.Cairns@tufts.edu	
2018 SUMR	Primary	Nina Dinjaski	Nina.Dinjaski@tufts.edu	

(Cross-listed as BIO 162 and BME162.) Overview of key aspects of molecular biology and engineering aspects of biotechnology. Lecture topics include molecular biology, recombinant DNA techniques, immunology, cell biology, protein purification, fermentation, cell culture, combinatorial methods, and bioinformatics. Includes a semester-long technical project and oral presentation. (Also offered as lower-level.)

<b>104806</b>	<b>Recombinant Dna Techniques</b>			
Subject:	Catalog Nbr:			
CHBE	0163			
2018 SUMR	Primary	Wenwen Huang	Wenwen.Huang@tufts.edu	
2018 SUMR	Primary	Zaira Martin Moldes	Zaira.Martin_Moldes@tufts.edu	

(Cross-listed as BIO 163 and BME 163.) This lecture and laboratory course is designed to familiarize students with methods used to produce recombinant products. The lectures cover fundamental aspects of recombinant DNA methodologies used in the laboratory as well as some of the commercial applications of these techniques. The laboratory provides hands-on experience with the key skills used in genetic engineering, including DNA isolation, restriction enzyme mapping, cloning and selection, protein expression, gel electrophoresis, polymerase chain reaction, DNA sequencing, and related techniques. Cannot be taken for credit if BIO 50 is taken for credit.  
Recommendations: CHBE 21 and 22, or permission of instructor.

<b>104831</b>	<b>Biomaterials and Regenerative Medicine</b>			
Subject:	Catalog Nbr:			
CHBE	0164			
2016 FALL	Primary	Rosalyn Abbott-Beauregard	No Email on file.	
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Jonathan Grasman	Jonathan.Grasman@tufts.edu	

(Cross-listed as BME 153.) Fundamental concepts of biomaterials and regenerative medicine (biomaterial types, synthesis, properties, mechanisms of degradation, biological interfaces, inflammation and related issues). Specific focus on biomaterials related to regenerative medicine. Course independent of, but complementary to, BME 154. Recommendations: Junior standing, BIO13, CHEM 1, or consent of instructor

<b>104850</b>	<b>Cell/microbe Cultivation</b>			
Subject:	Catalog Nbr:			
CHBE	0166			
2017 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2018 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	

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In-depth examination of microbial and mammalian cell cultivation and concomitant production of commercially important products. Mechanism and methods of measurement and quantitative analysis of growth, product formation, and nutrient utilization kinetics in characterizing and optimizing for cell mass or product formation. Discussion of fundamental parameters controlling bioreactor design and scale-up. Systems studied include production of proteins in recombinant organisms, antibiotics, amino acids, and the cultivation of mammalian cells.

Recommendations: Permission of Instructor

<b>104859</b>	<b>Machine Structure &amp; Assembly-language Programming</b>			
Subject:	Catalog Nbr:			
COMP	0040			
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	
2018 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
<p>Structure of machine-level data and code, including memory, cache, registers, machine arithmetic, and bitwise operations. Encapsulating machine functionality through interfaces and abstract data types. Structure of assembly code, relocatable object code, and binary machine code, and the translations between them. Applications of machine-level operations and code translations in programming projects.</p> <p>Recommendations: COMP 15.</p>				

<b>104871</b>	<b>Metabolic&amp;cellular Engin</b>			
Subject:	Catalog Nbr:			
CHBE	0167			
2017 FALL	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
<p>The goal is to present a framework for quantitative analysis of cellular functions, and introduce students to metabolic engineering. Metabolic engineering is a systems-oriented approach to the problem of remodeling and reconfiguring the many molecular components of the cell in order to achieve a desirable phenotype. Unlike molecule-centric approaches, which focus on only the final product-forming reaction, metabolic engineering emphasizes the metabolic pathway in its entirety. Course material analyzes cell-level processes as molecular systems. The processes to be discussed include: metabolism, protein synthesis, and regulation of gene expression. Analyses of these processes will emphasize an engineering, problem solving-oriented perspective, and will be integrated with discussions on core metabolic engineering methods: metabolic modeling, genetic engineering, and analytical biochemistry. Complementary disciplines very recently added to the metabolic engineering toolbox will also be discussed: omics technologies, computational systems biology, and synthetic biology. Selected metabolic engineering applications, including conversion of biomass into fuels, will be further explored through case studies and reviews of the current literature.</p> <p>Recommendations: Open to graduate students and seniors. Backgrounds in biochemistry, numerical methods, and chemical kinetics is highly recommended.</p>				

<b>104914</b>	<b>Biotechnology Processing Projects Lab</b>			
Subject:	Catalog Nbr:			
CHBE	0168			
2018 SUMR	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	

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(Cross-listed as BIO 168 and BME 168.) Laboratory experience with techniques in biotechnology processing: fermentation of recombinant E. coli cells, hybridoma cell culture, purification of proteins and antibodies and related analytical procedures. Laboratories accompanied by lectures and relevant readings to cover the underlying principles. Counts as laboratory course for biology major.

<b>104935</b>	<b>Seminar In Biotechnology</b>			
Subject:	Catalog Nbr:			
CHBE	0169			
(Cross-listed as BIO 169 and BME 169.) Seminar course. Journal articles on current biotechnology-related research are reviewed. Leading researchers in the field present seminars, and students assess future research directions based on in-depth review of articles and presentations.				

<b>104940</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
COMP	0050			
2016 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu	
2016 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2017 SPRG	Primary	Jeffrey Taliaferro	jeff.taliaferro@tufts.edu	
2017 SPRG	Primary	Ming Chow	ming.chow@tufts.edu	
2017 SPRG	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu	
2018 SPRG	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu	
2018 SPRG	Primary	Jason Wiser	Jason.Wiser@tufts.edu	
2018 SPRG	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu	
Content and prerequisites to be announced. Please see departmental website for specific details.				

<b>104955</b>	<b>Design And Analysis Of Experiments</b>			
Subject:	Catalog Nbr:			
CHBE	0170			
2018 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
The course starts with a brief introduction to applied statistics with emphasis to hypothesis testing and, in particular, the Analysis of Variance. It then examines how to design experiments and analyze the data they yield. Various designs are discussed and their respective differences, advantages, and disadvantages are noted. In particular, factorial, fractional factorial, response surface, and optimal designs are examined in detail.				

<b>104978</b>	<b>Clean Energy Technologies And Policy Issues</b>			
Subject:	Catalog Nbr:			
CHBE	0173			
2018 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu	

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(Cross-listed with Fletcher School.) This course considers current issues in power generation, identifying the technologies used to meet Clean Air Act regulations by the electric utilities and automobile manufacturers. Topics include the electric utility deregulation, distributed power sources, new energy markets, fuel efficiency, and global effects of fossil fuel use. Alternative fuels and engines will be examined from the point of view of technology readiness and global market penetration to curb air pollution and decrease carbon emissions. The costs of energy technologies and the global impacts of present policies in the U. S. and abroad will be evaluated.

104981	Discrete Mathematics			
Subject:	Catalog Nbr:			
COMP	0061			
2017 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu	
2017 SPRG	Primary	Moon Duchin	Moon.Duchin@tufts.edu	
2018 SPRG	Primary	Zachary Faubion	Zachary.Faubion@tufts.edu	
2018 SPRG	Primary	Jessica Dyer	Jessica.Dyer@tufts.edu	
2018 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu	
2018 SUMR	Primary	Srdjan Divac	No Email on file.	
(Cross-listed as MATH 61). Sets, relations and functions, logic and methods of proof, combinatorics, graphs and digraphs.				
Recommendations: MATH 32 or COMP 11 or permission of instructor.				

104997	Drug Product Formulation			
Subject:	Catalog Nbr:			
CHBE	0185			
2018 SPRG	Primary	Bernardo Perez-Ramirez	Bernardo.Perez_Ramirez@tufts.edu	
(Cross-listed as BME 185). Drug Product Formulation.				

105019	Special Topics			
Subject:	Catalog Nbr:			
CHBE	0193			
2017 FALL	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2017 FALL	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu	
2017 SUMR	Primary	Jerry Meldon	No Email on file.	
Guided individual study of an approved topic to develop the art of self-teaching. Appraisal of the student's knowledge in the approved area will be based on a written and/or oral examination. Arrangements with a department member are required by the student prior to registration in the course. For master's degree candidates. Please see departmental website for specific details.				

105039	Special Topics			
Subject:	Catalog Nbr:			

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CHBE 0194

2017 SUMR	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2018 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2018 SUMR	Primary	Gautham Sridharan	Gautham.Sridharan@tufts.edu

Guided individual study of an approved topic to develop the art of self-teaching. Appraisal of the student's knowledge in the approved area will be based on a written and/or oral examination. Arrangements with a department member are required by the student prior to registration in the course. For master's degree candidates. Please see departmental website for specific details.

## 105063 Programming Languages

Subject: Catalog Nbr:  
COMP 0080

An overview of language design and implementation, plus programming techniques for particular types of languages. Compilers and interpreters, binding, scope rules, formal semantic models, structure hiding, object-oriented programming, functional programming, and logic programming. Examples and problems from among Pascal, Algol, C++, Java, Scheme, Lisp, Prolog, and others. COMP 80 and COMP105 cannot both be taken for credit. Prerequisite: COMP 15.

## 105101 Object-oriented Programming For Graphical User Interfaces

Subject: Catalog Nbr:  
COMP 0086

2017 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu
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Object-oriented programming and design, including object-oriented encapsulation, inheritance, and subtype polymorphism. Foundational concepts of graphical user interfaces, including events, callbacks, and widgets. Connections between objects and user interfaces, e.g., interface widgets as objects. Design and programming projects.  
Recommendations: COMP 15

## 105142 Directed Study

Subject: Catalog Nbr:  
COMP 0093

2017 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu
2017 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu
2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2017 FALL	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu
2017 FALL	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
2017 FALL	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2017 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu

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2017 FALL	Primary	Benjamin Hescott	No Email on file.
2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu
2017 FALL	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2017 FALL	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2017 FALL	Primary	Christopher Gregg	No Email on file.
2017 FALL	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2017 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
Guided study of an approved topic. Credit as arranged. Please see departmental website for specific details.			

<b>105162</b>	<b>Mathematical Methods In Chemical Engineering</b>		
Subject:	Catalog Nbr:		
CHBE	0201		
2016 FALL	Primary	Jerry Meldon	No Email on file.
<p>Solution of algebraic equations, ordinary and partial differential equations, and sets of equations. Linear independence; basis vectors and functions; eigenvalues, eigenvector and eigenfunctions; initial and boundary value problems; generalized Fourier series; Sturm-Louisville problems; Green's function. Application examples in: chemical reaction engineering, and heat conduction and mass diffusion in one, two, or three dimensions at steady state or in transient mode. Emphasis is placed on linear problems but nonlinear ones are also discussed.</p> <p>Recommendations: Graduate Engineering Student and knowledge of MATLAB, or permission of instructor.</p>			

<b>105184</b>	<b>Advanced Kinetics and Reaction Engineering</b>		
Subject:	Catalog Nbr:		
CHBE	0202		
2018 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu
<p>Applied chemical kinetics, reaction rate theories, complex kinetics, reactor stability and sensitivity to operating parameters. The interplay of diffusion and reaction in non-catalytic and catalytic reaction systems. Case studies in reactor design.</p> <p>Recommendations: Graduate Engineering Student and CHBE 102 or equivalent.</p>			

<b>105207</b>	<b>Advanced Thermodynamics</b>		
Subject:	Catalog Nbr:		
CHBE	0203		
2017 FALL	Primary	Jerry Meldon	No Email on file.
2017 FALL	Primary	Derek Mess	Derek.Mess@tufts.edu
<p>Thermodynamics as applied to chemical engineering. Attention is given to the derivation of thermodynamic functions from concepts of statistical mechanics, chemical equilibrium, availability, and computation of</p>			

# Course Bulletin

vapor-liquid equilibrium compositions.

Recommendations: Graduate Engineering Student or Permission of Instructor

<b>105225</b>	<b>Directed Study</b>
Subject: COMP	Catalog Nbr: 0094
Guided study of an approved topic. Credit as arranged. Please see departmental website for specific details.	

<b>105227</b>	<b>Advanced Transport Phenomena</b>
Subject: CHBE	Catalog Nbr: 0204
2018 SPRG	Primary Prashant Deshlahra Prashant.Deshlahra@tufts.edu
Formulation, solution, and analysis of problems in momentum, energy and mass transport phenomena that occur in chemical and biological processes.	
Recommendations: Graduate Engineering Student, and CHBE 21 and CHBE 22 or equivalents.	

<b>105244</b>	<b>Senior Capstone Project I</b>
Subject: COMP	Catalog Nbr: 0097
2017 FALL	Primary Samuel Guyer Samuel.Guyer@tufts.edu
Requirements analysis and design of a senior capstone project. Requirements analysis and elicitation methods, and prototyping. Design principles and methods, including designing for usability, security, testability, performance, and scaling. Project management and planning, including cost and effort estimation. Writing effective documentation.	
Recommendations: COMP40 and Senior Standing.	

<b>105248</b>	<b>Graduate Seminar</b>
Subject: CHBE	Catalog Nbr: 0291
2016 FALL	Primary Daniel Ryder daniel.ryder@tufts.edu
2017 FALL	Primary Matthew Panzer Matthew.Panzer@tufts.edu
Presentaion of individual reports on basic topics to a seminar for discussion and criticism. Please see departmental website for specific details.	

<b>105261</b>	<b>Senior Capstone Project II</b>
Subject: COMP	Catalog Nbr: 0098
2018 SPRG	Primary Samuel Guyer Samuel.Guyer@tufts.edu
Implementation and testing of the project designed in COMP97. Implementation tools, strategies, and	



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platforms. Testing and debugging methodologies. Maintenance and release management. Legal, ethical, and social impacts of computing.  
Recommendations: COMP97.

<b>105285</b>	<b>Graduate Seminar</b>			
Subject:	Catalog Nbr:			
CHBE	0292			
2018 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
Presentaion of individual reports on basic topics to a seminar for discussion and criticism. Please see departmental website for specific details.				

<b>105303</b>	<b>Disc Grp/do Not Register</b>			
Subject:	Catalog Nbr:			
COMP	0100			

<b>105305</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
CHBE	0293			
Guided individual study of an approved topic. Designed to develop the art of self-teaching. Appraisal of the student's knowledge in the approved area based on a written and/or oral examination. Arrangemnts with a department memeber required prior to registration for the course. For doctoral degree candidates. Please see departmental website for specific details.				

<b>105327</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
CHBE	0294			
Guided individual study of an approved topic. Designed to develop the art of self-teaching. Appraisal of the student's knowledge in the approved area based on a written and/or oral examination. Arrangemnts with a department memeber required prior to registration for the course. For doctoral degree candidates. Please see departmental website for specific details.				

<b>105344</b>	<b>Programming Languages</b>			
Subject:	Catalog Nbr:			
COMP	0105			
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu	
2018 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu	
Principles and application of computer programming languages. Emphasizes ideas and techniques most relevant to practitioners, but includes foundations crucial for intellectual rigor: abstract syntax, lambda				

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calculus, type systems, dynamic semantics. Case studies, reinforced by programming exercises. Grounding sufficient to read professional literature.

Recommendations: COMP 15 (Data Structures) and one semester of Discrete Mathematics (COMP 22 or MATH 61 -formerly MATH 22).

105365	Master's Thesis Research			
Subject: CHBE	Catalog Nbr: 0295			
2017 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Jerry Meldon	No Email on file.	
2017 FALL	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	
2017 FALL	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
2017 FALL	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
2017 FALL	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	
2017 FALL	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 FALL	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
2017 FALL	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2017 FALL	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	
2017 FALL	Primary	James Van Deventer	James.Van_Deventer@tufts.edu	
2017 FALL	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu	
Guided research on a topic suitable for a master's thesis. Credit as arranged. Please see departmental website for specific details.				

105402	Master's Thesis Research			
Subject: CHBE	Catalog Nbr: 0296			
2017 SPRG	Primary	Jerry Meldon	No Email on file.	
2018 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2018 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	
2018 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
2018 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
2018 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	
2018 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
2018 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
2018 SPRG	Primary	Darryl Williams	Darryl.Williams@tufts.edu	
2018 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2018 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	

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2018 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2018 SPRG	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu
Guided research on a topic suitable for a master's thesis. Credit as arranged. Please see departmental website for specific details.			

105446	Doctoral Thesis Research			
Subject: CHBE	Catalog Nbr: 0297			
2017 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Jerry Meldon	No Email on file.	
2017 FALL	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	
2017 FALL	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
2017 FALL	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
2017 FALL	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	
2017 FALL	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 FALL	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
2017 FALL	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2017 FALL	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	
2017 FALL	Primary	James Van Deventer	James.Van_Deventer@tufts.edu	
2017 FALL	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu	
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.				

105467	Doctoral Thesis Research			
Subject: CHBE	Catalog Nbr: 0298			
2017 SPRG	Primary	Jerry Meldon	No Email on file.	
2018 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2018 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	
2018 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
2018 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
2018 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	
2018 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2018 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
2018 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2018 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	

# Course Bulletin

2018 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2018 SPRG	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.			

<b>105468</b>	<b>Operating Systems</b>		
Subject:	Catalog Nbr:		
COMP	0111		
2016 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu
(Cross-listed as EE 128). Fundamental issues in operating system design. Concurrent processes: synchronization, sharing, deadlock, scheduling. Relevant hardware properties of uniprocessor and multiprocessor computer systems. Recommendations: COMP 15 and either COMP 40 OR EE 14.			

<b>105487</b>	<b>Master Of Engineering Project</b>		
Subject:	Catalog Nbr:		
CHBE	0299		
2017 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu
2017 FALL	Primary	Jerry Meldon	No Email on file.
2017 FALL	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu
2017 FALL	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu
2017 FALL	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu
2017 FALL	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu
2017 FALL	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2017 FALL	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu
2017 FALL	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu
2017 FALL	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu
2017 FALL	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2017 FALL	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu
Master of Engineering Project. Please see departmental website for specific details.			

<b>105488</b>	<b>Networks</b>		
Subject:	Catalog Nbr:		
COMP	0112		
2018 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
Computer Networks and Protocols. Design and implementation of computer communication networks,			

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protocols, and applications, with an emphasis on the Internet protocol suite. Network architectures and programming interfaces. Data link, transport, and routing protocols. Congestion sources and remedies. Addressing and naming in local area and wide area networks. Network security and network management. Recommendations: COMP 15 and either COMP 40 or EE 14.

<b>105507</b>	<b>Non Major Credit</b>			
	Subject:	Catalog Nbr:		
	CHBE	0310		

<b>105508</b>	<b>Network And System Administration</b>			
	Subject:	Catalog Nbr:		
	COMP	0114		
<p>A survey of the theory and practice of maintaining reliable, robust, and secure computer networks. Planning, deployment, monitoring, and maintenance of computer systems, networks, network services, and user environments. Dependency analysis and network troubleshooting. Administrative maturity models and best practices. Security, ethics, and legal issues of system administration. Hands-on exercises in deploying network services and infrastructure.</p> <p>Recommendations: Comp 111</p>				

<b>105525</b>	<b>Lower Level Elective Crd</b>			
	Subject:	Catalog Nbr:		
	CHBE	0320		

<b>105547</b>	<b>Upper Level Elective Crd</b>			
	Subject:	Catalog Nbr:		
	CHBE	0330		

<b>105548</b>	<b>Database Systems</b>			
	Subject:	Catalog Nbr:		
	COMP	0115		
	2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu
	2017 SPRG	Primary	Manoussos Athanassoulis	No Email on file.
<p>Fundamental concepts of database systems, including conceptual design, relational and object-oriented data models, query languages (SQL, QBE), and implementation issues (indexing, transaction processing, concurrent control). The concepts and algorithms covered encompass many of those used in commercial and experimental database systems. Other topics include distributed databases and distributed query processing.</p>				

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Recommendations: COMP 15

<b>105569</b>	<b>Computer Systems Security</b>			
Subject:	Catalog Nbr:			
COMP	0116			
2018 SUMR	Primary	Ming Chow		ming.chow@tufts.edu
<p>A systems perspective on host-based and network-based computer security. Current vulnerabilities and measures for protecting hosts and networks. Firewalls and intrusion detection systems. Principles illustrated through hands-on programming projects.</p> <p>Recommendations: COMP 40</p>				

<b>105587</b>	<b>Web Engineering</b>			
Subject:	Catalog Nbr:			
COMP	0120			
2017 SPRG	Primary	Ming Chow		ming.chow@tufts.edu
<p>Essentials of designing, building, and analyzing enterprise websites embodying business processes. Correctness, validation, and security. Data models and scaffolding. Templating and view abstraction. Model-View-Controller decomposition and frameworks. Caching, pipelining, and performance tuning. Asynchronous client-server interactions. Web services and service decomposition. Web semantics.</p> <p>Recommendations: COMP15 and 20, or consent. COMP115 is also recommended as co-requisite, but not required.</p>				

<b>105588</b>	<b>Master's Degree Continuation - Part Time</b>			
Subject:	Catalog Nbr:			
CHBE	0401			
Part-time. Please see departmental website for specific details.				

<b>105631</b>	<b>Numerical Analysis</b>			
Subject:	Catalog Nbr:			
COMP	0126			
2016 FALL	Primary	Christoph Borgers		christoph.borgers@tufts.edu
<p>(Cross-listed as MATH 126.) Analysis of algorithms involving computation with real numbers. Interpolation, methods for solving linear and nonlinear systems of equations, numerical integration, methods for ordinary differential equations.</p> <p>Recommendations: MATH 51 and programming ability in a language such as C, C++, Fortran, Pascal, or Matlab.</p>				

<b>105652</b>	<b>Numerical Linear Algebra</b>			
Subject:	Catalog Nbr:			

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COMP 0128	2017 SPRG	Primary	Misha Kilmer	Misha.Kilmer@tufts.edu
(Cross-listed as MATH 128.) The two basic computational problems of linear algebra: solution of linear systems and computation of eigenvalues and eigenvectors.				
Recommendations: MATH 70 or 72 and COMP 11.				

<b>105667</b>	<b>Master's Degree Continuation - Full Time</b>			
Subject:	Catalog Nbr:			
CHBE	0402			
Full-time. Please see departmental website for specific details.				

<b>105668</b>	<b>Artificial Intelligence</b>			
Subject:	Catalog Nbr:			
COMP	0131			
2017 SPRG	Primary	Thomas Williams	No Email on file.	
2018 SUMR	Primary	Fabrizio Santini	Fabrizio.Santini@tufts.edu	
History, theory, and computational methods of artificial intelligence. Basic concepts include representation of knowledge and computational methods for reasoning. One or two application areas will be studied, to be selected from expert systems, robotics, computer vision, natural language understanding, and planning.				
Recommendations: COMP 15 and MATH 61-formerly MATH 22 (students not majoring in Computer Science may substitute COMP 14 for both COMP 15 and MATH 61-formerly MATH 22)				

<b>105687</b>	<b>Grad Teaching Assistant</b>			
Subject:	Catalog Nbr:			
CHBE	0405			
2017 SPRG	Primary	Jerry Meldon	No Email on file.	
2018 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2018 SPRG	Primary	Larry Cohen	larry.cohen@tufts.edu	
2018 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	
2018 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu	
2018 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu	
2018 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu	
2018 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
2018 SPRG	Primary	Derek Mess	Derek.Mess@tufts.edu	
2018 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu	
2018 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu	
2018 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	
2018 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu	
2018 SPRG	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu	

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<b>105711</b>	<b>Grad Research Assistant</b>			
Subject:	Catalog Nbr:			
CHBE	0406			
2017 FALL	Primary	Daniel Ryder		daniel.ryder@tufts.edu
2017 FALL	Primary	Jerry Meldon		No Email on file.
2017 FALL	Primary	Qiaobing Xu		Qiaobing.Xu@tufts.edu
2018 SPRG	Primary	David Kaplan		david.kaplan@tufts.edu
2018 SPRG	Primary	Maria		mflytzan@tufts.edu
		Flytzani-Stephanopoulos		
2018 SPRG	Primary	Kyongbum Lee		Kyongbum.Lee@tufts.edu
2018 SPRG	Primary	Christos Georgakis		Christos.Georgakis@tufts.edu
2018 SPRG	Primary	Hyunmin Yi		Hyunmin.Yi@tufts.edu
2018 SPRG	Primary	Matthew Panzer		Matthew.Panzer@tufts.edu
2018 SPRG	Primary	Ayse Asatekin		Ayse.Asatekin@tufts.edu
2018 SPRG	Primary	Nikhil Nair		Nikhil.Nair@tufts.edu
2018 SPRG	Primary	Emmanouhl Tzanakakis		Emmanuel.Tzanakakis@tufts.edu
2018 SPRG	Primary	James Van Deventer		James.Van_Deventer@tufts.edu
2018 SPRG	Primary	Prashant Deshlahra		Prashant.Deshlahra@tufts.edu

<b>105750</b>	<b>Doctoral Continuation - PT</b>			
Subject:	Catalog Nbr:			
CHBE	0501			
Part-time.Please see departmental website for specific details.				

<b>105772</b>	<b>Introduction To Machine Learning And Data Mining</b>			
Subject:	Catalog Nbr:			
COMP	0135			
2017 FALL	Primary	Roni Khardon		roni@eecs.tufts.edu
2017 SPRG	Primary	Anselm Blumer		ablumer@cs.tufts.edu
2017 SPRG	Primary	Simon Steel		Simon.Steel@tufts.edu
2018 SPRG	Primary	Liping Liu		Liping.Liu@tufts.edu
<p>An overview of methods whereby computers can learn from data or experience and make decisions accordingly. Topics include supervised learning,unsupervised learning, reinforcement learning, and knowledge extraction from large databases with applications to science,engineering, and medicine.</p> <p>Recommendations: COMP 15 and MATH 61 (formerly MATH 22) or permission of instructor (COMP 160 is highly recommended).</p>				



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<b>105795</b>	<b>Statistical Pattern Recognition</b>			
Subject:	Catalog Nbr:			
COMP	0136			
2017 FALL	Primary	Roni Khardon		roni@eecs.tufts.edu
<p>Statistical foundations and algorithms for machine learning with a focus on Bayesian modeling. Topics include: classification and regression problems, regularization, model selection, kernel methods, support vector machines, Gaussian processes, graphical models.</p> <p>Recommendations: MATH 70 (formerly MATH 46), EE 104 or MATH 162, COMP 40 or COMP 80, or permission of instructor.</p>				

<b>105817</b>	<b>Doctoral Degree Continuation - Full Time</b>			
Subject:	Catalog Nbr:			
CHBE	0502			
Full-time. Please see departmental website for specific details.				

<b>105833</b>	<b>Advanced Computer Architecture</b>			
Subject:	Catalog Nbr:			
COMP	0140			
2018 SPRG	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
<p>Elements of modern computer architectures, including instruction pipelining, memory hierarchy, instruction-level parallelism, threading, and multi-core processors. Architectural issues related to software optimization. Architectural design decisions and how they affect operating systems and compilers. Quantitative analysis and evaluation of modern computing systems, including selection of appropriate benchmarks to reveal and compare the performance of alternative design choices in system design.</p> <p>Recommendations: COMP 40.</p>				

<b>105871</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
COMP	0150			
2016 FALL	Primary	Anselm Blumer		ablumer@cs.tufts.edu
2016 FALL	Primary	Misha Kilmer		Misha.Kilmer@tufts.edu
2016 FALL	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
2016 FALL	Primary	Lenore Cowen		lenore.cowen@tufts.edu
2016 FALL	Primary	Elif Yamangil		No Email on file.
2016 FALL	Primary	Sergey Voronin		No Email on file.
2017 FALL	Primary	Johannes De Ruiter		jp.deruiter@tufts.edu
2017 FALL	Primary	Megan Monroe		Megan.Monroe@tufts.edu
2017 FALL	Primary	Fabrizio Santini		Fabrizio.Santini@tufts.edu
2017 FALL	Primary	Liping Liu		Liping.Liu@tufts.edu
2017 FALL	Primary	Jivko Sinapov		Jivko.Sinapov@tufts.edu

# Course Bulletin

2017 FALL	Primary	Michel Machado	Michel.Machado@tufts.edu
2017 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu
2017 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2017 SPRG	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu
2017 SPRG	Primary	Genevieve Patterson	No Email on file.
2018 SPRG	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2018 SPRG	Primary	Ming Chow	ming.chow@tufts.edu
2018 SPRG	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
2018 SPRG	Primary	Gavin Finn	Gavin.Finn@tufts.edu
2018 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Anthony Bucci	Anthony.Bucci@tufts.edu
2018 SPRG	Primary	Susan Landau	Susan.Landau@tufts.edu
2018 SUMR	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu

Content and prerequisites to be announced. Over the past three years, special topics courses have been offered in parallel computing, graph drawing, computational geometry, multimedia data compression, cryptography and security, digital network communication, spoken language systems, system and network administration, and machine learning. Please see departmental website for specific details.

<b>105893</b>	<b>Algorithms</b>			
Subject:	Catalog Nbr:			
COMP	0160			
2017 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu	
2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu	
2018 SPRG	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu	
2018 SUMR	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu	
<p>Introduction to the study of algorithms. Strategies such as divide-and-conquer, greedy methods, and dynamic programming. Graph algorithms, sorting, searching, integer arithmetic, hashing, and NP-complete problems. Recommendations: COMP 15 and MATH 61 (formerly MATH 22).</p>				

<b>105952</b>	<b>Computational Geometry</b>			
Subject:	Catalog Nbr:			
COMP	0163			
2017 FALL	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu	
<p>(Cross-listed as MATH 163.) Design and analysis of algorithms for geometric problems. Topics include proof of lower bounds, convex hulls, searching and point location, plane sweep and arrangements of lines, Voronoi diagrams, intersection problems, decomposition and partitioning, farthest-pairs and closest-pairs, rectilinear computational geometry.</p> <p>Recommendations: COMP 160 or permission of instructor.</p>				

<b>105973</b>	<b>Cryptography</b>			
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# Course Bulletin

Subject:	Catalog Nbr:			
COMP	0165			
2016 FALL	Primary	Anselm Blumer		ablumer@cs.tufts.edu
<p>Introduction to private and public-key cryptography as well as pseudo-randomness. Topics include: cryptographic protocols using block ciphers. Methods for key exchange, message authentication, and digital signals. Modern cryptographic problems regarding secure voting, secret sharing, and digital cash. Recommendations: COMP 0015 Data Structures and COMP0022/MATH 0061 (formerly MATH 22). Discrete Mathematics</p>				

<b>105995</b>	<b>Computational Biology</b>			
Subject:	Catalog Nbr:			
COMP	0167			
2017 FALL	Primary	Donna Slonim		Donna.Slonim@tufts.edu
Computational Biology. Please see departmental website for specific details.				

<b>106079</b>	<b>Computation Theory</b>			
Subject:	Catalog Nbr:			
COMP	0170			
2017 FALL	Primary	Lenore Cowen		lenore.cowen@tufts.edu
2017 SPRG	Primary	Benjamin Hescott		No Email on file.
2018 SPRG	Primary	Megan Monroe		Megan.Monroe@tufts.edu
2018 SUMR	Primary	Harry Mairson		No Email on file.
<p>(Cross-listed as MATH 170). Models of computation: Turing machines, pushdown automata, and finite automata. Grammars and formal languages, including context-free languages and regular sets. Important problems, including the halting problem and language equivalence theorems. Recommendations: COMP 15 and MATH 61.</p>				

<b>106100</b>	<b>Human Computer Interaction</b>			
Subject:	Catalog Nbr:			
COMP	0171			
2016 FALL	Primary	Simon Steel		Simon.Steel@tufts.edu
2018 SPRG	Primary	Robert Jacob		jacob@cs.tufts.edu
<p>Introduction to human-computer interaction, or how computers communicate with people. Methodology for designing and testing user interfaces, interaction styles (command line, menus, graphical user interfaces, virtual reality), interaction techniques (voice, gesture, eye movement), design guidelines, and user-interface management system software. Students will design a small user interface, program a prototype, and test the result for usability. Recommendations: COMP 14 or 15.</p>				

<b>106119</b>	<b>Computer Graphics</b>			
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# Course Bulletin

Subject: COMP	Catalog Nbr: 0175	2018 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu
<p>The course provides the background to understand and build interactive graphics systems. Introduction to computer graphics from simple two-dimensional graphics through three-dimensional viewing and transforms. Interactive graphics programming, raster graphics, raster algorithms, geometrical transformations, viewing in three dimensions, modeling and hierarchical data structures, visual realism, virtual reality, interaction devices, tasks and techniques. Final project.</p> <p>Recommendations: COMP 40, MATH 42 (formerly MATH 13), and MATH 70 (formerly MATH 46), or permission of instructor.</p>					

<b>106140</b>	<b>Software Engineering</b>				
Subject: COMP	Catalog Nbr: 0180				
<p>The special problems of creating very large programs, and methods for coping with these problems. Program design strategies, project management tools, programming environments.</p> <p>Recommendations: COMP 80.</p>					

<b>106184</b>	<b>Compilers</b>				
Subject: COMP	Catalog Nbr: 0181	2016 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
<p>Translation and implementation of programming languages. Parsing, code generation, and optimization. Compiler design projects for simple block-structured programming languages are used to illustrate the concepts and methods.</p> <p>Recommendations: COMP 40, 105, and 170.</p>					

<b>106249</b>	<b>Senior Design Project</b>				
Subject: COMP	Catalog Nbr: 0190				
<p>Team analysis, planning, development, and maintenance of a software product, using software engineering principles, practices, and tools. This course fulfills the project requirement of the Bachelor of Science in Computer Science in the School of Engineering.</p> <p>Recommendations: COMP 180.</p>					

<b>106268</b>	<b>Directed Study</b>				
Subject: COMP	Catalog Nbr: 0193	2017 FALL	Primary	Ethan Danahy	ethan.danahy@tufts.edu
		2017 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu

# Course Bulletin

2017 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu
2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu
2017 FALL	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu
2017 FALL	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
2017 FALL	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2017 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
2017 FALL	Primary	Benjamin Hescott	No Email on file.
2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu
2017 FALL	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2017 FALL	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2017 FALL	Primary	Christopher Gregg	No Email on file.
2017 FALL	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2017 SUMR	Primary	Bruce Molay	Bruce.Molay@tufts.edu
2017 SUMR	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 SUMR	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu

Guided study of an approved topic. Credit as arranged. Please see departmental website for specific details.

106285	Directed Study		
Subject:	Catalog Nbr:		
COMP	0194		
2017 SPRG	Primary	Benjamin Hescott	No Email on file.
2018 SPRG	Primary	Robert Jacob	jacob@cs.tufts.edu
2018 SPRG	Primary	Alva Couch	alva.couch@tufts.edu
2018 SPRG	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2018 SPRG	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2018 SPRG	Primary	Ming Chow	ming.chow@tufts.edu
2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2018 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2018 SPRG	Primary	Roni Khardon	roni@eecs.tufts.edu
2018 SPRG	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2018 SPRG	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
2018 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2018 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu
2018 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu

# Course Bulletin

2018 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2018 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2018 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2018 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu
2018 SPRG	Primary	Johannes De Ruiten	jp.deruiten@tufts.edu
2018 SPRG	Primary	Megan Monroe	Megan.Monroe@tufts.edu
2018 SPRG	Primary	Liping Liu	Liping.Liu@tufts.edu
2018 SPRG	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu

Guided study of an approved topic. Credit as arranged. Please see departmental website for specific details.

106309	Honors Thesis-computer Science A			
Subject:	Catalog Nbr:			
COMP	0197			
2017 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu	
2017 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu	
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu	
2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu	
2017 FALL	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu	
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu	
2017 FALL	Primary	Lenore Cowen	lenore.cowen@tufts.edu	
2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu	
2017 FALL	Primary	Donna Slonim	Donna.Slonim@tufts.edu	
2017 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu	
2017 FALL	Primary	Benjamin Hescott	No Email on file.	
2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu	
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu	
2017 FALL	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu	
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu	
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2017 FALL	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu	
2017 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu	
2017 FALL	Primary	Johannes De Ruiten	jp.deruiten@tufts.edu	
Honors Thesis Computer Science.Please see departmental website for specific details.				

106327	Internship Computer Science			
Subject:	Catalog Nbr:			
COMP	0199			
2017 SUMR	Primary	Lenore Cowen	lenore.cowen@tufts.edu	
2017 SUMR	Primary	Roni Khardon	roni@eecs.tufts.edu	
2017 SUMR	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu	
2018 SPRG	Primary	Ming Chow	ming.chow@tufts.edu	
Internship Computer Science. Please see departmental website for specific details.				

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<b>106526</b>	<b>Computational Learning Theory</b>			
	Subject:	Catalog Nbr:		
	COMP	0236		
<p>Probabilistic and adversarial models of machine learning. Development and analysis of machine learning principles and algorithms, their computational complexity, data complexity and convergence properties. Computational and cryptographic limitations on algorithms for machine learning.          Recommendations: COMP 160, EE 104 or MATH 162, or permission of instructor.</p>				

<b>107336</b>	<b>Advanced Special Topics</b>			
	Subject:	Catalog Nbr:		
	COMP	0250		
	2016 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu
	2016 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
	2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
	2018 SPRG	Primary	Susan Landau	Susan.Landau@tufts.edu
Content and prerequisites to be announced. Please see departmental website for specific details.				

<b>107376</b>	<b>Advanced Algorithms</b>			
	Subject:	Catalog Nbr:		
	COMP	0260		
	2018 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu
<p>Design and analysis of sequential, parallel, probabilistic, and approximation algorithms. Graph algorithms, sorting, searching, geometric algorithms, mathematical programming, lower bounds, and intractable problems.          Recommendations: COMP 160</p>				

<b>107398</b>	<b>Advanced Computational Geometry</b>			
	Subject:	Catalog Nbr:		
	COMP	0263		
<p>(Cross-listed as MATH 263.) Design and analysis of sequential, parallel, probabilistic, and approximation algorithms for geometry problems. Geometric data structures, complexity, searching, computation, and applications. Selected advanced topics.          Recommendations: COMP 163 or permission of instructor.</p>				

<b>107416</b>	<b>Parallel Computation</b>			
	Subject:	Catalog Nbr:		
	COMP	0265		
Existing and proposed architectures for parallel computation. Fundamental synchronization and				

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communication protocols. Algorithm development for distributed memory multicomputers.  
Recommendations: COMP 15 and 160.

<b>107435</b>	<b>Theory Of Computation</b>
Subject: COMP	Catalog Nbr: 0270
Computability, undecidability, computational complexity. Recommendations: COMP 170.	

<b>107460</b>	<b>User-interface Software</b>
Subject: COMP	Catalog Nbr: 0272
Emerging new non-WIMP (window icon menu pointer) user interface styles, such as virtual reality, lightweight, non-command, tangible, natural, continuous, and parallel interfaces. Techniques, languages, abstractions, and tools for building current and future user-computer interfaces. Project in designing, prototyping, and building a non-WIMP user interface, with class discussions and critiques. Recommendations: COMP 15, plus a course related to human-computer interaction.	

<b>107474</b>	<b>Advanced Computer Graphics</b>
Subject: COMP	Catalog Nbr: 0275
Advanced Topics in Computer Graphics. Emphasis will change from year to year and may include physics-based modeling (including particle systems, animation kinematics, deformation, fluid modeling), advanced rendering techniques, shape representation and modeling, and computer animation. Recommendations: COMP 175 and a good working knowledge of the C programming language.	

<b>107496</b>	<b>Data Visualization</b>
Subject: COMP	Catalog Nbr: 0277
Selected advanced topics on the visualization of abstract structures, user-interface design, scientific visualization, visual languages, and graph drawing. The course includes the study and design of applications to software visualization, digital libraries, and multimedia. The class format is seminar style with presentation of research papers. Final projects will use advanced visualization tools. Recommendations: COMP 160 or permission of instructor.	

<b>107687</b>	<b>Programming Project</b>
Subject: COMP	Catalog Nbr: 0290
Independent development of a complete computer program for an approved task, including design,	



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implementation, and documentation. Please see departmental website for specific details.

<b>107951</b>	<b>Introduction To Civil &amp; Environmental Engineering</b>			
Subject:	Catalog Nbr:			
CEE	0001			
2018 SPRG	Primary	Christopher Swan		chris.swan@tufts.edu
Fundamental principles of civil and environmental engineering and their application to engineered and natural systems. Engineering materials. Environmental, geotechnical, structural, and water resource systems. With Laboratory.				
Recommendations: MATH 34 (formerly MATH 12), EN 2, ES 5; Co-requisite: ES 9.				

<b>107993</b>	<b>Introduction To Hydraulic Engineering</b>			
Subject:	Catalog Nbr:			
CEE	0012			
2018 SPRG	Primary	Robert Viesca		Robert.Viesca@tufts.edu
The application of principles of fluid mechanics to problems of engineering design and practice. The equations of continuity, momentum, and energy are applied to problems in river engineering, dam design, hydromachinery, floodplain delineation, water-distribution systems, culverts, turbines, and other hydraulic structures. With laboratory.				
Recommendations: ES 8.				

<b>108013</b>	<b>Structural Analysis</b>			
Subject:	Catalog Nbr:			
CEE	0022			
2017 FALL	Primary	Masoud Sanayei		masoud.sanayei@tufts.edu
A first course in the application of mechanics to the analysis of structures, with the major emphasis on structural forms important to civil engineering. Deflections calculations of beams and frames using differential equations and moment-area theorems. Deflection of trusses and frames using virtual work. Indeterminate structural analysis using flexibility and stiffness methods. Moving loads calculations using influence lines. Introduction to computer analysis of structures. With laboratory.				
Recommendations: ES 9.				

<b>108055</b>	<b>Steel Design</b>			
Subject:	Catalog Nbr:			
CEE	0024			
2017 SPRG	Primary	Eric Hines		Eric.Hines@tufts.edu
2018 SPRG	Primary	Po-Shang Chen		Po-Shang.Chen@tufts.edu
Design of steel structural members. Determination of stresses and strains in structural members, the proportioning of members, and the design of connections for beams, girders, trusses, and frames. Work in structural representation.				

# Course Bulletin

Recommendations: CEE 22.

<b>108075</b>	<b>Reinforced Concrete Design</b>			
Subject:	Catalog Nbr:			
CEE	0025			
2017 FALL	Primary	Brian Brenner		brian.brenner@tufts.edu
<p>Analysis and design of reinforced concrete members. Working stress and ultimate strength theories are applied to beams, girders, slabs, columns, walls, and footings. Use of these elements in various structures is studied.</p> <p>Recommendations: CEE 22.</p>				

<b>108096</b>	<b>Environmental Chemistry</b>			
Subject:	Catalog Nbr:			
CEE	0030			
2016 FALL	Primary	John Durant		john.durant@tufts.edu
2017 FALL	Primary	Neelakshi Hudda		Neelakshi.Hudda@tufts.edu
<p>Basic principles of environmental chemistry related to environmental engineering. Thermodynamics, equilibrium, kinetics, mass balance, chemical partitioning, and reactions for predicting behavior of pollutants in air, water, and soil. Techniques for measuring dissolved oxygen, biochemical oxygen demand, nutrients, sewage indicator bacteria, airborne particles and hydrocarbons, and other pollutants. Applications to environmental processes. With laboratory.</p> <p>Recommendations: CHEM 2; CEE 32 or equivalent.</p>				

<b>108121</b>	<b>Environmental Engineering Principles</b>			
Subject:	Catalog Nbr:			
CEE	0032			
2017 SPRG	Primary	Kurt Pennell		Kurt.Pennell@tufts.edu
2018 SPRG	Primary	C. Andrew Ramsburg		Andrew.Ramsburg@tufts.edu
<p>Water quantity and quality, air quality, energy utilization, climate change, and sustainability. Material and energy balance. Chemical and biological transformations. Elementary transport and fate modeling. Quantitative description of natural and engineered processes affecting environmental sustainability at local, regional, and global scales.</p> <p>Recommendations: ES 2, MATH 34 (formerly MATH 12), CHEM 1 or 11 or 16, and PHY 11</p>				

<b>108135</b>	<b>Master's Project</b>			
Subject:	Catalog Nbr:			
COMP	0293			
2017 FALL	Primary	Anselm Blumer		ablumer@cs.tufts.edu
2017 FALL	Primary	Robert Jacob		jacob@cs.tufts.edu
2017 FALL	Primary	Alva Couch		alva.couch@tufts.edu

# Course Bulletin

2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2017 FALL	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu
2017 FALL	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
2017 FALL	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2017 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
2017 FALL	Primary	Benjamin Hescott	No Email on file.
2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu
2017 FALL	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2017 FALL	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2017 FALL	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2017 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu
2017 FALL	Primary	Liping Liu	Liping.Liu@tufts.edu
2017 FALL	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu

Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.

<b>108143</b>	<b>Introduction To Geotechnical Engineering</b>			
Subject:	Catalog Nbr:			
CEE	0042			
2016 FALL	Primary	Lucy Jen	Lucy.Jen@tufts.edu	
2017 FALL	Primary	Christopher Swan	chris.swan@tufts.edu	
2017 FALL	Primary	John Germaine	John.Germaine@tufts.edu	
<p>The engineering properties of soils and the behavior of soil masses subjected to loads and fluid flow. Flow of water through and stress in soil. Investigation of permeability, compressibility, and strength of soil. With laboratory.</p> <p>Recommendations: ES 9.</p>				

<b>108178</b>	<b>Biomedical Engineering Sophomore Design And Research I</b>			
Subject:	Catalog Nbr:			
BME	0003			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Michael Lovett	Michael.Lovett@tufts.edu	
2017 FALL	Primary	Rucsanda Preda	C.Preda@tufts.edu	
<p>Team design and research projects in molecular and cell biology related to regenerative medicine. Concepts of cell culture, cell signaling, biological structure-function, physiology and biological information transfer. How to keep records of design requirements, design solutions, experimental activities, and prepare written technical</p>				

# Course Bulletin

reports. 0.5 credit.

108214	Master's Project			
Subject:	Catalog Nbr:			
COMP	0294			
2017 SPRG	Primary	Anselm Blumer	ablumer@cs.tufts.edu	
2017 SPRG	Primary	Ming Chow	ming.chow@tufts.edu	
2017 SPRG	Primary	Bruce Molay	Bruce.Molay@tufts.edu	
2017 SPRG	Primary	Benjamin Hescott	No Email on file.	
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2017 SPRG	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu	
2018 SPRG	Primary	Robert Jacob	jacob@cs.tufts.edu	
2018 SPRG	Primary	Alva Couch	alva.couch@tufts.edu	
2018 SPRG	Primary	Soha Hassoun	soha.hassoun@tufts.edu	
2018 SPRG	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu	
2018 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu	
2018 SPRG	Primary	Roni Khardon	roni@eecs.tufts.edu	
2018 SPRG	Primary	Donna Slonim	Donna.Slonim@tufts.edu	
2018 SPRG	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu	
2018 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu	
2018 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu	
2018 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu	
2018 SPRG	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu	
2018 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	
2018 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2018 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu	
2018 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu	
2018 SPRG	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu	
2018 SPRG	Primary	Megan Monroe	Megan.Monroe@tufts.edu	
2018 SPRG	Primary	Liping Liu	Liping.Liu@tufts.edu	
2018 SPRG	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu	
Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.				

108220	Biomedical Engineering Sophomore Design And Research II			
Subject:	Catalog Nbr:			
BME	0004			
2018 SPRG	Primary	Martin Hunter	Martin.Hunter@tufts.edu	
Team design and research in basic optics, and biomedical optics. Geometrical and physical optics, fiber optics, light sources, optical detectors, and principles of spectroscopy. How to present design features and research results in the form of a technical/scientific poster. 0.5 credit.				
Recommendations: BME 3.				

# Course Bulletin

108232		Masters Thesis		
Subject:	Catalog Nbr:			
COMP	0295			
2017 FALL	Primary	Anselm Blumer		ablumer@cs.tufts.edu
2017 FALL	Primary	Robert Jacob		jacob@cs.tufts.edu
2017 FALL	Primary	Alva Couch		alva.couch@tufts.edu
2017 FALL	Primary	Soha Hassoun		soha.hassoun@tufts.edu
2017 FALL	Primary	Diane Souvaine		Diane.Souvaine@tufts.edu
2017 FALL	Primary	Ming Chow		ming.chow@tufts.edu
2017 FALL	Primary	Lenore Cowen		lenore.cowen@tufts.edu
2017 FALL	Primary	Roni Khardon		roni@eecs.tufts.edu
2017 FALL	Primary	Donna Slonim		Donna.Slonim@tufts.edu
2017 FALL	Primary	Samuel Guyer		Samuel.Guyer@tufts.edu
2017 FALL	Primary	Benjamin Hescott		No Email on file.
2017 FALL	Primary	Norman Ramsey		Norman.Ramsey@tufts.edu
2017 FALL	Primary	Remco Chang		Remco.Chang@tufts.edu
2017 FALL	Primary	Matthias Scheutz		Matthias.Scheutz@tufts.edu
2017 FALL	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
2017 FALL	Primary	Kathleen Fisher		Kathleen.Fisher@tufts.edu
2017 FALL	Primary	Noah Mendelsohn		Noah.Mendelsohn@tufts.edu
2017 FALL	Primary	Mark Sheldon		Mark.Sheldon@tufts.edu
2017 FALL	Primary	Fahad Dogar		Fahad.Dogar@tufts.edu
2017 FALL	Primary	Elena Strange		Elena.Strange@tufts.edu
2017 FALL	Primary	Johannes De Ruiter		jp.deruiter@tufts.edu
2017 FALL	Primary	Liping Liu		Liping.Liu@tufts.edu
2017 FALL	Primary	Jivko Sinapov		Jivko.Sinapov@tufts.edu
Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.				

108235		Introduction To Hazardous Materials Management		
Subject:	Catalog Nbr:			
CEE	0039			
2017 SPRG	Primary	Anne Marie Desmarais		annemarie.desmarais@tufts.edu
(Cross-listed as ENV 70.) A survey of technology, health, and policy issues in hazardous materials and hazardous waste management. Topics will be examined from a scientific and technological perspective and will include characteristics of hazardous materials; health effects; hazard, exposure, and risk assessment; regulatory framework; distribution of contaminants in the environment; and an overview of remedial technologies used to clean up hazardous waste. Recommendations: CHEM 1 or 16, ES 11 or BIO 13, and CEE 1 or CEE 32				

108250		Masters Thesis		
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# Course Bulletin

Subject:	Catalog Nbr:			
COMP	0296			
2017 SPRG	Primary	Anselm Blumer		ablumer@cs.tufts.edu
2017 SPRG	Primary	Bruce Molay		Bruce.Molay@tufts.edu
2017 SPRG	Primary	Benjamin Hescott		No Email on file.
2017 SPRG	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
2017 SPRG	Primary	Gregory Aloupis		Gregory.Aloupis@tufts.edu
2018 SPRG	Primary	Robert Jacob		jacob@cs.tufts.edu
2018 SPRG	Primary	Alva Couch		alva.couch@tufts.edu
2018 SPRG	Primary	Soha Hassoun		soha.hassoun@tufts.edu
2018 SPRG	Primary	Diane Souvaine		Diane.Souvaine@tufts.edu
2018 SPRG	Primary	Ming Chow		ming.chow@tufts.edu
2018 SPRG	Primary	Lenore Cowen		lenore.cowen@tufts.edu
2018 SPRG	Primary	Roni Khardon		roni@eecs.tufts.edu
2018 SPRG	Primary	Donna Slonim		Donna.Slonim@tufts.edu
2018 SPRG	Primary	Samuel Guyer		Samuel.Guyer@tufts.edu
2018 SPRG	Primary	Norman Ramsey		Norman.Ramsey@tufts.edu
2018 SPRG	Primary	Remco Chang		Remco.Chang@tufts.edu
2018 SPRG	Primary	Matthias Scheutz		Matthias.Scheutz@tufts.edu
2018 SPRG	Primary	Kathleen Fisher		Kathleen.Fisher@tufts.edu
2018 SPRG	Primary	Noah Mendelsohn		Noah.Mendelsohn@tufts.edu
2018 SPRG	Primary	Mark Sheldon		Mark.Sheldon@tufts.edu
2018 SPRG	Primary	Fahad Dogar		Fahad.Dogar@tufts.edu
2018 SPRG	Primary	Elena Strange		Elena.Strange@tufts.edu
2018 SPRG	Primary	Johannes De Ruiter		jp.deruiter@tufts.edu
2018 SPRG	Primary	Megan Monroe		Megan.Monroe@tufts.edu
2018 SPRG	Primary	Liping Liu		Liping.Liu@tufts.edu
2018 SPRG	Primary	Jivko Sinapov		Jivko.Sinapov@tufts.edu

Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.

108264	Biomedical Engineering Junior Design And Research I			
Subject:	Catalog Nbr:			
BME	0005			
2017 FALL	Primary	Brian Timko		Brian.Timko@tufts.edu
Team design and research in digital signal/image processing. Signal and noise, signal averaging, Fourier analysis, convolution, and correlation. How to present design features and research results in the form of a technical/scientific article. 0.5 credit.				
Recommendations: BME 4.				

108269	Graduate Research			
Subject:	Catalog Nbr:			
COMP	0297			

# Course Bulletin

2017 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu
2017 FALL	Primary	Robert Jacob	jacob@cs.tufts.edu
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu
2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2017 FALL	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu
2017 FALL	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
2017 FALL	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2017 FALL	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
2017 FALL	Primary	Benjamin Hescott	No Email on file.
2017 FALL	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu
2017 FALL	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 FALL	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
2017 FALL	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2017 FALL	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2017 FALL	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2017 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu

Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.

<b>108280</b>	<b>Civil And Environmental Engineering Design</b>			
Subject: CEE	Catalog Nbr: 0081			
2017 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu	
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu	
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu	
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu	
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
<p>Integrated design and project management methods used in conceiving, developing, and managing one-of-a-kind civil and environmental engineering projects. This capstone design experience includes pre-site investigation and site planning, detail drawings, bidding documents, quantity take-off and cost estimates, planning and scheduling, as well as contracts and procurement activities. The final group design project consists of a comprehensive written report and visual presentation using computer applications such as computer-aided design and electronic spreadsheets.</p> <p>Recommendations: Senior standing.</p>				

<b>108284</b>	<b>Graduate Research</b>			
Subject: COMP	Catalog Nbr: 0298			
2017 SPRG	Primary	Anselm Blumer	ablumer@cs.tufts.edu	

# Course Bulletin

2017 SPRG	Primary	Bruce Molay	Bruce.Molay@tufts.edu
2017 SPRG	Primary	Benjamin Hescott	No Email on file.
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 SPRG	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2018 SPRG	Primary	Robert Jacob	jacob@cs.tufts.edu
2018 SPRG	Primary	Alva Couch	alva.couch@tufts.edu
2018 SPRG	Primary	Soha Hassoun	soha.hassoun@tufts.edu
2018 SPRG	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu
2018 SPRG	Primary	Ming Chow	ming.chow@tufts.edu
2018 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2018 SPRG	Primary	Roni Khardon	roni@eecs.tufts.edu
2018 SPRG	Primary	Donna Slonim	Donna.Slonim@tufts.edu
2018 SPRG	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu
2018 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2018 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu
2018 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2018 SPRG	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
2018 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2018 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2018 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu
2018 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu
2018 SPRG	Primary	Johannes De Ruitter	jp.deruitter@tufts.edu
2018 SPRG	Primary	Megan Monroe	Megan.Monroe@tufts.edu
2018 SPRG	Primary	Liping Liu	Liping.Liu@tufts.edu
2018 SPRG	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu

Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.

<b>108304</b>	<b>Non Major Credit</b>		
Subject:	Catalog Nbr:		
COMP	0310		

<b>108316</b>	<b>Biomedical Engineering Junior Design And Research II</b>			
Subject:	Catalog Nbr:			
BME	0006			
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
<p>Technical and scientific literature databases, professional preparation and delivery of technical/scientific presentations, and preparation of technical proposals based on proper technical writing. 0.5 credit.  Recommendations: BME 5.</p>				

<b>108330</b>	<b>Lower Level Elective Crd</b>			
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# Course Bulletin

Subject:	Catalog Nbr:
COMP	0320

<b>108346</b>	<b>Special Topics In Civil And Environmental Engineering A</b>
Subject:	Catalog Nbr:
CEE	0093
Topical courses offered within civil and environmental engineering.	

<b>108350</b>	<b>Upper Level Elective Crd</b>
Subject:	Catalog Nbr:
COMP	0330

<b>108359</b>	<b>Biomedical Engineering Senior Design I</b>		
Subject:	Catalog Nbr:		
BME	0007		
2016 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu
<p>Critical thinking approaches in design and research. Planning, initiation, and evaluation of design and research projects, goals, and processes. Students will be required to regularly report on the status and progress of their design/research activities, and to formally and critically evaluate their projects.</p> <p>Recommendations: BME 6.</p>			

<b>108363</b>	<b>Independent Study</b>		
Subject:	Catalog Nbr:		
CEE	0094		
2016 FALL	Primary	John Durant	john.durant@tufts.edu
2016 FALL	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2017 SPRG	Primary	Jay Borkland	Jay.Borkland@tufts.edu
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
<p>Supervised, independent study of topics related to civil and environmental engineering. Departmental consent required.</p>			

<b>108393</b>	<b>Research Thesis A</b>
Subject:	Catalog Nbr:

# Course Bulletin

CEE	0095				
	2016 FALL	Primary	John Durant	john.durant@tufts.edu	
	2017 FALL	Primary	Steven Chapra	steven.chapra@tufts.edu	
	2017 FALL	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
<p>A course that permits the student to perform supervised research in a specialized field of civil and environmental engineering.          Recommendations: Consent of instructor.</p>					

<b>108400</b>	<b>Biomedical Engineering Senior Design II</b>				
	Subject:	Catalog Nbr:			
	BME	0008			
	2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
	2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
	2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
<p>Continuation of the design/research activities planned, initiated, and evaluated in BME 7. Students will be required submit regular progress reports and a final written report, and make a course-end oral presentation.          Prerequisites: BME 7.</p>					

<b>108412</b>	<b>Research Thesis B</b>				
	Subject:	Catalog Nbr:			
	CEE	0096			
	2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu	
	2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
<p>A course that permits the student to perform supervised research in a specialized field of civil and environmental engineering.          Recommendations: Consent of instructor.</p>					

<b>108430</b>	<b>Biophysics</b>				
	Subject:	Catalog Nbr:			
	BME	0025			
	2018 SPRG	Primary	Peggy Cebe	peggy.cebe@tufts.edu	
<p>(Cross-listed as BIO 119, PHY 25.) Presentation at an introductory level of selected topics in physics relevant to modern medicine and biology. Development of topics to the point of application to biomedical problems. Topics drawn from acoustics, physics of fluids, diffusion, laser physics, and other subjects varying from year to year. Offered alternate years. (Also offered as 100-level.)          Recommendations: PHY 1, 2, or 11, 12 or permission of instructor. Corequisite: MATH 42 (formerly MATH 13).</p>					

<b>108431</b>	<b>Internship In Civil And Environmental Engineering</b>				
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# Course Bulletin

Subject: Catalog Nbr:  
CEE 0099

2017 SUMR	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
2017 SUMR	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
2017 SUMR	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu

Field placement in the practice of civil engineering. The purpose is to apply the knowledge and skills developed in the classroom to a field situation of practical significance.  
Recommendations: Junior or senior standing in civil and environmental engineering.

## 108451 Introduction To Biomedical Engineering

Subject: Catalog Nbr:  
BME 0050

2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
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(Cross-listed as EE 50.) An introduction to the interdisciplinary nature of biomedical engineering. The biological, chemical, electrical, and mechanical principles involved in the design and operation of medical devices. Biopotentials, electrodes, transducers, biocompatibility of materials, and patient safety.  
Recommendations: PHY 2 or PHY 12, or permission of instructor.

## 108473 Introduction To Biophotonics

Subject: Catalog Nbr:  
BME 0051

2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2018 SPRG	Secondary	Martin Hunter	Martin.Hunter@tufts.edu

Basic concepts in electromagnetism and light matter interactions, including optical properties, absorption, near-infrared, light scattering and fluorescence spectroscopy, microscopy, optical coherence tomography and photodynamic therapy and their relevance to human disease diagnostic and therapeutic applications.  
Recommendations: PHY 12 or permission of instructor.

## 108475 Finite Elements Analysis

Subject: Catalog Nbr:  
CEE 0105

2016 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu

(Cross-listed with ME 0129). Finite element analysis of problems important in civil infrastructure engineering. Overview of direct stiffness method. Discretization of continuum to finite elements for approximate solution of complex engineering problems. Development of governing equations, stiffness and load matrices for deformation and stress analysis. Work and energy theorems. Hands-on experience with computers programs and practical applications in structural and geotechnical engineering.  
Recommendations: CEE 22 or ME 42, or consent of instructor

# Course Bulletin

<b>108507</b>	<b>Structural Dynamics And Earthquake Engineering</b>			
Subject:	Catalog Nbr:			
CEE	0106			
2017 SPRG	Primary	Masoud Sanayei		masoud.sanayei@tufts.edu
<p>Fundamentals of vibration theory with applications important in civil engineering. Free, forced, and transient vibration of one and two degrees of freedom systems, including damping and nonlinear behavior. Base excitation and seismic instrumentation. Duhamel's integral and time step integration. Multi-degree of freedom systems, modal analysis and seismic response spectra. Introduction to earthquake design.</p> <p>Recommendations: ES 9 and CEE 22, or consent of instructor</p>				

<b>108523</b>	<b>Quantitative Biomaterials Characterization Laboratory I</b>			
Subject:	Catalog Nbr:			
BME	0056			
2017 FALL	Primary	Irene Georgakoudi		Irene.Georgakoudi@tufts.edu
2017 FALL	Primary	Martin Hunter		Martin.Hunter@tufts.edu
<p>(SPRING 2013 &amp; BEYOND). Quantitative biomaterials characterization laboratory I. Selected topics in use of electromagnetic radiation to characterize biomaterials. Please see department website for more details.</p>				

<b>108529</b>	<b>Hydrology/water Resource</b>			
Subject:	Catalog Nbr:			
CEE	0112			
2017 FALL	Primary	Shafiqul Islam		Shafiqul.Islam@tufts.edu
<p>(Cross-listed as ENV 112.) An introduction to the science of hydrology and to the design of water resource systems. Basic hydrologic processes such as precipitation, infiltration, groundwater flow, evaporation, and streamflow are discussed. Applications of hydrology to water supply, flood control and watershed modeling are emphasized. Students develop their own hydrologic models using computer software.</p> <p>Recommendations: CEE12</p>				

<b>108544</b>	<b>Tufts Abroad Program</b>			
Subject:	Catalog Nbr:			
COMP	0340			
2017 SPRG	Primary	Ute Link		Ute.Link@tufts.edu
2017 SPRG	Primary	Simon Steel		Simon.Steel@tufts.edu
2017 SPRG	Primary	Susan Sanchez-Casal		susan.sanchez_casal@tufts.edu

<b>108547</b>	<b>Quantitative Biomaterials Characterization Laboratory II</b>			
Subject:	Catalog Nbr:			
BME	0057			
2017 SPRG	Primary	Irene Georgakoudi		Irene.Georgakoudi@tufts.edu

# Course Bulletin

2017 SPRG	Primary	Martin Hunter	Martin.Hunter@tufts.edu
Continuation of BME 56 consisting of topics not offered in BME56 in the same academic year and an introductory session focused on critical review of current biophotonics literature. Recommendations: BME 56.			

<b>108548</b>	<b>Groundwater</b>		
Subject: CEE	Catalog Nbr: 0113	2017 FALL	Primary
	Grant Garven	Grant.Garven@tufts.edu	
<p>(Cross-listed as ENV 113 and EOS 131-formerly GEO 131). The geology and hydrology of groundwater. Topics include: hydraulic properties of soils, sediments, and rocks; physics of groundwater flow; flow nets, modeling groundwater systems; geology of regional flow; aquifer exploration and water well construction methods; well hydraulics and aquifer testing; applications in the geosciences and in civil /geotechnical/environmental engineering.</p> <p>Recommendations: EOS 1 or EOS 2 (formerly GEO 1 or GEO 2), and MATH 32 (formerly MATH 11).</p>			

<b>108564</b>	<b>Masters Degree Continuation</b>		
Subject: COMP	Catalog Nbr: 0401		
Part-time.Please see departmental website for specific details.			

<b>108569</b>	<b>Field Methods In Hydrogeology</b>		
Subject: CEE	Catalog Nbr: 0114	2018 SPRG	Primary
	Grant Garven	Grant.Garven@tufts.edu	
<p>(Cross-listed as EOS 133-formerly GEO 133). Field aspects of hydrogeology, groundwater mapping and sampling, aquifer testing, well drilling, monitoring, and instrumentation of boreholes. Lecture and basic field methods to understand how monitoring and production wells are planned and drilled, and what types of geologic, geophysical, and geochemical data can be gathered for subsurface flow systems. A network of boreholes on the Tufts campus will be used as field sites to characterize subsurface parameters in the unsaturated and saturated zones, and study regional flow in an urban watershed. Field trips, quantitative analysis of hydrogeologic data.</p> <p>Recommendations: EOS 002 (formerly GEO 002) and PHY 011 or equivalent.</p>			

<b>108571</b>	<b>Introduction To Human Factors And Ergonomics</b>		
Subject: BME	Catalog Nbr: 0061	2017 FALL	Primary
	Linda Borghesani	Linda.Borghesani@tufts.edu	
	Sami Durrani	Sami.Durrani@tufts.edu	
(Cross-listed as ENP 61.) A practical introduction to human performance and to designing for human use.			

# Course Bulletin

Studies include human factors, ergonomics, work stations, and environmental and legal concerns that impact on design. Examples of good and bad designs illustrate course principles.

<b>108584</b>	<b>Masters Degree Continuation</b>
Subject: COMP	Catalog Nbr: 0402
Full-time. Please see departmental website for specific details.	

<b>108591</b>	<b>Molecular Biotechnology</b>		
Subject: BME	Catalog Nbr: 0062		
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu
2018 SPRG	Primary	Niall Lennon	No Email on file.
2018 SUMR	Primary	Dana Cairns	Dana.Cairns@tufts.edu
2018 SUMR	Primary	Nina Dinjaski	Nina.Dinjaski@tufts.edu
(Cross-listed as CHBE 62 and BIO 62.) Overview of key aspects of molecular biology and engineering aspects of biotechnology. Lecture topics include molecular biology, recombinant DNA techniques, immunology, cell biology, protein purification, fermentation, cell culture, combinatorial methods, bioethics, and bioinformatics. Includes a semester-long technical project. (May also be taken at 100 level.) Recommendations: CHEM 1, BIO 13, or permission of instructor.			

<b>108593</b>	<b>The Art Of Building</b>
Subject: CEE	Catalog Nbr: 0120
Late 19th and early 20th century problems in creating a built environment consistent with modern life. Work of key designers and writers. Connections between structural form and architectural theory form the basis for critiques of modern structure and architecture. Recommendations: Consent of instructor.	

<b>108606</b>	<b>Grad Teaching Assistant</b>
Subject: COMP	Catalog Nbr: 0405

<b>108622</b>	<b>Solid Mechanics</b>		
Subject: CEE	Catalog Nbr: 0122		
2017 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu
(Cross-listed as ME 122). Strain tensor, stress tensor, elastic stress analysis, isotropic and anisotropic			

# Course Bulletin

materials, torsion problem, inelastic behavior of materials, elements of plasticity and creep.  
Recommendations: ES 9 Strength of Materials or equivalent.

<b>108627</b>	<b>Grad Research Assistant</b>
Subject: COMP	Catalog Nbr: 0406

<b>108640</b>	<b>Advanced Structural Systems Analysis</b>
Subject: CEE	Catalog Nbr: 0123
2017 FALL	Primary      Babak Moaveni      Babak.Moaveni@tufts.edu
<p>The application of mechanics to the analysis of indeterminate structural forms important to civil and aeronautical engineering, with emphasis on modern structural types. The analysis of fundamental structural forms, including curved beams, arches, rings, thin-walled cell-type structures, and members with variable inertia, for stress and deflection by the classical methods. Influence lines for indeterminate structures. Introduction to matrix analysis and vibration of structures.</p> <p>Recommendations: CEE 22.</p>	

<b>108650</b>	<b>Internship</b>
Subject: BME	Catalog Nbr: 0087
2017 FALL	Primary      Qiaobing Xu      Qiaobing.Xu@tufts.edu
<p>Supervised internships at suitable locations in industry and government. Internships are offered on basis of availability. Term paper required. Credit not given retroactively. Prior arrangements necessary.</p>	

<b>108651</b>	<b>Doctoral Degree Continuation</b>
Subject: COMP	Catalog Nbr: 0501
Part-time. Please see departmental website for specific details.	

<b>108662</b>	<b>Advanced Steel Design</b>
Subject: CEE	Catalog Nbr: 0124
2016 FALL	Primary      Po-Shang Chen      Po-Shang.Chen@tufts.edu
<p>An advanced course in steel design using the Load Resistance Factor Design (LRFD). Component design, connections, composite and built-up sections are covered. Design problems involve braced and rigid structures subjected to gravity, wind, and seismic loads.</p> <p>Recommendations: CEE 24 and consent of instructor</p>	

# Course Bulletin

<b>108667</b>	<b>Doctoral Degree Continuation</b>			
Subject:	Catalog Nbr:			
COMP	0502			
Full-time. Please see departmental website for specific details.				

<b>108673</b>	<b>Internship</b>			
Subject:	Catalog Nbr:			
BME	0088			
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
Internships at suitable locations in industry and government. Internships are offered on basis of availability. Term paper required. Credit not given retroactively. Prior arrangements necessary.				

<b>108679</b>	<b>Advanced Reinforced Concrete</b>			
Subject:	Catalog Nbr:			
CEE	0125			
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu	
Further study of concrete design with emphasis on columns with biaxial bending, flat slab theory and design, torsion, and the analysis and design of prestressed concrete structural members. Recommendations: CEE 25				

<b>108692</b>	<b>Honors Thesis A</b>			
Subject:	Catalog Nbr:			
BME	0089			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Supervised research on a topic that has been approved as a suitable subject for an honors thesis. The work is performed over the fall and spring semesters of the senior year. Students will receive a Y grade at the end of the fall semester and the final grade at the end of the spring semester for a total of two credits. Please see departmental website for specific details. Recommendations: Senior standing or permission of instructor.				



# Course Bulletin

<b>108699</b>	<b>Structural Stability</b>			
Subject: CEE	Catalog Nbr: 0126			
Elastic buckling of columns, including the effects of initial crookedness and eccentricity. Large deflections of the Euler column. Tangent modulus and double modulus theory. Beam columns and the stability of frameworks and trusses. Torsional buckling of columns and lateral buckling of beams. Plate buckling with applications to flange buckling and web crippling of plate girders. Recommendations: ES 9 and CEE 22, or consent of instructor				

<b>108712</b>	<b>Honors Thesis B</b>			
Subject: BME	Catalog Nbr: 0090			
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Supervised research on a topic that has been approved as a suitable subject for an honors thesis. The work is performed over the fall and spring semesters of the senior year. Students will receive a Y grade at the end of the fall semester and the final grade at the end of the spring semester for a total of two credits. Please see departmental website for specific details. Recommendations: Senior standing or permission of instructor.				

<b>108721</b>	<b>Nonlinear Analysis of Materials and Structures</b>			
Subject: CEE	Catalog Nbr: 0128			
2017 FALL	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu	
(Cross-listed as ME 128.) Nonlinear solid mechanics, nonlinear constitutive models and variational principles as essential prerequisites for nonlinear finite element formulations. Recommendations: ES 9.				

<b>108734</b>	<b>Special Topics</b>			
Subject: BME	Catalog Nbr: 0093			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	

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2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL	Secondary	Lauren Black III	Lauren.Black@tufts.edu
Guided study of an approved topic in biomedical engineering. Credit as arranged.			

<b>108745</b>	<b>Bridge Design And Rehabilitation</b>		
Subject: CEE	Catalog Nbr: 0129		
2017 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu
<p>A practical introduction to bridge engineering, exploring the design, behavior, maintenance and rehabilitation of bridges. Bridge systems, loadings, superstructures, substructures, details, and inspections will be discussed. The theory behind development of certain provisions in AASHTO code will be reviewed, with the purpose of developing an understanding of the code and its related commentary, and the objective of preparing students to use the criteria not as a "black box." Approximate analysis methods will be discussed. Design of elements including steel and pre-stressed concrete beams, abutments, piers, joints, and bearings using AASHTO code (LRFD) will be covered.</p> <p>Recommendations: CEE 24 and CEE 25, or consent of instructor.</p>			

<b>108762</b>	<b>Special Topics</b>		
Subject: BME	Catalog Nbr: 0094		
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu
Guided study of an approved topic in biomedical engineering. Credit as arranged.			

<b>108768</b>	<b>River Hydraulics And Restoration</b>		
Subject: CEE	Catalog Nbr: 0131		
2017 FALL	Primary	James Limbrunner	James.Limbrunner@tufts.edu
<p>The physical and mathematical basis for steady and unsteady flow processes in hydraulic engineering, with emphasis on fluvial systems. Numerical procedures for gradually varied steady flow and rapidly varied</p>			

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unsteady flow will be covered with applications to floodplain delineations, flood routing, dam safety, and river restoration. Other applications may include the design of hydraulic structures such as culverts, stilling basins, spillways, levees, weirs, fish ladders, and retention/detention ponds. With laboratory.

Recommendations: MATH 51 (formerly MATH 38) and CEE 12

<b>108812</b>	<b>Environmental Engineering Processes</b>			
Subject: CEE	Catalog Nbr: 0132			
2017 SPRG	Primary	John Durant		john.durant@tufts.edu
2018 SPRG	Primary	Linda Abriola		Linda.Aabriola@tufts.edu
<p>Study of the chemical, physical, and biological basis for unit processes commonly used in environmental engineering. Processes representing applications in all environmental media are examined. Emphasis is on rational design of unit processes, with attention to fundamental principles and experimental methods. With laboratory.</p> <p>Recommendations: CEE 30 and CEE 32, or consent of instructor</p>				

<b>108840</b>	<b>Wastewater Plant Design</b>			
Subject: CEE	Catalog Nbr: 0133			
2018 SPRG	Primary	Wayne Chudyk		wayne.chudyk@tufts.edu
<p>Design of facilities for municipal drinking water and wastewater treatment. Synthesis of unit processes and operations into integrated treatment plant. Emphasis on conventional treatment processes. Additional topics include liquid and solids streams, hydraulics, chemical feed and control systems, costs, and performance requirements. Design projects and field trips.</p> <p>Recommendations: CEE 32 or consent of instructor</p>				

<b>108855</b>	<b>Design Of Medical Instrumentation</b>			
Subject: BME	Catalog Nbr: 0100			
2018 SPRG	Primary	Mark Cronin-Golomb		mark.cronin-golomb@tufts.edu
<p>(Cross-listed as EE 100.) An introduction to the design principles of medical instrumentation and simple biomedical signal analysis. Topics include analysis of the instrument and subject as a linear system, characteristics of various biological signals, design of transducers, modern implementation of A/D conversion, analog and digital filters, instrumentation amplifiers, patient isolation, and battery powered equipment.</p> <p>Recommendations: ES 3 and/or experience with basic electronics including operational amplifiers</p>				

<b>108886</b>	<b>Air Pollution Control</b>			
Subject: CEE	Catalog Nbr: 0136			
2017 FALL	Primary	Stephen Zemba		stephen.zemba@tufts.edu

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(Cross-listed as CHBE136.) A study of health and environmental effects from air pollution, dispersion modeling, air pollution laws and regulations, fate and transport of air pollution, and design of pollution control equipment and processes. Recommendations: (ES 8 & CEE 32) or CHBE 22

<b>108908</b>	<b>Public Health</b>			
	Subject:	Catalog Nbr:		
	CEE	0057		
	2017 FALL	Primary	David Gute	david.gute@tufts.edu
<p>An introduction to the public health approach is provided. The epidemiological model of the disease process is used to study a variety of infectious and noninfectious diseases. The wide variety of nonmedical approaches to disease control is emphasized. The public health aspects of vital statistics, evaluation, and administrative decision making are introduced and applied to current problems in public health.</p> <p>Recommendations: Consent of instructor.</p>				

<b>108931</b>	<b>Hazardous Waste Treatment Technologies</b>			
	Subject:	Catalog Nbr:		
	CEE	0138		
<p>(Cross-listed as CHBE138.) Hazardous waste treatment options based on physical, chemical, biological, and thermal processing technologies. Brief review of definitions and appropriate hazardous waste legislation. Introduction to pollution prevention. Traditional end-of-pipe treatment technologies. Applications to include solvent recovery, chemical fixation, land disposal, biodegradation, and special wastes. Incineration and associated environmental discharges constitute a major portion of course. Emerging technologies and evaluation of technical/economic process viability.</p> <p>Recommendations: Senior standing or consent of instructor.</p>				

<b>108951</b>	<b>Bioremediation: Natural And Enhanced</b>			
	Subject:	Catalog Nbr:		
	CEE	0139		
<p>(Cross-listed as ENV 139). Biodegradation of organic contaminants is evaluated in natural settings and in treatment processes. Aerobic and anaerobic pathways, their prediction and control are examined. Water, soil, and vapor phase transformations are evaluated. Subject areas include kinetics, equilibria, sorption, gas transfer, and transformation products. Process design for treatment plants and in-situ applications applied to case studies.</p> <p>Recommendations: CEE 132.</p>				

<b>108982</b>	<b>Geomechanics</b>			
	Subject:	Catalog Nbr:		
	CEE	0245		
	2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu
<p>Introduction to the mechanics of solids focused on earth materials as porous, deformable media. Strain,</p>				

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stress, and equations of motion. Elasticity and seismic wave propagation. Failure, inelastic deformation, and plasticity. Role of pore fluid in deformation and failure. Consolidation. Fluid flow and Darcy's law; seepage forces and design considerations. Recommendations: ES-9, CEE-42

<b>109003</b>	<b>Site Remediation</b>			
Subject: CEE	Catalog Nbr: 0143			
2017 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
<p>Conventional and innovative remediation technologies are examined under the remedial investigation/feasibility study (RI/FS) process. Knowledge of fundamental processes governing remedy implementation is integrated with an understanding of site characterization and applicable regulations to enable design of site-specific treatment systems for clean-up of the contaminated subsurface environment. Recommendations: CEE 12 and CEE 32, or consent of instructor</p>				

<b>109024</b>	<b>Computer Methods In Geotechnical Engineering</b>			
Subject: CEE	Catalog Nbr: 0145			
<p>Computer methods for processing subsurface information and for analyzing geotechnical/geoenvironmental engineering problems. Applications to be selected from settlement, deformation, bearing capacity, slope stability, pile driving, seepage, and soil amplification analyses. Finite element and finite difference applications. Recommendations: CEE 42</p>				

<b>109049</b>	<b>Foundation Engineering</b>			
Subject: CEE	Catalog Nbr: 0146			
2016 FALL	Primary	Damian Siebert	Damian.Siebert@tufts.edu	
2017 FALL	Primary	Lucy Jen	Lucy.Jen@tufts.edu	
<p>Foundation engineering design, with emphasis on bearing capacity and settlement for shallow (footings) and deep (pile) foundations. Design of footings, rafts, piles, and piers subjected to axial and lateral loads; building code requirements for design; and evaluation and selection of foundation types and alternatives. Case studies. Recommendations: CEE 42.</p>				

<b>109068</b>	<b>Geotechnical Earthquake Engineering</b>			
Subject: CEE	Catalog Nbr: 0247			
2017 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu	
<p>Review of seismicity, fault-rupture mechanisms, vibration and wave propagation theory. Deterministic and probabilistic seismic hazard analysis including ground motion prediction equations. Dynamic behavior of soils,</p>				

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including soil amplification concepts, liquefaction, and ground response analysis. Application of soil dynamics in terms of design codes and design ground motions. Recommendations: CEE 42 and ES56.

<b>109086</b>	<b>Earth Support Systems</b>			
Subject: CEE	Catalog Nbr: 0149			
2018 SPRG	Primary	Lucy Jen		Lucy.Jen@tufts.edu
<p>Examination of earth pressure theories and design problems related to earth-retaining structures and tunnels. Analysis and design of braced and unbraced excavations; code requirements; strut-waler systems; tie backs; ground movement control; reinforced earth and slurry wall methods. Slope stability analysis related to excavations and retaining structures. Recommendations: CEE 42.</p>				

<b>109111</b>	<b>Principles Epidemiology</b>			
Subject: CEE	Catalog Nbr: 0154			
2018 SUMR	Primary	Mark Woodin		mark.woodin@tufts.edu
<p>(Cross-listed as NUTR 204 and CH 154.) Methods that quantify disease processes in human populations. Topics include study design, sources of inaccuracy in experimental and observational studies, the methodology of data collection, and an introduction to the statistical evaluation of epidemiological data. Cannot receive credit for both CEE 154 and CEE 54</p>				

<b>109134</b>	<b>Occupational And Environmental Health</b>			
Subject: CEE	Catalog Nbr: 0158			
2017 SPRG	Primary	David Gute		david.gute@tufts.edu
2018 SPRG	Primary	Anne Marie Desmarais		annemarie.desmarais@tufts.edu
<p>(Cross-listed as ENV 158.) An examination of current topics in the area of occupational and environmental health, with particular emphasis on the types of materials that produce human health effects. Both clinical and epidemiologic data will be used to assess the public health importance of environmental pollutants and to evaluate the effectiveness of control strategies Recommendations: Senior standing or consent of instructor.</p>				

<b>109167</b>	<b>Project Study In Human Systems A</b>			
Subject: BME	Catalog Nbr: 0120			
<p>(Cross-listed as ENP 120 and PSY 120.) A senior-level project design (capstone course), led by faculty from engineering and psychology as well as outside lecturers. Students participate in team fashion in human factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects.</p>				

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Recommendations: BME/ENP 161, 162, PSY 31, 32, 130.

<b>109187</b>	<b>Epidemiological Methods</b>			
Subject: CEE	Catalog Nbr: 0155			
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu	
<p>(Continuation of CEE154.) Topics include the principles of data analysis, including hypothesis testing and estimation, options in study design, internal validity, screening programs, registries, and genetics. Both theoretical and practical aspects of each topic will be discussed.</p> <p>Recommendations: CEE 154 or CEE 54</p>				

<b>109213</b>	<b>Environmental Toxicology</b>			
Subject: CEE	Catalog Nbr: 0157			
2017 FALL	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
<p>(Cross-listed as ENV 167.) This course is designed to present the basic scientific principles of toxicology and the relationship of toxicology to health-based risk assessment and hazardous materials management. The toxic effects of hazardous substances on specific organ systems are described, as well as the mechanisms of action of some frequently encountered environmental contaminants. Specialized topics related to the field of toxicology are also discussed, including animal to human extrapolation of data, mutagenicity/carcinogenicity, and teratogenesis.</p> <p>Recommendations: Senior standing or consent of instructor.</p>				

<b>109218</b>	<b>Quantitative Physiology I</b>			
Subject: BME	Catalog Nbr: 0121			
2016 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu	
<p>(Cross-listed as EE 121). Coursework designed for students interested in advanced work in biomedical engineering. A quantitative approach to cell physiology, nerve/muscle interaction, the cardiovascular system, and the respiratory system, through the study of vital biological signals and their measurement. Anatomy and physiology of each organ system. Current engineering efforts in instrumentation and basic science to further study each system's physiology.</p> <p>Recommendations: BME/EE/ES 50, BIO 1 or BIO 13 or ES 11, or permission of instructor.</p>				

<b>109266</b>	<b>Quantitative Physiology II</b>			
Subject: BME	Catalog Nbr: 0122			
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
<p>(Cross-listed as EE 122). A laboratory course designed for students interested in advanced work in biomedical</p>				

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engineering. The course will involve labs covering nerve physiology, skeletal muscle physiology, and cardiopulmonary physiology, through the study of vital biological signals and their measurement. The course will be structured in modules, with labs in each module focused on 1) measurement and acquisition of the physiological data of interest and 2) computational modeling of acquired physiological data.

Recommendations: BME/EE/ES 121 or BIO 115, BME/EE/ES 50, BIO 13 or ES 11, or Permission of instructor.

<b>109277</b>	<b>Health Effects And Risk Assessment</b>			
Subject:	Catalog Nbr:			
CEE	0153			
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
<p>A study of chronic and acute human health effects of exposure to hazardous materials. Principles of toxicology and pharmacokinetics of toxic substances. Standards for environmental quality, risk assessment methodologies, and risk communication strategies.</p> <p>Recommendations: CHEM 1 or 16, senior standing and consent of instructor</p>				

<b>109287</b>	<b>Biophysics</b>			
Subject:	Catalog Nbr:			
BME	0125			
2018 SPRG	Primary	Peggy Cebe	peggy.cebe@tufts.edu	
<p>(Cross-listed as BIO 119, PHY 25 .) Presentation at an introductory level of selected topics in physics relevant to modern medicine and biology. Development of topics to the point of application to biomedical problems. Topics drawn from acoustics, physics of fluids, diffusion, laser physics, and other subjects varying from year to year. Offered alternate years. (Also offered as lower-level.)</p> <p>Recommendations: PHY 1, 2, or 11, 12 or permission of instructor. Corequisite: MATH 42 (formerly MATH 13).</p>				

<b>109305</b>	<b>Principles Of Medical Imaging</b>			
Subject:	Catalog Nbr:			
BME	0131			
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
<p>(Cross-listed as EE 131 and BIO 131.) This interdisciplinary course presents the principles of medical imaging techniques such as diagnostic ultrasound, radiography, X-ray computed tomography (CT), and magnetic resonance imaging (MRI). For each imaging modality, topics include the physical principles, key aspects of instrumentation design, mathematical methods, and the anatomical/physiological information content of the images. Representative medical images will be discussed and interpreted. This course cannot be taken for basic science requirement for engineering students.</p> <p>Recommendations: MATH 32 (formerly MATH 11), PHY 2 or 12, or permission of instructor.</p>				

<b>109326</b>	<b>Analytical Tools For Biomedical Engineering</b>			
Subject:	Catalog Nbr:			
BME	0141			



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2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu
<p>Statistical methods of data analysis with emphasis upon biomedical applications. Fourier analysis, probability, Bayes' theorem, interpretation of diagnostic tests (sensitivity, specificity, predictive values), random variables, covariance and correlation, normal distribution, samples, statistical tests, linear systems, spectral analysis, correlation, coherence, phase analysis, independent component analysis, principal component analysis. Students are required to review, critique, and prepare written and oral reports of selected research articles published in the literature.</p> <p>Recommendations: MATH 42 (formerly MATH 13), or permission of instructor.</p>			

<b>109329</b>	<b>Legal Issues Of Engineering</b>		
Subject: CEE	Catalog Nbr: 0185		
<p>This course examines the legal principles applicable to engineering design, construction, and manufacturing. Topics covered include introduction to the legal system, sources of law, contract law principles, professional liability risks, risk management practices, contract administration, differing site conditions claims, professional registration, and ethical issues.</p> <p>Recommendations: Junior standing or consent of instructor</p>			

<b>109349</b>	<b>Geographical Information Systems</b>		
Subject: CEE	Catalog Nbr: 0187		
2017 FALL	Primary	Laurie Baise	laurie.baise@tufts.edu
2018 SUMR	Primary	John Durant	john.durant@tufts.edu
<p>Spatial analysis with Geographic Information Systems (GIS), including their use for engineering applications. GIS data structure and management, techniques for spatial analysis. Applications including seismic hazard, water resources, and environmental health. Laboratory exercises in GIS.</p> <p>Recommendations: ES 56.</p>			

<b>109370</b>	<b>Engineer Design W/cad</b>		
Subject: CEE	Catalog Nbr: 0188		
<p>The structure and potential for CAD systems will be assessed through the use of CAD-based user programming languages. Specialized topics related to specific engineering applications will be studied through modeling, water surface profiling, part and assembly modeling with feature-based parametric solid modelers, forward and inverse kinematics links, and the merging of CAD models with photographic images. Additional topics to be covered include matrix and parametric mathematics used in CAD, interfacing CAD with other applications, and the concepts and techniques of engineering system animation including key framing and controllers, material mapping, and rendering.</p> <p>Recommendations: ES 88 or consent of instructor</p>			

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<b>109378</b>	<b>Biomechanics</b>			
Subject:	Catalog Nbr:			
BME	0149			
Graduate-level seminar course designed for students who are interested in getting a broad overview of different research methods and analytical techniques in human factors/ergonomics research. Topics to be covered are related to the acquiring, recording, and analyzing of empirical data. Theory underlying these methods in human factors/ergonomics research is also studied.				

<b>109421</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
CEE	0193			
2016 FALL	Primary	Lucy Jen	Lucy.Jen@tufts.edu	
2016 FALL	Primary	John Germaine	John.Germaine@tufts.edu	
2017 FALL	Primary	Elena Naumova	elena.naumova@tufts.edu	
2017 FALL	Primary	Eric Hines	Eric.Hines@tufts.edu	
2017 FALL	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu	
2017 FALL	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu	
2017 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu	
2017 SPRG	Primary	Magaly Koch	Magaly.Koch@tufts.edu	
2017 SUMR	Primary	David Gute	david.gute@tufts.edu	
Topical courses offered within civil and environmental engineering.				

<b>109444</b>	<b>Microprocessor Architecture And Applications W/lab</b>			
Subject:	Catalog Nbr:			
EE	0014			
2017 FALL	Primary	Chorng Chang	chorng.chang@tufts.edu	
Introduction to the microprocessor with a comparative analysis of some popular forms; memory devices, interface devices, and other support circuitry; machine language and assembly language programming. Microprocessor use in dedicated applications. The course includes a laboratory devoted to software and hardware design. Fall. Recommendations: ES 4, some programming experience.				

<b>109449</b>	<b>Land Use Planning II</b>			
Subject:	Catalog Nbr:			
CEE	0201			
(Cross-listed as UEP 201 and ENV 201.) An overview of land use planning methods, growth dynamics, and land development controls. Comparison of different approaches to land use planning and decision making. Impact of recent environmental legislation on land use. Techniques of mapping, site analysis, subdivision regulation, development controls, and fiscal incentives. Recommendations: Consent of instructor.				

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<b>109476</b>	<b>Environmental Statistics</b>		
Subject: CEE	Catalog Nbr: 0202		
<p>(Cross-listed as ENV 202). Methods for analyzing environmental data, which is often censored, skewed, and correlated in space and time. Topics include exploratory data analysis, nonparametric methods, hypothesis testing, multivariate statistics, frequency analysis, uncertainty analysis, experimental design, and model building.</p> <p>Recommendations: ES 56 or equivalent</p>			

<b>109495</b>	<b>Environmental Law</b>		
Subject: CEE	Catalog Nbr: 0207		
<p>(Cross-listed as UEP 207 and ENV 207.) Analysis of environmental law and natural resource management at the federal, Tribal, state and local levels of government. The course is designed for those planing careers in environmental science, land use planning and environmental management and should be of value to others interested in learning about the structure of the nation's primary pollution statues and mechanisms for managing and protecting natural resources.</p>			

<b>109516</b>	<b>Electromagnetic Fields And Waves W/lab</b>		
Subject: EE	Catalog Nbr: 0018		
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
<p>Coordinate systems and transformations, base vectors, scalar and vector point functions, gradient, divergence, curl, Laplacian, divergence theorem, Stokes theorem, source-point and field-point notation, electrostatic and magnetostatic fields and laws, scalar and vector potential functions, continuity equation, Maxwell's equations in differential and integral form, boundary conditions, wave equation, time-harmonic fields, plane waves, electromagnetic radiation, dipole antenna, Poynting theorem, distributed circuits and transmission lines. Associated laboratory work.</p> <p>Recommendations: ES 3, PHYS 12, MATH 51 (formerly MATH 38).</p>			

<b>109523</b>	<b>Chemical Principles In Environmental &amp; Water Resources Engineering</b>		
Subject: CEE	Catalog Nbr: 0212		
2017 FALL	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
<p>Basic principles of water chemistry related to environmental and water resources engineering. Thermodynamics, chemical equilibrium, acid-base reactions, alkalinity, complexation, precipitation, dissolution, sorption, and reduction-oxidation reactions. Quantitative problem solving. Fall.</p> <p>Recommendations: CHEM 1 or equivalent.</p>			

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<b>109537</b>	<b>Introduction To Human Factors And Ergonomics</b>			
Subject: BME	Catalog Nbr: 0160			
Same as BME 61, with additional requirements for graduate students. A practical introduction to human performance and to designing for human use. Studies include human factors, ergonomics, work stations, and environmental and legal concerns that impact on design. Examples of good and bad designs illustrate course principles. Includes a semester-long technical project and paper. (Also offered as lower-level.)				

<b>109542</b>	<b>Transport Principles In Environmental &amp; Water Resources Engineering</b>			
Subject: CEE	Catalog Nbr: 0213			
2016 FALL	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
An examination of transport phenomena in the natural or engineered environment. Topics include: momentum transport, energy transport, mass transport, interphase mass transfer, and environmental applications of ideal and non-ideal reactor models. Students will enhance their ability to apply a first principles approach for analysis of complex environmental systems. Fall. Recommendations: MATH 51 (formerly MATH 38) and ES 8, or equivalents				

<b>109559</b>	<b>Human Factor Product Design</b>			
Subject: BME	Catalog Nbr: 0161			
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
(Cross-listed as ENP 161.) Material relevant in consumer product design, biomedical engineering, architectural design, and machine design. Topics include design methodologies, user feedback techniques, performance measurements, sensory evaluation techniques, creative design, and prototyping. Extensive individual and group project design work. Emphasis on designing and creativity. Recommendations: EN 1, 2, ENP 61, PSY 31, 32, 53, and junior standing, or permission of instructor.				

<b>109562</b>	<b>Environmental And Water Resource Systems</b>			
Subject: CEE	Catalog Nbr: 0214			
2017 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu	
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu	
Mathematical models of water resource and environmental systems are presented in combination with optimization procedures, decision theory, and environmental applied statistics to generate an integrated approach to the planning, design, and management of complex water resources systems. Water resources systems applications are formulated as decision problems where an optimal solution is sought, yet cost, safety, environment, and technology appear as competing constraints. Applications include regional water quality management; siting treatment plants; reservoir system operations; and design, irrigation, flood control, and watershed planning.				

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<b>109563</b>	<b>Electronics I W/lab</b>			
Subject: EE	Catalog Nbr: 0021			
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
<p>Characteristics of the operational amplifier; amplifiers and active filters using the operational amplifier; analysis and design of filters using phasors; characteristics of junction diodes, analysis and design of diode circuits; field-effect transistors, MOSFET device operation, small-signal models and the low-frequency analysis of transistor amplifiers; Elementary MOS amplifier configurations. Associated laboratory work. Students may not take both EE 21 and either EE 11 or EE 13 for credit.</p> <p>Recommendations: ES 3.</p>				

<b>109571</b>	<b>Electronics II W/lab</b>			
Subject: EE	Catalog Nbr: 0022			
2017 FALL	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
<p>Integrated circuit realizations of MOS transistor circuits, current mirrors, active loads; Bipolar Junction Transistors, (BJT), device operation, small signal model and analysis, elementary BJT amplifier configuration; differential amplifiers, multi-stage amplifiers; frequency response of amplifiers; feedback and stability in analog circuits, nyquist stability criteria, frequency compensation; RC oscillators, LC oscillators, and waveform generators; output structures; power amplifiers; AM/FM circuits. Associated laboratory work. Students may not take both EE 22 and EE 12 for credit.</p> <p>Recommendations: EE 21.</p>				

<b>109580</b>	<b>Molecular Biotechnology</b>			
Subject: BME	Catalog Nbr: 0162			
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Niall Lennon	No Email on file.	
2018 SUMR	Primary	Dana Cairns	Dana.Cairns@tufts.edu	
2018 SUMR	Primary	Nina Dinjaski	Nina.Dinjaski@tufts.edu	
<p>(Cross-listed as BIO 162 and CHBE 162.) Overview of key aspects of molecular biology and engineering aspects of biotechnology. Lecture topics include molecular biology, recombinant DNA techniques, immunology, cell biology, protein purification, fermentation, cell culture, combinatorial methods, bioethics, and bioinformatics. Includes a semester-long technical project and oral presentation. (Also offered as lower-level.)</p>				

<b>109581</b>	<b>Advanced Solid Mechanics</b>			
Subject: CEE	Catalog Nbr: 0221			
<p>(Cross-listed as ME 221). Mechanics of deformable bodies based on equilibrium, geometry of strain, and properties of materials. Theory of elasticity, plasticity, viscoelasticity and creep.</p>				

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<b>109588</b>	<b>Linear Systems</b>			
Subject:	Catalog Nbr:			
EE	0023			
	2017 FALL	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
<p>Vector spaces, orthogonality, the continuous and discrete bi-lateral and uni-lateral Fourier transform, the bi-lateral and uni-lateral Laplace transform, convolution, and correlation; Introduction to discrete Fourier transform and Fast Fourier transform via MatLab; the Z transform.; matrices, eigenvectors, and eigenvalues; numerical methods for linear systems through stability and causality for control systems for analog applications and up-sampling an down-sampling for discrete systems. Students may not take both EE 23 and EE 102 for credit.</p> <p>Recommendations: EE 21 and MATH 51 (formerly MATH 38).</p>				

<b>109635</b>	<b>Recombinant DNA Techniques</b>			
Subject:	Catalog Nbr:			
BME	0163			
	2017 SUMR	Primary	David Kaplan	david.kaplan@tufts.edu
	2018 SUMR	Primary	Wenwen Huang	Wenwen.Huang@tufts.edu
	2018 SUMR	Primary	Zaira Martin Moldes	Zaira.Martin_Moldes@tufts.edu
<p>(Cross-listed as BIO 163 and CHBE 163.) This lecture and laboratory course is designed to familiarize the student with methods employed to produce recombinant products. The lectures cover fundamental aspects of the recombinant DNA methodologies used in the laboratory as well as some commercial applications of the techniques. The laboratory provides hands-on experience with the key skills used in genetic engineering including DNA isolation, restriction enzyme mapping, cloning and selection, protein expression, gel electrophoresis, polymerase chain reaction, DNA sequencing, and related techniques.</p> <p>Recommendations: CHEM 1, BIO 13, or permission of instructor.</p>				

<b>109650</b>	<b>Advanced Structural Dynamics</b>			
Subject:	Catalog Nbr:			
CEE	0225			
<p>The design of structures and structural elements to resist dynamic loads. Applications of classical, numerical, and shock spectrum methods to problems in engineering seismology, blast resistance, shock and vibration isolation, and impact, including linear and nonlinear effects.</p> <p>Recommendations: CEE 105 and 106.</p>				

<b>109681</b>	<b>Advanced Structural Design</b>			
Subject:	Catalog Nbr:			
CEE	0228			
<p>Please see departmental website for detailed course description.</p> <p>Recommendations: Consent of instructor</p>				

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<b>109688</b>	<b>Principles Of Controlled Release And Drug Delivery</b>			
Subject:	Catalog Nbr:			
BME	0165			
2017 FALL	Primary	Anthony Barry		Anthony.Barry@tufts.edu
<p>Fundamentals of drug product development and formulation with particular emphasis on novel and developing technologies for controlled release and drug delivery for biopharmaceuticals. Course includes coverage of formulation principles and discussion of the interplay between physiology, pathophysiology and dosage form development, pharmacokinetics, and novel materials used in controlled release.</p> <p>Recommendations: CHEM 1 or 16, BIO 13 or ES 11, ES 2, and MATH 34 (formerly MATH 12), or permission.</p>				

<b>109702</b>	<b>Digital Logic Systems W/lab</b>			
Subject:	Catalog Nbr:			
EE	0026			
2018 SPRG	Primary	Chorng Chang		chorng.chang@tufts.edu
<p>Integrated circuit logic families and their characteristics. Review of combinatorial and sequential design using SSI devices. Arithmetic circuits, shift registers, and counters. Random access and read only memories. Design of memory systems. Waveshaping devices and display devices. Programmable logic arrays and their applications. Asynchronous and synchronous system design using MSI and LSI devices. Finite state machines and the specification of system controllers. Systematic approaches to controller realization. Associated laboratory work. Spring.</p> <p>Recommendations: ES 4 and EE 14, or permission.</p>				

<b>109704</b>	<b>Reactive Transport In Porous Media</b>			
Subject:	Catalog Nbr:			
CEE	0230			
2017 SPRG	Primary	Linda Abriola		Linda.Aabriola@tufts.edu
<p>The fundamental processes governing component transported in porous media. Volume averaging, dispersion, reactive transport, non-linear and non-equilibrium sorption, anomalous transport, mass transfer, multiphase flow and transport. Theoretical foundation on which to base critical assessments of component transport in complex porous media. Spring (alternating years).</p> <p>Recommendations: CEE 213 or consent of instructor.</p>				

<b>109717</b>	<b>Junior Design Project</b>			
Subject:	Catalog Nbr:			
EE	0031			
2018 SPRG	Primary	Ronald Lasser		Ron.Lasser@tufts.edu
<p>Junior level team project with ECE faculty direction and guidance. Introduction of the engineering method: concept, planning and analysis, design, test. Integration of theoretical concepts from circuit theory, digital and analog electronics, signal processing, engineering economics, and engineering design practices to deliver a</p>				

# Course Bulletin

working prototype. Use of microcontroller and peripherals, analog-to-digital converters, digital signal-processors, memory and computer aided design tools. Students are expected to provide schedules, schematics and specifications; build prototypes; present their projects orally; and deliver a working system. Pre-reqs: EE or Comp-Eng Majors. EE 14, EE 21, EE 22 and EE 23 or permission of instructor

<b>109730</b>	<b>Biology of Water &amp; Health</b>			
Subject:	Catalog Nbr:			
CEE	0251			
2017 FALL	Primary	David Gute		david.gute@tufts.edu

<b>109743</b>	<b>Computer Interface Design</b>			
Subject:	Catalog Nbr:			
BME	0166			
2017 SPRG	Primary	Michael Wiklund		michael.wiklund@tufts.edu
2018 SPRG	Primary	Jonathan Tilliss		Jon.Tilliss@tufts.edu
<p>(Cross-listed as ENP 166.) This hands-on course challenges students to design computer-based products and systems that are easy to learn and use. Lectures cover the user interface-design process, basic design principles, and design evaluation methods. In-class exercises and projects reinforce the students' understanding of the lecture material and provide practical design experience. Students use computer-based prototyping tools to model and demonstrate their design solutions. Frequent guest lectures by user-interface design specialists from industry.</p> <p>Recommendations: EN 1, 2, and junior standing, or permission of instructor.</p>				

<b>109751</b>	<b>Laboratory And In-situ Measurement Of Soil Property</b>			
Subject:	Catalog Nbr:			
CEE	0244			
2017 FALL	Primary	John Germaine		John.Germaine@tufts.edu
<p>In-depth study of various laboratory and in-situ tests used to measure the shear strength, compressibility, and permeability of soils. Laboratory work includes index, consolidation, and triaxial tests. Field tests discussed include SPT, cone, vane, pressuremeter, and dilatometer. Discussion of methods used to process laboratory and field data. Report writing and hands-on laboratory testing.</p> <p>Recommendations: CEE 42.</p>				

<b>109757</b>	<b>Introduction To Biomedical Engineering</b>			
Subject:	Catalog Nbr:			
EE	0050			
<p>(Cross-listed as BME 50.) An introduction to the interdisciplinary nature of biomedical engineering. The biological, chemical, electrical, and mechanical principles involved in the design and operation of medical devices. Biopotentials, electrodes, transducers, biocompatibility of materials, and patient safety. Fall.</p>				



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Recommendations: PHY 2 or PHY 12, or permission of instructor.

<b>109773</b>	<b>Biotechnology Processing Projects Lab</b>			
Subject:	Catalog Nbr:			
BME	0168			
2018 SUMR	Primary	Hyunmin Yi		Hyunmin.Yi@tufts.edu
(Cross-listed as CHBE 168 and BIO 168.) Laboratory experience with techniques in biotechnology processing: fermentation of recombinant E. coli cells, hybridoma cell culture, purification of protein and antibodies and related analytical procedures. Laboratories accompanied by lectures and relevant readings to cover the underlying principles.				

<b>109782</b>	<b>Corporate Management Of Environmental Issues</b>			
Subject:	Catalog Nbr:			
CEE	0265			
2017 FALL	Primary	Ann Rappaport		ann.rappaport@tufts.edu
(Cross-listed as UEP 265 and ENV 265.) Explores companies' responses to pressure from stockholders, regulatory agencies, community and nongovernmental organizations to exercise greater responsibility toward the environment. Topics include strategy, staffing and organization, decision making, codes of conduct, resources, program development, product responsibility, pollution prevention, trade associations, and foreign operations.				

<b>109786</b>	<b>Seminar</b>			
Subject:	Catalog Nbr:			
EE	0092			
An undergraduate course devoted to the study of the special problems in electrical engineering. Credit as arranged. Please see departmental website for specific details.				

<b>109798</b>	<b>Seminar In Biotechnology</b>			
Subject:	Catalog Nbr:			
BME	0169			
(Cross-listed as CHBE169 and BIO 169.) Seminar course. Journal articles on current biotechnology-related research are reviewed and presented. Leading researchers in the field present seminars and students assess future research directions based on in-depth review of articles and presentations. Please see departmental website for specific details: <a href="http://ase.tufts.edu/biology/">http://ase.tufts.edu/biology/</a>				

<b>109799</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
EE	0093			
2016 FALL	Primary	Soha Hassoun		soha.hassoun@tufts.edu

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2017 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
Guided independent study of an approved topic. Credit as arranged. Please see departmental website for specific details.			

<b>109812</b>	<b>Special Topics</b>		
Subject:	Catalog Nbr:		
EE	0094		
2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu
Guided independent study of an approved topic. Credit as arranged. Please see departmental website for specific details.			

<b>109825</b>	<b>Tissue Engineering Research Laboratory</b>		
Subject:	Catalog Nbr:		
BME	0175		
2017 FALL	Primary	Bruce Panilaitis	bruce.panilaitis@tufts.edu
To gain hands-on experience in the field of tissue engineering by preparing and characterizing scaffold biomaterials, expansion and handling human adult stem cell, preparation and use of bioreactors and assembling a functional system to grow a tissue. In addition, safety, ethical, and general laboratory protocol issues are covered.			

<b>109827</b>	<b>Subsurface Fluid Dynamics</b>		
Subject:	Catalog Nbr:		
CEE	0287		
2017 FALL	Primary	Grant Garven	Grant.Garven@tufts.edu
(Cross-listed as EOS 287-formerly GEO 287). Advanced theory in groundwater hydrology. Topics include: hydrodynamics of groundwater flow; Darcy's Law in porous sediments and fractured rocks; fluid potential; flow nets and hodographs; vorticity of inhomogeneous fluids; physics of the unsaturated zone; two-phase flow in petroleum reservoirs and carbon sequestration; flow in deforming media; aqueous mass transport in reactive formations; fluid and heat transport in geothermal reservoirs. Recommendations: MATH 51 (formerly MATH 38) and ES 8, or equivalents			

<b>109844</b>	<b>Special Projects</b>		
Subject:	Catalog Nbr:		
EE	0095		
Undergraduate research under supervision of a member of the department. Credit as arranged. Please see			

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departmental website for specific details.

<b>109848</b>	<b>Introduction Biomedical Devices</b>			
Subject: BME	Catalog Nbr: 0180			
An introduction to the principles and applications of biomedical microdevices, with emphasis on miniaturization and the integration of diverse, leading-edge technologies to produce devices and systems for medical diagnosis and therapy. Basic principles of optics, electronics, mechanics, and microfluidics are explored as they apply to the development of new bioMEMS, fiberoptic, and electronic devices for sensing, data acquisition, and analysis. Discussions are to include micro-devices for hearing, endoscopy, imaging, and various clinical and diagnostic applications.				

<b>109857</b>	<b>Master's Seminar</b>			
Subject: CEE	Catalog Nbr: 0291			
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu	
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu	
Presentation of individual reports on basic topics to a seminar group for discussion and criticism. Please see departmental website for specific details.				

<b>109875</b>	<b>Drug Product Formulation</b>			
Subject: BME	Catalog Nbr: 0185			
2018 SPRG	Primary	Bernardo Perez-Ramirez	Bernardo.Perez_Ramirez@tufts.edu	
(Cross-listed as CHBE 185). Drug Product Formulation.				

<b>109878</b>	<b>Special Projects</b>			
Subject: EE	Catalog Nbr: 0096			
Undergraduate research under supervision of a member of the department. Credit as arranged. Please see departmental website for specific details.				

<b>109879</b>	<b>Graduate Seminar</b>			
Subject: CEE	Catalog Nbr: 0292			
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	

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2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu
Presentation of individual reports on basic topics to a seminar group for discussion and criticism. Credit as arranged. Please see departmental website for specific details.			
Recommendations: Consent of instructor			

<b>109909</b>	<b>Senior Design Project</b>		
Subject:	Catalog Nbr:		
EE	0097		
2017 FALL	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
A comprehensive design project undertaken during the senior year, individually or as a team, under the guidance of a faculty supervisor. The work is spread over two terms. Please see departmental website for specific details.			
Pre Requisites: EE 31 or equivalent or permission of instructor.			

<b>109926</b>	<b>Special Topics</b>		
Subject:	Catalog Nbr:		
CEE	0293		
2016 FALL	Primary	Laurie Baise	laurie.baise@tufts.edu
2016 FALL	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2017 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2017 SPRG	Primary	Stephen Levine	stephen.levine@tufts.edu
2017 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
2017 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
2017 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
2017 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
2017 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu
2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
2018 SPRG	Primary	Grant Garven	Grant.Garven@tufts.edu
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
Topical courses offered within civil and environmental engineering.			

<b>109965</b>	<b>Senior Design Project</b>		
Subject:	Catalog Nbr:		
EE	0098		
2018 SPRG	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
A comprehensive design project undertaken during the senior year, individually or as a team, under the guidance of a faculty supervisor. The work is spread over two terms. Please see departmental website for specific details.			

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Recommendations: Senior standing and permission of instructor and EE 97.

109970		Master's Thesis			
Subject:	Catalog Nbr:				
CEE	0295				
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu		
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu		
2018 SPRG	Primary	David Gute	david.gute@tufts.edu		
2018 SPRG	Primary	John Durant	john.durant@tufts.edu		
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu		
2018 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu		
2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu		
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu		
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu		
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu		
2018 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu		
2018 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu		
2018 SPRG	Primary	Linda Abriola	Linda.Aabriola@tufts.edu		
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu		
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu		
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu		
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu		
2018 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu		
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu		
2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu		
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu		
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu		
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu		
2018 SPRG	Primary	Amy Pickering	Amy.Pickering@tufts.edu		
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu		
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu		
Guided research on a topic that has been approved as a suitable subject for a master's thesis. Required: Consent of instructor.					

109987		Master's Thesis II			
Subject:	Catalog Nbr:				
CEE	0296				
2017 SPRG	Primary	Lewis Edgers	lewis.edgers@tufts.edu		
2017 SPRG	Primary	Stephen Levine	stephen.levine@tufts.edu		
2017 SPRG	Primary	Richard Vogel	richard.vogel@tufts.edu		
2017 SPRG	Primary	Elena Naumova	elena.naumova@tufts.edu		
2017 SPRG	Primary	Grant Garven	Grant.Garven@tufts.edu		

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2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu
2018 SPRG	Primary	David Gute	david.gute@tufts.edu
2018 SPRG	Primary	John Durant	john.durant@tufts.edu
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu
2018 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu
2018 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu
2018 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu
2018 SPRG	Primary	Linda Abriola	Linda.Aabriola@tufts.edu
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
2018 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu
2018 SPRG	Primary	Amy Pickering	Amy.Pickering@tufts.edu
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu

Guided research on a topic that has been approved as a suitable subject for a master's thesis. Required: CEE 295 and consent of instructor.

110024	Doctoral Thesis II			
Subject:	Catalog Nbr:			
CEE	0298			
2017 SPRG	Primary	Lewis Edgers	lewis.edgers@tufts.edu	
2017 SPRG	Primary	Stephen Levine	stephen.levine@tufts.edu	
2017 SPRG	Primary	Richard Vogel	richard.vogel@tufts.edu	
2017 SPRG	Primary	Elena Naumova	elena.naumova@tufts.edu	
2017 SPRG	Primary	Grant Garven	Grant.Garven@tufts.edu	
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu	
2018 SPRG	Primary	David Gute	david.gute@tufts.edu	
2018 SPRG	Primary	John Durant	john.durant@tufts.edu	
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu	
2018 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu	

# Course Bulletin

2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu
2018 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu
2018 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu
2018 SPRG	Primary	Linda Abriola	Linda.Abriola@tufts.edu
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
2018 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu
2018 SPRG	Primary	Amy Pickering	Amy.Pickering@tufts.edu
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu

Guided research on a topic suitable for a doctoral dissertation. Required: CEE 297 and consent of instructor.

110039	Undergraduate Internship In Electrical Engineering			
Subject:	Catalog Nbr:			
EE	0099			
2018 SPRG	Primary	Alva Couch	alva.couch@tufts.edu	
2018 SUMR	Primary	Karen Panetta	Karen@eecs.tufts.edu	
2018 SUMR	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
2018 SUMR	Primary	Chorng Chang	chorng.chang@tufts.edu	
2018 SUMR	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
2018 SUMR	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2018 SUMR	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2018 SUMR	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
2018 SUMR	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
2018 SUMR	Primary	Eric Miller	Eric.Miller@tufts.edu	
2018 SUMR	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
2018 SUMR	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
2018 SUMR	Primary	Usman Khan	Usman.Khan@tufts.edu	
2018 SUMR	Primary	Brian Tracey	brian.tracey@tufts.edu	
2018 SUMR	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2018 SUMR	Primary	Mai Vu	Mai.Vu@tufts.edu	

Supervised internships at suitable locations in industry and government. Jobs offered on basis of availability. Term paper required. Credit not given retroactively. Prior arrangements necessary.

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<b>110042</b>		<b>Doctoral Thesis III</b>		
Subject:	Catalog Nbr:			
CEE	0299			
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu	
2018 SPRG	Primary	David Gute	david.gute@tufts.edu	
2018 SPRG	Primary	John Durant	john.durant@tufts.edu	
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu	
2018 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu	
2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu	
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu	
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu	
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu	
2018 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu	
2018 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu	
2018 SPRG	Primary	Linda Abriola	Linda.Abriola@tufts.edu	
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu	
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu	
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu	
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu	
2018 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu	
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu	
2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu	
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu	
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu	
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu	
2018 SPRG	Primary	Amy Pickering	Amy.Pickering@tufts.edu	
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu	
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu	
Guided research on a topic suitable for a doctoral dissertation. Required: CEE 298 and consent of instructor.				

<b>110067</b>		<b>Non Major Credit</b>		
Subject:	Catalog Nbr:			
CEE	0310			

<b>110073</b>		<b>Design Of Medical Instrumentation</b>		
Subject:	Catalog Nbr:			
EE	0100			
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	



# Course Bulletin

(Cross-listed as BME 100.) An introduction to the design principles of microprocessor-based medical instrumentation and simple biomedical signal analysis. Topics include the origin of bioelectric potentials, characteristics of various biological signals, transducers, A/D converters, analog and digital filters, instrumentation amplifiers, patient isolation, battery powered equipment, and microprocessor design. Each student will be required to complete a paper design of a biomedical instrument. Spring.  
Recommendations: ES 3.

<b>110097</b>	<b>Lower Level Elective Crd</b>		
Subject:	Catalog Nbr:		
CEE	0320		

<b>110117</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
BME	0193			
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 FALL	Primary	Janet Krevolin	Janet.Krevolin@tufts.edu	
2017 FALL	Primary	Jean-Michel Molenaar	Jean-Michel.Molenaar@tufts.edu	
2017 FALL	Primary	Skander Limem	Skander.Limem@tufts.edu	
2017 FALL	Primary	Hoda Koushyar	Hoda.Koushyar@tufts.edu	
Guided study of an approved topic. Credit as arranged.				

<b>110120</b>	<b>Upper Level Crd</b>		
Subject:	Catalog Nbr:		
CEE	0330		

<b>110137</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
BME	0194			
2018 SPRG	Primary	Gregory Altman	gregory.altman@tufts.edu	
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	

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2018 SPRG	Primary	Anh Quynh Hoang	Anh.Hoang@tufts.edu
2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu
2018 SPRG	Primary	Steven Jacques	Steven.Jacques@tufts.edu

Guided study of an approved topic. Credit as arranged. Please see departmental website for details.

<b>110141</b>	<b>Master's Degree Continuation-pt</b>		
Subject:	Catalog Nbr:		
CEE	0401		
Part-time.Please see departmental website for specific details.			

<b>110161</b>	<b>Optics And Wave Motion</b>		
Subject:	Catalog Nbr:		
BME	0215		
2016 FALL	Primary	Cristian Staii	Cristian.Staii@tufts.edu
2017 FALL	Primary	Gary Goldstein	gary.goldstein@tufts.edu
(Cross-listed as PHY 31). Propagation of electromagnetic waves; geometrical optics; polarization; optical properties of metals, insulators, and semiconductors; Fraunhofer and Fresnel diffraction; interference; Fourier optics. Lectures and laboratories. Recommendations: PHY 2 or 2N or 12 or 12N. Corequisite: MATH 42 (formerly MATH 13)			

<b>110187</b>	<b>Master's Degree Continuation-ft</b>		
Subject:	Catalog Nbr:		
CEE	0402		
Full-time.Please see departmental website for specific details.			

<b>110203</b>	<b>Principles Of Biomedical Engineering</b>		
Subject:	Catalog Nbr:		
BME	0250		
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
(Cross-listed as EE 250). The role of biomedical engineering in the diagnosis and treatment of various pathologies such as cardiovascular disease, cancer, diabetes, and neurological disorders. For each disease model, biomedical engineering principles are used to examine the function of the organ, mechanisms of the disease, diagnostic tools, and treatment approaches. Covered biomedical engineering areas include biomaterials, implantable devices, bioimaging techniques, gene therapy, and biosensors. Recommendations: ES 121 or equivalent, or permission of instructor.			

<b>110221</b>	<b>Graduate Teaching Assistant</b>		
Subject:	Catalog Nbr:		

# Course Bulletin

CEE 0405

Please see departmental website for specific details.

110231	Graduate Introduction To Biophotonics			
Subject: BME	Catalog Nbr: 0251			
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2018 SPRG	Secondary	Martin Hunter	Martin.Hunter@tufts.edu	
A graduate-level version of BME 51. Additional homework problems and a term paper are required for graduate level credit. Recommendations: PHY 31, or BME 215, or permission of instructor. Graduate students only.				

110242	Graduate Research Assistant			
Subject: CEE	Catalog Nbr: 0406			
Please see departmental website for specific details.				

110281	Graduate Quantitative Biomaterials Characterization Laboratory I			
Subject: BME	Catalog Nbr: 0256			
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 FALL	Primary	Martin Hunter	Martin.Hunter@tufts.edu	
(SPRING 2013 & BEYOND). Graduate quantitative biomaterials characterization laboratory I. A graduate version of BME 56 including BME56 topics and weekly journal club meetings focused on critical reviews of current biophotonics articles.				

110292	Doctoral Degree Continuation-pt			
Subject: CEE	Catalog Nbr: 0501			
Part-time. Please see departmental website for specific details.				

110334	Introduction To Vlsi Design			
Subject: EE	Catalog Nbr: 0103			
2017 FALL	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
An introduction to CMOS VLSI design. Topics include the structure of the MOS transistor, theory of operation, fabrication methods, CMOS circuit design, subsystem design, the PLA and finite state machines, introduction to memory design, system timing techniques. Students will design a circuit of modest complexity. Recommendations: Senior standing or permission of instructor.				

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<b>110340</b>	<b>Graduate Quantitative Biomaterials Characterization Laboratory II</b>			
Subject:	Catalog Nbr:			
BME	0257			
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 SPRG	Primary	Martin Hunter	Martin.Hunter@tufts.edu	
<p>A graduate version of BME 57 including BME57 topics and weekly journal club meetings focused on critical reviews of current biophotonics articles.</p> <p>Recommendations: BME 56, or BME 256. Graduate students only.</p>				

<b>110348</b>	<b>Doctoral Degree Continuation-ft</b>			
Subject:	Catalog Nbr:			
CEE	0502			
Full-time.Please see departmental website for specific details.				

<b>110360</b>	<b>Graduate Seminar</b>			
Subject:	Catalog Nbr:			
BME	0291			
2016 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu	
<p>Biomedical engineering seminar series and presentation of individual reports to a seminar group for discussion. Credit as arranged.</p>				

<b>110369</b>	<b>Probabilistic Systems Analysis</b>			
Subject:	Catalog Nbr:			
EE	0104			
2016 FALL	Primary	Eric Miller	Eric.Miller@tufts.edu	
2017 FALL	Primary	Brian Aull	Brian.Aull@tufts.edu	
<p>Advanced analysis in probabilistic systems with strong emphasis on theoretical methods. Development of analytical tools for the modeling and analysis of random phenomena with application to problems across a range of engineering and applied science disciplines. Probability theory, sample and event spaces, discrete and continuous random variables, conditional probability, expectations and conditional expectations, and derived distributions. Sums of random variables, moment generating functions, central limit theorem, laws of large numbers. Statistical analysis methods including hypothesis testing, confidence intervals and nonparametric methods. Undergraduates may not take both EE 0024 and EE 0104 for degree credit. Prerequisite: Math 0042 or equivalent.</p> <p>Recommendation: Senior or graduate standing or consent of instructor.</p>				

<b>110409</b>	<b>Graduate Seminar</b>			
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# Course Bulletin

Subject: BME	Catalog Nbr: 0292			
2017 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Biomedical engineering seminar series and presentation of individual reports to a seminar group for discussion. Credit as arranged.				

<b>110437</b>	<b>Special Topics</b>			
Subject: BME	Catalog Nbr: 0293			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu	
Guided individual study of an approved topic. Credit as arranged.				

<b>110444</b>	<b>Feedback-control Systems</b>			
Subject: EE	Catalog Nbr: 0105			
2017 FALL	Primary	Usman Khan	Usman.Khan@tufts.edu	
Modern control and fundamentals of state-feedback including matrix differential equations, controllability, state transformations, canonical forms, and control matrix design. Classical control and output-feedback with topics including transfer functions, s-plane analysis, stability criteria, PID controllers, root locus, controller design using op-amps, and compensation networks. Prerequisite: EE23 and Math 70; OR graduate standing				

<b>110453</b>	<b>Special Topics</b>			
Subject: BME	Catalog Nbr: 0294			
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	

# Course Bulletin

2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu
Guided individual study of an approved topic. Credit as arranged.			

<b>110472</b>	<b>Master's Thesis</b>		
Subject: BME	Catalog Nbr: 0295		
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu
2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu
Guided research on an approved topic suitable for a master's thesis. Credit as arranged.			

<b>110493</b>	<b>Advanced Feedback-control Systems</b>		
Subject: EE	Catalog Nbr: 0106		
A continuation of EE 105. Topics include an introduction to digital control systems, difference equations, the Z-transform, implementation of the discrete filter, the W-transform, stability of sample-data systems, an introduction to state-space concepts and the control of multivariable systems. Spring. Recommendations: EE 105.			

<b>110513</b>	<b>Master's Thesis</b>		
Subject: BME	Catalog Nbr: 0296		
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu
2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu
2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu
2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu
Guided research on an approved topic suitable for a master's thesis. Credit as arranged.			

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<b>110537</b>		<b>Doctoral Thesis</b>			
Subject:	Catalog Nbr:				
BME	0297				
	2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
	2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
	2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
	2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
	2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
	2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu	
	2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
	2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
	2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu	
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged.					

<b>110573</b>		<b>Doctoral Thesis</b>			
Subject:	Catalog Nbr:				
BME	0298				
	2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
	2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
	2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
	2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
	2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
	2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
	2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
	2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
	2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged.					

<b>110627</b>		<b>Master Of Engineering Project</b>			
Subject:	Catalog Nbr:				
BME	0299				
	2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
	2018 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
	2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
	2018 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
	2018 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
	2018 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
	2018 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
	2018 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
	2018 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	

# Course Bulletin

Execution of a major project equivalent to one course credit under the guidance of a faculty adviser. Each project must address a substantive engineering analysis or design problem. Students are required to submit a written report and make an oral presentation of their project work. Students are expected to enroll in this course in the last term of their degree program. Enrollment is limited to and required for matriculated students in the master of engineering program.

Recommendations: Enrollment is limited to and required for matriculated students in the master of engineering program.

<b>110652</b>	<b>Communications Systems</b>			
Subject:	Catalog Nbr:			
EE	0107			
2017 FALL	Primary	Mai Vu		Mai.Vu@tufts.edu
<p>Fundamentals of analog and digital communication systems. Analog and digital modulations, including AM, FM, pulse code modulation, PAM, PSK, QAM techniques. Effects of noise and transmission medium on communication performance via the signal-to-noise ratio, bit error rate and inter-symbol interference. Concept of channel capacity. Associated laboratory work and design project.</p> <p>Prerequisites: EE23, EE24</p>				

<b>110660</b>	<b>Non Major Credit</b>			
Subject:	Catalog Nbr:			
BME	0310			

<b>110688</b>	<b>Wireless Communications</b>			
Subject:	Catalog Nbr:			
EE	0108			
2018 SPRG	Primary	Mai Vu		Mai.Vu@tufts.edu
<p>Wireless propagation characteristics, path loss, shadowing and fading; statistical channel models; wireless channel capacity; fading and diversity techniques, multiple antenna and MIMO techniques, multicarrier and OFDMA techniques; multiuser systems, cellular and ad hoc wireless networks.</p> <p>Prerequisites: EE107 or equivalent, EE104 or equivalent</p>				

<b>110710</b>	<b>Lower Level Elective Crd</b>			
Subject:	Catalog Nbr:			
BME	0320			

<b>110747</b>	<b>Upper Level Elective Crd</b>			
Subject:	Catalog Nbr:			



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BME	0330
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110815	Master's Continuation			
Subject: BME	Catalog Nbr: 0401			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu	
Master's Continuation - Part Time				

110867	Master's Continuation			
Subject: BME	Catalog Nbr: 0402			
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Full-time.				

110902	Grad Teaching Assistant			
Subject: BME	Catalog Nbr: 0405			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu	

# Course Bulletin

2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu

<b>110929</b>	<b>Grad Research Assistant</b>			
Subject:	Catalog Nbr:			
BME	0406			
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	

<b>110955</b>	<b>Doctoral Continuation - Part Time</b>			
Subject:	Catalog Nbr:			
BME	0501			
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	
2017 SPRG	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu	
2017 SPRG	Primary	Lauren Black III	Lauren.Black@tufts.edu	
2017 SPRG	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
2017 SPRG	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu	
2017 SPRG	Primary	Brian Timko	Brian.Timko@tufts.edu	
Doctoral Continuation - Part Time				

<b>110988</b>	<b>Doctoral Continuation - Full Time</b>			
Subject:	Catalog Nbr:			
BME	0502			
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu	

# Course Bulletin

2017 FALL	Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2017 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu
2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu
Full-time doctoral continuation.			

<b>111244</b>	<b>Semiconductor Devices</b>			
Subject:	Catalog Nbr:			
EE	0113			
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2018 SPRG	Primary	Brian Aull	Brian.Aull@tufts.edu	
<p>Introduction to semiconductor physics; quantum mechanics, equilibrium distribution; charge transport; P-N junction theory; diodes; bipolar junction transistors; field-effect devices; heterojunction devices; novel semiconductor devices such as carbon nanotubes.</p> <p>Recommendations: EE 21 and MATH 51 (formerly MATH 38).</p>				

<b>111296</b>	<b>Entrepreneurship And Business Planning</b>			
Subject:	Catalog Nbr:			
ELS	0101			
2017 FALL	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu	
2017 FALL	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu	
2018 SPRG	Primary	Tina Weber	Tina.Weber@tufts.edu	
2018 SPRG	Primary	Lana Caron	Lana.Caron@tufts.edu	
<p>This course focuses on investigating, understanding, and implementing the process of founding a start-up firm. Elements of searching out new venture opportunities, matching skills with a new venture, financing, competitive strategy, intellectual property, and operating a new venture will be explored. The focus of the course will be the development and presentation of a business plan created by teams of students with various academic backgrounds.</p>				

<b>111335</b>	<b>Entrepreneurial Finance</b>			
Subject:	Catalog Nbr:			
ELS	0103			
2018 SPRG	Primary	Alicia Amaral	Alicia.Amaral@tufts.edu	
2018 SPRG	Primary	Frank Apeseche	Frank.Apeseche@tufts.edu	
<p>This course focuses on understanding how to construct the data and find appropriate financing for a startup venture. Various forms of financing are introduced: vendor financing, factoring, etc. Through a medley of tests, case studies, and team exercises, students exercise basic financial skills such financial statement formulation, NPV analysis and scenario analysis. The course focuses as much attention on how to reject a bad idea as support a good one.</p> <p>Recommended: at least one core ELS class or accounting elective</p>				

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111371	Entrepreneurial Marketing			
Subject: ELS	Catalog Nbr: 0105			
	2018 SPRG	Primary	John Derby	John.Derby@tufts.edu
	2018 SPRG	Primary	Gavin Finn	Gavin.Finn@tufts.edu
<p>This course focuses on institutional and product marketing methods used by start-up to medium-sized companies. After an overview of basic marketing principles, the course will cover the spectrum from day-to-day marketing activities of the entrepreneurial business to positioning and strategy. Students will learn to analyze, formulate, and implement marketing strategies, explore concepts for understanding customer behavior and creating entrepreneurial marketing strategy, and learn the fundamentals of market research, pricing, and reaching and selling to customers.</p>				

111394	Entrepreneurial Leadership			
Subject: ELS	Catalog Nbr: 0107			
	2017 SPRG	Primary	Roger Patkin	Roger.Patkin@tufts.edu
	2018 SPRG	Primary	Pamela Stepp	Pamela.Stepp@tufts.edu
	2018 SPRG	Primary	Elizabeth McCarthy	Elizabeth.McCarthy@tufts.edu
<p>This course is designed to help students develop the knowledge, confidence, skills, and self-image necessary to pursue entrepreneurial ventures in such domains as business, government, and public service. It provides a foundation in the fundamentals of entrepreneurial leadership, as well as a source of inspiration and energy in the art and science of taking visions and bringing them to reality.</p>				

111412	Introduction Microwaves			
Subject: EE	Catalog Nbr: 0117			
	2017 FALL	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
<p>Transmission and reflection of guided waves. The Smith chart and matching. Scattering parameters and flow graphs. Biological effects. Laboratory measurement of power, frequency, attenuation, Q-factor, and time-domain reflectometry. Fall. Recommendations: EE 18, or 13 and permission of instructor.</p>				

111425	Innovative Social Enterprises			
Subject: ELS	Catalog Nbr: 0141			
	2018 SPRG	Primary	Julianne Zimmerman	Julianne.Zimmerman@tufts.edu
<p>(Cross-listed as AMER 141 &amp; TCS 141) Social entrepreneurs bring innovative, practical solutions to social problems. Entrepreneurs are opportunity oriented, resourceful, value-creating change agents. Social entrepreneurs are similar, but they focus on public problems. Students will consider the role of social</p>				

# Course Bulletin

enterprises in improving society, and learn to develop a business plan to create enduring social impact: Identify social impact model, plan needed activities and resources, conduct market research and create a marketing plan, build a team, prepare a financial model, and create a plan to attract the support the mission requires. Recommendations: Sophomore standing.

<b>111441</b>	<b>Special Topics</b>			
Subject: ELS	Catalog Nbr: 0193			
2016 FALL	Primary	Inge Milde	No Email on file.	
2017 FALL	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu	
2018 SPRG	Primary	Scott Warren	Scott.Warren@tufts.edu	
Special Topics. Please see departmental website for specific details. Recommended: at least one core ELS class or accounting elective				

<b>111448</b>	<b>Microwave Semiconductor Devices And Circuits</b>			
Subject: EE	Catalog Nbr: 0118			
2017 FALL	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
Varistor and varactor diodes, PIN diodes, microwave transistors, negative resistance devices. Gallium arsenide properties and technology. Receiving mixers, transmitting modulators, amplifiers, oscillators, switches, limiters, duplexers, phase shifters, and harmonic generators. Laboratory characterization of devices and circuits, including noise measurements. Spring. Recommendations: EE 117 or permission of instructor.				

<b>111461</b>	<b>Special Topics</b>			
Subject: ELS	Catalog Nbr: 0194			
2017 FALL	Primary	Nancy Lippe	Nancy.Lippe@tufts.edu	
2017 FALL	Primary	Tina Weber	Tina.Weber@tufts.edu	
2017 FALL	Primary	Steven Koltai	Steven.Koltai@tufts.edu	
2017 SPRG	Primary	Inge Milde	No Email on file.	
2017 SPRG	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu	
2017 SPRG	Primary	Roger Patkin	Roger.Patkin@tufts.edu	
2018 SPRG	Primary	Partha Ghosh	Partha.Ghosh@tufts.edu	
2018 SPRG	Primary	John Derby	John.Derby@tufts.edu	
2018 SPRG	Primary	Gavin Finn	Gavin.Finn@tufts.edu	
2018 SPRG	Primary	Christopher Manos	Christopher.Manos@tufts.edu	
2018 SPRG	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu	
Special Topics. Please see departmental website for specific details.				

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<b>111478</b>	<b>Entrepreneurial Fieldstudy</b>			
Subject: ELS	Catalog Nbr: 0199			
	2018 SPRG	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu
<p>This course enables students to apply the learning and skills acquired by other courses on entrepreneurship. Students have the option of starting a new business based on an actual business plan or consulting in an actual start-up operation. Students who select the new business option will be expected to submit a project-scope paper that outlines the elements of the launch that could be accomplished within the term limits.</p>				

<b>111499</b>	<b>Non Major Credit</b>			
Subject: ELS	Catalog Nbr: 0310			

<b>111514</b>	<b>Lower Level Elective Crd</b>			
Subject: ELS	Catalog Nbr: 0320			

<b>111531</b>	<b>Upper Level Elective Crd</b>			
Subject: ELS	Catalog Nbr: 0330			

<b>111575</b>	<b>Engineering Management</b>			
Subject: EM	Catalog Nbr: 0051			
	2018 SPRG	Primary	Monica Pheifer	Monica.Pheifer@tufts.edu
	2018 SPRG	Primary	Jennifer Braggin	Jennifer.Braggin@tufts.edu
<p>Organization of companies and engineering groups. Financial fluency, including time value of money, return on investment, income and cash flow statements, and balance sheets. Management of people and organizations. Project and program management techniques and tools. Management of research, development, and design. Operations management, including manufacturing operations and supply chains.</p>				

<b>111589</b>	<b>Technical &amp; Managerial Communication</b>			
Subject: EM	Catalog Nbr: 0052			
	2018 SPRG	Primary	Amy Hirschfeld	amy.hirschfeld@tufts.edu

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Written and oral communications in the business setting. Written communications including technical reports and papers, memoranda, and electronic communications. Design and delivery of effective presentations. Informal communication styles and techniques. Communication across cultures.

<b>111606</b>	<b>Engineering Leadership</b>			
Subject: EM	Catalog Nbr: 0054			
	2018 SPRG	Primary	Annette Sawyer	Annette.Sawyer@tufts.edu
Development of knowledge, skills, and mindset essential for leading programs and teams in a business organization. Topics include understanding personalities of self and others, emotional intelligence, creating high performance teams, influencing without authority, managing conflict, fostering creativity, creating shared visions, and organizational change. Communicating to inspire. Cultural differences in leadership style. Ethical considerations.				

<b>111626</b>	<b>Management Of Innovation</b>			
Subject: EM	Catalog Nbr: 0153			
	2017 FALL	Primary	Samuel Ligero	Samuel.Ligero@tufts.edu
	2017 SPRG	Primary	Anna Thornton	No Email on file.
	2018 SPRG	Primary	Eli Cushner	Eli.Cushner@tufts.edu
Knowledge and skill development for students who aspire to lead and manage innovation initiatives in technology based companies. Technology strategy and its role in the overall business strategy of commercial firms. Role of innovation in entrepreneurial ventures and established firms. Skills to present new product development proposals to senior management and/or prospective investors.				

<b>111642</b>	<b>Quantitative Methods for Data-Driven Design</b>			
Subject: EM	Catalog Nbr: 0210			
	2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
	2017 FALL	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Application-oriented engineering tools and techniques, including data analysis, simulations and modeling, statistical process control, and experimental design.				

<b>111662</b>	<b>Developing Winning Projects</b>			
Subject: EM	Catalog Nbr: 0220			
	2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
	2017 FALL	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
In depth treatment of both business and technical aspects of new product development, including voice of the customer, concept generation and evaluation, marketing, supply chain, intellectual property and usability.				

# Course Bulletin

<b>111692</b>	<b>Computer Animation For Technical Communications</b>			
Subject: EE	Catalog Nbr: 0120			
<p>Create 2-D and 3-D animations to present and analyze complex scientific topics. Examples include NASA visualizations of atmospheric data and aerospace design mathematics of 3-D space, rotation, and displacement. Rendering algorithms including Phong, Garoud, and Ray Tracing. Hands-on experience in animation and graphic development, including manipulation of scanned images, storyboarding, video production, and CD-ROM technology. Computer-based lectures augmented with major animation and CD-ROM projects. Fall.</p> <p>Recommendations: COMP 11.</p>				

<b>111726</b>	<b>Project &amp; Operations Management</b>			
Subject: EM	Catalog Nbr: 0230			
	2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
	2017 FALL	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
<p>Series of modules providing best practices in project management, operations management, supply chain, and an introduction to finance and accounting.</p>				

<b>111783</b>	<b>Physiology For Engineers I</b>			
Subject: EE	Catalog Nbr: 0121			
	2016 FALL	Primary	Lauren Black III	Lauren.Black@tufts.edu
	2017 FALL	Primary	Brian Timko	Brian.Timko@tufts.edu
<p>(Cross-listed as BME 121). Coursework designed for students interested in advanced work in biomedical engineering. A quantitative approach to cell physiology, nerve/muscle interaction, the cardiovascular system, and the respiratory system, through the study of vital biological signals and their measurement. Anatomy and physiology of each organ system. Current engineering efforts in instrumentation and basic science to further study each system's physiology.</p> <p>Recommendations: BME/EE/ES 50, BIO 1 or BIO 13 or ES 11, or permission of instructor.</p>				

<b>111798</b>	<b>Global Strategic Management</b>			
Subject: EM	Catalog Nbr: 0240			
	2018 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
<p>Introduction to a strategy development for high technology businesses. Explores the basis of competition, core competencies, functional (technology, marketing, supply chain) strategies, best practices in innovation, and multinational growth.</p>				



# Course Bulletin

<b>111823</b>	<b>Humanistic Perspectives on Leadership</b>			
Subject: EM	Catalog Nbr: 0250			
	2018 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Introduction to responsible leadership through the lens of classical literary works. Increases students' understanding of cultural, social and ethical contexts of leadership in complex and uncertain environments.				

<b>111837</b>	<b>Leading Teams and Organizations</b>			
Subject: EM	Catalog Nbr: 0260			
	2018 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Development of the interpersonal skills necessary for leadership. Involves 360 degree assessment tools. Topics include creating high performance teams,, giving feedback, influencing without authority, managing conflict, fostering creativity, communicating to inspire and working across cultures.				

<b>111855</b>	<b>Industry Consulting Project – Team Practicum</b>			
Subject: EM	Catalog Nbr: 0270			
	2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
	2017 FALL	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Team consulting project, conducted at a local business during summer intersession to provide students with opportunity to apply classroom learning.				

<b>111898</b>	<b>Quantitative Physiology II</b>			
Subject: EE	Catalog Nbr: 0122			
(Cross-listed as EE 122). A laboratory course designed for students interested in advanced work in biomedical engineering. The course will involve labs covering nerve physiology, skeletal muscle physiology, and cardiopulmonary physiology, through the study of vital biological signals and their measurement. The course will be structured in modules, with labs in each module focused on 1) measurement and acquisition of the physiological data of interest and 2) computational modeling of acquired physiological data. Recommendations: BME/EE/ES 121 or BIO 115, BME/EE/ES 50, BIO 13 or ES 11, or Permission of instructor.				

<b>111911</b>	<b>Capstone Leadership Project</b>			
Subject: EM	Catalog Nbr: 0280			

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2018 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu

Student led 'real-life' engineering project to demonstrate business acumen and leadership skills. Project must be complex and involve risk with a 6-9 month duration, often done with the student's current employer.

<b>111932</b>	<b>Non Major Credit</b>		
Subject:	Catalog Nbr:		
EM	0310		

<b>111951</b>	<b>Lower Level Elective Crd</b>		
Subject:	Catalog Nbr:		
EM	0320		

<b>111969</b>	<b>Upper Level Elective Crd</b>		
Subject:	Catalog Nbr:		
EM	0330		

<b>111990</b>	<b>Masters Continuation - Part Time</b>		
Subject:	Catalog Nbr:		
EM	0401		
2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
Part-time.Please see departmental website for specific details.			

<b>112032</b>	<b>Digital Signal Processing</b>		
Subject:	Catalog Nbr:		
EE	0125		
2017 FALL	Primary	Brian Tracey	brian.tracey@tufts.edu
Discrete signals and systems, digital simulation of analog systems. Z transforms, recursion equations, finite-order systems. Fourier transforms, line spectra and Fourier series, discrete Fourier series and Fast Fourier Transforms (FFT). Sampling and interpolation, mean-square approximations. Nonrecursive and recursive filters. Selected topics on algorithms, design and applications of digital signal processing. Fall.			

<b>112034</b>	<b>Masters Degree Continuation</b>		
Subject:	Catalog Nbr:		
EM	0402		

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2017 FALL	Primary	Mary Viola	Mary.Viola@tufts.edu
Full-time. Please see departmental website for specific details.			

<b>112076</b>	<b>Computer Engineering W/lab</b>		
Subject: EE	Catalog Nbr: 0126	2017 FALL	Primary
	Mark Hempstead	Mark.Hempstead@tufts.edu	
<p>(Cross-listed w/ COMP46) Topics covered include computer abstractions, performance measurements, instruction set architectures, designing processor datapath and control, pipelining, memory hierarchy, I/O, multiprocessors. The associated lab consists of designing, implementing, and validating a simplified MIOS processor using Verilog, a hardware description language. Fall. Recommendations: EE 14.</p>			

<b>112117</b>	<b>Information Theory</b>		
Subject: EE	Catalog Nbr: 0127	2018 SPRG	Primary
	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
<p>Information theory as a systematic framework to address fundamental laws and limits of data compression and digital communication. Source coding/data compression; information measures on discrete memory-less sources; practical schemes and algorithms for lossless data compression such as Huffman coding, arithmetic coding, Lempel-Ziv Coding; channel coding for reliable communication and rate distortion for lossy source compression. Advanced topics such as information theoretic cryptography. Recommendations: EE 104 or permission of instructor.</p>			

<b>112309</b>	<b>Operating Systems</b>		
Subject: EE	Catalog Nbr: 0128	2016 FALL	Primary
	Elena Strange	Elena.Strange@tufts.edu	
	Alva Couch	2017 FALL	Primary
	alva.couch@tufts.edu		
<p>(Cross-listed as COMP 111). Fundamental issues in operating system design. Concurrent processes: synchronization, sharing, deadlock, scheduling. Relevant hardware properties of uniprocessor and multiprocessor computer systems. Recommendations: COMP 15 and either COMP 40 OR EE 14.</p>			

<b>112329</b>	<b>Introduction To Computing In Engineering</b>		
Subject: ES	Catalog Nbr: 0002	2018 SPRG	Primary
	Brian Tracey	brian.tracey@tufts.edu	
<p>An introduction to engineering problem-solving with the aid of computational software. Scientific computing concepts will be introduced including number representation, arrays, structured programming techniques,</p>			

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and good coding practices. Basic numerical and data analysis methods will be introduced including numerical differentiation and integration, matrix operations, descriptive statistics, curve fitting, and optimization. Examples drawn from a variety of engineering disciplines will give students extensive practice in coding solutions and applying them to data.

<b>112452</b>	<b>Computer Communication Networks</b>			
Subject: EE	Catalog Nbr: 0129			
2017 FALL	Primary	Chorng Chang	chorng.chang@tufts.edu	
<p>Data communications concepts. Communications networking techniques: switching and broadcast networks, access protocols, local networks. Design issues, overview of current products. Computer communications architecture: hardware/software issues, protocols and architecture, layered approach and hierarchical approach. Prerequisite: senior or graduate electrical engineering degree candidate, or consent. Recommendations: Senior or graduate electrical engineering degree candidate, or permission of instructor.</p>				

<b>112629</b>	<b>Principles Of Medical Imaging</b>			
Subject: EE	Catalog Nbr: 0131			
2018 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu	
<p>(Cross-listed as BIO 131 and BME 131.) This interdisciplinary course presents the principles of medical imaging techniques such as diagnostic ultrasound, radiography, X-ray computed tomography (CT), and magnetic resonance imaging (MRI). For each imaging modality, topics include the physical principles, key aspects of instrumentation design, mathematical methods, and the anatomical/physiological information content of the images. Representative medical images will be discussed and interpreted. This course cannot be taken for basic science requirement for engineering students. Recommendations: MATH 32 (formerly MATH 11), PHY 2 or 12, or permission of instructor.</p>				

<b>112651</b>	<b>Digital Image Processing</b>			
Subject: EE	Catalog Nbr: 0133			
2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu	
<p>Fundamentals and some practical applications of digital image processing. Topics include image formation, sampling, and quantization; distortions due to lens aberrations, image motion and detector noise; image enhancement and restoration by spatial filtering and maximum entropy; image coding for bandwidth compression by DPCM, transform coding, and entropy coding; and image understanding. Recommendations: EE 23 or permission of instructor.</p>				

<b>112656</b>	<b>Introduction To Electrical Systems W/ Lab</b>			
Subject: ES	Catalog Nbr: 0003			

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2016 FALL	Primary	Brian Aull	Brian.Aull@tufts.edu
2017 FALL	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu

Definitions of circuit elements, fundamental laws, selected network theorems, controlled sources, introduction to the oscilloscope, energy and power, natural response and complete response of first order circuits, steady state sinusoidal behavior, algebra of complex numbers, phasors, impedance, average and reactive power, introduction to analog and digital systems, frequency response and filters, measurements and instrumentation, introduction to computer applications for circuit analysis and design. Associated laboratory project work.

Recommendations: Must be preceded or accompanied by MATH 34 (formerly MATH 12).

<b>112675</b>	<b>Advanced Electromagnetics</b>		
Subject: EE	Catalog Nbr: 0135	2018 SPRG	Primary
		Thomas Vandervelde	tvanderv@ece.tufts.edu

Stationary electric and magnetic fields. Differential and integral forms of Maxwell's equations. Time-harmonic fields and potential functions. Electromagnetics of circuits. Transmission line transients and coupling. Plane wave propagation. Guided wave propagation. Electromagnetic radiation. Electromagnetic properties of materials. Practical applications. Fall.

Recommendations: EE 18 or equivalent.

<b>112721</b>	<b>Antennas For Radar, Avionics, And Communications</b>		
Subject: EE	Catalog Nbr: 0136	2017 FALL	Primary
		Khaled ElMahgoub	Khaled.ElMahgoub@tufts.edu

Definition of fields, radiation patterns, sources, linearity, and superposition. Antennae parameters: gain, effective aperture, beamwidth, sidelobes, impedance, polarization, and bandwidth. Radiation: electric dipole, multiple sources. Transmission lines and waveguides. Radiation from discontinuities, slots, and horns. Techniques of antenna measurements. Theory of antenna arrays. Spring.

Recommendations: Senior or graduate standing in electrical engineering or physics.

<b>112747</b>	<b>Radar Engineering</b>		
Subject: EE	Catalog Nbr: 0137	2018 SPRG	Primary
		Khaled ElMahgoub	Khaled.ElMahgoub@tufts.edu

Physical principles and basic equations. Pulsed, continuous-wave, and pulsed-Doppler radars. Antenna systems; transmitters; detection theory. Waveform considerations, including pulse compression. Principles of synthetic aperture radar. Miscellaneous topics: propagation, clutter, and airborne radar. Fall.

Recommendations: EE 18 or equivalent.

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<b>112767</b>	<b>Introduction To Digital Logic Circuits W/ Lab</b>			
Subject: ES	Catalog Nbr: 0004	2018 SPRG	Primary	Karen Panetta Karen@eecs.tufts.edu
<p>Number systems and their conversions. Boolean algebra and Karnaugh map minimizations of Boolean expressions. Logic gates. Analysis and design of combinational logic circuits. Characteristics of various flip-flops. Analysis and design of sequential logic circuits. Design of counter and shift register circuits. Various binary codes and code conversion circuits. Binary arithmetic and arithmetic circuits. Introduction to iterative design. Associated laboratory work. Spring.</p> <p>Recommendations: ES 3.</p>				

<b>112912</b>	<b>Advanced Digital Signal Processing</b>			
Subject: EE	Catalog Nbr: 0145			
<p>Discrete time signals in time and frequency domains. Advanced topics in digital processing of continuous-time signals. Digital filter structures, design, implementation, finite wordlength effects. Multirate signal processing. Applications. Associated laboratory work.</p> <p>Recommendations: EE 125 or permission of instructor.</p>				

<b>112960</b>	<b>Analog And Mixed Signal Mos Integrated Circuit Design</b>			
Subject: EE	Catalog Nbr: 0147	2017 SPRG	Primary	Sameer Sonkusale sameer@ece.tufts.edu
<p>Practical and theoretical aspects of analog and mixed-signal MOS IC design. Basic building blocks including current sources, gain stages, and two-stage opamps. Opamp circuit feedback and noise modeling. Switched capacitor (SC) circuits from Z-transform, sample hold circuit, SC filters, and SC gain circuit. Noise and nonlinear effects in SC circuits. Component matching, layout of analog building blocks. Fundamentals of data converters.</p>				

<b>112982</b>	<b>Silicon Radio Frequency Ic Design</b>			
Subject: EE	Catalog Nbr: 0148	2018 SPRG	Primary	Mohammed Afsar mohammed.afsar@tufts.edu
<p>An overview of Silicon Germanium BICMOS semiconductor process (SiGe) and technology. Bipolar and CMOS transistor models, resistor, capacitor and inductor models, process variation of devices, corner, statistical simulation techniques for the process, voltage and temperature variation, and device matching. Voltage gain, power gain and their conversions. Class A and B amplifiers, output power compression, and inter-modulation and IP3 from two tone analyses. Noise classification of bipolar transistor, noise figure definition and analysis. S-parameters and smith-charts. Applications including low-noise, cascade, differential, and various-gain amplifiers, as well as practical bias circuits for current and voltage reference (band-gap voltage). Associated laboratories utilizing Electronic Design Automation (EDA) tools.</p> <p>Recommendations: EE 11 and 12.</p>				

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<b>113042</b>	<b>Introduction To Mechanics- Statics And Dynamics</b>			
Subject: ES	Catalog Nbr: 0005			
	2016 FALL	Primary	Stephen Levine	stephen.levine@tufts.edu
	2017 FALL	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
	2017 FALL	Primary	Robert Viesca	Robert.Viesca@tufts.edu
	2018 SUMR	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
<p>Introduction to analysis and problem solving in statics and dynamics. Equilibrium of particles and rigid bodies in two and three dimensions. Vector and matrix analysis. Force-moment balance equations. Applications include trusses, frames, machines, beams, and friction problems. Kinematics and kinetics of particles and rigid bodies. Newton's equation, impulse-momentum, work and energy, Centroids and moments of inertia.            Recommendations: MATH 32 (formerly MATH 11) and PHY 11</p>				

<b>113161</b>	<b>Thermodynamics</b>			
Subject: ES	Catalog Nbr: 0007			
	2017 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2017 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
	2017 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
	2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
	2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
<p>A course stressing the concepts and the laws of classical thermodynamics. Thermodynamics functions, first law, second law, properties of pure substances, availability and irreversibility. Emphasis is placed on applying the thermodynamic mode of reasoning.</p>				

<b>113270</b>	<b>Fluid Mechanics</b>			
Subject: ES	Catalog Nbr: 0008			
	2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu
	2017 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2017 FALL	Primary	Robert Peattie	Robert.Peattie@tufts.edu
	2017 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu
	2017 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
	2018 SUMR	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
<p>An introduction to fluids at rest and in motion. Fluid properties. Pressure and velocity variations in flows. Mass, momentum, and energy conservation in a flowing fluid. Bernoulli's equation and inviscid flows. An introduction to viscous flows. Dimensional analysis. Drag and lift of moving objects. Fall.</p>				

<b>113357</b>	<b>Computer-aided Design Of Microwave Circuits</b>
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# Course Bulletin

Subject: EE	Catalog Nbr: 0160	2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
<p>Microwave network representation, scattering matrix, constant gain circles, stability and gain concepts, microwave amplifier design. Modeling of circuit elements: coaxial lines, striplines, microstriplines, coplanar lines, coupled lines, lumped elements. Sensitivities and measurement techniques. Constant noise circles and low-noise broad-band amplifier design. Microwave circuit analysis and gradient techniques, multiband and multimode optimization of filters, phase shifters, and switches. Extensive laboratory and project work using state-of-the-art CAD software.</p> <p>Recommendations: EE 117</p>					

<b>113425</b>	<b>Microwave Integrated Circuits</b>				
Subject: EE	Catalog Nbr: 0161	2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
<p>Review of CAD techniques for microwave circuits. Substrate, conductor, dielectric, and resistive film materials for integrated circuits. Mask layout, mask layout tools, and mask fabrication. Hybrid microwave integrated circuits, monolithic integrated circuits, foundry requirements, hybrid versus monolithic circuits, performance and testing. Extensive laboratory work.</p> <p>Recommendations: EE 160.</p>					

<b>113468</b>	<b>Applied Mechanics (strength Of Materials)</b>				
Subject: ES	Catalog Nbr: 0009	2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
<p>Analysis of stress and strain. Behavior of isotropic materials, theories of failure. Behavior of members subjected to axial, torsional, and flexural loadings, combined stress, Mohr's circle, compression members and columns.</p> <p>Recommendations: ES 5.</p>					

<b>113601</b>	<b>Introduction To Materials Science</b>				
Subject: ES	Catalog Nbr: 0010	2018 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu
<p>Structure of materials; chemical composition; phase transformations; properties of metals, ceramics, polymers, biopolymers, and related materials. Material selection in chemical and biological engineering applications.</p> <p>Recommendations: MATH 34 (formerly MATH 12), CHEM 1 or 16.</p>					

<b>113663</b>	<b>Fundamentals Of Biological Systems</b>				
Subject:	Catalog Nbr:				



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ES	0011				
	2016 FALL	Primary	Dana Cairns		Dana.Cairns@tufts.edu
	2017 FALL	Primary	David Kaplan		david.kaplan@tufts.edu
	2017 FALL	Primary	Arsia Jamali		Arsia.Jamali@tufts.edu
<p>Fundamentals of biology in the context of engineering disciplines. Chemical and physical mechanisms underlying biological functions in complex environments. Case studies of relevance in various engineering disciplines, with a focus on cells and information transfer. May not be counted toward the Biology major. One may not receive credit for both ES 11 and BIO 13. Potential premedical students are advised to take BIO 13 instead of this course.</p> <p>Recommendations: MATH 34 (formerly MATH 12), PHY 11, and CHEM 1.</p>					

<b>113762</b>	<b>Electrical Engineering Seminar</b>				
	Subject:	Catalog Nbr:			
	EE	0191			
	2017 FALL	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
<p>A course devoted to the study of special problems in electrical engineering. Credit as arranged. Please see departmental website for specific details.</p>					

<b>113778</b>	<b>Electrical Engineering Seminar</b>				
	Subject:	Catalog Nbr:			
	EE	0192			
	2017 SPRG	Primary	Thomas Vandervelde		tvanderv@ece.tufts.edu
	2018 SPRG	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
<p>A course devoted to the study of special problems in electrical engineering. Credit as arranged. Please see departmental website for specific details.</p>					

<b>113810</b>	<b>Special Topics</b>				
	Subject:	Catalog Nbr:			
	EE	0193			
	2016 FALL	Primary	Mohammed Afsar		mohammed.afsar@tufts.edu
	2016 FALL	Primary	Soha Hassoun		soha.hassoun@tufts.edu
	2016 FALL	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
	2016 FALL	Primary	Valencia Koomson		Valencia.Koomson@tufts.edu
	2016 FALL	Primary	Mai Vu		Mai.Vu@tufts.edu
	2017 FALL	Primary	Karen Panetta		Karen@eecs.tufts.edu
	2017 FALL	Primary	Ronald Lasser		Ron.Lasser@tufts.edu
	2017 FALL	Primary	Sameer Sonkusale		sameer@ece.tufts.edu
	2017 FALL	Primary	Usman Khan		Usman.Khan@tufts.edu
	2017 FALL	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
	2017 FALL	Primary	Joel Grodstein		Joel.Grodstein@tufts.edu
	2018 SPRG	Primary	Thomas Vandervelde		tvanderv@ece.tufts.edu
<p>Guided independent study of an approved topic at an intermediate level. Prerequisite: consent. Credit as</p>					

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arranged. Please see departmental website for specific details.

113825		Special Topics			
Subject:	EE	Catalog Nbr:	0194		
	2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
	2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu	
	2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
	2017 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu	
	2018 SPRG	Primary	Ming Chow	ming.chow@tufts.edu	
	2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
	2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
	2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
	2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
	2018 SPRG	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu	
	2018 SPRG	Primary	Kemal Kulovic	Kemal.Kulovic@tufts.edu	
	2018 SUMR	Primary	Karen Panetta	Karen@eecs.tufts.edu	
	2018 SUMR	Primary	Ronald Lasser	Ron.Lasser@tufts.edu	
Guided independent study of an approved topic at an intermediate level. Credit as arranged.					

113886		Honors Thesis			
Subject:	EE	Catalog Nbr:	0197		
	2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
Honors Thesis.Please see departmental website for specific details.					

113925		Internship			
Subject:	EE	Catalog Nbr:	0199		
	2018 SPRG	Primary	Alva Couch	alva.couch@tufts.edu	
	2018 SUMR	Primary	Karen Panetta	Karen@eecs.tufts.edu	
	2018 SUMR	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
	2018 SUMR	Primary	Chorng Chang	chorng.chang@tufts.edu	
	2018 SUMR	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
	2018 SUMR	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
	2018 SUMR	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
	2018 SUMR	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
	2018 SUMR	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
	2018 SUMR	Primary	Eric Miller	Eric.Miller@tufts.edu	
	2018 SUMR	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
	2018 SUMR	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
	2018 SUMR	Primary	Usman Khan	Usman.Khan@tufts.edu	

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2018 SUMR	Primary	Brian Tracey	brian.tracey@tufts.edu
2018 SUMR	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SUMR	Primary	Mai Vu	Mai.Vu@tufts.edu

Supervised internships at suitable locations in industry and government. Jobs offered on basis of availability. Term paper required. Credit not given retroactively. Prior arrangements necessary. Please see departmental website for specific details.

<b>113948</b>	<b>Digital Systems Design For Testability</b>			
Subject:	Catalog Nbr:			
EE	0202			
<p>Fault modeling and simulation using VHDL. Test generation algorithms for combinational and sequential circuits. Testability techniques including ad hoc methods, scan design, and built-in self-test. Logic synthesis and testability, testability analysis and random pattern testability. Linear feedback shift registers, error-detecting codes, and self-checking codes. Requires a major design project and applications for industrial partners. Spring.</p> <p>Recommendations: EE 26.</p>				

<b>113998</b>	<b>Environment And Technology</b>			
Subject:	Catalog Nbr:			
ES	0025			
2017 FALL	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
<p>(Cross-listed as ENV 25.) The impact and interaction of technology and the environment will be evaluated using historical examples. Environmental problems and their solutions will be evaluated from an engineering viewpoint. This course is a core requirement of the Environmental Studies program.</p> <p>Recommendations: CHEM 1 or 16 and sophomore standing</p>				

<b>114014</b>	<b>Advanced Topics In Computer Architecture</b>			
Subject:	Catalog Nbr:			
EE	0216			
<p>Introduction to parallel processing. Design of pipeline processors, array processors, and multiprocessors. Interconnection network analysis and design. Parallel processing algorithms and parallel programming languages. Spring.</p> <p>Recommendations: EE 215.</p>				

<b>114097</b>	<b>Detection And Estimation Theory</b>			
Subject:	Catalog Nbr:			
EE	0229			
<p>A systematic development of optimal detection and estimation theory, including Bayesian, Maximum Likelihood (MLE), Maximum A Posteriori (MAP), and minimum mean squared error (MMSE) techniques. The Karhunen-Loeve expansion for non-white noise is studied. Applications to digital and analog communications,</p>				

# Course Bulletin

and radar problems are included. Nonparametric approaches, spectral estimation, and spread spectrum systems are examined.

Recommendations: EE 108 or equivalent.

<b>114115</b>	<b>Advanced Analog &amp; Mixed Signal Ic Design</b>			
Subject: EE	Catalog Nbr: 0247			
2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
<p>Advanced topics in analog VLSI design, switched capacitor filters, continuous time filters, principles of nyquist rate analog to digital converters and digital to analog converters, oversampled delta sigma analog to digital converter design. Design and implementation of phase locked loops, frequency synthesizer and related building blocks for communication systems. Novel concepts in analog and mixed signal circuit design from current literature.</p> <p>Recommendations: EE 147.</p>				

<b>114138</b>	<b>Devices &amp; Circuits For Optical Communications</b>			
Subject: EE	Catalog Nbr: 0249			
<p>Underlying principles and integrated circuit design techniques for optical communication systems (fiber-based and free-space). Optoelectronic device operation, receiver circuit fundamentals, noise analysis, transimpedance amplifiers, lasers and modulators, driver circuits, and clock/data recovery circuit blocks. Opto-electronic integration methods, modulation schemes, system-level simulation, and applications to problems in broadband communication and frequency-domain optical imaging are also presented. Projects employing VLSI CAD software.</p> <p>Recommendations: EE 103 or consent of instructor. Corequisite: EE 147.</p>				

<b>114161</b>	<b>Biomedical Engineering</b>			
Subject: EE	Catalog Nbr: 0250			
2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu	
<p>An introduction to the interdisciplinary nature of biomedical engineering. The biological, chemical, electrical, and mechanical principles involved in the design and operation of medical devices. Biopotentials, electrodes, transducers, biocompatibility of materials, and patient safety.</p>				

<b>114174</b>	<b>Public Health Engineering</b>			
Subject: CEE	Catalog Nbr: 0052			
2017 SPRG	Secondary	David Gute	david.gute@tufts.edu	
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu	
(Cross-listed as ENV 27 and CH 52). An introduction to public health engineering. Elements of waterborne				

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disease control, hazardous materials management, occupational health and safety, and environmental interventions. Applications to environmental engineering and environmental engineering science.

<b>114205</b>	<b>Plasma Engineering</b>
Subject: EE	Catalog Nbr: 0251
<p>Engineering applications and physics of gaseous plasmas. Plasma applications include integrated circuit fabrication; plasma displays; ion thrusters; plasma science coverage of Boltzmann equation; energy distribution functions; ion and electron transport; electromagnetic interaction with plasma; plasma sheath; collision statistics; mass and energy balance; analytical and numerical modeling.</p> <p>Recommendations: EE 117 or equivalent, EE 104 or equivalent.</p>	

<b>114290</b>	<b>Introduction To Chemical And Biological Engineering (chbe)</b>
Subject: EN	Catalog Nbr: 0069
<p>Fundamentals and applications of Chemical and Biological Engineering. Relevance of fundamental sciences (math, physics, chemistry, and biology), and basic chemical engineering concepts, including thermodynamics, transport phenomena, reaction kinetics, reactor and separation system design, in solving industrial problems. Introduction to chemical process synthesis, design, optimization, control, and economic analysis. Discussion of the many career paths choices for graduates in chemical and biological engineering. Guest speakers from a broad spectrum of industries employing Chemical Engineers, field trips to local companies, and a semester-long group project to research, describe, and design a process for the production of a common consumer chemical product.</p>	

<b>114449</b>	<b>Master's Project</b>		
Subject: EE	Catalog Nbr: 0293		
2017 FALL	Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 FALL	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 FALL	Primary	Chorng Chang	chorng.chang@tufts.edu
2017 FALL	Primary	Douglas Preis	DPreis@eecs.tufts.edu
2017 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 FALL	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 FALL	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 FALL	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 FALL	Primary	Eric Miller	Eric.Miller@tufts.edu
2017 FALL	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 FALL	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2017 FALL	Primary	Usman Khan	Usman.Khan@tufts.edu
2017 FALL	Primary	Brian Tracey	brian.tracey@tufts.edu
2017 FALL	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 FALL	Primary	Mai Vu	Mai.Vu@tufts.edu

# Course Bulletin

Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.

<b>114505</b>	<b>Non Major Credit</b>
Subject: EN	Catalog Nbr: 0310

<b>114523</b>	<b>Lower Level Elective Crd</b>
Subject: EN	Catalog Nbr: 0320

<b>114541</b>	<b>Upper Level Elective Crd</b>
Subject: EN	Catalog Nbr: 0330

<b>114553</b>	<b>Master's Project</b>		
Subject: EE	Catalog Nbr: 0294		
2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu

Guided individual study of an approved topic suitable for a master's design project. Credit as arranged. Please see departmental website for specific details.

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<b>114616</b>	<b>Numerical Methods</b>			
Subject:	Catalog Nbr:			
ES	0055			
2017 FALL	Primary	Steven Chapra	steven.chapra@tufts.edu	
<p>Introduction to using computers to solve engineering-oriented mathematical problems. Topics include mathematical modeling, round-off and truncation error, root location, linear algebraic equations, optimization, regression, interpolation, numerical differentiation and integration, ordinary and partial differential equations. Applications using software and programming languages.</p> <p>Recommendations: ES 2 and MATH 51 (formerly MATH 38)</p>				

<b>114618</b>	<b>Master's Thesis</b>			
Subject:	Catalog Nbr:			
EE	0295			
2017 FALL	Primary	Karen Panetta	Karen@eecs.tufts.edu	
2017 FALL	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
2017 FALL	Primary	Chorng Chang	chorng.chang@tufts.edu	
2017 FALL	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
2017 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2017 FALL	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2017 FALL	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
2017 FALL	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
2017 FALL	Primary	Eric Miller	Eric.Miller@tufts.edu	
2017 FALL	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
2017 FALL	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
2017 FALL	Primary	Usman Khan	Usman.Khan@tufts.edu	
2017 FALL	Primary	Brian Tracey	brian.tracey@tufts.edu	
2017 FALL	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2017 FALL	Primary	Mai Vu	Mai.Vu@tufts.edu	
<p>Guided research on a topic that has been approved as a suitable subject for a master's thesis. Credit as arranged. Please see departmental website for specific details.</p>				

<b>114655</b>	<b>Probability And Statistics</b>			
Subject:	Catalog Nbr:			
ES	0056			
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu	
2018 SUMR	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu	
<p>Application of the concepts of probability and statistics to problem solving in engineering systems. Topics include data reduction techniques, probability, probability distribution functions, error propagation, sampling distributions, estimation, hypothesis testing, simple comparative experiments, and linear regression. Examples are drawn from a variety of disciplines, including the environment, materials, manufacturing, computing, and process design.</p> <p>Recommendations: MATH 42 (formerly MATH 13)</p>				

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<b>114664</b>		<b>Master's Thesis</b>		
Subject:	Catalog Nbr:			
EE	0296			
2018 SPRG	Primary	Karen Panetta		Karen@eecs.tufts.edu
2018 SPRG	Primary	Mohammed Afsar		mohammed.afsar@tufts.edu
2018 SPRG	Primary	Chorng Chang		chorng.chang@tufts.edu
2018 SPRG	Primary	Douglas Preis		DPreis@eecs.tufts.edu
2018 SPRG	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
2018 SPRG	Primary	Sameer Sonkusale		sameer@ece.tufts.edu
2018 SPRG	Primary	Valencia Koomson		Valencia.Koomson@tufts.edu
2018 SPRG	Primary	Jeffrey Hopwood		Jeffrey.Hopwood@tufts.edu
2018 SPRG	Primary	Eric Miller		Eric.Miller@tufts.edu
2018 SPRG	Primary	Thomas Vandervelde		tvanderv@ece.tufts.edu
2018 SPRG	Primary	Aleksandar Stankovic		alex.stankovic@tufts.edu
2018 SPRG	Primary	Usman Khan		Usman.Khan@tufts.edu
2018 SPRG	Primary	Brian Tracey		brian.tracey@tufts.edu
2018 SPRG	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Mai Vu		Mai.Vu@tufts.edu
Guided research on a topic that has been approved as a suitable subject for a master's thesis. Credit as arranged. Please see departmental website for specific details.				

<b>114719</b>		<b>Doctoral Thesis</b>		
Subject:	Catalog Nbr:			
EE	0297			
2017 FALL	Primary	Karen Panetta		Karen@eecs.tufts.edu
2017 FALL	Primary	Mohammed Afsar		mohammed.afsar@tufts.edu
2017 FALL	Primary	Chorng Chang		chorng.chang@tufts.edu
2017 FALL	Primary	Douglas Preis		DPreis@eecs.tufts.edu
2017 FALL	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
2017 FALL	Primary	Sameer Sonkusale		sameer@ece.tufts.edu
2017 FALL	Primary	Valencia Koomson		Valencia.Koomson@tufts.edu
2017 FALL	Primary	Jeffrey Hopwood		Jeffrey.Hopwood@tufts.edu
2017 FALL	Primary	Eric Miller		Eric.Miller@tufts.edu
2017 FALL	Primary	Thomas Vandervelde		tvanderv@ece.tufts.edu
2017 FALL	Primary	Aleksandar Stankovic		alex.stankovic@tufts.edu
2017 FALL	Primary	Usman Khan		Usman.Khan@tufts.edu
2017 FALL	Primary	Brian Tracey		brian.tracey@tufts.edu
2017 FALL	Primary	Shuchin Aeron		Shuchin.Aeron@tufts.edu
2017 FALL	Primary	Mai Vu		Mai.Vu@tufts.edu
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.				



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<b>114755</b>	<b>Appropriate Technology In Sustainable Engineering</b>		
Subject: ES	Catalog Nbr: 0060		
Selection of culturally appropriate technology and attainment of economic sustainability. Topics include community needs assessment, green manufacturing, societal issues, and sustainable implementation strategies. Emphasis on interdisciplinary approach at the intersection of community resource allocation, engineering technology, and government policy.			

<b>114809</b>	<b>Doctoral Thesis</b>		
Subject: EE	Catalog Nbr: 0298		
2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.			

<b>114828</b>	<b>Non Major Credit</b>		
Subject: EE	Catalog Nbr: 0310		

<b>114862</b>	<b>Lower Level Elective Crd</b>		
Subject: EE	Catalog Nbr: 0320		

<b>114869</b>	<b>Musical Instrument Design And Manufacture</b>		
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# Course Bulletin

Subject:	Catalog Nbr:			
ES	0073			
	2017 SPRG	Primary	Kelsey Hochgraf	Kelsey.Hochgraf@tufts.edu
Review of the underlying engineering and the basic fabrication of musical instruments, including an introduction to musical acoustics, computer-based simulation tools, laboratory measurement, and manufacturing. The bulk of the class is dedicated to designing, simulating, building, and testing of an instrument.				

<b>114874</b>	<b>Upper Level Elective Crd</b>			
Subject:	Catalog Nbr:			
EE	0330			

<b>114891</b>	<b>Masters Degree Continuation</b>			
Subject:	Catalog Nbr:			
EE	0401			
	2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
	2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
	2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
	2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
	2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
	2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
	2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
	2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
	2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
	2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
	2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
	2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
	2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
	2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
	2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu
Part-time.Please see departmental website for specific details.				

<b>114927</b>	<b>Masters Degree Continuation</b>			
Subject:	Catalog Nbr:			
EE	0402			
	2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
	2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
	2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
	2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
	2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
	2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu

# Course Bulletin

2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu

Full-time. Please see departmental website for specific details.

<b>114966</b>	<b>Grad Teaching Assistant</b>		
Subject:	Catalog Nbr:		
EE	0405		
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu

<b>114972</b>	<b>Cad For Engineers</b>		
Subject:	Catalog Nbr:		
ES	0088		
<p>Two-and three-dimensional geometric modeling with computer-aided design (CAD) systems. The use of CAD technology for the design and analysis of civil structures and mechanical assemblies. Topics covered include; creating engineering drawings from CAD models, digital terrain modeling, parametric feature-based solid modeling, constraint-based assembly modeling, spline technology and the modeling of sculptured surfaces, CAD photorealism, and animation for engineering applications.</p> <p>Recommendations: EN 2 or equivalent</p>			

<b>114981</b>	<b>Grad Research Assistant</b>		
Subject:	Catalog Nbr:		
EE	0406		
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu

<b>114989</b>	<b>Special Topics In Engineering</b>		
Subject:	Catalog Nbr:		
ES	0093		
<p>Guided study of chosen topics in Engineering and Engineering Science. Please see the School of Engineering Website for further details.</p> <p>Recommendations: Permission of instructor.</p>			

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114999		Doctoral Degree Continuation			
Subject:	Catalog Nbr:				
EE	0501				
2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu		
2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu		
2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu		
2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu		
2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu		
2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu		
2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu		
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu		
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu		
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu		
2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu		
2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu		
2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu		
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu		
2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu		
Part-time.Please see departmental website for specific details.					

115032		Doctoral Degree Continuation			
Subject:	Catalog Nbr:				
EE	0502				
2018 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu		
2018 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu		
2018 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu		
2018 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu		
2018 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu		
2018 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu		
2018 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu		
2018 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu		
2018 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu		
2018 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu		
2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu		
2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu		
2018 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu		
2018 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu		
2018 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu		
Full-time. Please see departmental website for specific details.					

115273		Electronic Musical Instrument Design			
Subject:	Catalog Nbr:				

# Course Bulletin

ES	0095				
	2018 SPRG	Primary	Paul Lehrman		paul.lehrman@tufts.edu
<p>(Cross-listed as MUS 66). Non-standard electronic musical instruments or "controllers," incorporating sensors that respond to touch, position, movement, finger pressure, wind pressure, and other human factors, and their translation to Musical Instrument Digital Interface (MIDI) data. Designing and building original systems using common materials and object-oriented music-specific programming languages and software-based synthesis. Students will complete several creative projects using music hardware and software. Recommendations: Experience in one or more of the following--electronic music, electronic prototyping, mechanical engineering, computer programming.</p>					

<b>115411</b>	<b>Numerical Methods</b>				
	Subject:	Catalog Nbr:			
	ES	0101			
	2017 FALL	Primary	Jason Rife		Jason.Rife@tufts.edu
<p>Numerical methods are studied and applied to the solution of problems in applied science and engineering. Interpolation, approximation, numerical linear algebra, including system solution and eigenvalue problems, solution of nonlinear equations, numerical differentiation and integration, ordinary differential equation algorithms, and finite-difference solution of partial differential equations. Applications using calculative software. Recommendations: MATH 51 (formerly MATH 38) and the ability to implement computer solutions.</p>					

<b>115714</b>	<b>Engineering Systems: Stochastic Models</b>				
	Subject:	Catalog Nbr:			
	ES	0152			
<p>An introduction to network models in the study/design of engineering, economic, environmental, and social systems with an emphasis on systems exhibiting probabilistic behavior. Topics include network models, Markov chains, queuing theory, reliability analysis, and genetic algorithms (GAs). Practical treatment is stressed; applications and projects are chosen from several areas, including civil and environmental engineering. Recommendations: Junior Standing or consent of instructor</p>					

<b>115942</b>	<b>Engineering Psychology</b>				
	Subject:	Catalog Nbr:			
	ENP	0053			
	2016 FALL	Primary	Thaddeus Brunye		Thaddeus.Brunye@tufts.edu
	2017 FALL	Primary	Nathan Ward		Nathan.Ward@tufts.edu
<p>(Cross-listed as PSY 53). Survey of the applied areas of psychology that have proven useful in the design of equipment for human use and in the design of man-machine systems. Recommendations: PSY 1 or junior or senior standing.</p>					

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<b>115987</b>	<b>Non Major Credit</b>		
Subject:	Catalog Nbr:		
ES	0310		

<b>115999</b>	<b>Lower Level Elective Crd</b>		
Subject:	Catalog Nbr:		
ES	0320		

<b>116016</b>	<b>Upper Level Elective Crd</b>		
Subject:	Catalog Nbr:		
ES	0330		

<b>116022</b>	<b>Introduction To Human Factors And Ergonomics</b>			
Subject:	Catalog Nbr:			
ENP	0061			
2017 FALL	Primary	Sami Durrani	Sami.Durrani@tufts.edu	
2018 SPRG	Primary	Linda Borghesani	Linda.Borghesani@tufts.edu	
2018 SPRG	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu	
(Cross-listed as BME 61.) A practical introduction to human performance and to designing for human use. Studies include human factors, ergonomics, work stations, and environmental and legal concerns that impact on design. Examples of good and bad designs illustrate course principles.				

<b>116048</b>	<b>Internship In Engineering Psychology</b>			
Subject:	Catalog Nbr:			
ENP	0099			
2016 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2017 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
2017 SUMR	Primary	Brian Gravel	brian.gravel@tufts.edu	
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
A mentored preprofessional experience in engineering psychology at an off-site organization. The internship must conform to all the requirements of the School of Engineering internship programs. The engineering psychology program will grant course credit for internships if the following conditions are met: 1) The student has junior or senior standing and has declared a major in engineering psychology. 2) The student has submitted a written internship proposal that has been approved prior to the semester in which the internship will be performed. No internships with course credit will be approved once the semester of the internship has started. 3) A faculty mentor in engineering psychology holds supervisory and technical control of any work that receives credit. 4) The student submits a written report that is to be evaluated by the faculty adviser and				

# Course Bulletin

the outside institutional supervisor. Work of a proprietary nature cannot be used as a basis for the granting of course credit.

Recommendations: Junior or Senior standing or permission of instructor.

<b>116058</b>	<b>Tufts Program Abroad</b>			
Subject:	Catalog Nbr:			
ES	0340			

<b>116068</b>	<b>Assistive Technology</b>			
Subject:	Catalog Nbr:			
ENP	0105			
2017 FALL	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu	
<p>(Cross-listed as OTS 105). Examination of problems in designing and providing assistive devices to individuals with disabilities, to assist mobility, communication, positioning, and environmental control and daily living. Processes discussed include needs assessment, search for available devices, resources available, and creative problem solving. Students work with materials commonly used to create individualized devices, in cross-disciplinary teams on a design for a specific user or group. Problems of funding and delivery of devices also explored. For students in occupational therapy and engineering, and for educators, speech/language pathologists, and rehabilitation personnel.</p>				

<b>116129</b>	<b>Project Study In Human Systems A</b>			
Subject:	Catalog Nbr:			
ENP	0120			
2016 FALL	Primary	David Aurelio	David.Aurelio@tufts.edu	
2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu	
<p>(Cross-listed as BME 120 and PSY 120.) A senior-level project design (capstone course), led by faculty from engineering and psychology as well as outside lecturers. Students participate in team fashion in human-factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects. Spring.</p> <p>Recommendations: ENP 161, 162, PSY 31, 32, 130.</p>				

<b>116201</b>	<b>Seminar In Engineering Psychology</b>			
Subject:	Catalog Nbr:			
ENP	0149			
2017 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2017 SPRG	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu	
2018 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu	
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2018 SPRG	Primary	Nathan Ward	Nathan.Ward@tufts.edu	

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2018 SPRG	Primary	Jennaca Davies	Jennaca.Davies@tufts.edu
2018 SPRG	Primary	Mary Stearns	Mary.Stearns@tufts.edu
2018 SPRG	Primary	Eric Bogner	Eric.Bogner@tufts.edu
2018 SPRG	Primary	John Pollard	John.Pollard@tufts.edu
2018 SUMR	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
2018 SUMR	Primary	Sami Durrani	Sami.Durrani@tufts.edu
2018 SUMR	Primary	James Intriligator	James.Intriligator@tufts.edu

Graduate-level seminar course designed for students who are interested in getting a broad overview of different research methods and analytical techniques in human factors/ergonomics research. Topics to be covered are related to the acquiring, recording, and analyzing of empirical data. Theory underlying these methods in human factors/ergonomics research also studied. Three term assignments. Fall.

<b>116409</b>	<b>Human Factor Product Design</b>			
Subject:	Catalog Nbr:			
ENP	0161			
2018 SPRG	Primary	Sami Durrani	Sami.Durrani@tufts.edu	
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
2018 SUMR	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
<p>(Cross-listed as BME 161.) Material relevant in consumer product design, biomedical engineering, architectural design, and machine design. Topics include design methodologies, user feedback techniques, performance measurements, sensory evaluation techniques, creative design, and prototyping. Extensive individual and group project design work. Emphasis on designing and creativity.</p> <p>Recommendations: EN 1, 2, ENP 61, PSY 31, 32, 53, and junior standing, or permission of instructor.</p>				

<b>116464</b>	<b>Human-machine System Design</b>			
Subject:	Catalog Nbr:			
ENP	0162			
2016 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2017 FALL	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu	
<p>Techniques for man-machine system designs in which cognitive and dynamic aspects are of major importance. Applications to computer-interface design, auto/semiautomated systems, biomedical systems, and others. Topics include information processing, decision making, reaction times, and signal detection theory. Individual and group projects, laboratory demonstrations.</p> <p>Recommendations: EN 1, 2, ENP 161, PSY 31, 32,107, or CEE 102.</p>				

<b>116481</b>	<b>Analytical Methods In Human Factors Engineering</b>			
Subject:	Catalog Nbr:			
ENP	0163			
2016 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu	
2017 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
<p>Field and laboratory research design, empirical data acquisition, recording and analysis: knowledge elicitation techniques, psychophysical methods, subjective scaling, human performance modeling, measurement of</p>				



# Course Bulletin

dynamic continuous signals including sampling, spectra filtering, etc, measurement of discrete signals, spectral and correlational data analysis.

Recommendations: ENP 162 or graduate standing.

<b>116557</b>	<b>Computer Interface Design</b>			
Subject: ENP	Catalog Nbr: 0166			
2017 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu	
2018 SPRG	Primary	Jonathan Tilliss	Jon.Tilliss@tufts.edu	
<p>(Cross-listed as BME 166.) This hands-on course challenges students to design computer-based products and systems that are easy to learn and use. Lectures cover the user interface-design process, basic design principles, and design evaluation methods. In-class exercises and projects reinforce the students' understanding of the lecture material and provide practical design experience. Students use computer-based prototyping tools to model and demonstrate their design solutions. Frequent guest lectures by user-interface design specialists from industry.</p> <p>Recommendations: EN 1, 2, and junior standing, or permission of instructor.</p>				

<b>116608</b>	<b>Special Topics</b>			
Subject: ENP	Catalog Nbr: 0193			
2016 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu	
2016 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu	
2016 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
2016 FALL	Primary	Anil Saigal	anil.saigal@tufts.edu	
2016 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu	
2016 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2016 FALL	Primary	Robert White	R.White@tufts.edu	
2016 FALL	Primary	Jason Rife	Jason.Rife@tufts.edu	
2016 FALL	Primary	Robert Hannemann	No Email on file.	
2016 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu	
2016 FALL	Primary	Thomas James	No Email on file.	
2016 FALL	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu	
2016 FALL	Primary	Pratap Misra	Pratap.Misra@tufts.edu	
2016 FALL	Primary	William Messner	William.Messner@tufts.edu	
2016 FALL	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
2016 FALL	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu	
2017 FALL	Primary	Michael Wiklund	michael.wiklund@tufts.edu	
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2017 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2017 FALL	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu	
2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu	
Guided individual study of an approved topic. Credit as arranged.Please see departmental website for specific				

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details.

116631	Special Topics				
Subject:	Catalog Nbr:				
ENP	0194				
2018 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu		
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu		
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu		
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu		
Guided individual study of an approved topic. Credit as arranged. Please see departmental website for specific details.					

116649	Human Factors In Medical Systems				
Subject:	Catalog Nbr:				
ENP	0210				
Advanced topics in medical error analysis, user-centered medical technology design, product development and testing, FDA requirements, patenting, simulation, displays and controls, computerization, system implementation and maintenance, and product usability and accessibility.					
Recommendations: ENP 163					

116670	Interface Design In Complex Systems				
Subject:	Catalog Nbr:				
ENP	0215				
Computer-based interfaces, complex human-machine systems (e.g., power plant control room and emergency response dispatch centers), ecological approach, work environment analysis, information representation.					
Recommendations: ENP 161 or equivalent.					

116694	Special Topics				
Subject:	Catalog Nbr:				
ENP	0293				
2018 SPRG	Primary	David Aurelio	David.Aurelio@tufts.edu		
Guided individual study on an approved topic. Credit as arranged. Please see departmental website for specific details.					

116710	Special Topics				
Subject:	Catalog Nbr:				
ENP	0294				
Guided individual study on an approved topic. Credit as arranged. Please see departmental website for specific details.					

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<b>116724</b>		<b>Thesis</b>			
Subject:	ENP	Catalog Nbr:	0295		
	2016 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu	
	2016 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu	
	2016 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
	2016 FALL	Primary	Anil Saigal	anil.saigal@tufts.edu	
	2016 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu	
	2016 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
	2016 FALL	Primary	Robert Hannemann	No Email on file.	
	2016 FALL	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu	
	2016 FALL	Primary	Pratap Misra	Pratap.Misra@tufts.edu	
	2017 FALL	Primary	Michael Wiklund	michael.wiklund@tufts.edu	
	2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
	2017 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
	2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu	
Guided research on a topic that has been approved as a suitable subject for a master's thesis. Please see departmental website for specific details.					

<b>116734</b>		<b>Thesis</b>			
Subject:	ENP	Catalog Nbr:	0296		
	2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu	
	2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
	2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
Guided research on a topic that has been approved as a suitable subject for a master's thesis. Please see departmental website for specific details.					

<b>116762</b>		<b>Graduate Research</b>			
Subject:	ENP	Catalog Nbr:	0298		
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.					

<b>116782</b>		<b>Non Major Credit</b>			
Subject:	ENP	Catalog Nbr:	0310		

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<b>116801</b>	<b>Lower Level Elective Crd</b>		
Subject:	Catalog Nbr:		
ENP	0320		

<b>116819</b>	<b>Upper Level Elective Crd</b>		
Subject:	Catalog Nbr:		
ENP	0330		

<b>121277</b>	<b>Special Topics In Engineering</b>			
Subject:	Catalog Nbr:			
ME	0149			
2016 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu	
2017 FALL	Primary	Tadeu Carneiro	Tadeu.Carneiro@tufts.edu	
2017 FALL	Primary	Hoda Koushyar	Hoda.Koushyar@tufts.edu	
2017 FALL	Primary	Bradley Duncan	Bradley.Duncan@tufts.edu	
2017 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2017 SPRG	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu	
2017 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
2017 SPRG	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu	
2017 SPRG	Primary	Ehud Yariv	No Email on file.	
2017 SPRG	Primary	Sauro Liberatore	Sauro.Liberatore@tufts.edu	
2017 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2018 SPRG	Primary	James Vlahakis	James.Vlahakis@tufts.edu	
2018 SPRG	Primary	Robert Peattie	Robert.Peattie@tufts.edu	
2018 SPRG	Primary	Matthew Kelly	Matthew.Kelly@tufts.edu	
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
2018 SPRG	Primary	Kelsey Hochgraf	Kelsey.Hochgraf@tufts.edu	
2018 SUMR	Primary	Pratap Misra	Pratap.Misra@tufts.edu	
Study of selected engineering problems in the analysis and design of physical systems. Please see departmental website for specific details: <a href="http://engineering.tufts.edu/me/about/courses/index.htm">http://engineering.tufts.edu/me/about/courses/index.htm</a>				

<b>121501</b>	<b>Applied Mathematics For Engineers</b>			
Subject:	Catalog Nbr:			
ME	0150			
2016 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
2017 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu	
Review of ordinary differential equations and oscillatory phenomena. Fourier series and applications.				

# Course Bulletin

Orthogonal functions, Bessel functions. Partial differential equations and their applications to fluid mechanics, heat transfer, vibration and wave propagation. In no case may both ME 150 and MATH 151 be taken for credit.

Recommendations: MATH 51 (formerly MATH 38) or equivalent.

<b>121513</b>	<b>Biomechanics</b>		
	Subject:	Catalog Nbr:	
	ME	0152	
<p>Mechanical properties of muscle and bone, activation of muscles, kinematics and dynamics of joints, forces and energy in movement, movement data recording and analysis. Classroom presentations and research projects.</p> <p>Recommendations: ES 9 Applied Mechanics (Strength of Materials) or equivalent.</p>			

<b>121726</b>	<b>Wind Engineering</b>		
	Subject:	Catalog Nbr:	
	ME	0167	
<p>Structure interaction with atmospheric boundary layers. Characterization of wind data, wind variation with height, and variation with local topography. Boundary layer turbulence and connection to meteorological events. Wind forces on basic shapes, mean loading, and wind tunnel techniques. Dynamic effects including vortex oscillations, response of rigid and flexible structures and suppression. Building geometries and special cases such as masts, towers, bridges, and special structures. Wind turbine aerodynamics and wind turbine design.</p> <p>Recommendations: ES 8 - Fluid Mechanics.</p>			

<b>121812</b>	<b>Seminar In Fluid Mechanics And Heat Transfer</b>		
	Subject:	Catalog Nbr:	
	ME	0168	
<p>Presentation to a seminar group of selected topics on recent developments in fluid mechanics and heat transfer. Student, faculty, or an outside guest carries out the presentation, which is followed by discussion. Individual guided study is required for students taking this course for credit.</p> <p>Recommendations: ME 65 or 165.</p>			

<b>122006</b>	<b>Digital Control Of Dynamic Systems</b>		
	Subject:	Catalog Nbr:	
	ME	0180	
	2017 FALL	Primary	William Messner
			William.Messner@tufts.edu
<p>Fundamental concepts and modern techniques for the modeling and control of dynamic systems with multiple inputs and outputs. Formal modeling methods and linear closed-loop control principles. State-space techniques for continuous and discrete time controller design.. Analysis of system properties and performance. Related mathematical methods, computational software tools, and controller hardware.</p>			

# Course Bulletin

Recommendations: ME 80 or consent.

<b>122016</b>	<b>Advanced Dynamics</b>			
Subject:	Catalog Nbr:			
ME	0181			
2018 SPRG	Primary	Jason Rife		Jason.Rife@tufts.edu
Kinematics and dynamics of rigid bodies in three dimensions. Lagrange's equations for the derivation of system equations of motion. Numerical solution of nonlinear ordinary differential equations. Computer tools. Recommendations: ME 80, ME 180 or consent.				

<b>122068</b>	<b>Robotics</b>			
Subject:	Catalog Nbr:			
ME	0184			
2017 FALL	Primary	Chris Rogers		chris.rogers@tufts.edu
Broad review of theoretical and applied aspects of robotic manipulators and mobile robots. Statics, kinematics, dynamics, actuation, sensing, sensor fusion, trajectory planning and control with hands-on applications. Pre-requisites: ME 0084 or graduate standing or permission of instructor.				

<b>122154</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
ME	0193			
2017 SPRG	Primary	Ethan Danahy		ethan.danahy@tufts.edu
2017 SPRG	Primary	Chris Rogers		chris.rogers@tufts.edu
2017 SPRG	Primary	Pratap Misra		Pratap.Misra@tufts.edu
2018 SPRG	Primary	James Moore		No Email on file.
2018 SPRG	Primary	Mark Moeller		Mark.Moeller@tufts.edu
Guided study of an approved topic. Please see departmental website for specific details.				

<b>122168</b>	<b>Special Topics</b>			
Subject:	Catalog Nbr:			
ME	0194			
Guided study of an approved topic. Please see departmental website for specific details.				

<b>122414</b>	<b>Special Tps:study Abroad</b>			
Subject:	Catalog Nbr:			
ME	0197			

# Course Bulletin

<b>122554</b>	<b>Advanced Structural Dynamics</b>			
Subject:	Catalog Nbr:			
ME	0225			
Study of free and forced vibration of continuous structures such as plates and shells. Laplace transform and Fourier series, Rayleigh-Ritz and Galerkin methods. The use of discrete techniques such as finite-difference and finite-element methods to solve practical problems in structural dynamics.				

<b>122720</b>	<b>Flow-real Viscous Fluids</b>			
Subject:	Catalog Nbr:			
ME	0265			
Stress tensor in viscous fluids, incompressible boundary-layer equations, Blasius equation, Karman-Polhausen method, semiempirical and statistical theories of turbulence.				

<b>122775</b>	<b>Advanced Engineering Controls</b>			
Subject:	Catalog Nbr:			
ME	0280			
A case-study exploration of modern control design techniques for multidisciplinary engineering and manufacturing applications. State-space methods are implemented in linear systems for multivariable controller and observer design, as well as in nonlinear system analysis by describing functions and sliding mode control. Linear quadratic techniques in optimal and robust control of time-varying systems, as well as adaptive control algorithms with system identification are also introduced. Emphasis is placed on use of the computer as a real-time controller in laboratory projects related to the students' own research. Recommendations: ME 180 or permission of instructor.				

<b>122817</b>	<b>Graduate Seminar</b>			
Subject:	Catalog Nbr:			
ME	0291			
	2016 FALL	Primary	Megan Dauphinais	No Email on file.
	2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu
	2017 FALL	Primary	Robert White	R.White@tufts.edu
Presentation of individual reports on basic topics to a seminar group for discussion and criticism. Please see departmental website for specific details.				

<b>122869</b>	<b>Graduate Seminar</b>			
Subject:	Catalog Nbr:			
ME	0292			
	2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
	2018 SPRG	Primary	Robert White	R.White@tufts.edu
	2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu
Presentation of individual reports on basic topics to a seminar group for discussion and criticism. Please see				

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departmental website for specific details.

122898	Special Topics			
Subject: ME	Catalog Nbr: 0293			
2016 FALL	Primary	Jason Rife	Jason.Rife@tufts.edu	
2016 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu	
2017 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu	
2017 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu	
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
Guided individual study of an approved topic. Credit as arranged. Please see departmental website for specific details.				

122913	Special Topics			
Subject: ME	Catalog Nbr: 0294			
Guided individual study of an approved topic. Credit as arranged. Please see departmental website for specific details.				

122944	Master's Thesis			
Subject: ME	Catalog Nbr: 0295			
2016 FALL	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu	
2017 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu	
2017 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
2017 FALL	Primary	Anil Saigal	anil.saigal@tufts.edu	
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2017 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu	
2017 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2017 FALL	Primary	Robert White	R.White@tufts.edu	
2017 FALL	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu	
2017 FALL	Primary	Jason Rife	Jason.Rife@tufts.edu	
2017 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu	
2017 FALL	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu	
2017 FALL	Primary	William Messner	William.Messner@tufts.edu	
2017 FALL	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
2017 FALL	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu	
2017 FALL	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu	
2017 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu	



# Course Bulletin

Guided research on an approved topic suitable for a master's thesis. Credit as arranged. Please see departmental website for specific details.

<b>122996</b>		<b>Master's Thesis</b>		
Subject:	Catalog Nbr:			
ME	0296			
2017 SPRG	Primary	David Kaplan		david.kaplan@tufts.edu
2018 SPRG	Primary	Michael Zimmerman		Michael.Zimmerman@tufts.edu
2018 SPRG	Primary	Michael Wiklund		michael.wiklund@tufts.edu
2018 SPRG	Primary	Behrouz Abedian		behrouz.abedian@tufts.edu
2018 SPRG	Primary	Mark Kachanov		mark.kachanov@tufts.edu
2018 SPRG	Primary	Anil Saigal		anil.saigal@tufts.edu
2018 SPRG	Primary	Chris Rogers		chris.rogers@tufts.edu
2018 SPRG	Primary	Daniel Hannon		Dan.Hannon@tufts.edu
2018 SPRG	Primary	Douglas Matson		Douglas.Matson@tufts.edu
2018 SPRG	Primary	Gary Leisk		Gary.LEISK@tufts.edu
2018 SPRG	Primary	Robert White		R.White@tufts.edu
2018 SPRG	Primary	Kristen Wendell		Kristen.Wendell@tufts.edu
2018 SPRG	Primary	Jason Rife		Jason.Rife@tufts.edu
2018 SPRG	Primary	Marc Hodes		Marc.Hodes@tufts.edu
2018 SPRG	Primary	Luisa Chiesa		Luisa.Chiesa@tufts.edu
2018 SPRG	Primary	Pratap Misra		Pratap.Misra@tufts.edu
2018 SPRG	Primary	William Messner		William.Messner@tufts.edu
2018 SPRG	Primary	Igor Sokolov		Igor.Sokolov@tufts.edu
2018 SPRG	Primary	Jeffrey Guasto		Jeffrey.Guasto@tufts.edu
2018 SPRG	Primary	Erica Kemmerling		Erica.Kemmerling@tufts.edu
2018 SPRG	Primary	Iryna Zenyuk		Iryna.Zenyuk@tufts.edu
2018 SPRG	Primary	James Intriligator		James.Intriligator@tufts.edu
Guided research on an approved topic suitable for a master's thesis. Credit as arranged. Please see departmental website for specific details.				

<b>123035</b>		<b>Doctoral Thesis</b>		
Subject:	Catalog Nbr:			
ME	0297			
2017 FALL	Primary	Michael Zimmerman		Michael.Zimmerman@tufts.edu
2017 FALL	Primary	Behrouz Abedian		behrouz.abedian@tufts.edu
2017 FALL	Primary	Mark Kachanov		mark.kachanov@tufts.edu
2017 FALL	Primary	Anil Saigal		anil.saigal@tufts.edu
2017 FALL	Primary	Chris Rogers		chris.rogers@tufts.edu
2017 FALL	Primary	Douglas Matson		Douglas.Matson@tufts.edu
2017 FALL	Primary	Gary Leisk		Gary.LEISK@tufts.edu
2017 FALL	Primary	Robert White		R.White@tufts.edu

# Course Bulletin

2017 FALL	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
2017 FALL	Primary	Jason Rife	Jason.Rife@tufts.edu
2017 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu
2017 FALL	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
2017 FALL	Primary	William Messner	William.Messner@tufts.edu
2017 FALL	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
2017 FALL	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
2017 FALL	Primary	Jianmin Qu	Jianmin.Qu@tufts.edu
2017 FALL	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2017 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu

Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.

**123064****Graduate Research**

Subject: Catalog Nbr:  
ME 0298

2018 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2018 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu
2018 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
2018 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
2018 SPRG	Primary	Robert White	R.White@tufts.edu
2018 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
2018 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu
2018 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu
2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
2018 SPRG	Primary	William Messner	William.Messner@tufts.edu
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
2018 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2018 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu

Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental website for specific details.

**123213****Master Of Engineering Project**

Subject: Catalog Nbr:

# Course Bulletin

ME	0299			
	2018 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
	2018 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu
	2018 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2018 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
	2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
	2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
	2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
	2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
	2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
	2018 SPRG	Primary	Robert White	R.White@tufts.edu
	2018 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
	2018 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu
	2018 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu
	2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
	2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
	2018 SPRG	Primary	William Messner	William.Messner@tufts.edu
	2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
	2018 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
	2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
	2018 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
	2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu

Execution of a major project equivalent to one course credit under the guidance of a faculty adviser. Each project must address a substantive engineering analysis or design problem. Students are required to submit a written report and make an oral presentation of their project work. Students are expected to enroll in this course in the last term of their degree program. Enrollment is limited to and required for matriculated students in the master of engineering program.

<b>123233</b>	<b>Non Major Credit</b>
Subject:	Catalog Nbr:
ME	0310

<b>123260</b>	<b>Lower Level Elective Crd</b>
Subject:	Catalog Nbr:
ME	0320

<b>123283</b>	<b>Upper Level Elective Crd</b>
Subject:	Catalog Nbr:
ME	0330

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<b>123330</b>	<b>Tufts Abroad Program</b>			
Subject:	Catalog Nbr:			
ME	0340			
2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu	

<b>123490</b>	<b>Master's Degree Continuation</b>			
Subject:	Catalog Nbr:			
ME	0401			
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
Part-time. Please see departmental website for specific details.				

<b>123543</b>	<b>Master's Degree Continuation</b>			
Subject:	Catalog Nbr:			
ME	0402			
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
Full-time. Please see departmental website for specific details.				

<b>123584</b>	<b>Grad Teaching Assistant</b>			
Subject:	Catalog Nbr:			
ME	0405			
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	

<b>123607</b>	<b>Grad Research Assistant</b>			
Subject:	Catalog Nbr:			
ME	0406			
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	

# Course Bulletin

<b>123772</b>	<b>Doctoral Degree Continuation</b>			
Subject:	Catalog Nbr:			
ME	0501			
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
Part-time. Please see departmental website for specific details.				

<b>123827</b>	<b>Doctoral Degree Continuation</b>			
Subject:	Catalog Nbr:			
ME	0502			
2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu	
Full-time. Please see departmental website for specific details.				

<b>127097</b>	<b>Mechanical Design And Fabrication</b>			
Subject:	Catalog Nbr:			
ME	0001			
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu	
<p>Fabrication techniques focusing on manual and CNC machines. Engineering drawings. Fundamentals of machine design. Elastic and plastic deformation, theories of failure, impact, and fatigue of machine elements. The design of machines is approached through selected design problems that are integrated throughout the course.</p> <p>Recommendations: ES 5 (Statics and Dynamics)</p>				

<b>127281</b>	<b>Heat Transfer</b>			
Subject:	Catalog Nbr:			
ME	0016			
2017 SPRG	Primary	Robert Peattie	Robert.Peattie@tufts.edu	
2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu	
<p>A first course in thermal analysis. Steady-state and transient conduction in solids; numerical solution of conduction problems; radiative heat transfer; forced and natural convection. Introduction to boiling and condensation heat transfer. Heat exchanger analysis. A mandatory weekly lab session designated as ME 16L (no credit) must be taken concurrently. These scheduled laboratory periods involve either experiments from ME 16 or 37, demonstrations both experimental and computational, and problem-solving recitations.</p> <p>Recommendations: ES 7 and 8, MATH 51 (formerly MATH 38).</p>				

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<b>127439</b>		<b>Instruments And Experiments</b>			
Subject:	Catalog Nbr:				
ME	0018				
	2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu	
	2017 SPRG	Primary	Alfram Bright	Alfram.Bright@tufts.edu	
	2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu	
	2018 SPRG	Primary	Robert White	R.White@tufts.edu	
Design, execution, and analysis of experiments in different fields of mechanical engineering, such as fluid mechanics, heat transfer, dynamics, and materials. Specific topics include sensors, software-based data acquisition, instrument control, data reduction, report writing, and statistical analysis.					

<b>127673</b>		<b>Materials Science and Engineering</b>			
Subject:	Catalog Nbr:				
ME	0025				
	2016 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu	
	2017 FALL	Primary	Anil Saigal	anil.saigal@tufts.edu	
	2017 FALL	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
A study of the structure-property relationships of engineering materials. It covers the internal structure of both perfect and imperfect materials and the principles and techniques by which this structure can be controlled. The relationship of mechanical properties to structure is studied, and the influence of these properties on actual production processes is covered.					

<b>127791</b>		<b>Dynamics And Vibration</b>			
Subject:	Catalog Nbr:				
ME	0037				
	2016 FALL	Primary	Robert White	R.White@tufts.edu	
	2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu	
	2016 FALL	Primary	Pratap Misra	Pratap.Misra@tufts.edu	
	2017 FALL	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
	2017 FALL	Primary	Sauro Liberatore	Sauro.Liberatore@tufts.edu	
Kinematics and kinetics of particles and of rigid bodies in plane motion. Free and forced vibration of damped and undamped single-degree of freedom systems. Recommendations: ES 9 and MATH 51 (formerly MATH 38).					

<b>128033</b>		<b>Machine Design</b>			
Subject:	Catalog Nbr:				
ME	0042				
	2016 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
	2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu	
	2017 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu	

# Course Bulletin

2017 FALL	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
<p>Design and selection of individual machine elements, including gears, bearings, springs, fasteners, brakes, motors, fluid actuators etc. Design projects that relate to these topics are assigned with emphasis placed on the application of fundamental engineering concepts as well as establishing the validity and practicality of the solution.</p> <p>Recommendations: ME 1 (Mechanical Design and Fabrication) and ES 9 (Strength of Materials)</p>			

<b>128322</b>	<b>Senior Design Project</b>		
Subject: ME	Catalog Nbr: 0043		
2017 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu
2017 FALL	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
2017 FALL	Primary	Natasha Wright	Natasha.Wright@tufts.edu
<p>Individual and group independent design projects under the supervision of a department faculty member. The design must be open-ended and make use of the elements of design, as well as use the student's knowledge of engineering science. Please see departmental website for specific details: <a href="http://ase.tufts.edu/mechanical/">http://ase.tufts.edu/mechanical/</a></p> <p>Recommendations: ME 42, senior standing. Permission of instructor.</p>			

<b>128706</b>	<b>System Dynamics &amp; Controls</b>		
Subject: ME	Catalog Nbr: 0080		
2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
2018 SPRG	Primary	William Messner	William.Messner@tufts.edu
<p>Fundamental design concepts in modeling and control of dynamic electromechanical systems. Differential mathematical models of continuous system physics. Behavior in the time and frequency domains. Performance tuning using feedback control, proportional-integral-derivative controllers, sensors, actuators, root locus methods, and frequency response methods. Computer tools for design and measurement.</p> <p>Recommendations: ME 37.</p>			

<b>128724</b>	<b>Introductory Robotics And Mechatronics</b>		
Subject: ME	Catalog Nbr: 0084		
2018 SPRG	Primary	Ethan Danahy	ethan.danahy@tufts.edu
<p>Introduction to controls, image processing, sensor development, filtering, and state machines through weekly robotic competitions. Basic concepts from circuit theory, artificial intelligence, microprocessor control and physical design used to solve practical problems.</p> <p>Recommendations: ES 3 and 5, and MATH 51 (formerly MATH 38). These courses may be taken concurrently.</p>			

<b>128830</b>	<b>Special Topics</b>		
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Subject:	Catalog Nbr:			
ME	0093			
	2016 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2016 FALL	Primary	Robert Hannemann	No Email on file.
	2016 FALL	Primary	Megan Dauphinais	No Email on file.
	2017 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
	2017 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu
	2017 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
	2017 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
	2017 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
	2017 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
	2017 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
	2017 SPRG	Primary	Robert White	R.White@tufts.edu
	2017 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
	2017 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu
	2017 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu
	2017 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
	2017 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
	2017 SPRG	Primary	David Aurelio	David.Aurelio@tufts.edu
	2017 SPRG	Primary	William Messner	William.Messner@tufts.edu
	2017 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
	2017 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
	2017 SPRG	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
	2017 SPRG	Primary	Sami Durrani	Sami.Durrani@tufts.edu
	2017 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
	2017 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
	2018 SPRG	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu
	2018 SPRG	Primary	Natasha Wright	Natasha.Wright@tufts.edu
	2018 SPRG	Primary	Brandon Stafford	Brandon.Stafford@tufts.edu
	2018 SPRG	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu
	2018 SUMR	Primary	Chris Rogers	chris.rogers@tufts.edu

Supervised study in some specialized field of mechanical engineering. Please see departmental website for specific details.

Recommendations: Permission of instructor and department chair.

**128868**
**Undergraduate Research**

Subject:	Catalog Nbr:			
ME	0094			
	2016 FALL	Primary	Robert Hannemann	No Email on file.
	2016 FALL	Primary	Megan Dauphinais	No Email on file.
	2017 SPRG	Primary	David Aurelio	David.Aurelio@tufts.edu
	2017 SPRG	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
	2017 SPRG	Primary	Sami Durrani	Sami.Durrani@tufts.edu
	2018 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu



# Course Bulletin

2018 SPRG	Primary	Michael Wiklund	du michael.wiklund@tufts.edu
2018 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
2018 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
2018 SPRG	Primary	Robert White	R.White@tufts.edu
2018 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu
2018 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu
2018 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu
2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
2018 SPRG	Primary	William Messner	William.Messner@tufts.edu
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
2018 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2018 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu

Independent undergraduate research in the field of mechanical engineering. Please see departmental website for specific details.

Recommendations: Permission of instructor and Department Chair.

128897	Thesis		
Subject: ME	Catalog Nbr: 0096		
2016 FALL	Primary	Robert Hannemann	No Email on file.
2016 FALL	Primary	Megan Dauphinais	No Email on file.
2017 SPRG	Primary	David Aurelio	David.Aurelio@tufts.edu
2017 SPRG	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
2017 SPRG	Primary	Sami Durrani	Sami.Durrani@tufts.edu
2018 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2018 SPRG	Primary	Michael Wiklund	du michael.wiklund@tufts.edu
2018 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
2018 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
2018 SPRG	Primary	Robert White	R.White@tufts.edu
2018 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu

# Course Bulletin

2018 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu
2018 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu
2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
2018 SPRG	Primary	William Messner	William.Messner@tufts.edu
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
2018 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu
2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2018 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu

Supervised research in some specialized field of mechanical engineering. Please see departmental website for specific details.

Recommendations: Permission of instructor and Department Chair.

128929	Internship In Mechanical Engineering			
Subject:	Catalog Nbr:			
ME	0099			
2016 FALL	Primary	Megan Dauphinais	No Email on file.	
2018 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu	
2018 SPRG	Primary	Michael Wiklund	michael.wiklund@tufts.edu	
2018 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu	
2018 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu	
2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu	
2018 SPRG	Primary	Chris Rogers	chris.rogers@tufts.edu	
2018 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu	
2018 SPRG	Primary	Douglas Matson	Douglas.Matson@tufts.edu	
2018 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
2018 SPRG	Primary	Robert White	R.White@tufts.edu	
2018 SPRG	Primary	Kristen Wendell	Kristen.Wendell@tufts.edu	
2018 SPRG	Primary	Jason Rife	Jason.Rife@tufts.edu	
2018 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu	
2018 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu	
2018 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu	
2018 SPRG	Primary	William Messner	William.Messner@tufts.edu	
2018 SPRG	Primary	Igor Sokolov	Igor.Sokolov@tufts.edu	
2018 SPRG	Primary	Jeffrey Guasto	Jeffrey.Guasto@tufts.edu	
2018 SPRG	Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu	
2018 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu	
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
<p>A mentored preprofessional experience in mechanical engineering at an off-site organization. The internship must conform to all the requirements of the School of Engineering Internship Program. The department will grant course credit for internships if the following conditions are met: 1) The student submits a written internship proposal that is approved by the department prior to the semester in which the internship will be performed (no internships with course credit will be approved once the semester of the internship has</p>				

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started), 2) a faculty mentor has supervisory control of any work that receives credit, and 3) a written report is submitted that will be evaluated by the faculty adviser and the outside institutional supervisor.  
 Recommendations: Junior or senior standing. Permission of Instructor.

<b>128952</b>	<b>Inventive Design</b>			
Subject:	Catalog Nbr:			
ME	0102			
2016 FALL	Primary	Natasha Wright	Natasha.Wright@tufts.edu	
2017 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu	
<p>The invention, design, and development of new products. The identification of product opportunities from marketing, manufacturing, and consumers' viewpoints. The organization of new product effort within a corporation. Primary assignments are design projects that are presented before a jury of professionals in the field.</p> <p>Recommendations: Senior Standing.</p>				

<b>128969</b>	<b>Micro-fabrication And Design</b>			
Subject:	Catalog Nbr:			
ME	0103			
<p>An introduction to Micro-Electro-Mechanical Systems (MEMS). Topics include fabrication, design, and applications of MEMS devices. Introduction to computer-aided design techniques and tools.</p> <p>Recommendations: Senior Standing.</p>				

<b>129074</b>	<b>Statistical Quality Control</b>			
Subject:	Catalog Nbr:			
ME	0108			
2018 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu	
<p>This course deals with principle, role, management, and history of quality control in modern manufacturing and servicing organizations. Topics covered include statistical process control, probability and statistics, Pareto diagrams, statistical design of experiments, Taguchi methods, acceptance sampling, and cost of quality.</p> <p>Recommendations: Senior standing or permission of instructor.</p>				

<b>129137</b>	<b>Thermal Management Of Electronics</b>			
Subject:	Catalog Nbr:			
ME	0110			
2016 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu	
<p>Design of hardware to control temperature of electronic and photonic components. Thermal management challenges from component-to-data center scales and dependence of reliability on temperature. Fundamentals of heat transfer review. Design and analysis of key technologies: thermal interface materials, heat pipes, heat sinks, thermoelectric modules. Selected emerging technologies. Energy efficient solutions.</p> <p>Recommendations: ME 16 - Heat Transfer or permission of instructor.</p>				

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<b>129155</b>	<b>Thermal-fluid Transport I</b>			
Subject:	Catalog Nbr:			
ME	0111			
2017 FALL	Primary	Erica Kemmerling		Erica.Kemmerling@tufts.edu
<p>(Cross-listed as CHBE 111). Advanced topics in fluid mechanics. Viscous and inviscid flows. Strain rate, vorticity and streamline coordinates. Differential conservation laws for mass, momentum and energy. Dimensional analysis. Lubrication flows. Momentum and thermal laminar boundary layers. Laminar-turbulent transition. Reynolds stress and turbulence modeling. Turbulent boundary layers. Flow modeling.</p> <p>Recommendations: ES 8 - Fluid Mechanics or permission of instructor.</p>				

<b>129219</b>	<b>Thermal-fluid Transport II</b>			
Subject:	Catalog Nbr:			
ME	0112			
2018 SPRG	Primary	Marc Hodes		Marc.Hodes@tufts.edu
<p>(Cross-listed as CHBE 112). Multi-dimensional conduction. Transient conduction including moving boundary problems. External forced and natural convection. Internal forced and natural convection. Developing flows and transition to turbulence. Condensation and boiling heat transfer. Radiation and conjugate heat transfer involving radiation. Temperature and heat flux measurements. Numerical techniques.</p> <p>Recommendations: ME 111 Thermal-Fluid Transport I or equivalent.</p>				

<b>129270</b>	<b>Advanced Thermodynamics</b>			
Subject:	Catalog Nbr:			
ME	0115			
<p>Classical thermodynamics; chemical thermodynamics and statistical thermodynamics. Applications to materials engineering and processes. Recommendations: MATH 51.</p>				

<b>129309</b>	<b>Mass Transfer And Phase Transformations In Materials Processing</b>			
Subject:	Catalog Nbr:			
ME	0116			
<p>The course is designed for students interested in thermal, fluid, and mass transport aspects of materials processing. Topics include heat treatment, continuum diffusion, atomistics of diffusion, oxidation, evaporation, and solidification. A wide range of practical examples and applications is drawn on, and class work and readings are supplemented by in-class presentations, guest lectures, and small projects.</p> <p>Recommendations: ME 16 or permission of instructor.</p>				

<b>129432</b>	<b>Advanced Data Acquisition And Image Processing</b>			
Subject:	Catalog Nbr:			

# Course Bulletin

ME 0118

An upper-level course designed for students interested in laboratory techniques relevant to mechanical engineering experimentation, including temperature, velocity, and stress measurement. Topics include image processing and advanced signal processing. After an initial review of computer interface and experiment control, the course is dedicated to how video signals are generated, acquired, and processed, including filtering techniques (Sobel, Median, Lapacian, etc.) as well as pattern recognition and identification.

**129549**

**Biomaterials**

Subject: Catalog Nbr:

ME 0121

2017 SPRG

Primary

Kenneth James

ken.james@tufts.edu

This course presents the following topics: elementary solid mechanics; aspects of material science applied to metals, polymers, ceramics, and biological tissues; tissue reactions to artificial materials; pathohistology; and inflammatory and immune responses. The course is completed by a survey of artificial materials and devices in clinical use, emphasizing vascular and orthopedic prostheses. A literature review and oral presentation covering a current device is assigned.

Recommendations: ME 25 or permission of instructor.

**129642**

**Solid Mechanics**

Subject: Catalog Nbr:

ME 0122

2017 FALL

Primary

Mark Kachanov

mark.kachanov@tufts.edu

(Cross-listed as CEE 122). Strain tensor, stress tensor, elastic stress analysis, isotropic and anisotropic materials, torsion problem, inelastic behavior of materials, elements of plasticity and creep.

Recommendations: ES 9 Strength of Materials or equivalent.

**129680**

**Mechanics Of Composite And Heterogeneous Materials**

Subject: Catalog Nbr:

ME 0123

2018 SPRG

Primary

Michael Zimmerman

Michael.Zimmerman@tufts.edu

Anisotropic materials, tensors of elastic stiffnesses and compliances, dependence of elastic properties on direction, effective properties of fiber-reinforced and laminated materials, properties of heterogeneous materials (with pores, cracks, foreign particles).

Recommendations: ME 122 or consent of the instructor.

**129701**

**Fracture Mechanics**

Subject: Catalog Nbr:

ME 0124

Fundamental physical concepts of fracture science and the basic mechanics models of fracture propagation. Cracks and stress concentration. Brittle fracture, elastic-plastic fracture, creep fracture. Damage mechanics,

# Course Bulletin

phenomenological criteria of strength. Applications to engineering problems.  
Recommendations: ME 122 or CEE 122, or ES 9 and permission of instructor.

<b>129749</b>	<b>Manufacturing Processes And Materials Technology</b>			
Subject: ME	Catalog Nbr: 0125			
2016 FALL	Primary	Simon Steel		Simon.Steel@tufts.edu
2018 SPRG	Primary	Anil Saigal		anil.saigal@tufts.edu
<p>A study of traditional and nontraditional manufacturing processes related to processing of metals, ceramics, and polymers, including computer-aided manufacturing. Topics include properties and behavior of materials, selection of materials and processes subject to surface finish, tolerance, design, and economic constraints. Recommendations: ME 25.</p>				

<b>129829</b>	<b>Computer-integrated Engineering</b>			
Subject: ME	Catalog Nbr: 0126			
<p>This is a project-oriented course that introduces students to the concept of integrated engineering consisting of design, analysis, optimization, and manufacturing. Microcomputer-based commercial software packages will be used to design and optimize a mechanical component or an assembly. Engineering constraints such as costs, material selection, and manufacturing techniques will be discussed. The students will then use a CNC Machining Center to produce their optimized design. Recommendations: Senior standing or permission of instructor.</p>				

<b>129898</b>	<b>Theory And Applications Of Polymer Materials And Processing</b>			
Subject: ME	Catalog Nbr: 0127			
2017 FALL	Primary	Michael Zimmerman		Michael.Zimmerman@tufts.edu
<p>Design processes for developing plastic parts. Physical, rheological, environmental and electrical properties of engineering polymers. Material selection methods, mold filling simulation techniques for plastics, mechanics of polymer processing, mold design techniques, secondary assembly techniques, secondary plastic part processing. Agency considerations and economics. Applications in injection molding. Recommendations: ME 25 or permission of instructor.</p>				

<b>129926</b>	<b>Nonlinear Analysis of Materials and Structures</b>			
Subject: ME	Catalog Nbr: 0128			
2016 FALL	Primary	Simon Steel		Simon.Steel@tufts.edu
2017 FALL	Primary	Luis Dorfmann		Luis.Dorfmann@tufts.edu
<p>(Cross-listed as CEE 128.) Nonlinear solid mechanics, nonlinear constitutive models and variational principles as essential prerequisites for nonlinear finite element formulations.</p>				

# Course Bulletin

Recommendations: ES 9.

129977	Finite Elements			
Subject: ME	Catalog Nbr: 0129			
2016 FALL	Primary	Michael Zimmerman		Michael.Zimmerman@tufts.edu
2018 SPRG	Primary	Masoud Sanayei		masoud.sanayei@tufts.edu
<p>(Cross-listed with CEE 0105). Finite element analysis of problems important in civil infrastructure engineering. Overview of direct stiffness method. Discretization of continuum to finite elements for approximate solution of complex engineering problems. Development of governing equations, stiffness and load matrices for deformation and stress analysis. Work and energy theorems. Hands-on experience with computers programs and practical applications in structural and geotechnical engineering. Recommendations: CEE 22or ME 42, or consent of instructor</p>				

130089	Advanced Vibrations			
Subject: ME	Catalog Nbr: 0137			
2017 SPRG	Primary	Robert White		R.White@tufts.edu
<p>Extension and generalization of single- and two-degree-of-freedom systems to discrete systems with many degrees of freedom, using Lagrange's equations and matrix theory. Numerical integration methods with computer applications. Introduction to continuous systems and random vibration. Recommendations: ME 37 or permission of instructor.</p>				

130187	Acoustics			
Subject: ME	Catalog Nbr: 0139			
2016 FALL	Primary	James Moore		No Email on file.
2016 FALL	Primary	Mark Moeller		Mark.Moeller@tufts.edu
2017 FALL	Primary	Robert White		R.White@tufts.edu
<p>Wave propagation in fluids and solid structures; sound sources and sound radiation by vibrating structures; fluid-structure interaction; sound transmission and attenuation; laboratory and field measurements; design criteria and methods. Recommendations: ME 37.</p>				

130256	Power Generation Systems			
Subject: ME	Catalog Nbr: 0145			
<p>Design and engineering of electric power production systems. Thermal-mechanical principles of electrical energy conversion, cogeneration, and storage using fossil fuel, geothermal, hydroelectric, nuclear, ocean, solar thermal, and wind power sources. Direct generation using fuel cells and photovoltaics. Economic and</p>				

# Course Bulletin

environmental sustainability aspects.

Recommendations: Senior standing. ES 7 and 8, or equivalent thermal-fluids background with permission of instructor.

138656	Honors Thesis B			
Subject:	Catalog Nbr:			
COMP	0197			
2017 SPRG	Primary	Anselm Blumer	ablumer@cs.tufts.edu	
2017 SPRG	Primary	Robert Jacob	jacob@cs.tufts.edu	
2017 SPRG	Primary	Alva Couch	alva.couch@tufts.edu	
2017 SPRG	Primary	Soha Hassoun	soha.hassoun@tufts.edu	
2017 SPRG	Primary	Diane Souvaine	Diane.Souvaine@tufts.edu	
2017 SPRG	Primary	Ming Chow	ming.chow@tufts.edu	
2017 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu	
2017 SPRG	Primary	Roni Khardon	roni@eecs.tufts.edu	
2017 SPRG	Primary	Donna Slonim	Donna.Slonim@tufts.edu	
2017 SPRG	Primary	Samuel Guyer	Samuel.Guyer@tufts.edu	
2017 SPRG	Primary	Bruce Molay	Bruce.Molay@tufts.edu	
2017 SPRG	Primary	Benjamin Hescott	No Email on file.	
2017 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu	
2017 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu	
2017 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu	
2017 SPRG	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu	
2017 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	
2017 SPRG	Primary	Mark Sheldon	Mark.Sheldon@tufts.edu	
2017 SPRG	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu	
2017 SPRG	Primary	Fahad Dogar	Fahad.Dogar@tufts.edu	
2017 SPRG	Primary	Elena Strange	Elena.Strange@tufts.edu	
2017 SPRG	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu	
Honors Thesis Computer Science.Please see departmental website for specific details.				

138675	Tufts Programs Abroad			
Subject:	Catalog Nbr:			
EE	0340			
Tufts Programs Abroad				

138860	Honors Thesis Research B			
Subject:	Catalog Nbr:			
CHBE	0096			
2017 SPRG	Primary	Jerry Meldon	No Email on file.	
2018 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu	
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	



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2018 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu
2018 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu
2018 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu
2018 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu
2018 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2018 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu
2018 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu
2018 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu
2018 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2018 SPRG	Primary	Prashant Deshlahra	Prashant.Deshlahra@tufts.edu
Supervised research in chemical and biological engineering leading to the completion of the undergraduate honors thesis. Please see the Departmental website for specific program details and qualification requirements.			

<b>139046</b>	<b>Computer Aided Design w/ Lab</b>		
Subject:	Catalog Nbr:		
ES	0018		
2018 SPRG	Primary	Ryan Marshall	Ryan.Marshall@tufts.edu
Two-and three-dimensional geometric modeling with Computer Aided Design (CAD) systems. The use of CAD technology for the design and analysis of civil structures and mechanical assemblies. Topics include traditional modeling, parametric feature-based solid part and assembly modeling, creating engineering drawings from CAD, Building Information Modeling (BIM), sculptured surface modeling, material mapping and lighting for rendering CAD models, and animation for engineering applications. Laboratory.			

<b>139047</b>	<b>Biological Systems Analysis</b>		
Subject:	Catalog Nbr:		
BME	0143		
2017 FALL	Primary	Bree Aldridge	Bree.Aldridge@tufts.edu
Mathematical and computational methods of biological systems at molecular and cell levels including regression, logic, statistics, kinetics, dynamical systems, pharmacodynamics, and agent-based modeling. Biological questions coordinated with appropriate mathematical modeling approach. Recommendations: Junior standing, CHEM 2, BIO 13, MATH 42, or permission of instructor			

<b>139048</b>	<b>Biomaterials and Regenerative Medicine</b>		
Subject:	Catalog Nbr:		
BME	0153		
2016 FALL	Primary	Rosalyn Abbott-Beauregard	No Email on file.
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu
2017 FALL	Primary	Jonathan Grasman	Jonathan.Grasman@tufts.edu

# Course Bulletin

(Cross-listed as CHBE 164). Fundamental concepts of biomaterials and regenerative medicine (biomaterial types, synthesis, properties, mechanisms of degradation, biological interfaces, inflammation and related issues). Specific focus on biomaterials related to regenerative medicine. Course independent of, but complementary to, BME 154.

Recommendations: Junior standing, BIO13, CHEM 1, or consent of instructor

<b>139050</b>	<b>Tissue Engineering and Regenerative Medicine</b>			
Subject:	Catalog Nbr:			
BME	0154			
2018 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
2018 SPRG	Primary	Whitney Stoppel	Whitney.Stoppel@tufts.edu	
<p>Fundamental concepts of tissue engineering and regenerative medicine (scaffolds, stem cells and bioreactors); progress with specific tissue systems; applications for tissue engineering; and current state-of-the art of tissue regeneration. Additional topics: transport phenomena and mechanical regulation of stem cell function, with focus on mechanisms of mechanotransduction. Course independent of, but complementary to, BME 153. Recommendations: Junior standing, BIO 13, CHEM 51, PHYS 11, ES 9, or consent of instructor.</p>				

<b>139051</b>	<b>Electronic Devices for Energy Applications</b>			
Subject:	Catalog Nbr:			
CHBE	0175			
2017 FALL	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu	
<p>Design and operating principles of a variety of thin-film devices related to electrical energy generation, storage, or conversion. An overview of optical and electronic processes in a variety of materials (metals, insulators, semiconductors), thin film deposition and characterization techniques, as well as photovoltaics (solar cells), electrochemical capacitors, batteries, field-effect transistors, colloidal quantum dot devices, and light-emitting diodes (LEDs). Recent research advances in the field of novel optoelectronic devices for energy applications.</p> <p>Prerequisites: Chem 0002 Recommendations: junior standing.</p>				

<b>139053</b>	<b>Research</b>			
Subject:	Catalog Nbr:			
COMP	0191			
<p>Research on a topic in Computer Science or a related discipline, culminating in a final paper describing accomplishments, with the goal of advancing the state of the art. Topic is proposed by a faculty sponsor in Computer Science. Credit as arranged.</p> <p>Recommendation: Permission of instructor.</p>				

<b>139054</b>	<b>Physics of Solar Cells</b>			
Subject:	Catalog Nbr:			

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EE	0114				
	2017 FALL	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
<p>Physics of photovoltaic cells including physics of semiconductors in photovoltaic devices, physical models of solar cell operation, characteristics and design of common types of solar cells, and approaches to increasing solar cell efficiency.</p> <p>Recommendations: MATH 42, MATH 51, EE 18, PHYS 42/43, or instructor permission</p>					

<b>139055</b>	<b>Networked Estimation and Control</b>				
	Subject:	Catalog Nbr:			
	EE	0130			
	2018 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu	
<p>Networked estimation and control methodologies for large-scale, complex, inter-connected dynamical systems. Analysis of distributed algorithms using concepts from Markov chains and irreducible non-negative matrices. Distributed implementation of Kalman filter and related control algorithms.</p> <p>Recommendations: EE 105 and EE 125 or equivalent, or permission of instructor.</p>					

<b>139056</b>	<b>Power Systems</b>				
	Subject:	Catalog Nbr:			
	EE	0170			
	2017 FALL	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
<p>Analysis and design of AC transmission and distribution systems, transmission lines, transformers and generators. Understanding, modeling, operating and controlling such systems; basics of voltage control and power flows in electricity networks. Graduate students are expected to complete and present an additional class project.</p> <p>Recommendations: EE 22 or graduate student standing</p>					

<b>139057</b>	<b>Power Electronics</b>				
	Subject:	Catalog Nbr:			
	EE	0171			
	2018 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
<p>Analysis and design of energy conversion circuits that contain electronic switching devices. Emphasis on understanding and modeling, and providing engineering background to evaluate power converters. Also covers dynamics and control of this class of systems. Graduate students are expected to complete and present an additional class project.</p> <p>Recommendations: EE 22 or graduate student standing.</p>					

<b>139058</b>	<b>Optoelectronic Characterization</b>				
	Subject:	Catalog Nbr:			
	EE	0214			
<p>Tools and techniques used to characterize optoelectronic materials and devices. Photoluminescence,</p>					

# Course Bulletin

ellipsometry, scanning probe microscopy, electron microscopy, and AC/DC electrical characterization. Theoretical underpinning of and practical experience with the measurement techniques. Laboratory.

<b>139066</b>	<b>Bioinformatics</b>			
Subject:	Catalog Nbr:			
COMP	0007			
2016 FALL	Primary	Donna Slonim		Donna.Slonim@tufts.edu
(Cross-listed with BIO 0040) Bioinformatics for students with little or no computer science background. Basic programming skills for data manipulation and analysis. Methods and applications of online tools for sequence alignment, molecular phylogeny, gene expression data analysis, and linking molecular variation to disease. Recommendations: Biology 41 or BME 62 or equivalent.				

<b>139213</b>	<b>Human Factors in Medical Technology</b>			
Subject:	Catalog Nbr:			
ENP	0110			
2017 FALL	Primary	Michael Wiklund		michael.wiklund@tufts.edu
Techniques for ensuring the safety and efficacy of medical technology ranging from over-the-counter devices to complex diagnostic and therapeutic workstations to clinical information systems. Global standards and regulations, usability engineering program planning, function and task analysis, user interface requirements, applied user interface design, user interface simulation, design verification, and design validation via usability testing. Pre-requisites: senior or graduate standing or permission of instructor.				

<b>139374</b>	<b>Master's Degree Continuation</b>			
Subject:	Catalog Nbr:			
ENP	0401			
2018 SPRG	Primary	Briana Bouchard		Briana.Bouchard@tufts.edu
2018 SPRG	Primary	James Intriligator		James.Intriligator@tufts.edu
Part-time. Please see departmental website for specific details.				

<b>139375</b>	<b>Master's Degree Continuation</b>			
Subject:	Catalog Nbr:			
ENP	0402			
2018 SPRG	Primary	Briana Bouchard		Briana.Bouchard@tufts.edu
2018 SPRG	Primary	James Intriligator		James.Intriligator@tufts.edu
Full-time. Please see departmental website for specific details.				

<b>139447</b>	<b>Special Topics in Engineering Management</b>			
Subject:	Catalog Nbr:			
EM	0293			

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2017 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
Special topics in engineering management. Guided independent study of an approved topic at the graduate level. Credit as arranged. Prerequisite: Consent of instructor			

<b>139448</b>	<b>Leadership for Technical Professionals</b>		
Subject: EM	Catalog Nbr: 0261		
2016 FALL	Primary	Jerome Brightman	Jerome.Brightman@tufts.edu
2017 FALL	Primary	Stacy Lennon	Stacy.Lennon@tufts.edu
2018 SPRG	Primary	Ewa Winston	Ewa.Winston@tufts.edu
Development of self-awareness and skills necessary for leadership. Involves 360 degree assessment tools and extensive experiential learning. Oral communication, systems thinking, high performance teams, fostering creativity, team decision making, leading change, influence without authority. Note: for graduate students not enrolled in Gordon Institute Master of Science in Engineering Management (MSEM) program. Pre-requisite: undergraduate degree.			

<b>139449</b>	<b>Financial Management for High Technology Firms</b>		
Subject: EM	Catalog Nbr: 0155		
Concepts in accounting and finance. Review and discussion of business cases. Course project to create a financial plan for a new product or service. Pre-requisites: Available to Juniors, Seniors & Graduate students.			

<b>139451</b>	<b>Business Analytics</b>		
Subject: EM	Catalog Nbr: 0241		
Developing the knowledge and skills needed to employ analytics to solve business problems in the management of high tech firms. Topics include corporate strategies in high tech firms, a framework for defining strategic problems and opportunities, and tools to transform data into insights and business solutions. Offered in a blended learning mode: 30-40% of the classroom contact hours will be on-line. Prerequisite: Undergraduate degree			

<b>139522</b>	<b>Project Study In Human Systems B</b>		
Subject: ENP	Catalog Nbr: 0120		
2017 SPRG	Primary	David Aurelio	David.Aurelio@tufts.edu
2018 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu
(Cross-listed as BME 120 and PSY 120.) A senior-level project design (capstone course), led by faculty from engineering and psychology as well as outside lecturers. Students participate in team fashion in			

# Course Bulletin

human-factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects. Spring.

<b>139523</b>	<b>Project Study In Human Systems B</b>			
Subject: BME	Catalog Nbr: 0120	2018 SPRG	Primary	James Intriligator James.Intriligator@tufts.edu
(Cross-listed as ENP 120 and PSY 120.) A senior-level project design (capstone course), led by faculty from engineering and psychology as well as outside lecturers. Students participate in team fashion in human factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects.				

<b>140067</b>	<b>Microwave System Engineering</b>			
Subject: EE	Catalog Nbr: 0119			
Planning and deploying microwave systems and networks. Design and construction of system components. Design and management of microwave networks .Cellular systems Best network topologies and paths for lowest possible operations and maintenance costs. System components: oscillators, attenuators, phase shifters, modulators, mixers, filters, amplifiers, and antennas, A to D and D to A converters. Transmitter and receiver characteristics, Transceiver Design, System Gain, Satellite Communications, Radio Thermal Noise, signal to noise ratio SIN, receiver sensitivity, modulation and SIN, design principles, antenna system considerations. Prerequisite: EE117 and EE107				

<b>140069</b>	<b>Project Management and Software Methodologies</b>			
Subject: EM	Catalog Nbr: 0231	2018 SPRG	Primary	Kishore Pochampally Kishore.Pochampally@tufts.edu
Development of knowledge and skills to plan and execute engineering projects. Topics include creating work break down structures, schedules, critical path determination, and risk assessment and mitigation. Methodologies also include iterative techniques (agile and scrum) often used in software development. Prerequisite: Undergraduate degree.				

<b>140070</b>	<b>Innovating Breakthrough Products and Processes</b>			
Subject: EM	Catalog Nbr: 0254			
Development of knowledge and skills to identify opportunities by reframing problems and generating solutions using systematic innovation based on the principles of TRIZ. Understand technology trends and evolution and the role of technology strategy in the overall business strategy of organizations, from entrepreneurial ventures to established firms. Prerequisite: Undergraduate degree.				

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<b>140071</b>	<b>Conflict Resolution</b>			
Subject:	Catalog Nbr:			
EM	0262			
2017 FALL	Primary	Mark Bamford		Mark.Bamford@tufts.edu
Introduces conceptual frameworks, tools, and skills to effectively manage conflict and negotiate win/win solutions in the workplace. Course will involve lectures, cases, and role plays to simulate real on the job conflicts. Prerequisite: Undergraduate degree.				

<b>140282</b>	<b>Lean Six Sigma</b>			
Subject:	Catalog Nbr:			
EM	0211			
2018 SUMR	Primary	Kishore Pochampally		Kishore.Pochampally@tufts.edu
Provides principles and methods for process improvement by eliminating non-value added work and by reducing output variability. Tools include the define-measure-analyze-improve-control problem solving methodology, statistical process control, statistically designed experiments and risk identification and mitigation strategies. Prerequisite: Undergraduate degree				

<b>140391</b>	<b>Tufts Abroad Program</b>			
Subject:	Catalog Nbr:			
CEE	0340			

<b>140782</b>	<b>Probabilistic Systems Analysis</b>			
Subject:	Catalog Nbr:			
EE	0024			
2017 SPRG	Primary	Brian Aull		Brian.Aull@tufts.edu
2018 SPRG	Primary	Eric Miller		Eric.Miller@tufts.edu
Development of analytical tools for the modeling and analysis of random phenomena with application to problems across a range of engineering and applied science disciplines. Probability theory, sample and event spaces, discrete and continuous random variables, conditional probability, expectations and conditional expectations, and derived distributions. Sums of random variables, moment generating functions, central limit theorem, laws of large numbers. Statistical analysis methods including hypothesis testing, confidence intervals and nonparametric methods. Undergraduates may not take both EE 0024 and EE 0104 for degree credit. Prerequisite: Math 0042 or equivalent				

<b>140783</b>	<b>Stochastic Processes, Detection, and Estimation</b>			
Subject:	Catalog Nbr:			

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EE	0140				
	2017 FALL	Primary	Eric Miller		Eric.Miller@tufts.edu
<p>Random vectors including second order characterization; Detection including binary, M-ary, Neyman-Pearson methods; Estimation including Bayes least squares, maximum a posteriori, and maximum likelihood methods; Random processes including notions of stationarity, wide sense stationarity, and independent increments; Bernoulli process, Poisson process, Markov processes including Markov chains, Weiner processes; Wide sense stationary processes and linear systems including power spectral density, spectral factorization, noncausal and causal Weiner filters; Mean square stochastic calculus including Karhunen-Loeve decompositions. Prerequisite: EE-0023, EE-0024 or EE-0104, Math 72 or consent of instructor.</p>					

<b>140784</b>	<b>New Product Innovation</b>				
	Subject:	Catalog Nbr:			
	EM	0221			
	2017 FALL	Primary	Kevin Oye		Kevin.Oye@tufts.edu
<p>Treatment of both business and technical aspects of new product development. Topics include voice of the customer, concept generation and evaluation, marketing, supply chain, intellectual property and usability. Course enrollment limited to graduate students in the Master of Science in Innovation and Leadership program.</p>					

<b>140785</b>	<b>Business Communications</b>				
	Subject:	Catalog Nbr:			
	EM	0252			
	2016 FALL	Primary	Kathryn Roy		No Email on file.
	2017 FALL	Primary	Amy Hirschfeld		amy.hirschfeld@tufts.edu
<p>Written and oral communications in the business setting. Topics include making conscious communications decisions, principles of effective written and oral communication, and different workplace audiences. Design and delivery of effective presentations. Consideration is given to the practical, philosophical and ethical context of communication in the modern globalized business world.</p>					

<b>140786</b>	<b>Innovation and Technology Strategy</b>				
	Subject:	Catalog Nbr:			
	EM	0253			
	2018 SPRG	Primary	Kevin Oye		Kevin.Oye@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin		Rebekah.Plotkin@tufts.edu
<p>Knowledge and skills to lead and manage innovation initiatives in technology based companies. Topics include understanding technology strategy and its role in the overall business strategy of commercial firms, the role of innovation in entrepreneurial ventures as well as in established firms, and developing skills to present new product development proposals to senior management and/or prospective investors.</p>					

<b>140787</b>	<b>Financial Management in Technology Firms</b>				
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Subject: EM	Catalog Nbr: 0255	2017 FALL	Primary	Frank Apeseche	Frank.Apeseche@tufts.edu
<p>Concepts in accounting and finance. Review and discussion of business cases. Course project to create a financial plan for a new product or service. Enrollment limited to graduate students in the Master of Science in Innovation and Leadership program.</p>					

<b>140788</b>	<b>Capstone Innovation and Leadership Project</b>				
Subject: EM	Catalog Nbr: 0281	2017 SUMR	Primary	Kevin Oye	Kevin.Oye@tufts.edu
<p>Engineering project that demonstrate business acumen and leadership skills. Projects taken from employer for which student interns or works full time. Enrollment limited to graduate students in the Master of Science in Innovation and Leadership program.</p>					

<b>140789</b>	<b>Applications in Engineering</b>				
Subject: EN	Catalog Nbr: 0001	2016 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu
		2016 FALL	Primary	John Durant	john.durant@tufts.edu
		2016 FALL	Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
		2016 FALL	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu
		2017 FALL	Primary	Ethan Danahy	ethan.danahy@tufts.edu
		2017 FALL	Primary	Soha Hassoun	soha.hassoun@tufts.edu
		2017 FALL	Primary	Christopher Swan	chris.swan@tufts.edu
		2017 FALL	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
		2017 FALL	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
		2017 FALL	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
		2017 FALL	Primary	Darryl Williams	Darryl.Williams@tufts.edu
		2017 FALL	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
		2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
		2017 FALL	Primary	Brandon Stafford	Brandon.Stafford@tufts.edu
		2017 FALL	Primary	Jennaca Davies	Jennaca.Davies@tufts.edu
		2017 FALL	Secondary	Laurie Baise	laurie.baise@tufts.edu
<p>Introduction of various concepts in engineering. Emphasis on project work, engineering ethics, and engineering design process. Discipline topic areas vary each term. Limited to first-year students.</p>					

<b>140795</b>	<b>Engineering and Science for Elementary School Educators I</b>				
Subject: ENE	Catalog Nbr: 0110	2017 FALL	Primary	Merredith Portsmore	merredith.portsmore@tufts.edu

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2017 FALL	Primary	John Heffernan	John.Heffernan@tufts.edu
Introduction to engineering for those with limited STEM background. Topics include fundamentals of engineering in society, basics of the engineering design process, introduction to programming (sense-think-act), and the integration of a selection of simple machines with engineering.			

<b>140797</b>	<b>Engineering and Science for Elementary School Educators II</b>		
Subject: ENE	Catalog Nbr: 0111	2018 SUMR	Primary
	John Heffernan	John.Heffernan@tufts.edu	
Exploring client-centered engineering design for novices. Topics will include techniques for defining design requirements and constraints, approaches to testing prototypes and interpreting results and engineering connections to science topics in circuits.			

<b>140798</b>	<b>Teaching and Learning in Engineering I</b>		
Subject: ENE	Catalog Nbr: 0130	2017 SPRG	Primary
	Jessica Watkins	Jessica.Watkins@tufts.edu	
	Merredith Portsmore	merredith.portsmore@tufts.edu	
Practices for understanding of K-12 students' engineering thinking and teaching practices that support innovative K-12 engineering education curricula. Additional topics include issues of access, equity and social justice in the engineering classroom as well as instructional strategies that support students' engagement with open-ended engineering design challenges. Design an engineering lesson is required.			

<b>140799</b>	<b>Teaching and Learning in Engineering II</b>		
Subject: ENE	Catalog Nbr: 0131	2017 FALL	Primary
	Merredith Portsmore	merredith.portsmore@tufts.edu	
	Chelsea Andrews	Chelsea.Andrews@tufts.edu	
Structures for responsive teaching as well as assessment of students' competencies in engineering. Additional topics include foundational knowledge of current policy and research in K-12 engineering education. Design of a curriculum unit is required.			

<b>140800</b>	<b>Engineering and Science for Middle and High School Educators</b>		
Subject: ENE	Catalog Nbr: 0150	2016 FALL	Primary
	Susan Bitetti	Susan.Bitetti@tufts.edu	
	Merredith Portsmore	merredith.portsmore@tufts.edu	
	Fayette Shaw	Fay.Shaw@tufts.edu	
Understanding of the relationship between science and engineering, and techniques and knowledge that			

# Course Bulletin

support the formative modeling of design ideas and summative testing of prototypes. Topics will include the following: techniques for analysis of design ideas (vibrations and controls), instrumentation, and computer programming

<b>140801</b>	<b>Engineering and Science for Middle and High School Educators II</b>			
Subject:	Catalog Nbr:			
ENE	0151			
The role of product design, manufacturing and human factors elements of engineering in design process. Additional topics will include fundamental human factors techniques and theories and tools for prototyping and modeling (CAD, 3-D printing).				

<b>140802</b>	<b>Robotics for Educators</b>			
Subject:	Catalog Nbr:			
ENE	0152			
Fundamental robotics knowledge in the domains of mechanical and electrical engineering as well as computer science-- include understanding actuators, microprocessors and sensors, controls, and human-robotics interfaces. Uses robotics kits and a graphical programming environment.				

<b>140803</b>	<b>Engineering and Science for Middle and High School Educators II</b>			
Subject:	Catalog Nbr:			
ENE	0151			
2017 SUMR	Primary	Merredith Portsmore	merredith.portsmore@tufts.edu	
2017 SUMR	Primary	Brian O'Connell	Brian.O_Connell@tufts.edu	
The role of product design, manufacturing and human factors elements of engineering in design process. Additional topics will include fundamental human factors techniques and theories and tools for prototyping and modeling (CAD, 3-D printing).				

<b>141009</b>	<b>Information Theory</b>			
Subject:	Catalog Nbr:			
COMP	0139			
(Cross-listed as EE 127). Information theory as a systematic framework to address fundamental laws and limits of data compression and digital communication. Source coding/data compression; information measures on discrete memory-less sources; practical schemes and algorithms for lossless data compression such as Huffman coding, arithmetic coding, Lempel-Ziv Coding; channel coding for reliable communication and rate distortion for lossy source compression. Advanced topics such as information theoretic cryptography. Recommendations: EE 104 or permission of instructor.				

<b>141134</b>	<b>Mechanics of Materials at the Micro &amp; Nano Scale</b>			
Subject:	Catalog Nbr:			

# Course Bulletin

ME	0130				
	2016 FALL	Primary	Igor Sokolov		Igor.Sokolov@tufts.edu
<p>Mechanics of materials, in particular, soft materials when studied at the micro and nanoscale. Classical approaches to mechanics of materials, both static and dynamic properties. Extension of classical knowledge to the micro and nanoscale, with methods to measure the material mechanics at those scales. Practical examples of biological tissues, cells, and polymers in different environments. Recommendations: ME 37, ME42, or Senior standing.</p>					

<b>141135</b>	<b>Mechanics of Materials at the Micro &amp; Nano Scale</b>				
	Subject:	Catalog Nbr:			
	ME	0230			
	2016 FALL	Primary	Igor Sokolov		Igor.Sokolov@tufts.edu
<p>Mechanics of materials, in particular, soft materials when studied at the micro and nanoscale. Classical approaches to mechanics of materials, both static and dynamic properties. Extension of classical knowledge to the micro and nanoscale, with methods to measure the material mechanics at those scales. Practical examples of biological tissues, cells, and polymers in different environments. Assignments identical to ME130 with additional project paper.</p>					

<b>141384</b>	<b>Music Recording and Production</b>				
	Subject:	Catalog Nbr:			
	ES	0065			
	2017 FALL	Primary	Paul Lehrman		paul.lehrman@tufts.edu
	2017 FALL	Primary	Bradford Swanson		Bradford.Swanson@tufts.edu
<p>Theory and techniques for recording, editing, and producing acoustic music. Acoustics, audio perception, physics and electronics of transducers, analog and digital audio principles, stereo and multi-track recording, mixing, virtual instruments, and synchronization. Development of technical and listening skills to understand and evaluate the aesthetics of recorded sound. Additional material in analog and digital audio circuit design and signal processing. Students may not receive credit for both ES 65 and MUS 65. ES65 will satisfy a requirement for the Sound Recording and Production track of the Music Engineering minor (MUS 65 will not). Co-requisite or prerequisite: ES3. Recommended: Musical literacy, PHY 11, PHY 12.</p>					

<b>141451</b>	<b>Computer Engineering W/lab</b>				
	Subject:	Catalog Nbr:			
	COMP	0046			
	2017 FALL	Primary	Mark Hempstead		Mark.Hempstead@tufts.edu
<p>(Cross-listed w/ EE 126) Topics covered include computer abstractions, performance measurements, instruction set architectures, designing processor datapath and control, pipelining, memory hierarchy, I/O, multiprocessors. The associated lab consists of designing, implementing, and validating a simplified MIOS processor using Verilog, a hardware description language. Fall. Recommendations: EE 14.</p>					

# Course Bulletin

<b>141475</b>	<b>Tufts Abroad Program</b>			
Subject:	Catalog Nbr:			
EN	0340			
Tufts Abroad Program				

<b>141488</b>	<b>Internet-scale Distributed Systems</b>			
Subject:	Catalog Nbr:			
COMP	0117			
2018 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	
<p>Principles and practices in designing large-scale distributed software systems on the Internet and beyond, including core principles of the design of the World-Wide Web. Key issues and fundamental principles are explored, e.g. global uniform naming, location independence, Metcalfe's law and network effects, function placement and the End-to-End principle, extensibility and evolution of distributed systems including Postel's law, leaky abstractions, etc. Comparison with more traditional distributed system designs, e.g. distributed objects, client/server, publish/subscribe, reliable queuing, and remote procedure calls. Prerequisite: Computer Science 40 or permission of the instructor.</p>				

<b>141489</b>	<b>Cloud Computing</b>			
Subject:	Catalog Nbr:			
COMP	0118			
<p>Cloud computing fundamentals, including cloud architecture, scalability, elasticity, and metrics of cloud performance including service-level objectives (SLOs) and service-level agreements (SLAs). Cloud programming models and abstractions including Map/Reduce. Persistent storage mechanisms, including key/value stores and cold storage. Geo-distributed cloud systems. Cloud networking, including data center architecture, software defined networking, and middleboxes. Cloud security. Prerequisites: Computer Science 40</p>				

<b>141490</b>	<b>Visualization</b>			
Subject:	Catalog Nbr:			
COMP	0177			
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu	
2018 SPRG	Primary	Megan Monroe	Megan.Monroe@tufts.edu	
<p>Visualization as a tool for data analysis, recall, inference, and decision-making. Tools for visual description and presentation. Principles of effective visualization, including data-visual mapping, interaction techniques, color theory, cognitive and perceptual psychology, and human factors of visual depictions of data. Prerequisite: Computer Science 15 and 61, or permission of instructor.</p>				

<b>141491</b>	<b>Optimal Control and State Estimation</b>			
Subject:	Catalog Nbr:			

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ME	0282
<p>State-space methods for multi-input, multi-output controller and observer design. LQR control. Bayesian estimation techniques including least-squares estimation, Kalman filters, unscented Kalman filters, and particle filters. Effects of process noise and sensor noise. Emphasis on applications through student projects. Recommendations: ME 180, EE105, or permission of instructor.</p>	

<b>141564</b>	<b>Internship In Computer Science</b>		
Subject: COMP	Catalog Nbr: 0299	2018 SPRG	Primary
	Ming Chow	ming.chow@tufts.edu	
<p>Study of approved topics in Computer Science in concert with an internship in computing or a related field outside the University. Limited to 0.5 credits. Prerequisites: Permission of instructor</p>			

<b>141729</b>	<b>Creative Design Process of Products</b>		
Subject: ELS	Catalog Nbr: 0162	2017 SPRG	Primary
	Joshua Wiesman	Joshua.Wiesman@tufts.edu	
<p>Engineering process of product design from conception to pre-production. Basic project risk management, engineering and analysis for delivering a product on schedule. Design specifications, Occam's Razor, Abbe Errors, professional responsibilities and ethics. Includes project to practice creation, engineering, and prototyping of a novel product. Prerequisite: Sophomore Standing</p>			

<b>141730</b>	<b>Societal Aspects of Design: Integration, Innovation, and Impact</b>		
Subject: ELS	Catalog Nbr: 0109	2017 SPRG	Primary
	Ronald Lasser	Ron.Lasser@tufts.edu	
<p>Multi-disciplinary perspective of innovative technology-based design process for societal and community influence. Elements and principles of design from product development process, thought and emotion, ethics and responsibility. Experiments to explore failure and iteration, reflection for self-discovery and innovation. Articulation and expression via written, oral and pre-recorded audio and video presentations showing measurable impact of solutions as societal benefits.</p>			

<b>141815</b>	<b>Operations and Applied Data Science</b>		
Subject: EM	Catalog Nbr: 0212	2017 SPRG	Primary
	Kevin Oye	Kevin.Oye@tufts.edu	
	Antonius Breur	Antonius.Breur@tufts.edu	
	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu	
<p>Data collection design, analysis, and interpretation to drive strategic and organizational decisions in high tech</p>			

# Course Bulletin

ventures. Simulations and modeling, statistical process control, and experimental design, planning, control, and improvement of manufacturing and service operations including the coordination of operations in concert with the whole organization.

Course enrollment limited to graduate students in the Master of Science in Innovation and Management program.

<b>141816</b>	<b>MSIM Graduate Seminar</b>			
Subject:	Catalog Nbr:			
EM	0292			
	2018 SPRG	Primary	Kevin Oye	Kevin.Oye@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Contemporary innovation issues and topics via presentations, workshops, and discussion. Pre-reading, post-seminar writing, or other project assignments. See department website for specific details.				

<b>141817</b>	<b>Special Topics in Innovation and Management</b>			
Subject:	Catalog Nbr:			
EM	0294			
	2018 SPRG	Primary	Kevin Oye	Kevin.Oye@tufts.edu
	2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
Special topics course within the field of innovation and management. Please see department website for specific details on focus of the course.				

<b>141853</b>	<b>Special Topics for non-majors</b>			
Subject:	Catalog Nbr:			
COMP	0005			
	2017 FALL	Primary	Marie-Claire Beaulieu	Marie-Claire.Beaulieu@tufts.edu
	2017 FALL	Primary	Anthony Bucci	Anthony.Bucci@tufts.edu
	2018 SPRG	Primary	Donna Qualters	Donna.Qualters@tufts.edu
Content and prerequisites to be announced. Please see department website for specific details.				

<b>141854</b>	<b>Convex Optimization</b>			
Subject:	Catalog Nbr:			
EE	0109			
Convex optimization theory and algorithms. Convex sets, convex functions and convex optimization problems; duality theory and optimality conditions; algorithms for solving convex problems including descent, gradient descent, Newton and interior point methods. Examples of application taken from communications, signal processing and other fields. Project. Prerequisite: Math 70 or graduate standing.				

<b>142322</b>	<b>Undergraduate research</b>			
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Subject: BME	Catalog Nbr: 0091
Independent undergraduate research in the field of biomedical engineering. Term paper required. Credit not given retroactively. Prior arrangements necessary. Prerequisite: Permission of instructor.	

<b>142323</b>	<b>Undergraduate research</b>			
Subject: BME	Catalog Nbr: 0092			
2018 SPRG	Primary	David Kaplan		david.kaplan@tufts.edu
2018 SPRG	Primary	Fiorenzo Omenetto		Fiorenzo.Omenetto@tufts.edu
Independent undergraduate research in the field of biomedical engineering. Term paper required. Credit not given retroactively. Prior arrangements necessary. Prerequisite: Permission of instructor.				

<b>142324</b>	<b>Field Methods for Global Health</b>			
Subject: CEE	Catalog Nbr: 0150			
2017 FALL	Primary	Daniele Lantagne		Daniele.Lantagne@tufts.edu
Hands-on approach to evaluating global health projects. Research question and study design, human subjects research ethics, survey tool development, sampling techniques (water quality/anthropometrics), data collection and analysis, and information dissemination. Emphasis on applying topics to develop a full evaluation protocol for a self-selected project.				

<b>142325</b>	<b>Principles of Biostatistics</b>			
Subject: CEE	Catalog Nbr: 0156			
2017 FALL	Primary	Mark Woodin		mark.woodin@tufts.edu
2018 SPRG	Primary	Amy Pickering		Amy.Pickering@tufts.edu
(cross-listed as CH 156) Examination of statistical methods used in the analysis of data generated by biomedical and public health studies. Descriptive statistics, probability, basic hypothesis testing with parametric and non-parametric data, ANOVA, linear regression, logistic regression, and an introduction to survival analysis. Instruction in the use of statistical software will be provided throughout the course.				

<b>142326</b>	<b>Cataldo Scholar Research</b>			
Subject: CEE	Catalog Nbr: 0090			
2018 SPRG	Primary	C. Andrew Ramsburg		Andrew.Ramsburg@tufts.edu
Supervised research through the Cataldo Scholars Program within Civil and Environmental Engineering. Department consent and Senior standing required				



# Course Bulletin

<b>142327</b>		<b>Doctoral Thesis I</b>			
Subject:	Catalog Nbr:				
CEE	0297				
2018 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu		
2018 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu		
2018 SPRG	Primary	David Gute	david.gute@tufts.edu		
2018 SPRG	Primary	John Durant	john.durant@tufts.edu		
2018 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu		
2018 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu		
2018 SPRG	Primary	Christopher Swan	chris.swan@tufts.edu		
2018 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu		
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu		
2018 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu		
2018 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu		
2018 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu		
2018 SPRG	Primary	Linda Abriola	Linda.Aabriola@tufts.edu		
2018 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu		
2018 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu		
2018 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu		
2018 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu		
2018 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu		
2018 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu		
2018 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu		
2018 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu		
2018 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu		
2018 SPRG	Primary	John Germaine	John.Germaine@tufts.edu		
2018 SPRG	Primary	Amy Pickering	Amy.Pickering@tufts.edu		
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu		
2018 SPRG	Primary	Jonathan Lamontagne	Jonathan.Lamontagne@tufts.edu		
Guided research on a topic suitable for a doctoral dissertation. Required: Consent of instructor.					

<b>142328</b>		<b>Independent Study</b>			
Subject:	Catalog Nbr:				
CEE	0294				
2018 SPRG	Primary	Helen Suh	Helen.Suh@tufts.edu		
Supervised, independent study of topics related to civil and environmental engineering. Departmental consent required					

<b>142503</b>		<b>Marketing and Business Communications</b>			
Subject:	Catalog Nbr:				
EM	0242				
2017 FALL	Primary	Kevin Oye	Kevin.Oye@tufts.edu		

# Course Bulletin

2017 FALL	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu
2017 FALL	Primary	Marci Sapers	Marci.Sapers@tufts.edu
<p>Institutional and product marketing methods used by businesses launching new ventures. Overview of basic marketing principles, from day-to-day marketing activities to positioning and strategy. Analysis, formulation, and implementation of marketing strategies; concepts for understanding customer behavior and creating marketing strategy; fundamentals of market research, pricing, and reaching and selling to customers. Generating and delivering written and oral communications with clarity and precision, for different stakeholders and audiences. Course enrollment limited to Master of Science in Innovation and Management (MSIM) students.</p>			

<b>142504</b>	<b>Leading for Impact</b>		
Subject:	Catalog Nbr:		
EM	0263		
2017 FALL	Primary	Stacy Lennon	Stacy.Lennon@tufts.edu
<p>Development of self-awareness and skills necessary for leadership. 360 degree assessment tools and extensive experiential learning. Oral communication, systems thinking, high performance teams, fostering creativity, team decision making, leading change, influence without authority. Conceptual frameworks, tools, and skills to effectively manage conflict and negotiate win/win solutions in the workplace. Cases and role plays to simulate real on the job conflicts. Course enrollment limited to Master of Science in Innovation and Management (MSIM) students.</p>			

<b>142811</b>	<b>Introduction to Remote Sensing</b>		
Subject:	Catalog Nbr:		
CEE	0189		
2018 SPRG	Primary	Magaly Koch	Magaly.Koch@tufts.edu
<p>Satellite remote sensing technology and its applications to a variety of fields including urban and land use planning, natural resources monitoring and management, and environmental sciences. Physical processes in remote sensing; optical, thermal and microwave based sensors; image analysis to derive desired information, and applications for geo-environmental studies. Laboratory exercises in remote sensing.</p>			

<b>142812</b>	<b>Environmental Systems Modeling</b>		
Subject:	Catalog Nbr:		
CEE	0215		
2018 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
<p>Numerical computer modeling for environmental and water-resources simulation. Mass and energy balances, reaction kinetics, transport, and numerical solution techniques. Pollutants including pathogens, toxic substances, organic carbon/oxygen, heat, eutrophication, and pH in rivers, lakes and estuaries. Recommendations: Math 51 and CEE1, or equivalents.</p>			

<b>142813</b>	<b>Scanning Probe Microscopy</b>		
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# Course Bulletin

Subject:      Catalog Nbr:  
ME            0132

Scanning probe microscopy (SPM) and atomic force microscopy (AFM). Basic principles of operation. Scanning in basic (contact, tapping, non-contact) modes. Advanced modes of operation (Electrical Force Microscopy, Chem AFM, Piezo AFM, sub-resonance tappings). Modern SPMs/AFMs. How to choose the right microscope/mode. Applications of SPM/AFM to study different types of materials, from hard materials used in the semiconductor industry, to soft materials such as polymers or biological tissues. Limitations of resolution, possible artifacts. Prerequisites: Senior or graduate standing

<b>142814</b>	<b>Scanning Probe Microscopy</b>
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Subject:      Catalog Nbr:  
ME            0232

Scanning probe microscopy (SPM) and atomic force microscopy (AFM). Basic principles of operation. Scanning in basic (contact, tapping, non-contact) modes. Advanced modes of operation (Electrical Force Microscopy, Chem AFM, Piezo AFM, sub-resonance tappings). Modern SPMs/AFMs. How to choose the right microscope/mode. Applications of SPM/AFM to study different types of materials, from hard materials used in the semiconductor industry, to soft materials such as polymers or biological tissues. Limitations of resolution, possible artifacts. A project related to graduate research is required.

<b>142815</b>	<b>New Product Development</b>
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Subject:      Catalog Nbr:  
EM            0220A

Students learn what questions to ask and actions to take at various phases of new product evolution. Emphasis is placed on customer input and cross-functional team roles and responsibilities. Elements of marketing are presented including: market research tools, product positioning, branding and marketing communications. The central focus of this module is the development of a new product concept by cross-functional student teams that integrates learning from other modules. The student teams formally present their concepts at the end of the semester and develop effective techniques to present to senior management and/or prospective investors. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 220).

<b>142816</b>	<b>Project Management and Software Methodologies</b>
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Subject:      Catalog Nbr:  
EM            0230A

Students learn the fundamentals and modern heuristics for project management, with a focus on product development/engineering projects. The Project Management Body of Knowledge from the Project Management Institute (PMI) is explored in depth. Additional special topics include: quantitative project management; iterative and agile project lifecycles; software development lifecycles; and project defect models. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 230).

# Course Bulletin

<b>142817</b>	<b>Financial and Managerial Accounting</b>
Subject: EM	Catalog Nbr: 0230B
<p>Students learn how to analyze and create financial statements including the income statement, balance sheet and cash flow statement. We explore managerial tools for optimizing financial decisions including the economic feasibility of projects and products. In conjunction with the course project in the New Product Development course, student teams are required to develop a complete financial plan including a full set of pro forma financial statements and an analysis of return on investment. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 230).</p>	

<b>142818</b>	<b>Building Teams and Leading Teams</b>
Subject: EM	Catalog Nbr: 0260A
<p>In this two module sequence (260A and 260B), students learn the basic concepts of leadership, management and teamwork. The uniqueness of this course is within the teaching methodology, which has been developed to accelerate the advancement of self-awareness and interpersonal competencies. Specific topics covered in Building and Leading Effective Teams include: personality types (Myers-Briggs type indicator assessment), best practices in forming and maintaining team performance, giving and receiving feedback, individual and team creativity, communicating to inspire and influencing without authority. Topics in Leading Organizations include systems thinking, team decision-making, communication across cultures, shared visions and organizational change. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 260).</p>	

<b>142819</b>	<b>Business Communications</b>
Subject: EM	Catalog Nbr: 0260D
<p>Students learn and apply principles of effective written and oral communication for different purposes and different audiences in the workplace. Students reflect on their on communication practices and explore ways to improve their tone, focus, and organization to get better results from both day-to-day and formal communications. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 260).</p>	

<b>142820</b>	<b>Capstone Leadership Project Prep 2 Year Only</b>
Subject: EM	Catalog Nbr: 0282

<b>142822</b>	<b>Design of Experiments and Predictive Models</b>
Subject:	Catalog Nbr:

# Course Bulletin

EM 0210B

Students gain expertise with Design of Experiments, a method for characterizing a process or system as a transfer function of its input variables, using the transfer function to obtain optimal, real-world settings for the input variables. Other approaches to transfer functions are explored, including big data approaches, regression analysis, and logistic regression. Statistical process control methods for analyzing and maintaining the behavior of systems and processes over time are explored. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 210).

**142823**

## **Systems Engineering and Optimization**

Subject: Catalog Nbr:  
EM 0210C

This module presents statistical approaches to systems thinking and system design engineering. Methods for measuring, analyzing, predicting and improving product reliability are explored. Statistical tolerancing of system components is introduced, together with techniques for aggregating and measuring system-level quality and probability-of-failure. Big data approaches to systems optimization are discussed, including Dependent Variable Analysis and Machine Learning. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 210).

**142824**

## **Experience Design**

Subject: Catalog Nbr:  
EM 0220B

This module explores the core principles of experience design and shows how these principles can be applied to the creation of compelling products, services, brands and environments. Topics covered include: the role of brand in experience design; approaches to customer understanding; the development of customer personas and journey maps; envisioning systems; experiential modeling; and designing for products and services. At the final session student teams present class projects and consider the role of experience design in business strategy. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 220).

**142825**

## **Sustainability**

Subject: Catalog Nbr:  
EM 0220C

The Sustainability module introduces lifecycle thinking to product design, as well as the business case for sustainability. Students learn about sustainable product development, cradle-to-cradle lifecycle concepts, life-cycle assessments, nature-inspired design and systems thinking. In addition, students have the opportunity to develop sustainability initiatives for their own workplace and learn how to drive sustainable thinking into product development and the corporation. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 220).

**142826**

## **Systematic Innovations**

# Course Bulletin

Subject:	Catalog Nbr:
EM	022D

**142827****Supply Chain Management**

Subject:	Catalog Nbr:
EM	0230C

The module focuses on the strategic impact of supply chain excellence, using case studies and simulations from high tech, retail and large scale manufacturing to convey best practices and decision factors in supply chain management. Success in building a world-class supply chain requires functional integration both within the firm and across the network of companies, and practical application of this concept is a recurring theme in course discussion, reading and assignments. Topics explored include: strategic supplier management, global supply chains, outsourcing decisions, inventory management and replenishment methodologies. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 230).

**142828****Operations Management**

Subject:	Catalog Nbr:
EM	0230D

2018 SPRG	Primary	Kishore Pochampally	Kishore.Pochampally@tufts.edu
2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu

Students are introduced to problems and analysis related to the design, planning, control, and improvement of manufacturing and service operations. Topics include: how to map and analyze process flows, determining process capacities and bottlenecks, and designing and coordinating operations in concert with the whole organization. Through cases and an online simulation, students will practice diagnosing and solving problems, and recommending and implementing process improvement actions. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 230).

**142829****Business Strategy**

Subject:	Catalog Nbr:
EM	0240A

2018 SPRG	Primary	Frank Apeseche	Frank.Apeseche@tufts.edu
2018 SPRG	Primary	Kevin Oye	Kevin.Oye@tufts.edu
2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu

Business Strategy provides the background and insights required to develop a differentiating business strategy for an organization. The lectures and readings cover business fundamentals, the strategic planning process, competitive strategies, core competencies, strategic alliances, acquisitions and mergers, and franchising. Working in teams, the students develop a complete business strategy for a high tech company. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 240).

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142830	Technology Strategy			
Subject: EM	Catalog Nbr: 0240B			
2018 SPRG	Primary	Samuel Liggero	Samuel.Liggero@tufts.edu	
2018 SPRG	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu	
2018 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu	
<p>This module provides insight into many factors that drive innovation and the successful commercialization on new technologies in established and new businesses. The module includes best practices in new product portfolio management, technology road mapping, and discussion of incremental, radical and disruptive innovation. Reading assignments include "The Innovator's DNA" by Jeff Dyer, Hal Gregersen and Clayton M. Christensen, selected chapters from "Seeing What's Next" by Clayton M. Christensen, Geoffrey Moore's "Crossing the Chasm," as well as several case histories. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 240).</p>				

142831	Fundamentals of Economics			
Subject: EM	Catalog Nbr: 0240C			
<p>This module offers an overview of both macro and microeconomics and provides students with the background required for the Globalization and Multinational Strategies module. Students learn to (i) analyze current global economic issues that are related to trade balance, government budgets, unemployment, competitiveness of innovation and manufacturing processes, (ii) assess how fiscal and monetary discipline impact economic growth and social &amp; political stability (iii) examine how different economic philosophies shape individual and collective behaviors (iv) analyze market behaviors and (v) develop an understanding of the basics of game theory. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 240).</p>				

142832	Globalization and Multinational Strategy			
Subject: EM	Catalog Nbr: 0240D			
<p>Students develop a full understanding of the forces behind globalization and the evolution of multinational companies from different regions of world. The module examines the strategic, organizational and operational implications of working and leading in the global environment both in a large multinational organization and in a start-up and discusses how different globalization models work across various industries. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 240).</p>				

142833	Personal Leadership			
Subject: EM	Catalog Nbr: 0250A			
2018 SPRG	Primary	Ewa Winston	Ewa.Winston@tufts.edu	

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2018 SPRG

Primary

Rebekah Plotkin

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The ability to lead starts with the process of self-discovery. In order to succeed externally, leaders need to develop an ability to understand their own internal environments - their energy, motivation, priorities, core values, etc. They need to develop their self-management skills and cultivate their self-confidence. Learning in this context does not mean simply acquiring new information, but elevating self-awareness, discovering one's authentic self and taking responsibility for her/his development as a leader. This module helps students develop a better understanding of their internal environment and to learn (and implement) techniques for improving their personal effectiveness. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 250).

**142834****Ethics of Leadership**

Subject: Catalog Nbr:  
EM 0250B

Students learn what constitutes a situation with moral or ethical stakes, how such situations develop and how leaders think through these challenges. Topics discussed include: different types of moral challenges, moral leadership, moral identity and professionalism, as well as moral reasoning, and moral action. This module gives students the intellectual tools and depth of understanding to assess moral issues as they arise in their personal and professional life. Students apply these concepts and insights into their own growth as engineering leaders. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 250).

**142835****Practice of Ethical Leadership**

Subject: Catalog Nbr:  
EM 0250C

Students are encouraged to look outward and expand their understanding of leadership, the world and their place in it as future engineering leaders. Students are challenged to formulate their own leadership message, to translate it into action and demonstrate it in the real world. Topics discussed include: giving voice to values, taking stand, exercising authority and emergent leadership. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 250).

**142836****Leading Organizations**

Subject: Catalog Nbr:  
EM 0260B

2018 SPRG	Primary	Mary Viola	Mary.Viola@tufts.edu
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In this two module sequence (260A and 260B), students learn the basic concepts of leadership, management and teamwork. The uniqueness of this course is within the teaching methodology, which has been developed to accelerate the advancement of self-awareness and interpersonal competencies. Specific topics covered in Building and Leading Effective Teams include: personality types (Myers-Briggs type indicator assessment), best practices in forming and maintaining team performance, giving and receiving feedback, individual and team



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creativity, communicating to inspire and influencing without authority. Topics in Leading Organizations include systems thinking, team decision-making, communication across cultures, shared visions and organizational change. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 260).

<b>142837</b>	<b>Conflict Resolution</b>
Subject: EM	Catalog Nbr: 0260C
<p>A practitioner-focused module, students are introduced to frameworks, tools, and skills to effectively manage conflict in the workplace. Building on prior modules and tailored to address the specific challenges students have faced (or anticipate facing in the future), this module draws upon relevant literature and uses student examples and action learning to develop insights and approaches. A central feature of this module is an exercise, in which students perform a real life negotiation in a session with two classmates and an instructor. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 260).</p>	

<b>142838</b>	<b>Capstone Leadership Project 2 year format</b>
Subject: EM	Catalog Nbr: 0280A

<b>142839</b>	<b>Prep and Capstone Leadership Project 3 year format</b>
Subject: EM	Catalog Nbr: 0280B

<b>143014</b>	<b>Systematic Innovations</b>
Subject: EM	Catalog Nbr: 022D
<p>This module introduces students to the general principles of TRIZ-based systematic innovation. A collection of tools is applied algorithmically to identify the right problem, solve the problem efficiently and ensure the solutions align with the business strategy. Students develop skills that can be applied to improve functionality within existing products, develop new generation products, or reduce cost. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 220).</p>	

<b>143027</b>	<b>Systematic Innovations</b>
Subject: EM	Catalog Nbr: 0220D
<p>This module introduces students to the general principles of TRIZ-based systematic innovation. A collection of</p>	

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tools is applied algorithmically to identify the right problem, solve the problem efficiently and ensure the solutions align with the business strategy. Students develop skills that can be applied to improve functionality within existing products, develop new generation products, or reduce cost. This course is only open to students in the MS Engineering Management Program and is a subcomponent of a larger course (EM 220).