Course Bulletin

103583	Chemical Process Principles			
Subject:	Catalog Nbr:			
CHBE	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.				

103643	Chemical Engineering Thermodynamics			
Subject:	Catalog Nbr:			
CHBE	0011			
2017 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.				

103699	Transport Phenomena I			
Subject:	Catalog Nbr:			
CHBE	0021			
2016 FALL	Primary	Ara Philipossian	Ara.Philipossian@tufts.edu	
2017 FALL	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.				

103757	Transport Phenomena II			
Subject:	Catalog Nbr:			
CHBE	0022			
2017 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).				

103906	Applied Numerical Methods For Chemical & Biological Engineering			
Subject:	Catalog Nbr:			
CHBE	0039			
2017 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu	
Numerical analysis methods and their implementation using commercially available software are reviewed.				

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Scientific programming methodology. Application of commercial process simulation software to the analysis of chemical and biological process models.

103945	Chemical And Biological Separations			
Subject:	Catalog Nbr:			
CHBE	0045			
2016 FALL		Primary	Ara Philipossian	Ara.Philipossian@tufts.edu
2017 FALL		Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu

Design and analysis of separation processes. Equilibrum-stage processes, stagewise separation processes, mass transfer operations, and rate-controlled separations. Fundamental study of distillation, extraction, adsorption, membrane separation, and precipitation & crystallization processes.
Pre-Requisite: CHBE 22

103965	Chemical And Biological Engineering Laboratory			
Subject:	Catalog Nbr:			
CHBE	0051			
2017 FALL		Primary	Derek Mess	Derek.Mess@tufts.edu

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.

103986	Chemical And Biological Engineering Laboratory			
Subject:	Catalog Nbr:			
CHBE	0052			
2017 SPRG		Primary	Derek Mess	Derek.Mess@tufts.edu

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.

104016	Various Topics In Computer Science
Subject:	Catalog Nbr:
COMP	0009

Please see departmental website for detailed information. One-half credit.
Recommendations: A sincere interest in learning more about computer science and no prior programming experience.

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104031	Product & Process Design			
Subject:	Catalog Nbr:			
CHBE	0060			
2017 SPRG		Primary	Daniel Ryder	daniel.ryder@tufts.edu

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.

104049	Molecular Biotechnology			
Subject:	Catalog Nbr:			
CHBE	0062			
2017 SPRG		Primary	David Kaplan	david.kaplan@tufts.edu
2017 SPRG		Primary	Niall Lennon	No Email on file.
2017 SUMR		Primary	Dana Cairns	Dana.Cairns@tufts.edu
2017 SUMR		Primary	Nina Dinjaski	Nina.Dinjaski@tufts.edu

(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.

104066	Independent Study
Subject:	Catalog Nbr:
CHBE	0093

Guided Indivdual 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 .

104086	Independent Study			
Subject:	Catalog Nbr:			
CHBE	0094			
2017 SPRG		Primary	Derek Mess	Derek.Mess@tufts.edu

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.

Course Bulletin

104132	Undergraduate Research			
Subject:	Catalog Nbr:			
CHBE	0095			
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
2017 SPRG		Primary	Darryl Williams	Darryl.Williams@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.				

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104248	Internship In Chemical & Biological Engineering			
Subject:	Catalog Nbr:			
CHBE	0099			
2016 FALL		Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2017 SUMR		Primary	Christos Georgakis	Christos.Georgakis@tufts.edu

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.

104290	Reactor Design			
Subject:	Catalog Nbr:			
CHBE	0102			
2017 SPRG		Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu
2017 SPRG		Primary	Simon Steel	Simon.Steel@tufts.edu

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.

104334	Separation Processes
Subject:	Catalog Nbr:
CHBE	0104

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

104353	Membrane Separation Processes			
Subject:	Catalog Nbr:			
CHBE	0107			
2017 SPRG		Primary	Jerry Meldon	No Email on file.

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.

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104372	Various Topics In Computer Science			
Subject:	Catalog Nbr:			
COMP	0010			
2016 SUMR	Primary	Ethan Danahy	ethan.danahy@tufts.edu	
Please see departmental website for detailed information. One Credit.				

104399	Process Dynamics And Control			
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.				

104420	Introduction Optimization
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 unconstrianed optimization; linear programming; non-linear programming with constriants; mixed-integer programming; selected applications.	

104459	Thermal-fluid Transport I			
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.				

104481	Thermal-fluid Transport II			
Subject:	Catalog Nbr:			
CHBE	0112			
2017 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 involving radiation. Temperature and heat flux measurements. Numerical techniques.				

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Recommendations: ME 111 Thermal-Fluid Transport I or equivalent.

104507	Introduction To Computer Science			
Subject:	Catalog Nbr:			
COMP	0011			
2016 FALL		Primary	Christopher Gregg	No Email on file.
2017 FALL		Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL		Primary	Megan Monroe	Megan.Monroe@tufts.edu
2017 SUMR		Primary	Michael Shah	Michael.Shah@tufts.edu

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.

104569	Principles Of Polymerization			
Subject:	Catalog Nbr:			
CHBE	0121			
2017 FALL		Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu

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

104592	Physical Chemistry Of Polymers
Subject:	Catalog Nbr:
CHBE	0122

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

104621	Data Structures
Subject:	Catalog Nbr:

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COMP	0015			
2017 FALL		Primary	Mark Sheldon	Mark.Sheldon@tufts.edu
2017 SUMR		Primary	Partha Biswas	Partha.Biswas@tufts.edu

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.

104635	**Air Pollution Control**

Subject:	Catalog Nbr:
CHBE	0136

(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

104656	**Hazardous Waste Treatment Technologies**

Subject:	Catalog Nbr:			
CHBE	0138			
2017 FALL		Primary	Larry Cohen	larry.cohen@tufts.edu

(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.

104659	**Web Programming**

Subject:	Catalog Nbr:			
COMP	0020			
2017 FALL		Primary	Ming Chow	ming.chow@tufts.edu

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.

104678	**Surface And Colloid Chemistry**

Subject:	Catalog Nbr:			
CHBE	0140			
2016 FALL		Primary	Matthew Panzer	Matthew.Panzer@tufts.edu

Emphasis on fundamental concepts: attractive and repulsive forces between particles in a dispersion;

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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.

104699	Biochemical Engineering

Subject:	Catalog Nbr:			
CHBE	0160			
2017 FALL		Primary	Daniel Ryder	daniel.ryder@tufts.edu

Thermodynamics of biological reactions, principles of fermentation processes, and chemical engineering applications to bioreactor analysis are studied.
Recommendations: CHBE 102.

104720	Game Development

Subject:	Catalog Nbr:
COMP	0023

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.

104760	Protein Purification

Subject:	Catalog Nbr:			
CHBE	0161			
2017 SPRG		Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu

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.

104783	Molecular Biotechnology

Subject:	Catalog Nbr:			
CHBE	0162			
2017 SPRG		Primary	David Kaplan	david.kaplan@tufts.edu
2017 SPRG		Primary	Niall Lennon	No Email on file.
2017 SUMR		Primary	Dana Cairns	Dana.Cairns@tufts.edu
2017 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

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biology, protein purification, fermentation, cell culture, combinatorial methods, and bioinformatics. Includes a semester-long technical project and oral presentation. (Also offered as lower-level.)

104806	**Recombinant Dna Techniques**
Subject:	Catalog Nbr:
CHBE	0163
(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.	

104831	**Biomaterials and Regenerative Medicine**			
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				

104850	**Cell/microbe Cultivation**		
Subject:	Catalog Nbr:		
CHBE	0166		
2017 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu
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			

104859	**Machine Structure & Assembly-language Programming**
Subject:	Catalog Nbr:

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COMP	0040			
2017 FALL		Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu
2017 SPRG		Primary	Mark Sheldon	Mark.Sheldon@tufts.edu

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.
Recommendations: COMP 15.

104871	**Metabolic&cellular Engin**			
Subject:	Catalog Nbr:			
CHBE	0167			
2017 FALL		Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu

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.
Recommendations: Open to graduate students and seniors. Backgrounds in biochemistry, numerical methods, and chemical kinetics is highly recommended.

104914	**Biotechnology Processing Projects Lab**			
Subject:	Catalog Nbr:			
CHBE	0168			
2017 FALL		Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu

(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.

104935	**Seminar In Biotechnology**
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

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directions based on in-depth review of articles and presentations.

104940	Special Topics			
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 FALL		Primary	Jason Wiser	Jason.Wiser@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

Content and prerequisites to be announced. Please see departmental website for specific details.

104955	Design And Analysis Of Experiments			
Subject:	Catalog Nbr:			
CHBE	0170			
2017 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.
Recommendations: MATH 51.

104978	Clean Energy Technologies And Policy Issues			
Subject:	Catalog Nbr:			
CHBE	0173			
2017 SPRG		Primary	Simon Steel	Simon.Steel@tufts.edu

(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

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2016 FALL	Primary	Srdjan Divac	No Email on file.
2016 SUMR	Primary	Bruce Boghosian	bruce.boghosian@tufts.edu
2017 FALL	Primary	Zachary Faubion	Zachary.Faubion@tufts.edu
2017 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 SPRG	Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 SPRG	Primary	Moon Duchin	Moon.Duchin@tufts.edu
2017 SPRG	Primary	Jessica Dyer	Jessica.Dyer@tufts.edu

(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: CHBE Catalog Nbr: 0185

2017 SPRG	Primary	Bernardo Perez-Ramirez	No Email on file.

(Cross-listed as BME 185). Drug Product Formulation.

105019	**Special Topics**

Subject: CHBE Catalog Nbr: 0193

2016 SUMR	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu
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: CHBE Catalog Nbr: 0194

2017 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2017 SUMR	Primary	Matthew Panzer	Matthew.Panzer@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**

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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

Object-oriented programming and design, including oject-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
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.

Course Bulletin

105162	Mathematical Methods In Chemical Engineering			
Subject:	Catalog Nbr:			
CHBE	0201			
2016 FALL	Primary	Jerry Meldon	No Email on file.	

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.
Recommendations: Graduate Engineering Student and knowledge of MATLAB, or permission of instructor.

105184	Advanced Kinetics and Reaction Engineering			
Subject:	Catalog Nbr:			
CHBE	0202			
2017 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu	

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.
Recommendations: Graduate Engineering Student and CHBE 102 or equivalent.

105207	Advanced Thermodynamics			
Subject:	Catalog Nbr:			
CHBE	0203			
2017 FALL	Primary	Jerry Meldon	No Email on file.	

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 vapor-liquid equilibrium compositions.
Recommendations: Graduate Engineering Student or Permission of Instructor

105225	Directed Study
Subject:	Catalog Nbr:
COMP	0094

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

105227	Advanced Transport Phenomena
Subject:	Catalog Nbr:

Course Bulletin

CHBE	0204			
2017 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.

105244	**Senior Capstone Project I**

Subject:	Catalog Nbr:			
COMP	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.

105248	**Graduate Seminar**

Subject:	Catalog Nbr:			
CHBE	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.

105261	**Senior Capstone Project II**

Subject:	Catalog Nbr:			
COMP	0098			
2017 SPRG		Primary	Samuel Guyer	Samuel.Guyer@tufts.edu

Implementation and testing of the project designed in COMP97. Implementation tools, strategies, and platforms. Testing and debugging methodologies. Maintenance and release management. Legal, ethical, and social impacts of computing.
Recommendations: COMP97.

105285	**Graduate Seminar**

Subject:	Catalog Nbr:			
CHBE	0292			
2017 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.

Course Bulletin

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

105305	Special Topics
Subject: CHBE	Catalog Nbr: 0293
2016 SUMR Primary Christos Georgakis Christos.Georgakis@tufts.edu	
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.	

105327	Special Topics
Subject: CHBE	Catalog Nbr: 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.	

105344	Programming Languages
Subject: COMP	Catalog Nbr: 0105
2017 FALL Primary Kathleen Fisher Kathleen.Fisher@tufts.edu	
2017 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 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	

Course Bulletin

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:	Catalog Nbr:			
CHBE	0296			
2017 SPRG	Primary	Daniel Ryder	daniel.ryder@tufts.edu
2017 SPRG	Primary	Jerry Meldon	No Email on file.
2017 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu
2017 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu
2017 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu
2017 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu
2017 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2017 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu
2017 SPRG	Primary	Darryl Williams	Darryl.Williams@tufts.edu
2017 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu
2017 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu
2017 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2017 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:	Catalog Nbr:			
CHBE	0297			
2017 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu
2017 FALL	Primary	David Kaplan	david.kaplan@tufts.edu

Course Bulletin

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

105468	**Operating Systems**

Subject:	Catalog Nbr:			
COMP	0111			
2016 FALL		Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL		Primary	Alva Couch	alva.couch@tufts.edu

Course Bulletin

(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.

105487	Master Of Engineering Project

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.

105488	Networks

Subject:	Catalog Nbr:			
COMP	0112			
2016 FALL		Primary	Fahad Dogar	Fahad.Dogar@tufts.edu

Computer Networks and Protocols. Design and implementation of computer communication networks, 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.

105507	Non Major Credit

Subject:	Catalog Nbr:
CHBE	0310

Course Bulletin

105508	Network And System Administration
Subject:	Catalog Nbr:
COMP	0114

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.
Recommendations: Comp 111

105525	Lower Level Elective Crd
Subject:	Catalog Nbr:
CHBE	0320

105547	Upper Level Elective Crd
Subject:	Catalog Nbr:
CHBE	0330

105548	Database Systems			
Subject:	Catalog Nbr:			
COMP	0115			
2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu	
2017 SPRG	Primary	Manoussos Athanassoulis	No Email on file.	

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.
Recommendations: COMP 15

105569	Computer Systems Security			
Subject:	Catalog Nbr:			
COMP	0116			
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu	

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.
Recommendations: COMP 40

Course Bulletin

105587	Web Engineering
Subject: COMP	Catalog Nbr: 0120
2017 SPRG	Primary Ming Chow ming.chow@tufts.edu
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. Recommendations: COMP15 and 20, or consent. COMP115 is also recommended as co-requisite, but not required.	

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

105631	Numerical Analysis
Subject: COMP	Catalog Nbr: 0126
2016 FALL	Primary Christoph Borgers christoph.borgers@tufts.edu
(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. Recommendations: MATH 51 and programming ability in a language such as C, C++, Fortran, Pascal, or Matlab.	

105652	Numerical Linear Algebra
Subject: COMP	Catalog Nbr: 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.	

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

Course Bulletin

105668	Artificial Intelligence			
Subject:	Catalog Nbr:			
COMP	0131			
2017 SPRG		Primary	Thomas Williams	Thomas_E.Williams@tufts.edu
2017 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)

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

105711	Grad Research Assistant			
Subject:	Catalog Nbr:			
CHBE	0406			
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

Course Bulletin

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

105750	**Doctoral Continuation - PT**
Subject: CHBE	Catalog Nbr: 0501

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

105772	**Introduction To Machine Learning And Data Mining**
Subject: COMP	Catalog Nbr: 0135

2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu
2017 SPRG	Primary	Anselm Blumer	ablumer@cs.tufts.edu

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.
Recommendations: COMP 15 and MATH 61 (formerly MATH 22) or permission of instructor (COMP 160 is highly recommended).

105795	**Statistical Pattern Recognition**
Subject: COMP	Catalog Nbr: 0136

2017 FALL	Primary	Roni Khardon	roni@eecs.tufts.edu

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.
Recommendations: MATH 70 (formerly MATH 46), EE 104 or MATH 162, COMP 40 or COMP 80, or permission of instructor.

105817	**Doctoral Degree Continuation - Full Time**

Course Bulletin

Subject:	Catalog Nbr:
CHBE	0502

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

105833	Advanced Computer Architecture

Subject:	Catalog Nbr:
COMP	0140

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. Recommendations: COMP 40.

105871	Special Topics

Subject:	Catalog Nbr:
COMP	0150

2016 FALL	Primary	Anselm Blumer	ablumer@cs.tufts.edu
2016 FALL	Primary	Soha Hassoun	soha.hassoun@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	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2016 FALL	Primary	Elif Yamangil	No Email on file.
2016 FALL	Primary	Sergey Voronin	Sergey.Voronin@tufts.edu
2017 FALL	Primary	Ming Chow	ming.chow@tufts.edu
2017 FALL	Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2017 FALL	Primary	Johannes De Ruiter	jp.deruiter@tufts.edu
2017 FALL	Primary	Megan Monroe	Megan.Monroe@tufts.edu
2017 FALL	Primary	Liping Liu	Liping.Liu@tufts.edu
2017 FALL	Primary	Jivko Sinapov	Jivko.Sinapov@tufts.edu
2017 FALL	Primary	Michel Machado	Michel.Machado@tufts.edu
2017 SPRG	Primary	Norman Ramsey	Norman.Ramsey@tufts.edu
2017 SPRG	Primary	Gavin Finn	Gavin.Finn@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	Genevieve.Patterson@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.

Course Bulletin

105893	Algorithms			
Subject:	Catalog Nbr:			
COMP	0160			
2017 FALL		Primary	Anselm Blumer	ablumer@cs.tufts.edu
2017 FALL		Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu
2017 SPRG		Primary	Simon Steel	Simon.Steel@tufts.edu

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).

105952	Computational Geometry			
Subject:	Catalog Nbr:			
COMP	0163			
2017 FALL		Primary	Gregory Aloupis	Gregory.Aloupis@tufts.edu

(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.
Recommendations: COMP 160 or permission of instructor.

105973	Cryptography			
Subject:	Catalog Nbr:			
COMP	0165			
2016 FALL		Primary	Anselm Blumer	ablumer@cs.tufts.edu

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

105995	Computational Biology			
Subject:	Catalog Nbr:			
COMP	0167			
2017 FALL		Primary	Donna Slonim	Donna.Slonim@tufts.edu

Computational Biology.Please see departmental website for specific details.

106079	Computation Theory
Subject:	Catalog Nbr:

Course Bulletin

COMP	0170			
2016 SUMR		Primary	Rajasekhar Inkulu	No Email on file.
2017 FALL		Primary	Lenore Cowen	lenore.cowen@tufts.edu
2017 SPRG		Primary	Benjamin Hescott	No Email on file.
2017 SUMR		Primary	Harry Mairson	Harry.Mairson@tufts.edu

(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.

106100	**Human Computer Interaction**		
Subject:	Catalog Nbr:		
COMP	0171		
2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu
2017 SPRG	Primary	Robert Jacob	jacob@cs.tufts.edu

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.

106119	**Computer Graphics**
Subject:	Catalog Nbr:
COMP	0175

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.
Recommendations: COMP 40, MATH 42 (formerly MATH 13), and MATH 70 (formerly MATH 46), or permission of instructor.

106140	**Software Engineering**
Subject:	Catalog Nbr:
COMP	0180

The special problems of creating very large programs, and methods for coping with these problems. Program design strategies, project management tools, programming environments.
Recommendations: COMP 80.

Course Bulletin

106184	Compilers
Subject: COMP	Catalog Nbr: 0181
2016 FALL Primary Samuel Guyer Samuel.Guyer@tufts.edu	
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. Recommendations: COMP 40, 105, and 170.	

106249	Senior Design Project
Subject: COMP	Catalog Nbr: 0190
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. Recommendations: COMP 180.	

106268	Directed Study
Subject: COMP	Catalog Nbr: 0193

2017 FALL	Primary	Ethan Danahy	ethan.danahy@tufts.edu
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	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

Course Bulletin

	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	Robert Jacob	jacob@cs.tufts.edu
	2017 SPRG	Primary	Ming Chow	ming.chow@tufts.edu
	2017 SPRG	Primary	Benjamin Hescott	No Email on file.
	2017 SPRG	Primary	Remco Chang	Remco.Chang@tufts.edu
	2017 SPRG	Primary	Kathleen Fisher	Kathleen.Fisher@tufts.edu
	2017 SPRG	Primary	Elena Strange	Elena.Strange@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 Ruiter	jp.deruiter@tufts.edu
Honors Thesis Computer Science.Please see departmental website for specific details.				

106327	**Internship Computer Science**
Subject:	Catalog Nbr:

Course Bulletin

COMP	0199			
2016 SUMR		Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 SUMR		Primary	Ming Chow	ming.chow@tufts.edu
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

Internship Computer Science. Please see departmental website for specific details.

106526	**Computational Learning Theory**
Subject:	Catalog Nbr:
COMP	0236

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.

107336	**Advanced Special Topics**			
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

Content and prerequisites to be announced. Please see departmental website for specific details.

107376	**Advanced Algorithms**
Subject:	Catalog Nbr:
COMP	0260

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

107398	**Advanced Computational Geometry**
Subject:	Catalog Nbr:
COMP	0263

(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.

Course Bulletin

107416	Parallel Computation
Subject: COMP	Catalog Nbr: 0265
Existing and proposed architectures for parallel computation. Fundamental synchronization and communication protocols. Algorithm development for distributed memory multicomputers. Recommendations: COMP 15 and 160.	

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

107460	User-interface Software
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.	

107474	Advanced Computer Graphics
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.	

107496	Data Visualization
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.	

Course Bulletin

107687	Programming Project
Subject: COMP	Catalog Nbr: 0290
Independent development of a complete computer program for an approved task, including design, implementation, and documentation.Please see departmental website for specific details.	

107951	Introduction To Civil & Environmental Engineering
Subject: CEE	Catalog Nbr: 0001
2017 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.	

107993	Introduction To Hydraulic Engineering
Subject: CEE	Catalog Nbr: 0012
2017 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.	

108013	Structural Analysis
Subject: CEE	Catalog Nbr: 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.	

108055	Steel Design
Subject: CEE	Catalog Nbr: 0024

Course Bulletin

	2017 SPRG	Primary	Eric Hines	Eric.Hines@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.
Recommendations: CEE 22.

108075	**Reinforced Concrete Design**

Subject: CEE — Catalog Nbr: 0025

2017 FALL	Primary	Brian Brenner	brian.brenner@tufts.edu

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.
Recommendations: CEE 22.

108096	**Environmental Chemistry**

Subject: CEE — Catalog Nbr: 0030

2016 FALL	Primary	John Durant	john.durant@tufts.edu
2017 FALL	Primary	Neelakshi Hudda	Neelakshi.Hudda@tufts.edu

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.
Recommendations: CHEM 2; CEE 32 or equivalent.

108121	**Environmental Engineering Principles**

Subject: CEE — Catalog Nbr: 0032

2017 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu

Water quantity and quality, air quality, energy utilization, climate change, and sustainability. Material and energy balance. Chemical and biological transformations. Elementary transport and fatemodeling. Quantitative description of natural and engineered processes affecting environmental sustainability at local, regional, and global scales.
Recommendations: ES 2, MATH 34 (formerly MATH 12), CHEM 1 or 11 or 16, and PHY 11

108135	**Master's Project**

Subject: COMP — Catalog Nbr: 0293

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

108143	**Introduction To Geotechnical Engineering**

Subject: CEE — Catalog Nbr: 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

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.
Recommendations: ES 9.

108178	**Biomedical Engineering Sophomore Design And Research I**

Subject: BME — Catalog Nbr: 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

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

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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	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	Shuchin Aeron	Shuchin.Aeron@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	

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			
2017 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.

108232	Masters Thesis
Subject:	Catalog Nbr:
COMP	0295

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	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

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**

Subject:	Catalog Nbr:			
COMP	0296			
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

Course Bulletin

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	Shuchin Aeron	Shuchin.Aeron@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

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			
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

Course Bulletin

	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.

108280	**Civil And Environmental Engineering Design**

Subject:	Catalog Nbr:			
CEE	0081			
	2017 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu
	2017 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu

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.
Recommendations: Senior standing.

108284	**Graduate Research**

Subject:	Catalog Nbr:			
COMP	0298			
	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

Course Bulletin

2017 SPRG	Primary	Matthias Scheutz	Matthias.Scheutz@tufts.edu
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@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

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

108304	**Non Major Credit**
Subject:	Catalog Nbr:
COMP	0310

108316	**Biomedical Engineeering Junior Design And Research II**		
Subject:	Catalog Nbr:		
BME	0006		
2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu

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.

108330	**Lower Level Elective Crd**
Subject:	Catalog Nbr:
COMP	0320

108346	**Special Topics In Civil And Environmental Engineering A**
Subject:	Catalog Nbr:
CEE	0093

Topical courses offered within civil and environmental engineering.

108350	**Upper Level Elective Crd**
Subject:	Catalog Nbr:
COMP	0330

Course Bulletin

108359	Biomedical Engineering Senior Design And Research			
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

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.
Recommendations: BME 6.

108363	Independent Study			
Subject:	Catalog Nbr:			
CEE	0094			
2016 FALL		Primary	John Durant	john.durant@tufts.edu
2016 FALL		Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
2017 FALL		Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
2017 SPRG		Primary	Jay Borkland	Jay.Borkland@tufts.edu

Supervised, independent study of topics related to civil and environmental engineering. Departmental consent required.

108393	Research Thesis A			
Subject:	Catalog Nbr:			
CEE	0095			
2016 FALL		Primary	John Durant	john.durant@tufts.edu

A course that permits the student to perform supervised research in a specialized field of civil and environmental engineering.
Recommendations: Consent of instructor.

108400	Biomedical Engineering Senior Design & Research			
Subject:	Catalog Nbr:			
BME	0008			
2017 SPRG		Primary	Fiorenzo Omenetto	Fiorenzo.Omenetto@tufts.edu
2017 SPRG		Primary	Brian Timko	Brian.Timko@tufts.edu

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.
Recommendations: BME 7.

108412	Research Thesis B

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Subject:	Catalog Nbr:			
CEE	0096			
	2017 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu

A course that permits the student to perform supervised research in a specialized field of civil and environmental engineering.
Recommendations: Consent of instructor.

108430	Biophysics

Subject:	Catalog Nbr:			
BME	0025			
	2017 SPRG	Primary	Peggy Cebe	peggy.cebe@tufts.edu

(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).

108431	Internship In Civil And Environmental Engineering

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

(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.

108452	Water Quality Modeling

Subject:	Catalog Nbr:
CEE	0103

(Cross-listed as ENV 103.) The application of mathematical models to the study of water quality in rivers,

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lakes, and estuaries. Topics include transport, temperature, dissolved oxygen, eutrophication, chemical equilibrium, pathogen, and toxics modeling. Model calibration and corroboration, parameter estimation, analytical and numerical solutions.
Recommendations: MATH 51 (formerly MATH 38) and CEE 32, or equivalent

108473	Introduction To Biophotonics

Subject:	Catalog Nbr:			
BME	0051			
2017 SPRG		Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2017 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
2017 FALL		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 22or ME 42, or consent of instructor

108507	Structural Dynamics And Earthquake Engineering

Subject:	Catalog Nbr:			
CEE	0106			
2017 SPRG		Primary	Masoud Sanayei	masoud.sanayei@tufts.edu

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.
Recommendations: ES 9 and CEE 22, or consent of instructor

108523	Quantitative Biomaterials Characterization Laboratory I

Subject:	Catalog Nbr:
BME	0056

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	2017 FALL	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
	2017 FALL	Primary	Martin Hunter	Martin.Hunter@tufts.edu

(SPRING 2013 & BEYOND). Quantitative biomaterials characterization laboratory I. Selected topics in use of electromagnetic radiation to characterize biomaterials. Please see department website for more details.

108529	**Hydrology/water Resource**

Subject: CEE Catalog Nbr: 0112

2017 FALL	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu

(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.
Recommendations: CEE12

108544	**Tufts Abroad Program**

Subject: COMP Catalog Nbr: 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

108547	**Quantitative Biomaterials Characterization Laboratory II**

Subject: BME Catalog Nbr: 0057

2017 SPRG	Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
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.

108548	**Groundwater**

Subject: CEE Catalog Nbr: 0113

2017 FALL	Primary	Grant Garven	Grant.Garven@tufts.edu

(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

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engineering.
Recommendations: EOS 1 or EOS 2 (formerly GEO 1 or GEO 2), and MATH 32 (formerly MATH 11).

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

108569	Field Methods In Hydrogeology
Subject:	Catalog Nbr:
CEE	0114
2017 SPRG	Primary Grant Garven Grant.Garven@tufts.edu
(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. Anetwork of boreholes on the Tufts campus will be used as field sites to characterize subsurfaceparameters in the unsaturated and saturated zones, and study regional flow in an urban watershed. Field trips, quantitative analysis of hydrogeologic data. Recommendations: EOS 002 (formerly GEO 002) and PHY 011 or equivalent.	

108571	Introduction To Human Factors And Ergonomics
Subject:	Catalog Nbr:
BME	0061
2017 FALL	Primary Linda Borghesani Linda.Borghesani@tufts.edu
2017 FALL	Primary Sami Durrani Sami.Durrani@tufts.edu
(Cross-listed as ENP 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.	

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

108591	Molecular Biotechnology
Subject:	Catalog Nbr:
BME	0062
2017 SPRG	Primary David Kaplan david.kaplan@tufts.edu

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	2017 SPRG	Primary	Niall Lennon	No Email on file.
	2017 SUMR	Primary	Dana Cairns	Dana.Cairns@tufts.edu
	2017 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.

108593	**The Art Of Building**
Subject:	Catalog Nbr:
CEE	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.

108606	**Grad Teaching Assistant**
Subject:	Catalog Nbr:
COMP	0405

108622	**Solid Mechanics**			
Subject:	Catalog Nbr:			
CEE	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 materials, torsion problem, inelastic behavior of materials, elements of plasticity and creep.
Recommendations: ES 9 Strength of Materials or equivalent.

108627	**Grad Research Assistant**
Subject:	Catalog Nbr:
COMP	0406

108640	**Advanced Structural Systems Analysis**			
Subject:	Catalog Nbr:			
CEE	0123			
	2017 FALL	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu

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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.
Recommendations: CEE 22.

108650	Internship

Subject: BME | Catalog Nbr: 0087

2017 FALL | Primary | Qiaobing Xu | Qiaobing.Xu@tufts.edu

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.

108651	Doctoral Degree Continuation

Subject: COMP | Catalog Nbr: 0501

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

108662	Advanced Steel Design

Subject: CEE | Catalog Nbr: 0124

2016 FALL | Primary | Po-Shang Chen | No Email on file.

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.
Recommendations: CEE 24 and consent of instructor

108667	Doctoral Degree Continuation

Subject: COMP | Catalog Nbr: 0502

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

108673	Internship

Subject: BME | Catalog Nbr: 0088

2017 SUMR | 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.

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108679	Advanced Reinforced Concrete
Subject: CEE	Catalog Nbr: 0125
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	

108692	Honors Thesis A			
Subject: BME	Catalog Nbr: 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.				

108699	Structural Stability
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	

108700	Special Tps:study Abroad
Subject: CHE	Catalog Nbr: 0196

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108712	Honors Thesis B			
Subject:	Catalog Nbr:			
BME	0090			
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

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.

108721	Nonlinear Analysis of Materials and Structures			
Subject:	Catalog Nbr:			
CEE	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.

108734	Special Topics			
Subject:	Catalog Nbr:			
BME	0093			
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	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.

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108745	Bridge Design And Rehabilitation			
Subject:	Catalog Nbr:			
CEE	0129			
2017 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu	
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. Recommendations: CEE 24 and CEE 25, or consent of instructor.				

108762	Special Topics			
Subject:	Catalog Nbr:			
BME	0094			
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	
Guided study of an approved topic in biomedical engineering. Credit as arranged.				

108768	River Hydraulics And Restoration			
Subject:	Catalog Nbr:			
CEE	0131			
2017 FALL	Primary	James Limbrunner	James.Limbrunner@tufts.edu	
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 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				

108785	Special Tps:study Abroad
Subject:	Catalog Nbr:
CHE	0197

108812	Environmental Engineering Processes			
Subject:	Catalog Nbr:			
CEE	0132			
2017 SPRG	Primary	John Durant	john.durant@tufts.edu	
Study of the chemical, physical, and biological basis for unit processes commonly used in environmental				

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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.
Recommendations: CEE 30 and CEE 32, or consent of instructor

108840	Wastewater Plant Design			
Subject:	Catalog Nbr:			
CEE	0133			
2017 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu	

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.
Recommendations: CEE 32 or consent of instructor

108855	Design Of Medical Instrumentation			
Subject:	Catalog Nbr:			
BME	0100			
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	

(Cross-listed as EE 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.
Recommendations: ES 3.

108886	Air Pollution Control			
Subject:	Catalog Nbr:			
CEE	0136			
2017 FALL	Primary	Stephen Zemba	No Email on file.	

(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

108908	Public Health			
Subject:	Catalog Nbr:			
CEE	0057			
2017 FALL	Primary	David Gute	david.gute@tufts.edu	

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

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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.
Recommendations: Consent of instructor.

108931	Hazardous Waste Treatment Technologies
Subject: CEE	Catalog Nbr: 0138

(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.
Recommendations: Senior standing or consent of instructor.

108951	Bioremediation: Natural And Enhanced
Subject: CEE	Catalog Nbr: 0139

(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, equilbria, sorption, gas transfer, and transformation products. Process design for treatment plants and in-situ applications applied to case studies.
Recommendations: CEE 132.

108982	Geomechanics
Subject: CEE	Catalog Nbr: 0245
2017 SPRG	Primary Robert Viesca Robert.Viesca@tufts.edu

Introduction to the mechanics of solids focused on earth materials as porous, deformable media. Strain, 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

109003	Site Remediation
Subject: CEE	Catalog Nbr: 0143
2017 SPRG	Primary C. Andrew Ramsburg Andrew.Ramsburg@tufts.edu

Conventional and innovative remediation technologies are examined under the remedial investigation/feasibility study (RI/FS) process. Knowledge of fundamental processes governing remedy

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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

109024	Computer Methods In Geotechnical Engineering

Subject: CEE | Catalog Nbr: 0145

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

109049	Foundation Engineering

Subject: CEE | Catalog Nbr: 0146

2016 FALL	Primary	Damian Siebert	Damian.Siebert@tufts.edu
2017 FALL	Primary	Lucy Jen	Lucy.Jen@tufts.edu

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.

109068	Geotechnical Earthquake Engineering

Subject: CEE | Catalog Nbr: 0247

2017 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu

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, 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.

109086	Earth Support Systems

Subject: CEE | Catalog Nbr: 0149

2017 SPRG	Primary	Lucy Jen	Lucy.Jen@tufts.edu

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

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excavations and retaining structures.
Recommendations: CEE 42.

109111	Principles Epidemiology
Subject: CEE	Catalog Nbr: 0154
2017 FALL	Primary Mark Woodin mark.woodin@tufts.edu

(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

109134	Occupational And Environmental Health
Subject: CEE	Catalog Nbr: 0158
2017 SPRG	Primary David Gute david.gute@tufts.edu

(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.

109167	Project Study In Human Systems A
Subject: BME	Catalog Nbr: 0120

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

109187	Epidemiological Methods
Subject: CEE	Catalog Nbr: 0155

(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.
Recommendations: CEE 154 or CEE 54

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109213	Environmental Toxicology			
Subject:	Catalog Nbr:			
CEE	0157			
2017 FALL		Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu

(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.
Recommendations: Senior standing or consent of instructor.

109218	Quantitative Physiology I			
Subject:	Catalog Nbr:			
BME	0121			
2016 FALL		Primary	Lauren Black III	Lauren.Black@tufts.edu
2017 FALL		Primary	Brian Timko	Brian.Timko@tufts.edu

(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.
Recommendations: BME/EE/ES 50, BIO 1 or BIO 13 or ES 11, or permission of instructor.

109266	Quantitative Physiology II			
Subject:	Catalog Nbr:			
BME	0122			
2017 SPRG		Primary	Lauren Black III	Lauren.Black@tufts.edu

(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.

109277	Health Effects And Risk Assessment			
Subject:	Catalog Nbr:			
CEE	0153			
2017 SPRG		Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu

A study of chronic and acute human health effects of exposure to hazardous materials. Principles of toxicology

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and pharmacokinetics of toxic substances. Standards for environmental quality, risk assessment methodologies, and risk communication strategies.
Recommendations: CHEM 1 or 16, senior standing and consent of instructor

109287	Biophysics

Subject:	Catalog Nbr:			
BME	0125			
	2017 SPRG	Primary	Peggy Cebe	peggy.cebe@tufts.edu

(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.)
Recommendations: PHY 1, 2, or 11, 12 or permission of instructor. Corequisite: MATH 42 (formerly MATH 13).

109305	Principles Of Medical Imaging

Subject:	Catalog Nbr:			
BME	0131			
	2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu

(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.
Recommendations: MATH 32 (formerly MATH 11), PHY 2 or 12, or permission of instructor.

109326	Analytical Tools For Biomedical Engineering

Subject:	Catalog Nbr:			
BME	0141			
	2017 FALL	Primary	Sergio Fantini	sergio.fantini@tufts.edu

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.
Recommendations: MATH 42 (formerly MATH 13), or permission of instructor.

109329	Legal Issues Of Engineering

Subject:	Catalog Nbr:

Course Bulletin

CEE	0185

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.
Recommendations: Junior standing or consent of instructor

109349	**Geographical Information Systems**

Subject:	Catalog Nbr:			
CEE	0187			
2016 SUMR		Primary	John Durant	john.durant@tufts.edu
2017 FALL		Primary	Laurie Baise	laurie.baise@tufts.edu

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.
Recommendations: ES 56.

109370	**Engineer Design W/cad**

Subject:	Catalog Nbr:
CEE	0188

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.
Recommendations: ES 88 or consent of instructor

109378	**Biomechanics**

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.

109421	**Special Topics**

Subject:	Catalog Nbr:
CEE	0193

Course Bulletin

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.

109444	**Microprocessor Architecture And Applications W/lab**

Subject: EE — Catalog Nbr: 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.

109449	**Land Use Planning II**

Subject: CEE — Catalog Nbr: 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.

109476	**Environmental Statistics**

Subject: CEE — Catalog Nbr: 0202

(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.
Recommendations: ES 56 or equivalent

109495	**Environmental Law**

Course Bulletin

Subject:	Catalog Nbr:
CEE	0207

(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.

109516	Electromagnetic Fields And Waves W/lab

Subject:	Catalog Nbr:
EE	0018

2017 SPRG Primary Thomas Vandervelde tvanderv@ece.tufts.edu

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.
Recommendations: ES 3, PHYS 12, MATH 51 (formerly MATH 38).

109523	Chemical Principles In Environmental & Water Resources Engineering

Subject:	Catalog Nbr:
CEE	0212

2017 FALL Primary Wayne Chudyk wayne.chudyk@tufts.edu

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.
Recommendations: CHEM 1 or equivalent.

109537	Introduction To Human Factors And Ergonomics

Subject:	Catalog Nbr:
BME	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.)

109542	Transport Principles In Environmental & Water Resources Engineering

Subject:	Catalog Nbr:
CEE	0213

Course Bulletin

	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

109559	**Human Factor Product Design**			
Subject:	Catalog Nbr:			
BME	0161			
	2017 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.

109562	**Environmental And Water Resource Systems**			
Subject:	Catalog Nbr:			
CEE	0214			
	2017 SPRG	Primary	James Limbrunner	James.Limbrunner@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.

109563	**Electronics I W/lab**			
Subject:	Catalog Nbr:			
EE	0021			
	2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu

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.
Recommendations: ES 3.

Course Bulletin

109571	Electronics II W/lab			
Subject:	Catalog Nbr:			
EE	0022			
2017 FALL		Primary	Sameer Sonkusale	sameer@ece.tufts.edu

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.
Recommendations: EE 21.

109580	Molecular Biotechnology			
Subject:	Catalog Nbr:			
BME	0162			
2017 SPRG		Primary	David Kaplan	david.kaplan@tufts.edu
2017 SPRG		Primary	Niall Lennon	No Email on file.
2017 SUMR		Primary	Dana Cairns	Dana.Cairns@tufts.edu
2017 SUMR		Primary	Nina Dinjaski	Nina.Dinjaski@tufts.edu

(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.)

109581	Advanced Solid Mechanics
Subject:	Catalog Nbr:
CEE	0221

(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.

109588	Linear Systems			
Subject:	Catalog Nbr:			
EE	0023			
2017 FALL		Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu

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.
Recommendations: EE 21 and MATH 51 (formerly MATH 38).

Course Bulletin

109635	Recombinant DNA Techniques			
Subject:	Catalog Nbr:			
BME	0163			
2017 SUMR	Primary	David Kaplan	david.kaplan@tufts.edu	
2017 SUMR	Primary	Wenwen Huang	Wenwen.Huang@tufts.edu	
2017 SUMR	Primary	Zaira Martin Moldes	Zaira.Martin_Moldes@tufts.edu	

(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.
Recommendations: CHEM 1, BIO 13, or permission of instructor.

109650	Advanced Structural Dynamics
Subject:	Catalog Nbr:
CEE	0225

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.
Recommendations: CEE 105 and 106.

109681	Advanced Structural Design
Subject:	Catalog Nbr:
CEE	0228

Please see departmental website for detailed course description.
Recommendations: Consent of instructor

109688	Principles Of Controlled Release And Drug Delivery			
Subject:	Catalog Nbr:			
BME	0165			
2017 FALL	Primary	Anthony Barry	Anthony.Barry@tufts.edu	

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.
Recommendations: CHEM 1 or 16, BIO 13 or ES 11, ES 2, and MATH 34 (formerly MATH 12), or permission.

Course Bulletin

109702	Digital Logic Systems W/lab			
Subject:	Catalog Nbr:			
EE	0026			
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu	

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.
Recommendations: ES 4 and EE 14, or permission.

109704	Reactive Transport In Porous Media			
Subject:	Catalog Nbr:			
CEE	0230			
2017 SPRG	Primary	Linda Abriola	Linda.Abriola@tufts.edu	

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).
Recommendations: CEE 213 or consent of instructor.

109717	Junior Design Project			
Subject:	Catalog Nbr:			
EE	0031			
2017 SPRG	Primary	Ronald Lasser	Ron.Lasser@tufts.edu	

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 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

109730	Biology of Water & Health			
Subject:	Catalog Nbr:			
CEE	0251			
2017 FALL	Primary	David Gute	david.gute@tufts.edu	

Course Bulletin

109743	Computer Interface Design
Subject: BME	Catalog Nbr: 0166
2017 SPRG	Primary Michael Wiklund michael.wiklund@tufts.edu
(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. Recommendations: EN 1, 2, and junior standing, or permission of instructor.	

109751	Laboratory And In-situ Measurement Of Soil Property
Subject: CEE	Catalog Nbr: 0244
2017 FALL	Primary John Germaine John.Germaine@tufts.edu
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. Recommendations: CEE 42.	

109757	Introduction To Biomedical Engineering
Subject: EE	Catalog Nbr: 0050
(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. Recommendations: PHY 2 or PHY 12, or permission of instructor.	

109773	Biotechnology Processing Projects Lab
Subject: BME	Catalog Nbr: 0168
2017 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.	

109782	Corporate Management Of Environmental Issues

Course Bulletin

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.

109786	**Seminar**
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.

109798	**Seminar In Biotechnology**
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:http://ase.tufts.edu/biology/

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

109812	**Special Topics**			
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

Course Bulletin

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

109825	**Tissue Engineering Research Laboratory**
Subject: BME	Catalog Nbr: 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.	

109827	**Subsurface Fluid Dynamics**
Subject: CEE	Catalog Nbr: 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	

109844	**Special Projects**
Subject: EE	Catalog Nbr: 0095
Undergraduate research under supervision of a member of the department. Credit as arranged. Please see departmental website for specific details.	

109848	**Introduction Biomedical Devices**
Subject: BME	Catalog Nbr: 0180
2016 SUMR	Primary Gregory Sonek Gregory.Sonek@tufts.edu
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.	

Course Bulletin

109857	Master's Seminar			
Subject:	Catalog Nbr:			
CEE	0291			
2017 FALL	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu	
Presentation of individual reports on basic topics to a seminar group for discussion and criticism. Please see departmental website for specific details.				

109875	Drug Product Formulation			
Subject:	Catalog Nbr:			
BME	0185			
2017 SPRG	Primary	Bernardo Perez-Ramirez	No Email on file.	
(Cross-listed as CHBE 185). Drug Product Formulation.				

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

109879	Graduate Seminar			
Subject:	Catalog Nbr:			
CEE	0292			
2017 FALL	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu	
2017 FALL	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu	
2017 FALL	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				

109909	Senior Design Project			
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.				

Course Bulletin

109926	Special Topics			
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	Shafiqul Islam	Shafiqul.Islam@tufts.edu
2017 SPRG		Primary	Grant Garven	Grant.Garven@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
Topical courses offered within civil and environmental engineering.				

109965	Senior Design Project			
Subject:	Catalog Nbr:			
EE	0098			
2017 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. Recommendations: Senior standing and permission of instructor and EE 97.				

109970	Master's Thesis			
Subject:	Catalog Nbr:			
CEE	0295			
2017 FALL		Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu
2017 FALL		Primary	Mark Woodin	mark.woodin@tufts.edu
2017 FALL		Primary	David Gute	david.gute@tufts.edu
2017 FALL		Primary	John Durant	john.durant@tufts.edu
2017 FALL		Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
2017 FALL		Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
2017 FALL		Primary	Laurie Baise	laurie.baise@tufts.edu
2017 FALL		Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
2017 FALL		Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
2017 FALL		Primary	John Germaine	John.Germaine@tufts.edu
Guided research on a topic that has been approved as a suitable subject for a master's thesis. Required: Consent of instructor.				

Course Bulletin

109987	Master's Thesis II			
Subject:	Catalog Nbr:			
CEE	0296			
	2017 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu
	2017 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu
	2017 SPRG	Primary	Lewis Edgers	lewis.edgers@tufts.edu
	2017 SPRG	Primary	David Gute	david.gute@tufts.edu
	2017 SPRG	Primary	John Durant	john.durant@tufts.edu
	2017 SPRG	Primary	Stephen Levine	stephen.levine@tufts.edu
	2017 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu
	2017 SPRG	Primary	Richard Vogel	richard.vogel@tufts.edu
	2017 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
	2017 SPRG	Primary	Elena Naumova	elena.naumova@tufts.edu
	2017 SPRG	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
	2017 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
	2017 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu
	2017 SPRG	Primary	Laurie Baise	laurie.baise@tufts.edu
	2017 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu
	2017 SPRG	Primary	Linda Abriola	Linda.Abriola@tufts.edu
	2017 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
	2017 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu
	2017 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
	2017 SPRG	Primary	Grant Garven	Grant.Garven@tufts.edu
	2017 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
	2017 SPRG	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu
	2017 SPRG	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
	2017 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu
	2017 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
	2017 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
	2017 SPRG	Primary	John Germaine	John.Germaine@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 FALL	Primary	David Gute	david.gute@tufts.edu
	2017 FALL	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu
	2017 FALL	Primary	Laurie Baise	laurie.baise@tufts.edu
	2017 FALL	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu
	2017 FALL	Primary	Kurt Pennell	Kurt.Pennell@tufts.edu
	2017 FALL	Primary	Natalie Capiro	Natalie.Capiro@tufts.edu
	2017 FALL	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu

Course Bulletin

	2017 SPRG	Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu
	2017 SPRG	Primary	Mark Woodin	mark.woodin@tufts.edu
	2017 SPRG	Primary	Lewis Edgers	lewis.edgers@tufts.edu
	2017 SPRG	Primary	John Durant	john.durant@tufts.edu
	2017 SPRG	Primary	Stephen Levine	stephen.levine@tufts.edu
	2017 SPRG	Primary	James Limbrunner	James.Limbrunner@tufts.edu
	2017 SPRG	Primary	Richard Vogel	richard.vogel@tufts.edu
	2017 SPRG	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu
	2017 SPRG	Primary	Elena Naumova	elena.naumova@tufts.edu
	2017 SPRG	Primary	Steven Chapra	steven.chapra@tufts.edu
	2017 SPRG	Primary	Brian Brenner	brian.brenner@tufts.edu
	2017 SPRG	Primary	Eric Hines	Eric.Hines@tufts.edu
	2017 SPRG	Primary	Linda Abriola	Linda.Abriola@tufts.edu
	2017 SPRG	Primary	C. Andrew Ramsburg	Andrew.Ramsburg@tufts.edu
	2017 SPRG	Primary	Shafiqul Islam	Shafiqul.Islam@tufts.edu
	2017 SPRG	Primary	Grant Garven	Grant.Garven@tufts.edu
	2017 SPRG	Primary	Babak Moaveni	Babak.Moaveni@tufts.edu
	2017 SPRG	Primary	Robert Viesca	Robert.Viesca@tufts.edu
	2017 SPRG	Primary	Daniel Kuchma	Dan.Kuchma@tufts.edu
	2017 SPRG	Primary	John Germaine	John.Germaine@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: EE	Catalog Nbr: 0099

2016 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2016 SUMR	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2016 SUMR	Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SUMR	Primary	Eric Miller	Eric.Miller@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.

110042	**Doctoral Thesis III**
Subject: CEE	Catalog Nbr: 0299

Guided research on a topic suitable for a doctoral dissertation. Required: CEE 298 and consent of instructor.

110067	**Non Major Credit**
Subject: CEE	Catalog Nbr: 0310

Course Bulletin

110073	Design Of Medical Instrumentation			
Subject:	Catalog Nbr:			
EE	0100			
2017 SPRG	Primary	Mark Cronin-Golomb	mark.cronin-golomb@tufts.edu	
(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.				

110097	Lower Level Elective Crd			
Subject:	Catalog Nbr:			
CEE	0320			

110117	Special Topics			
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.				

110120	Upper Level Crd			
Subject:	Catalog Nbr:			
CEE	0330			

110137	Special Topics			
Subject:	Catalog Nbr:			
BME	0194			
2017 SPRG	Primary	Gregory Altman	gregory.altman@tufts.edu	
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu	

Course Bulletin

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

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

110141	**Master's Degree Continuation-pt**
Subject:	Catalog Nbr:
CEE	0401

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

110161	**Optics And Wave Motion**		
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)

110187	**Master's Degree Continuation-ft**
Subject:	Catalog Nbr:
CEE	0402

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

110203	**Principles Of Biomedical Engineering**		
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.

Course Bulletin

110221	Graduate Teaching Assistant
Subject:	Catalog Nbr:
CEE	0405
Please see departmental website for specific details.	

110231	Graduate Introduction To Biophotonics			
Subject:	Catalog Nbr:			
BME	0251			
2017 SPRG		Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2017 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:	Catalog Nbr:
CEE	0406
Please see departmental website for specific details.	

110281	Graduate Quantitative Biomaterials Characterization Laboratory I			
Subject:	Catalog Nbr:			
BME	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:	Catalog Nbr:
CEE	0501
Part-time.Please see departmental website for specific details.	

110334	Introduction To Vlsi Design			
Subject:	Catalog Nbr:			
EE	0103			
2017 FALL		Primary	Valencia Koomson	Valencia.Koomson@tufts.edu

Course Bulletin

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.

110340	Graduate Quantitative Biomaterials Characterization Laboratory II			
Subject:	Catalog Nbr:			
BME	0257			
2017 SPRG		Primary	Irene Georgakoudi	Irene.Georgakoudi@tufts.edu
2017 SPRG		Primary	Martin Hunter	Martin.Hunter@tufts.edu

A graduate version of BME 57 including BME57 topics and weekly journal club meetings focused on critical reviews of current biophotonics articles.
Recommendations: BME 56, or BME 256. Graduate students only.

110348	Doctoral Degree Continuation-ft
Subject:	Catalog Nbr:
CEE	0502

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

110360	Graduate Seminar			
Subject:	Catalog Nbr:			
BME	0291			
2016 FALL		Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
2017 FALL		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.

110369	Probabilistic Systems Analysis			
Subject:	Catalog Nbr:			
EE	0104			
2016 FALL		Primary	Eric Miller	Eric.Miller@tufts.edu
2017 FALL		Primary	Brian Aull	Brian.Aull@tufts.edu

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.

Course Bulletin

Recommendation: Senior or graduate standing or consent of instructor.

110409	Graduate Seminar			
Subject:	Catalog Nbr:			
BME	0292			
2017 SPRG		Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
Biomedical engineering seminar series and presentation of individual reports to a seminar group for discussion. Credit as arranged.				

110437	Special Topics			
Subject:	Catalog Nbr:			
BME	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.				

110444	Feedback-control Systems			
Subject:	Catalog Nbr:			
EE	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				

110453	Special Topics			
Subject:	Catalog Nbr:			
BME	0294			
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

Course Bulletin

	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
Guided individual study of an approved topic. Credit as arranged.				

110472	**Master's Thesis**			
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.				

110493	**Advanced Feedback-control Systems**
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, th W-transform, stability of sample-data systems, an introduction to state-space concepts and the control of multivariable systems. Spring. Recommendations: EE 105.	

110513	**Master's Thesis**			
Subject: BME	Catalog Nbr: 0296			
	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

Course Bulletin

Guided research on an approved topic suitable for a master's thesis. Credit as arranged.

110537	**Doctoral Thesis**			
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.				

110573	**Doctoral Thesis**			
Subject:	Catalog Nbr:			
BME	0298			
	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
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged.				

110627	**Master Of Engineering Project**			
Subject:	Catalog Nbr:			
BME	0299			
	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

Course Bulletin

	2017 FALL	Primary	Xiaocheng Jiang	Xiaocheng.Jiang@tufts.edu
	2017 FALL	Primary	Brian Timko	Brian.Timko@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.
Recommendations: Enrollment is limited to and required for matriculated students in the master of engineering program.

110652	**Communications Systems**

Subject:	Catalog Nbr:			
EE	0107			
	2017 FALL	Primary	Mai Vu	Mai.Vu@tufts.edu

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.
Prerequisites: EE23, EE24

110660	**Non Major Credit**

Subject:	Catalog Nbr:
BME	0310

110688	**Wireless Communications**

Subject:	Catalog Nbr:
EE	0108

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.
Prerequisites: EE107 or equivalent, EE104 or equivalent

110710	**Lower Level Elective Crd**

Subject:	Catalog Nbr:
BME	0320

110747	**Upper Level Elective Crd**

Course Bulletin

Subject:	Catalog Nbr:
BME	0330

110815	Master's Continuation

Subject:	Catalog Nbr:			
BME	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:	Catalog Nbr:			
BME	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:	Catalog Nbr:			
BME	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

Course Bulletin

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

110929	**Grad Research Assistant**

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

110955	**Doctoral Continuation - Part Time**

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

110988	**Doctoral Continuation - Full Time**

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

Course Bulletin

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

Full-time doctoral continuation.

111244	**Semiconductor Devices**

Subject:	Catalog Nbr:			
EE	0113			
2017 SPRG		Primary	Sameer Sonkusale	sameer@ece.tufts.edu

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.
Recommendations: EE 21 and MATH 51 (formerly MATH 38).

111296	**Entrepreneurship And Business Planning**

Subject:	Catalog Nbr:			
ELS	0101			
2017 FALL		Primary	Tina Weber	Tina.Weber@tufts.edu
2017 FALL		Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu
2017 FALL		Primary	Mark Ranalli	Mark.Ranalli@tufts.edu
2017 SPRG		Primary	Lana Caron	Lana.Caron@tufts.edu

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.

111335	**Entrepreneurial Finance**

Subject:	Catalog Nbr:			
ELS	0103			
2017 FALL		Primary	Alicia Amaral	Alicia.Amaral@tufts.edu
2017 FALL		Primary	Frank Apeseche	Frank.Apeseche@tufts.edu

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.
Recommended: at least one core ELS class or accounting elective

Course Bulletin

111371	Entrepreneurial Marketing			
Subject:	Catalog Nbr:			
ELS	0105			
2017 FALL	Primary	John Derby	John.Derby@tufts.edu	
2017 FALL	Primary	Gavin Finn	Gavin.Finn@tufts.edu	

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.

111394	Entrepreneurial Leadership			
Subject:	Catalog Nbr:			
ELS	0107			
2017 FALL	Primary	Pamela Stepp	Pamela.Stepp@tufts.edu	
2017 FALL	Primary	Elizabeth McCarthy	Elizabeth.McCarthy@tufts.edu	
2017 SPRG	Primary	Roger Patkin	Roger.Patkin@tufts.edu	

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.

111412	Introduction Microwaves			
Subject:	Catalog Nbr:			
EE	0117			
2017 FALL	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	

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.

111425	Innovative Social Enterprises			
Subject:	Catalog Nbr:			
ELS	0141			
2017 SPRG	Primary	Julianne Zimmerman	Julianne.Zimmerman@tufts.edu	

(Cross-listed as AMER 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 enteprises in improving

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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.

111441	Special Topics

Subject:	Catalog Nbr:			
ELS	0193			
	2016 FALL	Primary	Inge Milde	Inge.Milde@tufts.edu
	2017 FALL	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu

Special Topics.Please see departmental website for specific details.
Recommended: at least one core ELS class or accounting elective

111448	Microwave Semiconductor Devices And Circuits

Subject:	Catalog Nbr:			
EE	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.

111461	Special Topics

Subject:	Catalog Nbr:			
ELS	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 FALL	Primary	Mark Ranalli	Mark.Ranalli@tufts.edu
	2017 SPRG	Primary	John Derby	John.Derby@tufts.edu
	2017 SPRG	Primary	Inge Milde	Inge.Milde@tufts.edu
	2017 SPRG	Primary	Gavin Finn	Gavin.Finn@tufts.edu
	2017 SPRG	Primary	Christopher Manos	Christopher.Manos@tufts.edu
	2017 SPRG	Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu
	2017 SPRG	Primary	Roger Patkin	Roger.Patkin@tufts.edu

Special Topics. Please see departmental website for specific details.

111478	Entrepreneurial Fieldstudy

Subject:	Catalog Nbr:

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ELS	0199			
2017 FALL		Primary	Mark Ranalli	Mark.Ranalli@tufts.edu

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.

111499	**Non Major Credit**
Subject:	Catalog Nbr:
ELS	0310

111514	**Lower Level Elective Crd**
Subject:	Catalog Nbr:
ELS	0320

111531	**Upper Level Elective Crd**
Subject:	Catalog Nbr:
ELS	0330

111626	**Management Of Innovation**			
Subject:	Catalog Nbr:			
EM	0153			
2017 FALL		Primary	Samuel Liggero	Samuel.Liggero@tufts.edu
2017 SPRG		Primary	Anna Thornton	No Email on file.

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.

111692	**Computer Animation For Technical Communications**
Subject:	Catalog Nbr:
EE	0120

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

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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.
Recommendations: COMP 11.

111783	Physiology For Engineers I			
Subject:	Catalog Nbr:			
EE	0121			
2016 FALL		Primary	Lauren Black III	Lauren.Black@tufts.edu
2017 FALL		Primary	Brian Timko	Brian.Timko@tufts.edu

(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.
Recommendations: BME/EE/ES 50, BIO 1 or BIO 13 or ES 11, or permission of instructor.

111898	Quantitative Physiology II
Subject:	Catalog Nbr:
EE	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.

112032	Digital Signal Processing			
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.

112076	Computer Engineering W/lab			
Subject:	Catalog Nbr:			
EE	0126			
2017 FALL		Primary	Mark Hempstead	Mark.Hempstead@tufts.edu

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(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.

112117	Information Theory

Subject: EE
Catalog Nbr: 0127

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.

112309	Operating Systems

Subject: EE
Catalog Nbr: 0128

2016 FALL	Primary	Elena Strange	Elena.Strange@tufts.edu
2017 FALL	Primary	Alva Couch	alva.couch@tufts.edu

(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.

112329	Introduction To Computing In Engineering

Subject: ES
Catalog Nbr: 0002

2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu

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, 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.

112452	Computer Communication Networks

Subject: EE
Catalog Nbr: 0129

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	2017 FALL	Primary	Chorng Chang	chorng.chang@tufts.edu

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.

112629	**Principles Of Medical Imaging**

Subject:	Catalog Nbr:			
EE	0131			
	2017 SPRG	Primary	Sergio Fantini	sergio.fantini@tufts.edu

(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.

112651	**Digital Image Processing**

Subject:	Catalog Nbr:			
EE	0133			
	2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu

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.

112656	**Introduction To Electrical Systems W/ Lab**

Subject:	Catalog Nbr:			
ES	0003			
	2016 FALL	Primary	Brian Aull	Brian.Aull@tufts.edu
	2017 FALL	Primary	Douglas Preis	DPreis@eecs.tufts.edu
	2017 FALL	Primary	Ronald Lasser	Ron.Lasser@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).

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112675	Advanced Electromagnetics
Subject: EE	Catalog Nbr: 0135
2017 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.	

112721	Antennas For Radar, Avionics, And Communications
Subject: EE	Catalog Nbr: 0136
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.	

112747	Radar Engineering
Subject: EE	Catalog Nbr: 0137
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.	

112767	Introduction To Digital Logic Circuits W/ Lab
Subject: ES	Catalog Nbr: 0004
2017 SPRG	Primary Karen Panetta Karen@eecs.tufts.edu
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. Recommendations: ES 3.	

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112912	Advanced Digital Signal Processing
Subject:	Catalog Nbr:
EE	0145

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.
Recommendations: EE 125 or permission of instructor.

112960	Analog And Mixed Signal Mos Integrated Circuit Design
Subject:	Catalog Nbr:
EE	0147

2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu

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.

112982	Silicon Radio Frequency Ic Design
Subject:	Catalog Nbr:
EE	0148

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.\
Recommendations: EE 11 and 12.

113042	Introduction To Mechanics- Statics And Dynamics
Subject:	Catalog Nbr:
ES	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
2017 SUMR	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu

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.

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Recommendations: MATH 32 (formerly MATH 11) and PHY 11

113161	Thermodynamics			
Subject:	Catalog Nbr:			
ES	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
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.				

113270	Fluid Mechanics			
Subject:	Catalog Nbr:			
ES	0008			
2016 FALL		Primary	Simon Steel	Simon.Steel@tufts.edu
2016 FALL		Primary	Jeffrey Guasto	Jeffrey.Guasto@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
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.				

113357	Computer-aided Design Of Microwave Circuits			
Subject:	Catalog Nbr:			
EE	0160			
2017 SPRG		Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
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. Recommendations: EE 117				

113425	Microwave Integrated Circuits
Subject:	Catalog Nbr:
EE	0161

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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.
Recommendations: EE 160.

113468	Applied Mechanics (strength Of Materials)

Subject:	Catalog Nbr:			
ES	0009			
	2017 SPRG	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu

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.
Recommendations: ES 5.

113601	Introduction To Materials Science

Subject:	Catalog Nbr:			
ES	0010			
	2017 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu

Structure of materials; chemical composition; phase transformations; properties of metals, ceramics, polymers, biopolymers, and related materials. Material selection in chemical and biological engineering applications.
Recommendations: MATH 34 (formerly MATH 12), CHEM 1 or 16.

113663	Fundamentals Of Biological Systems

Subject:	Catalog Nbr:			
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

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.
Recommendations: MATH 34 (formerly MATH 12), PHY 11, and CHEM 1.

113762	Electrical Engineering Seminar

Subject:	Catalog Nbr:
EE	0191

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	2017 FALL	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
A course devoted to the study of special problems in electrical engineering. Credit as arranged.Please see departmental website for specific details.				

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

113810	**Special Topics**			
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	Usman Khan	Usman.Khan@tufts.edu
	2016 FALL	Primary	Mai Vu	Mai.Vu@tufts.edu
	2017 FALL	Primary	Karen Panetta	Karen@eecs.tufts.edu
	2017 FALL	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
	2017 FALL	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
	2017 FALL	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu
	2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
Guided independent study of an approved topic at an intermediate level. Prerequisite: consent. Credit as arranged. Please see departmental website for specific details.				

113825	**Special Topics**			
Subject:	Catalog Nbr:			
EE	0194			
	2017 SPRG	Primary	Ming Chow	ming.chow@tufts.edu
	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
	2017 SPRG	Primary	Joel Grodstein	Joel.Grodstein@tufts.edu
	2017 SUMR	Primary	Karen Panetta	Karen@eecs.tufts.edu
	2017 SUMR	Primary	Ronald Lasser	Ron.Lasser@tufts.edu
Guided independent study of an approved topic at an intermediate level. Credit as arranged.				

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113886	Honors Thesis
Subject: EE	Catalog Nbr: 0197
Honors Thesis.Please see departmental website for specific details.	

113925	Internship			
Subject: EE	Catalog Nbr: 0199			
2016 SUMR	Primary	Ming Chow	ming.chow@tufts.edu	
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
2017 SPRG	Primary	Alva Couch	alva.couch@tufts.edu	
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu	
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
2017 SUMR	Primary	Karen Panetta	Karen@eecs.tufts.edu	
2017 SUMR	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2017 SUMR	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
2017 SUMR	Primary	Eric Miller	Eric.Miller@tufts.edu	
2017 SUMR	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
2017 SUMR	Primary	Usman Khan	Usman.Khan@tufts.edu	
2017 SUMR	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2017 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.				

113948	Digital Systems Design For Testability
Subject: EE	Catalog Nbr: 0202
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. Recommendations: EE 26.	

113998	Environment And Technology
Subject:	Catalog Nbr:

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	ES	0025			
	2017 FALL		Primary	Anne Marie Desmarais	annemarie.desmarais@tufts.edu

(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.
Recommendations: CHEM 1 or 16 and sophomore standing

114014	**Advanced Topics In Computer Architecture**
Subject:	Catalog Nbr:
EE	0216

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.
Recommendations: EE 215.

114097	**Detection And Estimation Theory**
Subject:	Catalog Nbr:
EE	0229

A systematic development of optimal detection and estimation theory, including Bayesian, Maximum Likelihood (MLE), Maximum Aposteriori (MAP), and minimum mean squared error (MMSE) techniques. The Karhunen-Loeue expansion for non-white noise is studied. Applications to digital and analog communications, and radar problems are included. Nonparametric approaches, spectral estimation, and spread spectrum systems are examined.
Recommendations: EE 108 or equivalent.

114115	**Advanced Analog & Mixed Signal Ic Design**
Subject:	Catalog Nbr:
EE	0247

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.
Recommendations: EE 147.

114138	**Devices & Circuits For Optical Communications**
Subject:	Catalog Nbr:
EE	0249

Underlying principles and integrated circuit design techniques for optical communication systems (fiber-based and free-space). Optoelectronic device operation, receiver circuit fundamentals, noise analysis,

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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.
Recommendations: EE 103 or consent of instructor. Corequisite: EE 147.

114161	Biomedical Engineering

Subject:	Catalog Nbr:			
EE	0250			
	2017 FALL	Primary	Qiaobing Xu	Qiaobing.Xu@tufts.edu

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.

114174	Public Health Engineering

Subject:	Catalog Nbr:			
CEE	0052			
	2017 SPRG	Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu
	2017 SPRG	Secondary	David Gute	david.gute@tufts.edu

(Cross-listed as ENV 0027). An introduction to public health engineering. Elements of waterborne disease control, hazardous materials management, occupational health and safety, and environmental interventions. Applications to environmental engineering and environmental engineering science.

114205	Plasma Engineering

Subject:	Catalog Nbr:
EE	0251

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.
Recommendations: EE 117 or equivalent, EE 104 or equivalent.

114290	Introduction To Chemical And Biological Engineering (chbe)

Subject:	Catalog Nbr:
EN	0069

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

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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.

114449	Master's Project

Subject:	Catalog Nbr:			
EE	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

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

114505	Non Major Credit
Subject:	Catalog Nbr:
EN	0310

114523	Lower Level Elective Crd
Subject:	Catalog Nbr:
EN	0320

114541	Upper Level Elective Crd
Subject:	Catalog Nbr:
EN	0330

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114553	Master's Project			
Subject:	Catalog Nbr:			
EE	0294			
2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu	
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu	
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu	
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
2017 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu	
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu	
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2017 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.

114616	Numerical Methods			
Subject:	Catalog Nbr:			
ES	0055			
2017 FALL	Primary	Steven Chapra	steven.chapra@tufts.edu	

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.
Recommendations: ES 2 and MATH 51 (formerly MATH 38)

114618	Master's Thesis			
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	

Course Bulletin

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 that has been approved as a suitable subject for a master's thesis. Credit as arranged. Please see departmental website for specific details.

114655 **Probability And Statistics**

Subject: ES Catalog Nbr: 0056

2017 FALL	Primary	Wayne Chudyk	wayne.chudyk@tufts.edu

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.
Recommendations: MATH 42 (formerly MATH 13)

114664 **Master's Thesis**

Subject: EE Catalog Nbr: 0296

2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 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.

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114719	Doctoral Thesis

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.

114755	Appropriate Technology In Sustainable Engineering

Subject:	Catalog Nbr:
ES	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.

114809	Doctoral Thesis

Subject:	Catalog Nbr:
EE	0298

2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu
2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu

Course Bulletin

2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 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.

114828	**Non Major Credit**
Subject:	Catalog Nbr:
EE	0310

114862	**Lower Level Elective Crd**
Subject:	Catalog Nbr:
EE	0320

114869	**Musical Instrument Design And Manufacture**
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.

114874	**Upper Level Elective Crd**
Subject:	Catalog Nbr:
EE	0330

114891	**Masters Degree Continuation**
Subject:	Catalog Nbr:
EE	0401

2017 FALL	Primary	Eric Miller	Eric.Miller@tufts.edu
2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu

Course Bulletin

2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 SPRG	Primary	Mai Vu	Mai.Vu@tufts.edu

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

114927	**Masters Degree Continuation**

Subject:	Catalog Nbr:			
EE	0402			
2017 FALL		Primary	Eric Miller	Eric.Miller@tufts.edu
2017 SPRG		Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG		Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 SPRG		Primary	Chorng Chang	chorng.chang@tufts.edu
2017 SPRG		Primary	Douglas Preis	DPreis@eecs.tufts.edu
2017 SPRG		Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG		Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 SPRG		Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG		Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 SPRG		Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 SPRG		Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2017 SPRG		Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SPRG		Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG		Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 SPRG		Primary	Mai Vu	Mai.Vu@tufts.edu

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

114966	**Grad Teaching Assistant**

Subject:	Catalog Nbr:			
EE	0405			
2017 FALL		Primary	Eric Miller	Eric.Miller@tufts.edu

114972	**Cad For Engineers**

Subject:	Catalog Nbr:
ES	0088

Two-and three-dimensional geometric modeling with computer-aided design (CAD) systems. The use of CAD

Course Bulletin

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.
Recommendations: EN 2 or equivalent

114981	Grad Research Assistant			
Subject:	Catalog Nbr:			
EE	0406			
2017 FALL		Primary	Eric Miller	Eric.Miller@tufts.edu

114989	Special Topics In Engineering			
Subject:	Catalog Nbr:			
ES	0093			
2016 SUMR		Primary	Soha Hassoun	soha.hassoun@tufts.edu

Guided study of chosen topics in Engineering and Engineering Science. Please see the School of Engineering Website for further details.
Recommendations: Permission of instructor.

114999	Doctoral Degree Continuation			
Subject:	Catalog Nbr:			
EE	0501			
2017 SPRG		Primary	Karen Panetta	Karen@eecs.tufts.edu
2017 SPRG		Primary	Mohammed Afsar	mohammed.afsar@tufts.edu
2017 SPRG		Primary	Chorng Chang	chorng.chang@tufts.edu
2017 SPRG		Primary	Douglas Preis	DPreis@eecs.tufts.edu
2017 SPRG		Primary	Mark Hempstead	Mark.Hempstead@tufts.edu
2017 SPRG		Primary	Sameer Sonkusale	sameer@ece.tufts.edu
2017 SPRG		Primary	Valencia Koomson	Valencia.Koomson@tufts.edu
2017 SPRG		Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu
2017 SPRG		Primary	Eric Miller	Eric.Miller@tufts.edu
2017 SPRG		Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu
2017 SPRG		Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu
2017 SPRG		Primary	Usman Khan	Usman.Khan@tufts.edu
2017 SPRG		Primary	Brian Tracey	brian.tracey@tufts.edu
2017 SPRG		Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu
2017 SPRG		Primary	Mai Vu	Mai.Vu@tufts.edu

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

Course Bulletin

115032	Doctoral Degree Continuation			
Subject:	Catalog Nbr:			
EE	0502			
2017 SPRG	Primary	Karen Panetta	Karen@eecs.tufts.edu	
2017 SPRG	Primary	Mohammed Afsar	mohammed.afsar@tufts.edu	
2017 SPRG	Primary	Chorng Chang	chorng.chang@tufts.edu	
2017 SPRG	Primary	Douglas Preis	DPreis@eecs.tufts.edu	
2017 SPRG	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	
2017 SPRG	Primary	Sameer Sonkusale	sameer@ece.tufts.edu	
2017 SPRG	Primary	Valencia Koomson	Valencia.Koomson@tufts.edu	
2017 SPRG	Primary	Jeffrey Hopwood	Jeffrey.Hopwood@tufts.edu	
2017 SPRG	Primary	Eric Miller	Eric.Miller@tufts.edu	
2017 SPRG	Primary	Thomas Vandervelde	tvanderv@ece.tufts.edu	
2017 SPRG	Primary	Aleksandar Stankovic	alex.stankovic@tufts.edu	
2017 SPRG	Primary	Usman Khan	Usman.Khan@tufts.edu	
2017 SPRG	Primary	Brian Tracey	brian.tracey@tufts.edu	
2017 SPRG	Primary	Shuchin Aeron	Shuchin.Aeron@tufts.edu	
2017 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:			
ES	0095			
2017 SPRG	Primary	Paul Lehrman	paul.lehrman@tufts.edu	
(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.				

115411	Numerical Methods			
Subject:	Catalog Nbr:			
ES	0101			
2017 FALL	Primary	Jason Rife	Jason.Rife@tufts.edu	
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.				

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115714	Engineering Systems: Stochastic Models
Subject: ES	Catalog Nbr: 0152
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	

115942	Engineering Psychology			
Subject: ENP	Catalog Nbr: 0053			
2016 FALL	Primary	Thaddeus Brunye	Thaddeus.Brunye@tufts.edu	
2017 FALL	Primary	Nathan Ward	Nathan.Ward@tufts.edu	
(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.				

115987	Non Major Credit
Subject: ES	Catalog Nbr: 0310

115999	Lower Level Elective Crd
Subject: ES	Catalog Nbr: 0320

116016	Upper Level Elective Crd
Subject: ES	Catalog Nbr: 0330

116022	Introduction To Human Factors And Ergonomics			
Subject: ENP	Catalog Nbr: 0061			
2017 FALL	Primary	Linda Borghesani	Linda.Borghesani@tufts.edu	

Course Bulletin

	2017 FALL	Primary	Sami Durrani	Sami.Durrani@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.

116048	**Internship In Engineering Psychology**

Subject:	Catalog Nbr:
ENP	0099

2016 FALL	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2017 FALL	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu
2017 SUMR	Primary	Brian Gravel	brian.gravel@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 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.

116058	**Tufts Program Abroad**

Subject:	Catalog Nbr:
ES	0340

116068	**Assistive Technology**

Subject:	Catalog Nbr:
ENP	0105

2017 FALL	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu

(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.

Course Bulletin

116129	Project Study In Human Systems A			
Subject:	Catalog Nbr:			
ENP	0120			
2016 FALL		Primary	David Aurelio	David.Aurelio@tufts.edu
2017 FALL		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 human-factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects. Spring.
Recommendations: ENP 161, 162, PSY 31, 32, 130.

116201	Seminar In Engineering Psychology			
Subject:	Catalog Nbr:			
ENP	0149			
2017 FALL		Primary	Nathan Ward	Nathan.Ward@tufts.edu
2017 FALL		Primary	James Intriligator	James.Intriligator@tufts.edu
2017 SPRG		Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2017 SPRG		Primary	Gary Leisk	Gary.LEISK@tufts.edu
2017 SPRG		Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu
2017 SUMR		Primary	Timothy McEwen	Timothy.McEwen@tufts.edu
2017 SUMR		Primary	Sami Durrani	Sami.Durrani@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.

116409	Human Factor Product Design			
Subject:	Catalog Nbr:			
ENP	0161			
2017 SPRG		Primary	James Intriligator	James.Intriligator@tufts.edu

(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.
Recommendations: EN 1, 2, ENP 61, PSY 31, 32, 53, and junior standing, or permission of instructor.

116464	Human-machine System Design			
Subject:	Catalog Nbr:			
ENP	0162			
2016 FALL		Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2017 FALL		Primary	Timothy McEwen	Timothy.McEwen@tufts.edu

Course Bulletin

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.
Recommendations: EN 1, 2, ENP 161, PSY 31, 32,107, or CEE 102.

116481	**Analytical Methods In Human Factors Engineering**			
Subject:	Catalog Nbr:			
ENP	0163			
2016 FALL		Primary	James Intriligator	James.Intriligator@tufts.edu
2017 FALL		Primary	Daniel Hannon	Dan.Hannon@tufts.edu

Field and laboratory research design, empirical data acquisition, recording and analysis: knowledge elicitation techniques, psychophysical methods, subjective scaling, human performance modeling, measurement of dynamic continuous signals including sampling, spectra filtering, etc, measurement of discrete signals, spectral and correlational data analysis.
Recommendations: ENP 162 or graduate standing.

116557	**Computer Interface Design**			
Subject:	Catalog Nbr:			
ENP	0166			
2017 SPRG		Primary	Michael Wiklund	michael.wiklund@tufts.edu

(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.
Recommendations: EN 1, 2, and junior standing, or permission of instructor.

116608	**Special Topics**			
Subject:	Catalog Nbr:			
ENP	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	Robert.Hannemann@tufts.edu

Course Bulletin

2016 FALL	Primary	Marc Hodes	Marc.Hodes@tufts.edu
2016 FALL	Primary	Thomas James	Thomas.James@tufts.edu
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	James Intriligator	James.Intriligator@tufts.edu

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

116631	**Special Topics**

Subject:	Catalog Nbr:			
ENP	0194			
2017 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			
2017 FALL		Primary	David Aurelio	David.Aurelio@tufts.edu

Course Bulletin

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.	

116724	**Thesis**			
Subject:	Catalog Nbr:			
ENP	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	Robert.Hannemann@tufts.edu
	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.				

116734	**Thesis**			
Subject:	Catalog Nbr:			
ENP	0296			
	2017 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
	2017 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.				

116762	**Graduate Research**
Subject:	Catalog Nbr:
ENP	0298
Guided research on a topic suitable for a doctoral dissertation. Credit as arranged. Please see departmental	

Course Bulletin

website for specific details.

116782	Non Major Credit
Subject:	Catalog Nbr:
ENP	0310

116801	Lower Level Elective Crd
Subject:	Catalog Nbr:
ENP	0320

116819	Upper Level Elective Crd
Subject:	Catalog Nbr:
ENP	0330

121277	Special Topics In Engineering		
Subject:	Catalog Nbr:		
ME	0149		
2016 FALL	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
2017 FALL	Primary	Pratap Misra	Pratap.Misra@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	brad@exa.com
2017 SPRG	Primary	Daniel Hannon	Dan.Hannon@tufts.edu
2017 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
2017 SPRG	Primary	Jennifer Buxton	Jennifer.Buxton@tufts.edu
2017 SPRG	Primary	James Vlahakis	James.Vlahakis@tufts.edu
2017 SPRG	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu
2017 SPRG	Primary	Igor Sokolov	Igor.Sokolov@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
2017 SPRG	Primary	Kelsey Hochgraf	Kelsey.Hochgraf@tufts.edu
Study of selected engineering problems in the analysis and design of physical systems.Please see departmental website for specific details: http://ase.tufts.edu/mechanical/			

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121501	Applied Mathematics For Engineers			
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. 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.

121513	Biomechanics
Subject:	Catalog Nbr:
ME	0152

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.
Recommendations: ES 9 Applied Mechanics (Strength of Materials) or equivalent.

121726	Wind Engineering
Subject:	Catalog Nbr:
ME	0167

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.
Recommendations: ES 8 - Fluid Mechanics.

121812	Seminar In Fluid Mechanics And Heat Transfer
Subject:	Catalog Nbr:
ME	0168

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.
Recommendations: ME 65 or 165.

122006	Digital Control Of Dynamic Systems
Subject:	Catalog Nbr:

Course Bulletin

ME	0180			
2017 FALL		Primary	William Messner	William.Messner@tufts.edu

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. Recommendations: ME 80 or consent.

122016	**Advanced Dynamics**			
Subject:	Catalog Nbr:			
ME	0181			
2017 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.

122068	**Robotics**			
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.

122154	**Special Topics**			
Subject:	Catalog Nbr:			
ME	0193			
2016 SUMR		Primary	William Messner	William.Messner@tufts.edu
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

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

122168	**Special Topics**
Subject:	Catalog Nbr:
ME	0194

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

122414	**Special Tps:study Abroad**

Course Bulletin

Subject:	Catalog Nbr:
ME	0197

122554	Advanced Structural Dynamics
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.

122720	Flow-real Viscous Fluids
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.

122775	Advanced Engineering Controls
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.

122817	Graduate Seminar
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. Credit as arranged. Please see departmental website for specific details.

122869	Graduate Seminar
Subject:	Catalog Nbr:

Course Bulletin

ME	0292			
2017 SPRG		Primary	Briana Bouchard	Briana.Bouchard@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.

122898	**Special Topics**			
Subject:	Catalog Nbr:			
ME	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
2017 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:	Catalog Nbr:
ME	0294

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

122944	**Master's Thesis**			
Subject:	Catalog Nbr:			
ME	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

Course Bulletin

	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

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

122996	**Master's Thesis**

Subject:	Catalog Nbr:			
ME	0296			
	2017 SPRG	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
	2017 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2017 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
	2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu
	2017 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
	2017 SPRG	Primary	Chris Rogers	chris.rogers@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	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	Erica Kemmerling	Erica.Kemmerling@tufts.edu
	2017 SPRG	Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu

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

123035	**Doctoral Thesis**

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: ME Catalog Nbr: 0298

2017 SPRG	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
2017 SPRG	Primary	Mark Kachanov	mark.kachanov@tufts.edu
2017 SPRG	Primary	Anil Saigal	anil.saigal@tufts.edu
2017 SPRG	Primary	Chris Rogers	chris.rogers@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	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	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2017 SPRG	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.

123213 **Master Of Engineering Project**

Subject: ME Catalog Nbr: 0299

2017 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2017 FALL	Primary	Michael Wiklund	michael.wiklund@tufts.edu
2017 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu

Course Bulletin

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	Daniel Hannon	Dan.Hannon@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
2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu
2017 SPRG	Primary	Pratap Misra	Pratap.Misra@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.

123233	**Non Major Credit**
Subject:	Catalog Nbr:
ME	0310

123260	**Lower Level Elective Crd**
Subject:	Catalog Nbr:
ME	0320

123283	**Upper Level Elective Crd**
Subject:	Catalog Nbr:
ME	0330

123330	**Tufts Abroad Program**

Course Bulletin

Subject:	Catalog Nbr:			
ME	0340			
	2017 SPRG	Primary	Simon Steel	Simon.Steel@tufts.edu

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

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

123584	Grad Teaching Assistant			
Subject:	Catalog Nbr:			
ME	0405			
	2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu
	2017 FALL	Primary	Robert White	R.White@tufts.edu
	2017 FALL	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu

123607	Grad Research Assistant			
Subject:	Catalog Nbr:			
ME	0406			
	2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu
	2017 FALL	Primary	Robert White	R.White@tufts.edu
	2017 FALL	Primary	Briana Bouchard	Briana.Bouchard@tufts.edu

123772	Doctoral Degree Continuation			
Subject:	Catalog Nbr:			
ME	0501			
	2017 FALL	Primary	Chris Rogers	chris.rogers@tufts.edu

Course Bulletin

	2017 FALL	Primary	Robert White	R.White@tufts.edu
Part-time.Please see departmental website for specific details.				

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

127097	Mechanical Design And Fabrication			
Subject:	Catalog Nbr:			
ME	0001			
	2017 SPRG	Primary	Gary Leisk	Gary.LEISK@tufts.edu
	2017 SPRG	Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
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. Recommendations: ES 5 (Statics and Dynamics)				

127281	Heat Transfer			
Subject:	Catalog Nbr:			
ME	0016			
	2017 SPRG	Primary	Robert Peattie	Robert.Peattie@tufts.edu
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. Recommendations: ES 7 and 8, MATH 51 (formerly MATH 38).				

127439	Instruments And Experiments			
Subject:	Catalog Nbr:			
ME	0018			
	2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu
	2017 SPRG	Primary	Alfram Bright	Alfram.Bright@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.				

Course Bulletin

127673	Engineering Materials			
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.

127791	Dynamics And Vibration			
Subject:	Catalog Nbr:			
ME	0037			
2016 FALL		Primary	Robert White	R.White@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).

128033	Machine Design			
Subject:	Catalog Nbr:			
ME	0042			
2016 FALL		Primary	Gary Leisk	Gary.LEISK@tufts.edu
2017 FALL		Primary	Douglas Matson	Douglas.Matson@tufts.edu
2017 FALL		Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu

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.
Recommendations: ME 1 (Mechanical Design and Fabrication) and ES 9 (Strength of Materials)

128322	Senior Design Project			
Subject:	Catalog Nbr:			
ME	0043			
2017 FALL		Primary	Gary Leisk	Gary.LEISK@tufts.edu
2017 FALL		Primary	Kristen Wendell	Kristen.Wendell@tufts.edu

Course Bulletin

	2017 FALL	Primary	Natasha Wright	Natasha.Wright@tufts.edu

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: http://ase.tufts.edu/mechanical/
Recommendations: ME 42, senior standing. Permission of instructor.

128706	**System Dynamics & Controls**

Subject:	Catalog Nbr:			
ME	0080			
	2017 SPRG	Primary	Pratap Misra	Pratap.Misra@tufts.edu
	2017 SPRG	Primary	William Messner	William.Messner@tufts.edu

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.
Recommendations: ME 37.

128724	**Introductory Robotics And Mechatronics**

Subject:	Catalog Nbr:			
ME	0084			
	2017 SPRG	Primary	Ethan Danahy	ethan.danahy@tufts.edu

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.
Recommendations: ES 3 and 5, and MATH 51 (formerly MATH 38). These courses may be taken concurrently.

128830	**Special Topics**

Subject:	Catalog Nbr:			
ME	0093			
	2016 FALL	Primary	Behrouz Abedian	behrouz.abedian@tufts.edu
	2016 FALL	Primary	Robert Hannemann	Robert.Hannemann@tufts.edu
	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	Chris Rogers	chris.rogers@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

Course Bulletin

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

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: ME | Catalog Nbr: 0094

2016 FALL	Primary	Robert Hannemann	Robert.Hannemann@tufts.edu
2016 FALL	Primary	Megan Dauphinais	No Email on file.
2017 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2017 FALL	Primary	Michael Wiklund	michael.wiklund@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	Daniel Hannon	Dan.Hannon@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	Pratap Misra	Pratap.Misra@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
2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu

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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

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:	Catalog Nbr:			
ME	0096			
2016 FALL		Primary	Robert Hannemann	Robert.Hannemann@tufts.edu
2016 FALL		Primary	Megan Dauphinais	No Email on file.
2017 FALL		Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2017 FALL		Primary	Michael Wiklund	michael.wiklund@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	Daniel Hannon	Dan.Hannon@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	Pratap Misra	Pratap.Misra@tufts.edu
2017 FALL		Primary	William Messner	William.Messner@tufts.edu
2017 FALL		Primary	Igor Sokolov	Igor.Sokolov@tufts.edu
2017 FALL		Primary	Erica Kemmerling	Erica.Kemmerling@tufts.edu
2017 FALL		Primary	Iryna Zenyuk	Iryna.Zenyuk@tufts.edu
2017 FALL		Primary	James Intriligator	James.Intriligator@tufts.edu
2017 SPRG		Primary	Luisa Chiesa	Luisa.Chiesa@tufts.edu
2017 SPRG		Primary	David Aurelio	David.Aurelio@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

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:

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Subject:	Catalog Nbr:			
ME	0099			
	2016 FALL	Primary	Megan Dauphinais	No Email on file.
	2017 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
	2017 FALL	Primary	Michael Wiklund	michael.wiklund@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	Daniel Hannon	Dan.Hannon@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	Pratap Misra	Pratap.Misra@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
	2017 FALL	Primary	James Intriligator	James.Intriligator@tufts.edu

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 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.

128952 | **Inventive Design**

Subject:	Catalog Nbr:			
ME	0102			
	2016 FALL	Primary	Natasha Wright	Natasha.Wright@tufts.edu
	2017 FALL	Primary	Gary Leisk	Gary.LEISK@tufts.edu

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.
Recommendations: Senior Standing.

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128969	Micro-fabrication And Design
Subject:	Catalog Nbr:
ME	0103

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.
Recommendations: Senior Standing.

129074	Modern Quality Control
Subject:	Catalog Nbr:
ME	0108
2016 SUMR	Primary Anil Saigal anil.saigal@tufts.edu

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.
Recommendations: Senior standing or permission of instructor.

129137	Thermal Management Of Electronics
Subject:	Catalog Nbr:
ME	0110
2016 FALL	Primary Marc Hodes Marc.Hodes@tufts.edu

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.
Recommendations: ME 16 - Heat Transfer or permission of instructor.

129155	Thermal-fluid Transport I
Subject:	Catalog Nbr:
ME	0111
2017 FALL	Primary Erica Kemmerling Erica.Kemmerling@tufts.edu

(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.
Recommendations: ES 8 - Fluid Mechanics or permission of instructor.

129219	Thermal-fluid Transport II
Subject:	Catalog Nbr:

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ME	0112			
	2017 SPRG	Primary	Marc Hodes	Marc.Hodes@tufts.edu

(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.
Recommendations: ME 111 Thermal-Fluid Transport I or equivalent.

129270	**Advanced Thermodynamics**

Subject:	Catalog Nbr:			
ME	0115			
	2017 FALL	Primary	Douglas Matson	Douglas.Matson@tufts.edu

Classical thermodynamics; chemical thermodynamics and statistical thermodynamics. Applications to materials engineering and processes. Recommendations: MATH 51.

129309	**Mass Transfer And Phase Transformations In Materials Processing**

Subject:	Catalog Nbr:
ME	0116

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.
Recommendations: ME 16 or permission of instructor.

129432	**Advanced Data Acquisition And Image Processing**

Subject:	Catalog Nbr:
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

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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

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

129749	Manufacturing Processes And Materials Technology

Subject:	Catalog Nbr:			
ME	0125			
2016 FALL		Primary	Simon Steel	Simon.Steel@tufts.edu
2017 SPRG		Primary	Anil Saigal	anil.saigal@tufts.edu

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.

129829	Computer-integrated Engineering

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Subject:	Catalog Nbr:
ME	0126

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.

129898	**Theory And Applications Of Polymer Materials And Processing**

Subject:	Catalog Nbr:
ME	0127

2017 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu

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.

129926	**Nonlinear Analysis of Materials and Structures**

Subject:	Catalog Nbr:
ME	0128

2016 FALL	Primary	Simon Steel	Simon.Steel@tufts.edu
2017 FALL	Primary	Luis Dorfmann	Luis.Dorfmann@tufts.edu

(Cross-listed as CEE 128.) Nonlinear solid mechanics, nonlinear constitutive models and variational principles as essential prerequisites for nonlinear finite element formulations.
Recommendations: ES 9.

129977	**Finite Elements**

Subject:	Catalog Nbr:
ME	0129

2016 FALL	Primary	Michael Zimmerman	Michael.Zimmerman@tufts.edu
2017 FALL	Primary	Masoud Sanayei	masoud.sanayei@tufts.edu

(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

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130089	Advanced Vibrations			
Subject:	Catalog Nbr:			
ME	0137			
2017 SPRG		Primary	Robert White	R.White@tufts.edu

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.

130187	Acoustics			
Subject:	Catalog Nbr:			
ME	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

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.

130256	Power Generation Systems
Subject:	Catalog Nbr:
ME	0145

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 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

Course Bulletin

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	Daniel Ryder	daniel.ryder@tufts.edu
2017 SPRG	Primary	David Kaplan	david.kaplan@tufts.edu
2017 SPRG	Primary	Jerry Meldon	No Email on file.
2017 SPRG	Primary	Maria Flytzani-Stephanopoulos	mflytzan@tufts.edu
2017 SPRG	Primary	Kyongbum Lee	Kyongbum.Lee@tufts.edu
2017 SPRG	Primary	Christos Georgakis	Christos.Georgakis@tufts.edu
2017 SPRG	Primary	Hyunmin Yi	Hyunmin.Yi@tufts.edu
2017 SPRG	Primary	Matthew Panzer	Matthew.Panzer@tufts.edu
2017 SPRG	Primary	Ayse Asatekin	Ayse.Asatekin@tufts.edu
2017 SPRG	Primary	Nikhil Nair	Nikhil.Nair@tufts.edu
2017 SPRG	Primary	Emmanouhl Tzanakakis	Emmanuel.Tzanakakis@tufts.edu
2017 SPRG	Primary	James Van Deventer	James.Van_Deventer@tufts.edu
2017 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.

Course Bulletin

139046	Computer Aided Design w/ Lab			
Subject:	Catalog Nbr:			
ES	0018			
2017 FALL		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.

139047	Biological Systems Analysis			
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.
Recommedations: Junior standing, CHEM 2, BIO 13, MATH 42, or permission of instructor

139048	Biomaterials and Regenerative Medicine			
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

(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

139050	Tissue Engineering and Regenerative Medicine			
Subject:	Catalog Nbr:			
BME	0154			
2017 SPRG		Primary	David Kaplan	david.kaplan@tufts.edu
2017 SPRG		Primary	Whitney Stoppel	Whitney.Stoppel@tufts.edu

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

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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.

139051	Electronic Devices for Energy Applications

Subject: CHBE Catalog Nbr: 0175
2017 FALL Primary Matthew Panzer Matthew.Panzer@tufts.edu

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.
Recommendations: CHEM 2 and junior standing.

139053	Research

Subject: COMP Catalog Nbr: 0191

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.
Recommedation: Permission of instructor.

139054	Physics of Solar Cells

Subject: EE Catalog Nbr: 0114
2017 FALL Primary Thomas Vandervelde tvanderv@ece.tufts.edu

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 ceil efficiency.
Recommendations: MATH 42, MATH 51, EE 18, PHYS 42/43, or instructor permission

139055	Networked Estimation and Control

Subject: EE Catalog Nbr: 0130

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.
Recommendations: EE 105 and EE 125 or equivalent, or permission of instructor.

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139056	Power Systems
Subject: EE	Catalog Nbr: 0170
2017 FALL	Primary Aleksandar Stankovic alex.stankovic@tufts.edu
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. Recommendations: EE 22 or graduate student standing	

139057	Power Electronics
Subject: EE	Catalog Nbr: 0171
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. Recommendations: EE 22 or graduate student standing.	

139058	Optoelectronic Characterization
Subject: EE	Catalog Nbr: 0214
Tools and techniques used to characterize optoelectronic materials and devices. Photoluminescence, ellipsometry, scanning probe microscopy, electron microscopy, and AC/DC electrical characterization. Theoretical underpinning of and practical experience with the measurement techniques. Laboratory.	

139066	Bioinfomatics
Subject: COMP	Catalog Nbr: 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.	

139213	Human Factors in Medical Technology
Subject: ENP	Catalog Nbr: 0110
2017 FALL	Primary Michael Wiklund michael.wiklund@tufts.edu

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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.

139374	**Master's Degree Continuation**			
Subject:	Catalog Nbr:			
ENP	0401			
2017 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
Part-time. Please see departmental website for specific details.				

139375	**Master's Degree Continuation**			
Subject:	Catalog Nbr:			
ENP	0402			
2017 SPRG	Primary	James Intriligator	James.Intriligator@tufts.edu	
Full-time.Please see departmental website for specific details.				

139447	**Special Topics in Engineering Management**			
Subject:	Catalog Nbr:			
EM	0293			
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				

139448	**Leadership for Technical Professionals**		
Subject:	Catalog Nbr:		
EM	0261		
2016 FALL	Primary	Ewa Winston	Ewa.Winston@tufts.edu
2016 FALL	Primary	Jerome Brightman	Jerome.Brightman@tufts.edu
2017 FALL	Primary	Stacy Lennon	Stacy.Lennon@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.			

139449	**Financial Management for High Technology Firms**

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Subject:	Catalog Nbr:
EM	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.

139451	Business Analytics

Subject:	Catalog Nbr:
EM	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

139522	Project Study In Human Systems B

Subject:	Catalog Nbr:
ENP	0120

2017 SPRG Primary David Aurelio David.Aurelio@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 human-factors design problems set by industry sponsors. Professional-level work is required, including report preparation and presentations. Timely lectures supplement the projects. Spring.

139523	Project Study In Human Systems B

Subject:	Catalog Nbr:
BME	0120

(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.

140067	Microwave System Engineering

Subject:	Catalog Nbr:
EE	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,

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signal to noise ratio SIN, receiver sensitivity, modulation and SIN, design principles, antenna system considerations.
Prerequisite: EE117 and EE107

140069	Project Management and Software Methodologies

Subject:	Catalog Nbr:			
EM	0231			
2017 FALL		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.

140070	Innovating Breakthrough Products and Processes

Subject:	Catalog Nbr:
EM	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.

140071	Conflict Resolution

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.

140282	Lean Six Sigma

Subject:	Catalog Nbr:			
EM	0211			
2017 FALL		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

Course Bulletin

140391	Tufts Abroad Program
Subject: CEE	Catalog Nbr: 0340

140782	Probabilistic Systems Analysis
Subject: EE	Catalog Nbr: 0024
2016 FALL Primary Eric Miller	Eric.Miller@tufts.edu
2017 SPRG Primary Brian Aull	Brian.Aull@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

140783	Stochasic Processes, Detection, and Estimation
Subject: EE	Catalog Nbr: 0140
2017 FALL Primary Eric Miller	Eric.Miller@tufts.edu

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.

140784	New Product Innovation
Subject: EM	Catalog Nbr: 0221
2017 FALL Primary Kevin Oye	Kevin.Oye@tufts.edu

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.

Course Bulletin

140785	Business Communications			
Subject:	Catalog Nbr:			
EM	0252			
2016 FALL	Primary	Kathryn Roy	No Email on file.	
2017 FALL	Primary	Amy Hirschfeld	amy.hirschfeld@tufts.edu	
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.				

140786	Innovation and Technology Strategy			
Subject:	Catalog Nbr:			
EM	0253			
2017 SPRG	Primary	Kevin Oye	Kevin.Oye@tufts.edu	
2017 SPRG	Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu	
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.				

140787	Financial Management in Technology Firms			
Subject:	Catalog Nbr:			
EM	0255			
2017 FALL	Primary	Frank Apeseche	Frank.Apeseche@tufts.edu	
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.				

140788	Capstone Innovation and Leadership Project			
Subject:	Catalog Nbr:			
EM	0281			
2017 SUMR	Primary	Kevin Oye	Kevin.Oye@tufts.edu	
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.				

140789	Applications in Engineering			
Subject:	Catalog Nbr:			
EN	0001			
2016 FALL	Primary	Daniel Ryder	daniel.ryder@tufts.edu	

Course Bulletin

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

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.

140795	**Engineering and Science for Elementary School Educators I**

Subject:	Catalog Nbr:			
ENE	0110			
2017 FALL		Primary	Merredith Portsmore	merredith.portsmore@tufts.edu
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.

140797	**Engineering and Science for Elementary School Educators II**

Subject:	Catalog Nbr:			
ENE	0111			
2016 SUMR		Primary	Merredith Portsmore	merredith.portsmore@tufts.edu
2017 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.

140798	**Teaching and Learning in Engineering I**

Subject:	Catalog Nbr:			
ENE	0130			
2017 SPRG		Primary	Merredith Portsmore	merredith.portsmore@tufts.edu

Course Bulletin

	2017 SPRG	Primary	Jessica Watkins	Jessica.Watkins@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.

140799	**Teaching and Learning in Engineering II**			
Subject:	Catalog Nbr:			
ENE	0131			
	2017 FALL	Primary	Merredith Portsmore	merredith.portsmore@tufts.edu
	2017 FALL	Primary	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.

140800	**Engineering and Science for Middle and High School Educators**			
Subject:	Catalog Nbr:			
ENE	0150			
	2016 FALL	Primary	Susan Bitetti	Susan.Bitetti@tufts.edu
	2017 FALL	Primary	Merredith Portsmore	merredith.portsmore@tufts.edu
	2017 FALL	Primary	Fayette Shaw	Fay.Shaw@tufts.edu

Understanding of the relationship between science and engineering, and techniques and knowledge that 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

140801	**Engineering and Science for Middle and High School Educators II**
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).

140802	**Robotics for Educators**
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.

Course Bulletin

140803	Engineering and Science for Middle and High School Educators II			
Subject:	Catalog Nbr:			
ENE	0151			
2016 SUMR		Primary	Fayette Shaw	Fay.Shaw@tufts.edu
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).

141009	Information Theory
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.

141134	Mechanics of Materials at the Micro & Nano Scale			
Subject:	Catalog Nbr:			
ME	0130			
2016 FALL		Primary	Igor Sokolov	Igor.Sokolov@tufts.edu

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.

141135	Mechanics of Materials at the Micro & Nano Scale			
Subject:	Catalog Nbr:			
ME	0230			
2016 FALL		Primary	Igor Sokolov	Igor.Sokolov@tufts.edu

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.

Course Bulletin

141384	Music Recording and Production			
Subject:	Catalog Nbr:			
ES	0065			
2017 FALL	Primary	Paul Lehrman	paul.lehrman@tufts.edu	
2017 FALL	Primary	Bradford Swanson	Bradford.Swanson@tufts.edu	

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.

141451	Computer Engineering W/lab			
Subject:	Catalog Nbr:			
COMP	0046			
2017 FALL	Primary	Mark Hempstead	Mark.Hempstead@tufts.edu	

(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.

141475	Tufts Abroad Program
Subject:	Catalog Nbr:
EN	0340

Tufts Abroad Program

141488	Internet-scale Distributed Systems			
Subject:	Catalog Nbr:			
COMP	0117			
2017 SPRG	Primary	Noah Mendelsohn	Noah.Mendelsohn@tufts.edu	

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.

Course Bulletin

141489	Cloud Computing
Subject: COMP	Catalog Nbr: 0118
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	

141490	Visualization			
Subject: COMP	Catalog Nbr: 0177			
2016 FALL	Primary	Megan Monroe	Megan.Monroe@tufts.edu
2017 FALL	Primary	Remco Chang	Remco.Chang@tufts.edu
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.				

141491	Optimal Control and State Estimation
Subject: ME	Catalog Nbr: 0282
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.	

141564	Internship In Computer Science			
Subject: COMP	Catalog Nbr: 0299			
2016 SUMR	Primary	Ming Chow	ming.chow@tufts.edu
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				

141729	Creative Design Process of Products
Subject:	Catalog Nbr:

Course Bulletin

ELS	0162			
2017 SPRG		Primary	Joshua Wiesman	Joshua.Wiesman@tufts.edu

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

141730	**Societal Aspects of Design: Integration, Innovation, and Impact**			
Subject:	Catalog Nbr:			
ELS	0109			
2017 SPRG		Primary	Ronald Lasser	Ron.Lasser@tufts.edu

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.

141815	**Operations and Applied Data Science**			
Subject:	Catalog Nbr:			
EM	0212			
2017 SPRG		Primary	Kevin Oye	Kevin.Oye@tufts.edu
2017 SPRG		Primary	Antonius Breur	Antonius.Breur@tufts.edu
2017 SPRG		Primary	Rebekah Plotkin	Rebekah.Plotkin@tufts.edu

Data collection design, analysis, and interpretation to drive strategic and organizational decisions in high tech 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.

141816	**MSIM Graduate Seminar**			
Subject:	Catalog Nbr:			
EM	0292			
2017 FALL		Primary	Kevin Oye	Kevin.Oye@tufts.edu
2017 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.

141817	**Special Topics in Innovation and Management**
Subject:	Catalog Nbr:

Course Bulletin

EM	0294			
2017 SPRG		Primary	Kevin Oye	Kevin.Oye@tufts.edu
2017 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.

141853	**Special Topics for non-majors**			
Subject:	Catalog Nbr:			
COMP	0005			
2017 FALL		Primary	Marie-Claire Beaulieu	Marie-Claire.Beaulieu@tufts.edu
2017 FALL		Primary	Donna Qualters	Donna.Qualters@tufts.edu
2017 FALL		Primary	Anthony Bucci	Anthony.Bucci@tufts.edu

Content and prerequisites to be announced. Please see department website for specific details.

141854	**Convex Optimization**
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.

142322	**Undergraduate research**
Subject:	Catalog Nbr:
BME	0091

Independent undergraduate research in the field of biomedical engineering. Term paper required. Credit not given retroactively. Prior arrangements necessary. Prerequisite: Permission of instructor.

142323	**Undergraduate research**
Subject:	Catalog Nbr:
BME	0092

Independent undergraduate research in the field of biomedical engineering. Term paper required. Credit not given retroactively. Prior arrangements necessary. Prerequisite: Permission of instructor.

142324	**Field Methods for Global Health**			
Subject:	Catalog Nbr:			
CEE	0150			
2017 FALL		Primary	Daniele Lantagne	Daniele.Lantagne@tufts.edu

Course Bulletin

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.

142325	**Principles of Biostatistics**
Subject: CEE	Catalog Nbr: 0156
2017 FALL	Primary Mark Woodin mark.woodin@tufts.edu
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.	

142326	**Cataldo Scholar Research**
Subject: CEE	Catalog Nbr: 0090
2017 FALL	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	

142327	**Doctoral Thesis I**
Subject: CEE	Catalog Nbr: 0297
Guided research on a topic suitable for a doctoral dissertation. Required: Consent of instructor.	

142328	**Independent Study**
Subject: CEE	Catalog Nbr: 0294
Supervised, independent study of topics related to civil and environmental engineering. Departmental consent required	