A-Z COURSE LIST

APM - APPLIED MATHEMATICS

APM 101 Fundamentals/College Algebra (3)

Three hours of lecture/discussion per week. Algebraic operations on polynomials and rational functions as expressions, in equations, or inequalities. Graphing of linear and polynomial equations. An emphasis is placed on algebraic operations of expressions with rational exponents. Fall.

APM 103 Applied Algebra & Trigonometry (3)

Three hours of lecture per week. This course is designed to enable non-science students to solve practical problems in their specific areas of study. Topics include algebraic, exponential, logarithmic, and trigonometric functions used in measurement and modeling. Applications include percents, scaling, slopes, and contour mapping. Spring, Fall. Prerequisite(s): Math Placement or Consent of Instructor.

APM 104 College Algebra & PreCalculus (3)

Three hours of lecture/discussion per week. Course meets the SUNY general education requirement for mathematics. Elements of analytic geometry. Emphasis on the concepts of polynomial and rational functions, exponential and logarithmic functions, trigonometry and trigonometric functions and their application to design and life and management sciences. Fall and Spring. Prerequisite: Three years of high school mathematics.

APM 105 Survey Of Calc & Appl I (4)

Four hours of lecture per week. Introduction to calculus for students in the life and management sciences. Elements of analytic geometry, functions and their graphs, with an emphasis on the concepts of limits, and differentiation techniques for algebraic, exponential and logarithmic functions and their application to economics, and the life and management sciences. Some multivariable calculus including constrained optimization. Fall and Spring. Prerequisite: Precalculus or 3 1/2 years of high school mathematics. Note: Credit will not be granted for APM 105 after successful completion of MAT 284, MAT 285, or MAT 295 at SU. "

APM 106 Survey Of Calc & Appl II (4)

Four hours of lecture per week. A continuation of calculus for students in the life and management sciences. Elements of analytic geometry. An introduction to integration and applications of the definite integral. Differentiation and integration of trigonometric functions. Applications of first order differential equations and partial derivatives. Spring. Prerequisite: APM 105 or permission of the instructor. Note: Credit will not be granted for APM 106 after successful completion of MAT 286 or MAT 296 at SU.

APM 115 Essential Calculus (4)

A one semester course in differential and integral calculus. An emphasis on the concepts of limits, differentiation and integration techniques for algebraic, exponential, logarithmic functions, and trigonometric functions. This course is not intended for students that plan on taking additional Calculus courses. Offered in fall and spring. Credits will not be granted for APM 115 after successful completion of any Calculus course such as APM105, MAT 284, or beyond. Prerequisites: APM 103 or APM 104, or equivalent.

APM 205 Calculus I:Science & Engr (4)

Four hours of lecture/discussion per week. Analytic geometry, limits, derivatives of functions and equations, optimization, rates, graphs, differentials, mean-value theorem, and applications of the derivative. Fall. Prerequisite: APM 104 or permission of instructor.

APM 206 Calculus II:Science & Engr (4)

Four hours of lecture/discussion per week. This course is a one semester continuation of differential calculus. Integral calculus is used to describe growth and size. Topics include: techniques of integration and their application, convergence of sequences and series, separable and first-order differential equations, and polar coordinates. Spring. Prerequisite(s): Successful completion of a differential calculus course such as APM205 or MAT295.

APM 307 Multivariable Calculus (4)

4 hours of lecture/discussion per week. Topics include vectors three dimensions, analytic geometry of three dimensions, parametric curves, partial derivatives, the gradient, optimization in several variables, multiple integration with change of variables across different coordinate systems, line integrals, and Green's Theorem. Fall and Spring. Prerequisites: Completion of Differential and Integral Calculus with at least a C-; APM206 / MAT296, or the equivalent Note: Credit cannot be given for both APM307 and MAT397.

APM 391 Intro/Probability&Stats (3)

Three hours of lecture per week. Introduction to concepts and methods of statistics as applied to problems in environmental science and forestry. Topics include inference (confidence intervals and hypothesis testing), sampling distributions, descriptive statistics, exploratory data analysis, comparison of population means and proportions, categorical data analysis, regression and correlation, and nonparametric methods. Fall or Spring.

APM 395 Probability & Stats/Engr (3)

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring. Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

APM 485 Diff Equat/Engr&Scientist (3)

Three hours of lecture per week. First and second order ordinary differential equations, matrix algebra, eigen values and eigen vectors, linear systems of ordinary differential equations, numerical solution techniques and an introduction to partial differential equations. Spring. Prerequisite: MAT 295, MAT 296, MAT 397.

APM 510 Statistical Analysis (3)

Three hours of lecture per week. Applications of descriptive and inferential statistics to natural resource problems. Basic concepts and techniques of estimation, confidence intervals, and hypothesis testing applied to one- and two-sample settings, paired designs, simple linear regression and correlation, contingency tables, and goodness of fit tests. Statistical software used to enhance data analysis skills. Fall. Prerequisite(s): Graduate standing.

APM 585 Part Diff Equat/Engrs&Scientst (3)

Three hours of lecture per week. Analytical solutions of parabolic, hyperbolic and elliptic partial differential equations which appear in science and engineering. Numerical and approximate methods of solution. Spring.

APM 595 Probability & Stats/Engr (3)

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring. Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

APM 620 Experimental Design & ANOVA (3)

Three hours of lecture per week. Designing and analyzing experiments and observational studies; completely randomized, split plot, randomized complete block, and nested experiment designs; single-factor, factorial, and repeated measures treatment designs; expected mean squares and variance components; fixed, random, and mixed effects models; multiple comparison and contrast analyses; analysis of covariance; statistical computing. Spring. Prerequisites: Graduate status and an introductory course in statistics covering material through the one-way analysis of variance.

APM 625 Sampling Methods (3)

Three hours of lecture per week. Application of probability sampling methods to environmental science and forestry. Simple random, stratified, cluster, systematic, two-phase, line-intercept, point, variable radius plot, adaptive cluster, and other variable probability sampling designs; model-assisted ratio and regression estimators; inclusion probabilities; properties of estimators for design-based inference; Horvitz-Thompson estimation as a unifying theory. Fall.

APM 630 Regression Analysis (3)

Three hours of lecture per week. Topics include review of basic statistical concepts and matrix algebra, classical simple and multiple linear regression models, indicator or dummy variables in regression, residual analysis, transformation and logistic regression, weighted least squares, influence diagnostics, multicollinearity, nonlinear regression models, linear mixed models, statistical computing using SAS and interpretation of results. Fall. Prerequisite: APM 391 or equivalent.

APM 635 Multivariate Stat Method (3)

Three hours of lecture per week. Topics include review of basic statistical concepts and matrix algebra, multivariate normal distribution, Hotelling's T 2, multivariate analysis of variances, principal component analysis, factor analysis, discrimination and classification, cluster analysis, and canonical correlation analysis, statistical computing using SAS and interpretation of results. Spring. Prerequisites: APM 391 or equivalent.

APM 645 Nonparamet Stats&Cat Data Anal (3)

Three hours of lecture per week. Topics include: review of basic statistics, sign and ranked sign tests, median and Wilcoxon tests, binomial tests, x 2-test and contingency tables (with correspondence analysis), goodness-of-fit, nonparametric correlation and association analysis,

nonparametric and robust regression, generalized linear models (Logistic and Poisson regression), and re-sampling methods (bootstrapping and cross-validation), statistical computing using SAS and interpretation of results. Fall. Prerequisite: APM 391 or equivalent.

APM 671 Map Accuracy Assessment (1)

One hour of lecture per week.Statistical concepts and methods for quantifying the accuracy of maps. Sampling design and analysis for assessing accuracy of categorical attributes (e.g. land cover) is emphasized, with some discussion of continuous variables. Spring, even numbered years.

APM 696 Spec Topics/Quant Methods (1-3)

Experimental and developmental courses in areas of quantitative methods not covered in regularly scheduled courses. A course syllabus will be available to students and faculty advisors prior to registration. Fall or Spring.

APM 730 Adv Regression Modeling Methds (3)

Three hours of lecture per week. Topics include: review of basic regression modeling techniques, theory of generalized linear models and techniques (e.g. Logistic, Poisson and Beta regression), quantile regression, linear and nonlinear mixed models, variogram and kriging, spatial regression models (e.g., spatial lag and spatial error models), local spatial statistics and models (geographically weighted regression), statistical computing using SAS, and interpretation of results. Spring. Prerequisite: APM 630 or equivalent

BPE - BIOPROCESS ENGINEERING

BPE 296 Special Topics in Engineering (1-3)

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

BPE 300 Intro/Industrial Bioprocessing (3)

Three hours of lecture and discussions. Industrial examples of biotechnology and bioprocessing will be reviewed. Topics include applications of biotechnology and bioprocessing to the food, water and wastewater treatment, industrial biotechnology, biopharmaceutical, biochemical and biofuel industries. Through case studies of process flow sheets for different products students will develop an understanding of unit operations typically utilized in bioprocessing manufacturing operations. Fall. Prerequisite(s): EFB 103 and EFB 104; co-requisite(s): FCH 221 and FCH 222.

BPE 304 Prof Experience/Synthesis (1)

Twelve weeks full time employment approved by the department with an industrial or research partner acquired through on-campus interviews or other means. The student and the supervisor set goals and expectations for the internship. The students and supervisors also provide feedback on the performance of the student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Summer.

BPE 305 Professional Co-op (1)

A semester of full-time employment approved by the department with an industrial or research partner acquired through on-campus interviews or other means. The student and the supervisor

set goals and expectations for the co-op. The students and supervisors also provide feedback on the performance of the student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall or Spring.

BPE 306 Professional Synthesis (1)

Students will develop a synthesis of their work experience from either BPE 304 or BPE 305 and present their results both orally and in a written report. Fall or Spring.

BPE 310 Colloid and Interface Science (3)

Three hours of lecture per week. This course will cover the basic principles of colloidal and interfacial science as applied to bioprocesses. It will provide a foundation and theoretical understanding that will be applied in bioseparations, transport phenomena, biochemical/ bioprocess engineering and other advanced courses in the bioprocess engineering curriculum. Fall. Prerequisites: PSE 370, PSE 361, FCH 150, FCH 152. Note: Credit will not be granted for both BPE 310 and PSE 467.

BPE 321 Biomolecular Kinetics (3)

Three hours of lecture per week. Topics covered include: Reaction basics, biological basics, cell chemistry, equilibrium. Elementray reactions, collision theory, transitional state, free radicals, pseudo-steady state hypothesis and equilibrium steps, hydrolysis and polymerization reactions. Enzymatic reactions. Cell metabolism. Cell growth kinetics. Spring, and/or Summer. Prerequisite(s): FCH 360, EFB 103.

BPE 380 Bioprocess Engnrng Simulations (3)

One and a half hours of lecture two times per week. Use of software package (e.g., SuperPro Designer) to design, model and simulate chemical and bioprocess flow sheets. Model complex bioprocess simulations under continuous or batch mode, accessing databases for properties of chemicals, equipment sizing, material and energy balances of integrated processes, throughput analysis, detailed cost analysis, profitability, overall techno-economic evaluation and sensitivity analysis. Spring. Prerequisite(s): BPE 300

BPE 420 Bioseparations Engineering (3)

Three hours of lecture per week. Major unit operations used for the separation, purification and recovery of products from complex mixtures. Separation processes including sedimentation, filtration, centrifugation, membrane ultra-filtration, nanofiltration, ion exchange processes, chromatographic separations. Fall. Prerequisite: BPE 310. Note: Credit will not be granted for both BPE 420 and BPE 620.

BPE 421 Bioprocess Kinetics&Systm Eng (3)

Three hours of lecture per week. Topics in biochemical kinetics and reaction engineering are discussed including their application to microbiological systems used for bioprocessing. Batch and continuous biochemical reactor designs. The role of agitation in gas and solids delivery and heat removal for inclusion in design decisions. Impact of engineering parameters and design decisions on operability and economics. Fall. Prerequisite: BPE 335. Co-requisite: BPE 420. Note: Credit will not be granted for both BPE 421 and BPE 621.

BPE 422 Chem Reaction Eng&Prcss Safety (3)

Three hours of lecture per week. Main topics of coverage include conversion and reactor sizing, isothermal and non-isothermal reactor peration/design for flow and batch systems, multiple reactions, introduction to heterogeneous reactor design, sustainability and stability, reactor runaway, reactive hazard and process safety. Fall. Prerequisite: BPE 322.

BPE 438 Intro to Biorefinery Processes (3)

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign processes, with some discussions on political and social aspects of sustainability and renewability. Fall. Prerequisite(s): FCH 150 & 151 and PSE 370 or consent of Instructor. Note: Credit will not be granted for both BPE 438 and PSE 438 nor BPE 638 nor PSE 638.

BPE 440 Bioproc Kinetics&Sys Engr Lab (3)

One hour of lecture and six hours of laboratory per week. Measurement and analysis of bioprocess systems, including steady-state and dynamic modeling of systems. Investigation of various bioprocesses including fermentation, enzymatic reactions, and reactive processes involving lignocellulosic materials. Spring. Prerequisite: BPE 420 and BPE 421.

BPE 450 Chemical&BPE Product Design (3)

Three hours of lecture per week. Quality by design of chemical and biochemical products range from specialty chemicals like protein/tissue, biologics to devices that perform chemical and/or bio- transformations. This course integrates the steps of product design from brainstorming and concept selection through design and manufacturing. Students will be taught and practice using the basic tools and principles of chemical / biochemical product design, including inventive problem solving (or TRIZ), house of quality, robust design, design for manufacturability, Failure Modes and Effects Analysis (FMEA) and Six Sigma. Other topics include multi-generational product planning, sustainability and life cycle analysis, basic economic evaluations, risk management, an introduction to entrepreneurship and new business development, as well as intellectual property and freedom-to-operate assessments. Case studies drawn from industry will also be illustrated. Fall or Spring. Pre-requisites: APM 395 an

BPE 481 Bioprocess Eng Design (3)

2.5 hours of lecture and 1.5 hours of studio per week. Design project and procedure; open-ended design options; mass/energy balances; unit operations; safety considerations; and economic analysis. Process simulation and computer-aided design for process synthesis and plant layout. Formulation and solution of original design problem(s) under realistic (e.g., socioeconomic, process, environmental, safety) constraints. Spring. Prerequisites: PSE 480, BPE 420, BPE 421, BPE 435, or equivalents. Note: Credit will not be granted for both BPE 481 and BPE 681.

BPE 496 Special Topics (1-3)

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

BPE 498 Resrch Prob/Bioprocess Eng (1-4)

Independent study. The student is assigned a research problem in bioprocess engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis

is on application of correct research techniques rather than on discovery of results of commercial importance. The information obtained in the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, and Summer.

BPE 503 Bioprocesss Plant Design (3)

Three hours of lecture per week. Topics covered include integration of process and support systems and equipment; concepts of facility design integrating Good Manufacturing Practice (GMP), equipment and systems cleanability, people flow, product protection, capital investment, and operating costs. This course will focus towards facility design in the bioprocess industry. Spring. Prerequisite(s): BPE 620, BPE 621.

BPE 510 Intro to Polymer Coatings (3)

Fundamental science of polymerization and film formation for a wide class of organic coatings, including acrylics, latexes, polyesters, amino resins, epoxies, alkyds, and silicon derivatives as well as the integration of appropriate binders and additives affecting coating quality. Reaction chemistries and their distinguishing characteristics for several cross-linking agents. Reaction kinetics are considered with emphasis on the influence of conditions during synthesis. Various organic coatings are compared based on desired mechanical and optical properties along with specific applications. The nature of defects and the resulting effect on product lifetime of coatings are examined. Online Academic Year and/or Summer Session. Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

BPE 511 Radiatn Curing Equip,Inst&Sfty (3)

Technologies used for commercial radiation curing for energy-efficient and environmentally-responsible curing of resins, inks, coatings and adhesives pertinent to industry chemists, engineers, technicians, and managers. Ultra violet light (UV), electron beam (EB), radio frequency (RF) and Infrared (IR) generating systems, along with ancillary equipment used to quantify energy deposition. Basic equipment functions, interaction of radiation sources with specific substrates and chemistries, benefits and drawbacks of each technology, and safety and handling considerations. Emphasis is placed on effectively selecting and justifying equipment appropriate for specific applications. Online Academic Year and/or Summer Session. Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

BPE 522 Chem Reaction Engnrng Kinetics (3)

Three hours of lecture/discussion per week. Fundamental concepts in chemical reactions, basic reaction rate theory, steady-state approximation, transition-state theory, reaction mechanisms of chemical reactions, analysis of kinetic data. Evaluation of literature regarding kinetic measurements. Spring. Pre-requisites: APM 485 and BPE 362

BPE 535 Transport Phenomena (3)

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analysis. Discussion of specific bioprocess examples. Spring. Note: Credit will not be granted for both BPE 335 and BPE 535.

BPE 536 Radiation Curing/Polymer Tech (3)

Broad treatment of development and use of radiation curing of polymer technologies as they apply to industry-related roles such as chemists, engineers, technicians, and managers. Properties and development of free-radical and cationic systems initiated by various radiation sources. Chemical and physical underpinnings of common radiation curable materials and mechanisms. Analysis techniques that monitor the cure reaction and the properties of cured material. Emphasis on the considerations and challenges in common applications of radiation curable polymer systems and associated costs, regulatory, and safety considerations. Online Academic Year and/or Summer Session. Prerequisite(s): B.S. from an accredited institution with at least one semester of organic chemistry or permission of instructor.

BPE 596 Special Topics (1-3)

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

BPE 620 Bioseparations (3)

Three hours of lecture per week. Cell disruption, solid liquid separations, centrifugation, chromatographic techniques (gel filtration, affinity, ion exchange), and membrane processes. Extraction. Crystallization and drying. Aseptic filtration. Fall. Prerequisite: BPE 501. Note: Credit will not be granted for both BPE 620 and BPE 420.

BPE 621 Bioreaction Engineering (3)

Three hours of lecture/discussion per week. Bioprocess kinetics, reaction engineering, mass and energy balances, stoichiometry, enzyme kinetics, growth and product synthesis kinetics, mass transfer effects, bioreactor analysis and design, instrumentation and control, batch processing, bioreactor scale-up, agitation, oxygen delivery, heat removal and kinetics of sterilization (clean and sterilization in place (CIP and SIP). Spring. Prerequisites: Mass and Heat Transfer, or Transport Phenomena. Note: Credit will not be granted for both BPE 621 and PBE 421.

BPE 623 Chem/Lignocellulosic Biomass (3)

Three hours of lecture and discussion per week; advanced science course with discussion and literature research through the topics in chemistry of lignocellulosic biomass, including wood, grasses, and agriculture residues; major (cellulose, hemicelluloses, lignin) and minor constituents (extractives) -biosynthesis, structure, properties, physico-chemical association, use in biorefineries. Spring Prerequisite: Organic Chemistry I Lecture and Lab plus either Organic Chemistry II Lecture and Lab or PSE223 Lecture and Lab or equivalent or by instructor's permission

BPE 635 Unit Process Operations (3)

Two hours of lecture and three hours of laboratory and/or recitation, discussions. Topics include packed towers, tray columns, fluidized bed, fluid mechanic limitations, pressure drop, mass transfer coefficient, mass transfer limits, thermodynamic limits, equilibrium stage calculations, packed tower and tray column design and performance analysis. Fall.

BPE 638 Intro to Biorefinery Processes (3)

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and

biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign processes, with some discussions on political and social aspects of sustainability and renewability. Fall. Note: Credit will not be granted for BPE 638 and BPE 438 nor PSE 438 nor PSE 638.

BPE 640 Bioproc Kinetcs&Exp Data Analy (3)

One hour of lecture and six hours of laboratory per week. Planning and execution of laboratory exercises. Measurement and analysis of adsorption, chemical and biological transformations, including batch and/or continuous systems. Adsorption and chemical transformation or catalytic reactions may include solid catalyst(s), acid catalyst(s), base catalysts(s) or other agents. Biological transformation may include enzyme, bacteria, fungi or yeast. Bioprocess kinetics and mass transfer effects. Coaching fellow students on experimental procedures and safety requirements. Parametric analysis. Report writing and seminar presentation. Spring. Prerequisite(s): Consent of instructor Note: Credit will not be granted for both BPE 440 and BPE 640.

BPE 650 Adv Catalysis& Surface Reactns (3)

Three hours of lecture per week. Intended for graduate students in Bioprocess Engineering and Chemical Engineering. Topics covered in this course may include gas and/or liquid interactions with solid surfaces, adsorption, catalysis on solid surfaces, and kinetics in systems involving solid particles and/or macromolecules. Discussions will be on an advanced level especially for kinetics and reactor analysis. Spring. Pre-requisites: BPE 421, or permission of instructor

BPE 658 Advanced Biocatalysis (3)

Three hours of lecture per week. This course is intended for graduate students in Bioprocess Engineering. Topics covered in this course may include enzyme, microbial and/or mammalian cell catalyzed molecular transformations. Biotransformations occur, at the fundamental level, due to the particular enzymes. Interactions between enzyme and ligand / substrate hold the key on how the reaction is regulated. On the cell level, enzymes work in tandem to convert one or more key substrate into one or more desired product. The mechanism and progress in the understanding of molecular transformations in microbial and mammalian systems are selectively covered. Discussions will be on an advanced level especially for kinetics and reactor analysis. Fall. Prerequisite: BPE 421 Bioprocess Kinetics and System Engineering, or permission of instructor.

BPE 681 Bioprocess Plant Design (3)

Three hours of lecture per week. Topics covered include integration of process and support systems and equipment; concepts of facility design integrating Good Manufacturing Practice (GMP), equipment and systems cleanability, people flow, product protection, capital investment, and operating costs. This course will focus towards facility design in the biopharmaceutical industry. Spring. Prerequisites: BPE 620, BPE 621 or equivalents.

BPE 796 Advanced Topics (1-3)

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring. Prerequisite: Permission of instructor.

BPE 797 Seminar (1-3)

Discussion of assigned topics in the fields related to Bioprocess Engineering. Spring and Fall.

BPE 798 Resrch/Bioprocess Engineering (1-12)

Independent research topics in Bioprocess Engineering. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Credit hours to be arranged.

BPE 898 Prof Experience/Synthesis (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, or Summer. Pre- or co-requisite(s): Approval of proposed study plan by advisor, faculty, and any sponsoring organization.

BPE 899 Masters Thesis Research (1-12)

Research and independent study for the master's thesis. Fall, Spring or Summer. Credit hours to be arranged.

BPE 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral dissertation. Fall, Spring or Summer. Credit hours to be arranged.

BTC - BIOTECHNOLOGY

BTC 132 Orientation Seminar:BTC (1)

One hour of lecture or discussion per week. Occasional tour of laboratories or field trips. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options to facilitate transition of students into the program and assist them in making informed decisions on course selection and future career directions. Fall.

BTC 298 Rsrch Apprenticeship/Biotech (1-3)

Full- or part-time engagement as volunteer or employee on research project having a biotechnology focus consistent with the student's educational and professional goals. Tenure at SUNY-ESF or outside institution. Faculty member in the BTC program will serve as student's sponsor. Study plan outlining the apprenticeship's educational goals completed prior to its commencement. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Grading satisfactory/ Unsatisfactory. Fall, Spring, Summer. Prerequisite(s): Permission of Instructor.

BTC 401 Molecular Biol Techniques (3)

Two hours lecture and three hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall. Prerequisite(s): One year of Introductory Biology, one year of Introductory Chemistry, Genetics. Note: Credit will not be granted for both BTC 401 and EFB 601.

BTC 420 Internship in Biotechnology (1-5)

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational and

professional goals. The extent of the internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student and submitted to the sponsoring faculty member and on an evaluation of the student's performance written by the site supervisor to the sponsoring faculty member. Fall, Spring, Summer. Prerequisite: Consent of a faculty sponsor.

BTC 425 Plant Biotechnology (3)

Two hours of lecture and three hours of laboratory per week. The use of transgenic plants to improve the human condition and remediate environmental problems is a rapidly growing field of study. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, and a laboratory project. Spring. Note: Credit will not be granted for both BTC 425 and EFB 625.

BTC 426 Plant Tissue Culture Methods (3)

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. Fall. Prerequisites: One course in botany, microbiology, or genetics; or permission of instructor. Note: Credit will not be granted for BTC 426 and FOR 626/EFB 626.

BTC 496 Topics in Biotechnology (1-3)

Experimental, interdisciplinary, or special topic coursework in biotechnology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit if topic changes. Fall or Spring.

BTC 497 Research Dsgn&Prof Develop (1)

One hour of discussion or seminar each week covering the scientific method, professional ethics and responsibilities of the practicing scientist. Employment opportunities, future career choices, safety considerations, and use of the scientific literature are covered. Students will select a research topic and prepare a proposal, which may be applied to BTC 498 or BTC 420. Spring. Pre- or co-requisite: Biotechnology major or permission of instructor.

BTC 498 Resrch Prob/Biotechnology (1-9)

Laboratory research experience with research time agreed upon by student and instructor. Independent research experience covering biotechnological topics. Specific topics determined through consultation between student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Grading determined by the instructor and could include, but not required, evaluation of skills learned, data obtained, and laboratory notebook record keeping. A final written report is required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall or Spring. Prerequisite: Permission of instructor.

BTC 499 Senior Project Synthesis (1)

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

CME - CONSTRUCTION MANAGEMENT ENGINEERING

CME 132 Orientation Seminar:SCME (1)

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success in the area of Sustainable Construction Management and Engineering. Fall.

CME 151 Intro to Financial Accounting (3)

Three hours of lecture/discussion per week. Financial accounting concepts that aid entrepreneurs, managers, investors, and creditors in planning, operating, and analyzing a business. Emphasis is on interpretation of financial statements. Fall.

CME 202 Intro/Prof Communications (1)

Three hours of lab per week. Introduction to intermediate-level use and understanding of software for word processing, spreadsheet analysis, and database management. Focused on developing the ability to prepare reports including preparation of documents, data analysis, and written presentations. Fall.

CME 215 Sustainable Construction (3)

Three hours of lecture/discussion per week. Overview of sustainable design and construction concepts and practices. The emergence of green building, issues, and rating systems. Sources of chemicals in buildings, indoor air quality, and human comfort. Basic energy principles and energy-efficient technologies. Selection of materials. Role of the contractor in the management and construction of green projects. Spring.

CME 226 Statics&Mechanics of Materials (4)

Four hours of lecture/discussion per week. Equilibrium systems of forces in two and three dimensions. Analysis of structural components for stresses and deformations. Stability and design of beams and columns made of common engineering materials. Design methods and safety considerations. Spring and Fall. Prerequisite: Calculus I, Physics I.

CME 252 Intro to Managerial Accounting (3)

Three hours of lecture/discussion per week. Introduction to the role of accounting information systems in measuring performance, influencing employee behavior, and facilitating planning decisions such as what products and services to offer, in which markets, and at what prices. Spring. Prerequisite(s): CME 151.

CME 255 Plan Interpn&Quantity Takeoff (3)

Three hours of lecture/discussion per week. Introductory course in construction plan interpretation and quantity takeoff. Will address how to read and interpret construction plans and introduce basic quantity takeoff skills. Fall.

CME 303 Construction Mngmnt Internship (1-3)

Full or part-time employment with an organization that involves the student in an educational experience in a professional establishment. A resident faculty member must serve as the student's academic sponsor. A study plan that describes the internship's educational goals must be submitted prior to its commencement. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring. Prerequisite: Upper-division status.

CME 304 Envrn Perform Measures/Bldgs (3)

An overview of how building rating systems for green construction have developed, their present application, and future directions for growth. The course will explore the process for development of individual standards, the different building certification systems that have been developed using these standards, and long-term development and code adoption of such certification systems.

CME 305 Sustainable Energy Sys/Bldgs (3)

Three hours of lecture/discussion per week. Exploration of construction management-related issues in creating a more sustainable energy use in our building stock. Integrating sustainable energy sources in construction as well as issues related to using energy more efficiently. Fall.

CME 306 Engr Materials/Sustainble Cons (3)

Two hours of lecture/discussion per week and one lab per week. Introduction to the principal structural materials used for building construction and their engineering properties and environmental impacts. The production and performance of these materials will be explored through class discussion and laboratory experiments. The application of each of the materials during sustainable construction processes will be emphasized. Spring.

CME 322 Mechanical Processing (3)

Two hours of lecture and three hours of laboratory per week. Primary log reduction methods and industry practices. Lumber grading. Wood cutting principles. Machining practice in secondary wood-using industries. Experience in the operation of certain primary and secondary machining equipment. Fall.

CME 327 Site Investigatns & Solutions (3)

Three hours of lecture/discussion per week. Principles of geotechnical engineering, site investigation methods, methods for improving sites, and the role of geotechnical engineering in construction contracts. Fall.

CME 330 Building Code/New York State (3)

Three hours of lecture/discussion per week. Introduction to the Building Code that legally governs the design and construction of all building types within New York State. The course includes a basic understanding of the Code including history and origin, legal enforcement, basic definitions, and terminologies. Fall.

CME 331 Construction Safety (3)

Occupational Safety and Health Practices in the construction industry with coverage of the U. S. Department of Labor, Occupational Safety and Health Regulations (CFR 1910 and 1926 Standards). Detailed study of Construction Safety and Hazardous Communications programs, personal protective equipment, tools, electrical power, ladders, and scaffolding, floor and wall

openings, cranes and power equipment. Special problems related to concrete work, erection and demolition. OSHA 30 Hr. card earned. Fall. Note: Credit will not be granted for both CME 331 and CME 531.

CME 332 Mech/Elect Equipment (3)

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. Fall.

CME 335 Cost Engineering (3)

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis. Fall. Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 335 and CME 535.

CME 342 Light Construction (3)

Three hours of lecture per week. An introduction to the construction process with an emphasis on the unique aspects of light construction. Introduces construction management principles related to material properties, building science, structural design, estimating, and scheduling. Fall.

CME 343 Construction Estimating (3)

Three hours of lecture/discussion per week. Basic estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints and their role in the estimating/bidding process. How to perform a quantity takeoff, be able to create a final estimate/bid including the appropriate General Conditions and Markups. Several projects based upon the concepts are assigned on the material listed above as well as utilizing either a spreadsheet or Timberline Precision Computer Estimating. Spring. Prerequisite(s): CME 255 Plan Interpretation and QTO or permission of instructor. Note: Credit will not be granted for both CME 343 and CME 543.

CME 350 Const Methods&Equipment (3)

Three hours of lecture/discussion per week. The study of production, methods of operation and costs of heavy construction equipment. Analysis of heavy construction operations. Economics of equipment use. The fundamentals of decision making involved in the selection of methods and equipment that will result in the most effective and efficient performance on a project. Spring. Note: Credit will not be granted for both CME 350 and CME 525.

CME 387 Renewable Mat/Sustainable Cons (3)

Three hours of discussion, lecture and demonstration per week. Properties and uses of major structural construction materials. Identification and knowledge of the major wood species and their applications in construction. Fall.

CME 388 Wood And Fiber Ident Lab (2)

Six hours of laboratory per week. Wood and papermaking fiber identification using both gross and microscopic features. Fall. Prerequisite: CME 387 to be taken concurrently or previously.

CME 389 Wood Identification Lab (1)

Three hours of laboratory per week. Identification of principal commercial timbers of United States on gross characteristics. Spring. Prerequisite: CME 387.

CME 390 Fiber Identification Lab (1)

Three hours of laboratory per week. Identification of woody and nonwoody papermaking fibers. Spring. Prerequisite: CME 387.

CME 400 Intro to Forest Products (3)

Three hours of lecture per week. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

CME 404 Applied Structures (3)

Three hours of lecture/discussion/demonstration per week. Applications of statics/mechanics to common engineering structures. Analysis and design of wood, concrete and steel systems considering sustainability and life-cycle analysis. Spring. Prerequisite(s): CME 226, Statics and Mechanics of Materials.

CME 405 Bldg Info Modelng/Cons Mgt (3)

Three hours of lecture per week. An introduction to the basic concepts of building information modeling as a construction approach, and an exploration of its application to construction management. Emphasis on the use of building information modeling for estimation, scheduling, clash detection, and project communication. Spring. Prerequisite(s): CME 255 Plan Interpretation and Quantity Takeoff. Co-requisite: CME 343 Construction Estimating.

CME 422 Composite Mat/Sustainable Cons (3)

Two hours of lecture, three hours of laboratory per week. Properties, manufacture and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Spring. Prerequisite(s): CME 226, Statics and Mechanics of Materials and CME 387, Renewable Materials for Sustainable Construction.

CME 444 Materials Marketing (3)

Three hours of lecture and discussion per week. Fundamentals of marketing forest products, building and construction industry materials, including products, markets, distribution, segmentation, pricing, promotion and sales. Specific focus is on the unique nature and issues of forest products and building materials; vertical and horizontal integration, distribution channels, market segmentation and product positioning strategies. Fall. Prerequisite: FOR 207 Introduction to Economics or equivalent.

CME 453 Construct Plan/Scheduling (3)

Three hours of lecture per week. The use of common types of schedules: Gantt, Activity on Node, Precedence Diagram, PERT and Linear. Identification of activities and performance duration analyses of these activities. Updating of schedules, resource planning and assignment, cost planning and scheduling are all covered. Schedule development is performed both manually and with industry-accepted software. Fall. Prerequisite(s): CME 343 or permission of instructor. Note: Credit will not be granted for both CME 453 and CME 653.

CME 454 Construction Project Mgt (3)

Three hours of lecture/discussion and three hours of laboratory per week. How to define and properly identify company organizational structures and project delivery systems. Integration of estimating, bidding, scheduling and cost control into the management process. Safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements as integral parts of a construction project. Projects based upon Expedition project management software. Spring. Prerequisites: CME 343, CME 453, senior standing or permission of instructor. Note: Credit will not be granted for both CME 454 and CME 654.

CME 455 Construct Contracts/Specs (3)

Three hours of lecture/discussion per week. The types of contracts used in the construction industry. Analysis of the contractor, designer and owner duties and obligations as determined by the construction contract documents. Study of concepts, language, formats and procedures for project manual organization practice and the general conditions of the contract for construction. Spring. Prerequisite(s): Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 455 and CME 658.

CME 488 Prof Cons Project Mgt Pres Sem (2)

Two hours of lecture/seminar/preparation per week. A preparatory course for participation in a professional construction management proposal process including proposal development and professional presentation of the proposal. The course culminates in participation at a regional construction management competition sponsored by the Associated Schools of Construction Region 1. Fall. Prerequisites: Junior or Senior standing and permission of the instructor.

CME 495 Undergrad Exp/Coll Teach (1-3)

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. Fall and Spring. Prerequisites: Permission of instructor. The student must have previously completed, with grade of B or better, the course in which they will assist.

CME 497 Senior Ethics Seminar (1)

One hour of lecture/discussion per week. Student papers/ presentations are directed toward professional issues in ethics and career preparation, Fall. Prerequisite(s): Senior status in SCME.

CME 498 Research or Design Prob (1-3)

Conferences, library, laboratory and/or field research on a specific problem in wood products engineering. Written report required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Permission of instructor and advisor.

CME 504 Envrn Perform Measures/Bldgs (3)

Three hours of lecture per week. Environmental Performance Measures for Buildings - Three hours of lecture/discussion per week. Overview of building rating systems for green construction, their development, present application, and future directions for growth. Explores the process for development of individual standards, different building certification systems that have been developed using these standards, and long-term development and code adoption of such certification systems. An experiment-based, analytical, or evaluative project is required. Fall.

Prerequisite(s): Graduate standing, or upper division standing with approval of instructor. Note: Credit will not be given for both CME 304 and CME 504.

CME 505 Sustainable Energy Sys/Bldgs (3)

Three hours of lecture/discussion per week. Exploration of construction management-related issues in creating a more sustainable energy use in our building stock. Integrating sustainable energy sources in construction as well as issues related to using energy more efficiently. An experiment-based, analytical, or evaluative project is required. Fall. Prerequisite(s): Graduate standing, or upper division standing with approval of instructor. Note: Credit will not be given for both CME 305 and CME 505.

CME 525 Const Methods&Equipment (3)

Three hours of lecture/discussion per week. Analysis of heavy construction operations and related environmental concerns. Production calculations, means and methods selection and operating costs of heavy construction equipment are addressed. The economics of equipment use are analyzed. The use of a digitizer in earthwork quantity takeoff is explored. The outcome of the course is to select the most cost efficient and performance efficient method and equipment. A term paper is required. Spring. Note: Credit will not be granted for both CME 525 and CME 350.

CME 531 Construction Safety (3)

Three hours of lecture per week. Occupational Safety and Health practices in the construction industry. An overview of the US Department of Labor, Occupational Safety and Health Regulations, 29 CFR 1910 and 29 CFR 1926. Comprehensive review of: general safety and health requirements, hazard communication, confined space entry, lockout/tagout programs, workplace violence, personal protective equipment, fire protection, signs and barricades, rigging, small tools - hand and power, welding and cutting, electrical, fall protection, scaffolding, cranes, mobile equipment, excavation and trenching, steel erection, stairways and ladders and permissible exposure limits. A term paper is required. Fall. Note: Credit will not be granted for both CME 531 and CME 331.

CME 532 Mech/Elect Equipment (3)

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. An experiment-based project is required. Fall. Note: Credit will not be given for both CME 332 and CME 532.

CME 535 Cost Engineering (3)

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis. Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 535 and CME 335.

CME 543 Construction Estimating (3)

Three hours of lecture/discussion per week. Definition and explanation of estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints as well as their role in the estimating/bidding process. Perform a quantity takeoff. Create a final estimate/bid, including the appropriate General Conditions and Markups. Several

projects based on the concepts listed above as well as utilizing either a spreadsheet or Timberline Precision Estimating. A term paper describing how the relevant topics of the course fit a specific industry application, and production of an additional project based on Timberline Precision estimating software or equivalent are required. Spring. Prerequisites: CME 255 Plan Interpretation and QTO or basic estimating experience and permission of the instructor. Note: Credit will not be granted for both CME 543 and CME 343.

CME 565 Sustainable Innovatns/Res Cons (3)

Three hours of lecture per week. Principles of sustainable residential construction; the adaptation of biological, ecological, and cultural elements into building performance standards, practical building specifications, standards and systems. Spring.

CME 587 Renewable Mat/Sustainable Cons (3)

Three hours of discussion, lecture and demonstration per week. Properties and uses of wood and other renewable materials as a major construction materials. Identification and knowledge of the major wood species and their applications in construction. Evaluation of current practices and materials. Fall.

CME 605 Bldg Info Modelng/Cons Mgt (3)

Three hours of lecture/discussion per week. Introduction to the basic concepts of building information modeling as a construction approach, and exploration of its application to construction management. Emphasis on building information modeling for estimating, scheduling, clash detection, and project communication. An experiment‐based, analytical, or evaluative project is required. Spring. Prerequisite(s): Graduate standing Co-requisite: CME 543 Note: Credit will not be given for both CME 405 and CME 605.

CME 622 Composite Mat/Sustainable Cons (3)

Two hours of lecture, three hours of laboratory per week. Properties, manufacture and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Evaluation of current practices and materials. Spring. Prerequisite(s): CME 226, Statics and Mechanics of Materials, and CME 387 or CME 587, Renewable Materials for Sustainable Construction

CME 643 Estimating/Green Global Econ (3)

Three hours of lecture per week. Building upon the estimating skills developed through undergraduate coursework and professional experience this course will look at how to address global estimating concerns such as monetary value between various currencies, how the purchase of commodities futures effects material pricing, the linkages between financial, real estate development and policies and their effects on the construction markets. How to price multi-year projects addressing the previous issues and how to construct an estimate that will convey the information relative to green construction costs to the client in a proper manner will also be addressed. Fall or Spring. Prerequisites: CME 543 or equivalent or 3 to 5 years of professional estimating experience and permission of instructor.

CME 653 Construct Plan/Scheduling (3)

Three hours of lecture/discussion per week. The use of Gantt, Activity on Node, Precedence Diagram, PERT and Linear schedules. Identification of activities and duration analyses of these activities. Update schedules, plan and assign resources, plan cost and schedule. Schedule

development is performed both manually and with industry accepted software. A term paper describing how the relevant topics of the course fit a specific industry application and an additional project utilizing the software are required. Fall.

CME 654 Construction Project Mgt (3)

Three hours of lecture/discussion per week. How to define and properly identify company organizational structures. Project delivery systems, integration of estimating, bidding, scheduling and cost control into the management process. How safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements are integral parts of a construction project. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring. Prerequisite(s):CME 543, CME 653, or equivalent experience and permission of the instructor. Note: Credit will not be granted for both CME 654 and CME 454.

CME 658 Construct Contracts/Specs (3)

Three hours of lecture/discussion per week. The types of construction contracts used in the construction industry from the Owner, Contractor, Subcontractor and Supplier viewpoints. Types of required insurance and the remedies available to contractors are presented. The process of bidding and negotiating from the legal perspective is covered along with contract administration. Specifications are introduced by type and the requirements of each type are discussed, based on current industry-accepted standards. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring. Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 658 and CME 455.

CME 664 Urban Project Management (3)

Three hours of lecture per week. Building upon project management skills developed through undergraduate coursework and professional experience this course will look at the unique challenges of construction projects in urban settings. Topics to be addressed include but are not limited to: site logistics and their importance to a successful project, the influence of permits and codes on the project, the growing use of technology to solve urban project problems, the issues related to labor, subcontractors and suppliers in this high intensity setting. The importance of communication and project documentation will be addressed as well. Fall or Spring. Prerequisites: CME 654 or equivalent professional experience and permission of instructor.

CME 686 Wood-Water Relationships (3)

Two hours of lecture and three hours of laboratory per week. Relationship between wood moisture content and the environment, electrical and thermal properties, theories of moisture sorption, hygroscopic swelling and shrinking, thermodynamics of moisture sorption, mechanism of moisture movement as it relates to activation theory. Laboratory exercises will complement the theoretical topics discussed in the lecture. Fall. Prerequisite: Permission of instructor.

CME 770 Biodegradation of Wood (3)

Two hours of lecture and 1 hour of laboratory/demonstration/discussion per week. Biology of lignicolous fungi and other microorganisms concerning their effects on wood properties. Anatomical, biological and chemical aspects of the major types of wood decay. Spring. Prerequisite: Introductory biology and permission of instructor.

CME 797 Seminar (1-3)

Discussion of assigned topics in the fields related to Sustainable Construction Management and Wood Science. Spring and Fall.

CME 798 Resrch/Sustain Cons Mgt&Wd Sci (1-12)

Independent research topics in Sustainable Construction Management and Wood Science. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Credit hours to be arranged.

CME 898 Prof Experience/Synthesis (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, or Summer. Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

CME 899 Masters Thesis Research (1-12)

Research and independent study for the master's thesis. Fall, Spring or Summer. Credit hours to be arranged.

CME 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral dissertation. Fall, Spring or Summer. Credit hours to be arranged.

ECH - CHEMICAL ENGINEERING

ECH 132 Orientatn&Intro to Chem Eng I (1)

One hour lecture per week or three-hour lab/field trip per week. Introduction to chemical engineering as a general field of study and broad career path. Topics covered include broad field and applications of chemical engineering. sustainability, engineering ethics, laboratory and process safety, resumes and interviewing, and teamwork.

ECH 133 Orientatn&Intro to Chem Eng II (1)

One hours of lecture or three hours of workshop per week. Introduction to chemical engineering as a general field of study and broad career path. Topics covered include basic engineering calculations, statistics, engineering design, computer programming (MATLAB) and process simulators, ethics, sustainability and professional responsibility. The place of experiential learning such as research experience or industrial internships and co-op programs will be covered.

ECH 202 Prin Mass/Energy Balance (3)

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Pre/co-requisites: FCH152, PHY211, MAT296 (or concurrent).

ECH 212 Engr Thermodynamics (3)

Principles of classical thermodynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; fugacity; solutions and mixtures; power and refrigeration cycles. Thermodynamic analysis of chemically

reacting processes and systems via case studies and computer simulation applied to various types of reactor systems. Prerequisites: FCH153, ECH202.

ECH 304 Chemical Engineerng Internship (1)

Field. Twelve weeks full time employment approved by the department with an industrial or research partner acquired through on-campus interviews or other means. The student and the supervisor set goals and expectations for the internship. The students and supervisors also provide feedback on the performance of the student.

ECH 306 Professional Synthesis (1)

Seminar. Students will develop a synthesis of their work experience from either ECH 304 and present their results both orally and in a written report. Prerequisite: ECH 304.

ECH 312 Chemical Engrn Thermo&Colloids (3)

Three hours of lecture per week. Topics include thermodynamic properties of pure fluids and mixtures of fluids; vapor-liquid equilibrium, theory and applications of solution thermodynamics, chemical reaction equilibria, and colloidal systems. Prerequisite: ECH 212

ECH 322 Fluid Mechanics (3)

Three hours of lecture per week and (optional) 1 hour per week of recitation. Fluid statics. Principle of continuity and mass balance. Energy balance and Bernoulli's equation. Application of energy balance to flow systems. Flow measurement devices. Momentum balance. Steady and unsteady flow of liquids and gases in pipelines, ducts, and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the paper and bioprocess industry. Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Prerequisites: ECH312, ECH202, APM 485.

ECH 323 Transport Phenomena (3)

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analyses. Discussion of specific bioprocess examples. Prerequisites: ECH202, ECH322.

ECH 324 Unit Operations Laboratory (3)

1.5 hours of lecture and 4.5 hours of laboratory per week. Experiments on fluid mechanics like pressure drop and flow rate measurement in pipe flow, downstream units such as centrifugal pump operation, membrane filtration, adsorption/chromatography, centrifugation/ sedimentation, extraction, and other process operation including heat exchange, drying, etc. Data acquisition and parametric analysis. Planning and execution of laboratory experiments. Report writing and seminar presentation. This course is a junior-level course in the PSE and BPE fields of study, which makes use of campus resources available to ensure academic success. The course is designed for students to gain practical knowledge in the areas of transport phenomena and unit operations by performing experiments. The skills and information learned in this class will help students in many of their future courses and in their professional careers. Prerequisites: ECH312.

ECH 341 Chem Reaction Engnrng Kinetics (3)

Three hours of lecture per week. Fundamental concepts in chemical engineering reactions, basic reaction rate theory, steady-state approximation, transition-state theory, reaction mechanisms of chemical reactions, analysis of kinetic data. Prerequisites: APM 485 and ECH 312.

ECH 355 Engr Design Economics (3)

Three hours of lecture per week. Steps of process design, engineering economic analysis, estimation of capital investment, operating costs, profitability measures, evaluation of alternatives, inflation. Modeling and computer simulation of process units and systems; use of software. Design exercises and case studies. Prerequisites: APM 485 and ECH 202

ECH 371 Process Control (3)

Presents an introduction to the principles of process control. Linear analysis, LaPlace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Prerequisite: APM 485

ECH 422 Unit Process Operations (3)

Three hours of lecture per week. Topics include fluidization, equilibrium stage operation, distillation, evaporation, gas absorption, design of packed and tray towers, use of process simulation software (e.g. CHEMCAD). Prerequisite: ECH 322

ECH 442 Chem Reaction Eng&Prcss Safety (3)

Main topics of coverage include conversion and reactor sizing, isothermal and non-sothermal reactor peration/design for flow and batch systems, multiple reactions, introduction to heterogeneous reactor design, sustainability and stability, reactor runaway, reactive hazard and process safety.

ECH 454 Product Design in Chem Eng (3)

Three hours of lecture per week. Quality by design of chemical engineering products range from specialty chemicals to devices that perform chemical transformations. This course integrates the steps of product design from brainstorming and concept selection through design and manufacturing. Students will be taught and practice using the basic tools and principles of chemical / biochemical product design, including TRIZ, house of quality, robust design, design for manufacturability, FMEA and Six Sigma. Other topics include multi-generational product planning, sustainability and life cycle analysis, basic economic evaluations, risk management, an introduction to entrepreneurship and new business development, as well as intellectual property and freedom-to-operate assessments. Case studies drawn from industry will also be illustrated. Prerequisites: ECH 322, ECH 341, APM 395

ECH 455 Capstone Chemical Engnrng Lab (3)

1.5 hours of lecture per week and 4.5 hours of laboratory per week. Experimental design, data acquisition, and statistical analysis and interpretation of data. Professional communications with lab reports and presentations. The course is designed to help students acquire practical engineering knowledge in the areas of transport phenomena and unit operations by designing and performing experiments on material covered in earlier courses like ECH 212, ECH 324, ECH 322, ECH 422, and ECH 442. Prerequisites: ECH 212, ECH 324, ECH 322, ECH 422, and ECH 442.

ECH 457 Chemical Engnrng Plant Design (3)

Two hours of lecture and three hours of studio per week. Design project and procedure; open-ended design options; chemical engineering principles; unit operations; safety considerations; and economic analysis. Process simulation and computer-aided design for process synthesis and plant layout. Formulation and solution of original design problem(s) under realistic (e.g., socioeconomic, process, environmental, safety, etc) constraints. Prerequisites: ECH 355, ECH 422, and ECH 442.

ECH 498 Research Problem in Chem Eng (1-4)

Individual study, lecture and/or lab, 1 to 12 hours per week. The student is assigned a research problem in chemical engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research technique rather than on discovery of results of commercial importance. The information obtained in the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Prerequisites: consent of instructor

EFB - ENVIRONMENTAL AND FOREST BIOLOGY

EFB 100 Survey of Biology (4)

Three hours of lecture and three hours of laboratory per week. Introductory exploration of biological principles at molecular, cellular, organismal and ecological levels. Key topics include: the scientific method, biological molecules, cell structure and processes, cell division, genetics, evolution, phylogenetics and classification of life, plant and animal form/function, population dynamics, interspecific interactions, global biodiversity, ecosystem processes. Possibility of weekend field trips. Spring. This course will not replace any of the following course sequence: EFB101, EFB102, EFB103 or EFB104 (or equivalent).

EFB 101 Gen Bio I:Organismal Bio&Ecol (3)

Three hours of lecture per week. Introductory exploration of biological principles at ecosystem, population, and organismal levels. Emphasis on form, function, diversity, ecology and evolution of living organisms. Fall. Co-requisite: EFB 102.

EFB 102 General Biology I Laboratory (1)

Three hours of laboratory per week. Major concepts of organismal biology and ecology will be reinforced with hands-on laboratory exercises and required field trips exploring the form, function, diversity, ecology, and evolution of living organisms. Fall. Co-requisite: EFB 101.

EFB 103 Gen Bio II:Cell Bio & Genetics (3)

Three hours of lecture per week. Organization and function of living cells. Key topics include biological molecules, organelle structure and function, gene expression, cell division, metabolism, photosynthesis, cell signaling, genomics, and population genetics. Spring. Co-requisite: EFB 104.

EFB 104 General Biology II Laboratory (1)

Three hours of laboratory per week. Major concepts of cell biology and genetics will be reinforced with hands-on laboratory exercises using analytical and experimental techniques such as light microscopy, chromatography, electrophoresis, enzyme assays, aseptic culture techniques, and transformation of bacterial cells. Spring. Co-requisite: EFB 103.

EFB 120 The Global Envirnmnt & Society (3)

Three hours of lecture per week. Interdisciplinary overview of large-scale environmental issues and their relation to societal strategies. Focus is on human population patterns, pressures on physical and biotic resources, and sustainable design. Topics include energy-use, causes and socioeconomic implications of climate change, pollution, biodiversity loss, ecological restoration, environmental justice, and biological conservation. Fall and Spring.

EFB 132 Orientation Seminar:EFB (1)

One hour of lecture, discussion and/or exercises per week. Introduction to campus resources available to ensure academic success. Introduction to EFB as a field of inquiry. Fall.

EFB 200 Physics of Life (3)

Three hours of lecture and discussion per week. Introduction to basic principles of physics from a perspective of biological function, structure and adaptation. Fall.

EFB 202 Ecol Monitor&Bio Assessmnt (3)

Forty-five hours of lecture, laboratory and field instruction per week for three weeks. An introduction to the biodiversity of northeastern North American terrestrial, wetland, and aquatic communities with a focus on vascular plants and invertebrate and vertebrate animals, incorporating practical field exercises designed to acquaint the student with problem solving. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs.

EFB 210 Diversity of Life I (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall. Prerequisite(s): One year of introductory biology.

EFB 211 Diversity of Life II (3)

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on microbes, protistans and animals. Spring. Prerequisite(s): EFB 101 and 102 or equivalent year of introductory Biology.

EFB 217 Peoples, Plagues and Pests (3)

Three hours of lecture/discussion per week. Impacts of selected diseases and pests on the development and course of human civilizations. Emphasis is on the impacts of plagues and pests on non-western civilizations. Spring.

EFB 220 Urban Ecology (3)

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

EFB 222 Scuba & the Science of Diving (3)

Introduction to the science of diving. Incorporates skill sets that can lead to scuba certification. Students will learn fundamentals of diving as they apply to physics and physiology. Students will learn to perform basic scuba diving, nitrox gas diving, and use of a drysuit. These are required skills to progress in scientific diving and will prepare students for entry level diving and additional scuba classes. Available SDI certifications are Open Water Diver, Computer Nitrox, and Dry Suit Diver. Fall

EFB 245 Forest Health Colloquium (1)

One hour per week of discussion. An introduction to contemporary issues in forest health with a focus on the ecology and management of long-term and emerging threats to the forests of the northeastern U.S. Spring, odd years.

EFB 296 Spec Topics-Env&For Biol (1-4)

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

EFB 298 Rsrch Internship/Envrn Biology (1-3)

Full- or part-time engagement as volunteer or employee on research project having environmental biology focus consistent with the student's educational and professional goals. Tenure at SUNY ESF or outside institution. EFB-based faculty member serves as student's sponsor. Study plan outlining the apprenticeship's educational goals completed prior to its commencement. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Grading Satisfactory/Unsatisfactory. Fall, Spring, Summer. Prerequisite(s): Permission of Instructor

EFB 303 Intro Envrn Microbiology (4)

Three hours of lecture and three hours of laboratory per week. An introduction to the biology of microorganisms and a study of their interactions with other organisms and their environment. Topics include microbial physiology, nutrient cycling, microbial evolution, microbial ecology, and pathogenesis. Laboratory topics include microscopy, aseptic technique, and bacterial diagnostics. Fall. Prerequisites: Two semesters of General Biology (EFB101/102 and 103/104 or equivalent), and one semester of General Chemistry.

EFB 305 Indigenous Issues&the Envrnmnt (3)

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring. Note: Credit will not be granted for both EFB 305 and EFB 605.

EFB 306 Wildlife Field Techniques (3)

Field, laboratory, lecture. The study of theory and application of common field techniques for monitoring wildlife populations. Concepts and methods include ethical care and use of wildlife in field research; identification of New York mammals by tracks, photos, and in-hand specimens; assessment of habitat quality; monitoring of elusive forest species; techniques for capturing, handling, and measuring wild animals; radio telemetry; acoustic surveys. Satisfies field study elective requirement in all Environmental Biology majors. Room, board,

transportation and course fees will apply. Summer Prerequisites: Two semesters of General Biology (EFB101,102,103,104) or equivalent

EFB 307 Principles Of Genetics (3)

Three hours of lecture and discussion per week. A general course covering concepts of genetics and evolution basic to upper-division biology and biochemistry courses. Includes the inheritance and analysis of Mendelian and quantitative traits, the chemical nature of the gene and its action, genetic engineering, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Spring.

EFB 308 Prin Of Genetics Lab (1)

Three hours of auto-tutorial laboratory per week. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian traits and changes in populations caused by major forces in evolution or by breeding procedures. Numerical methods for characterizing quantitative traits and for testing hypotheses are introduced. Spring. Co-requisite: EFB 307.

EFB 311 Principles of Evolution (3)

Three hours of lecture or discussion per week. An introduction to the fundamental processes driving evolution (genetic drift, gene flow, mutation, sexual selection, and natural selection), the evolution of life-histories, trade-offs, and phenotypic plasticity. Macroevolutionary concepts covered include speciation, extinction, co-evolution, and the reconstruction of phylogenies. Spring. Prerequisites: EFB 307 and EFB 320, or equivalents.

EFB 320 General Ecology (4)

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

EFB 322 Scuba Diving Intl Foundations (3)

In person discussion and in water training/computer learning modules. This is the second in a sequence of three scientific diving courses instructed in collaboration between SUNY ESF and Scuba Diving International (SDI). This course will develop and refine student skills with recreational diving equipment configurations, and expand on gas planning techniques within a no-decompression context. Students will refine navigational skills that help them in an underwater environment. Students will have the opportunity to obtain up to three diving certifications(SDI Foundations, Computer Nitrox, and Dry Suit Diver). Students must be Open Water Dive certified to enroll. Spring Prerequisites: Open water dive certification

EFB 325 Cell Biology (3)

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring. Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

EFB 326 Plant Evol,Diversificatn&Cons (3)

Two hours of lecture and one three-hour laboratory per week. Evolutionary survey of the origin and diversification of land plants through geological time. Major land plants including bryophytes, lycophytes, pteridophytes, gymnosperms and angiosperms with emphasis on representative fossil and living taxa. Life histories and reproductive strategies, anatomical and morphological adaptations, species extinction and extinction events, and phylogenetic relationships within and among phyla. Highlights rare or endangered taxa in each phylum and related conservation strategies and management. Lab focused on analyses of plant structures, reproductive mechanisms, evolutionary adaptations, and identification of a variety of living and preserved specimens. Spring. Prerequisite: Two semesters of General Biology (EFB101,102,103,104) or equivalent

EFB 327 Adirondack Flora (3)

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification of vascular plants and recognition of ecological characteristics of major plant species and communities of the Adirondack Mountain region. Satisfies elective field study requirement in Environmental and Forest Biology. Appropriate for upper and lower division undergraduate students seeking instruction in plant identification and ecology. Summer, Cranberry Lake Biological Station. Prerequisite: General botany or general biology.

EFB 336 Dendrology I (3)

Two hours of lecture per week and one three-hour laboratory/field trip. Field study, identification, natural history and elementary silvics of important forest trees of North America. Fall.

EFB 337 Field Ethnobotany (3)

Two hours of lecture per week and six to eight hours of field work and discussion each day for two weeks. A field-based introduction to the identification and traditional cultural uses of plants in the Adirondack region for food, medicine and fiber. Topics include plant identification, traditional ecological knowledge and use of ecological and ethnobotanical methods. Satisfies elective field course requirement in programs offered by Department of Environmental and Forest Biology. Cranberry Lake Biological Station. Summer. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs. Prerequisite: EFB 226 General Botany or equivalent.

EFB 340 Forest/Shade Tree Path (3)

Two hours of lecture per week and three hours of auto-tutorial laboratory. Major diseases of forest, shade and ornamental trees; and deterioration of forest products, with emphasis on disease identification, principles of disease development, effects of disease on the host, and practical control measures. Spring.

EFB 342 Fungal Diversity & Ecology (3)

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course designed to provide an introduction to the collection, identification and ecology of fungi and fungal-like organisms. Included in the course are Oomycetes (Kingdom Straminipila) and Myxomycetes (Kingdom Protista), as well as the more familiar groups of Kingdom Fungi. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs. Prerequisite: General biology or general botany.

EFB 344 Forest Health Seminar (1)

One hour per week of presentation and discussion. In-depth analyses of contemporary issues in forest health with a focus on the ecology and management of long-term and emerging threats to the forests of the northeastern U.S. Prerequisites: Two semesters of general biology, or equivalent.

EFB 350 Microbial Consortia (3)

Two hours of lecture/discussion and a three-hour lab per week. This class provides an introduction to the biology of lichens, slime molds, gliding bacteria (Myxobacteria) and bacterial biofilms. Emphasis is on understanding the role of each component in the functioning of these microbial consortia either as complex multi-species ecosystems (lichens and biofilms), or as single species "superorganisms" (slime molds and Myxobacteria). Against this background of cooperation and collaboration, students will be introduced to the anatomy, morphology, systematics and evolution, physiology, and ecology of these overlooked groups through weekly lectures/discussions. Lab will focus on methods used to study these organisms and on characters used in species level identifications. Current initiatives in the conservation of lichens will also be discussed. Spring. Prerequisites: One year of Introductory Biology and either EFB 210 or EFB 211.

EFB 351 Forest Entomology (3)

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on insect pests of forested ecosystems. Designed for students in Environmental Biology, Forest Health and Forest Resources Management. Fall, even years. Note: Credit will not be granted for both EFB 351 and EFB 551.

EFB 352 Entomology (3)

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern U.S. Designed for students in Environmental Biology and Forest Health. Fall, even years. Note: Credit will not be granted for both EFB 352 and EFB 552.

EFB 355 Invertebrate Zoology (4)

Three hours of lecture and three hours of laboratory per week. Structure, function, classification and evolution of invertebrates. Emphasis on functional biology and ecological interactions. Spring.

EFB 360 Epidemiology (3)

Three hours of lecture/discussion per week. Introduction to the study of disease in populations and factors influencing disease occurrence. Case studies explore population measures of disease, clinical measures and causation. Emphasizes quantitative approaches, study design, ethics, intervention and implementation. Fall. Student enrolled in this course should have successfully completed one year of Introductory Biology and one semester of Introductory Statistics.

EFB 370 Population Ecology & Managemnt (3)

Two hours of lecture and discussion per week plus a 3-hour lab. An introduction to population ecology and genetics with consideration of their impact on population management. An integration of biological systems from molecular to ecosystem levels, with an emphasis on demystifying mathematical expression of complex ecological phenomena. We will draw on examples ranging from genetic diversity to human/wildlife conflicts to explore their influences on the maintenance of wild populations. Spring. Prerequisite: General Ecology or equivalent.

EFB 381 Vert Museum Techniques (2)

One hour of lecture and three hours of laboratory per week. Theory and practice of vertebrate museum methods, with emphasis on the preparation and curation of vertebrate specimens. Spring. Prerequisites: At least junior status and permission of instructor. Limited to 10 students.

EFB 384 Field Herpetology (3)

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification, natural history, ecology, and conservation of amphibians and reptiles of the Adirondack region. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs. Prerequisite: General biology or general zoology.

EFB 385 Comparative Vert Anatomy (4)

Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns and phylogenetic relationships in vertebrates. Spring.

EFB 388 Ecology/Adirondack Fishes (3)

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course in the identification of fish and recognition of ecological characteristics of major fish species and communities of Adirondack waters. Satisfies a component of the field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station. Students must register for summer session, to which appropriate tuition and fees apply in addition to travel and lodging costs. Prerequisite: General zoology or general biology.

EFB 390 Wildlife Ecology&Mgt (4)

Three hours of lecture and one hour of recitation per week. A study of the ecological principles governing wild animal populations and their habitats, and the relationship of these principles to management programs and decisions. Directed primarily toward students majoring in wildlife science, conservation biology, and forest resources management. Fall. Prerequisite or co-requisite: General ecology.

EFB 400 Toxic Health Hazards (3)

Three hours of lecture per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Fall. Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

EFB 402 Microbial Ecology (2)

Two hours of lecture per week. This course focuses on microbes in their environment including the environmental factors that shape microbial communities and how microbes, in turn, change their environment. An in-depth survey of contemporary topics in microbial ecology including nutrient limitations; carbon, nitrogen, sulfur, and metal cycling; microbial degradation of recalcitrant compounds; microbial influence on climate; and methods in microbial ecology

including metagenomics and fluorescent microscopy. Spring (odd years). Credit will not be given for both 402 and 602. Prerequisites: EFB 303, a similar microbiology course, or instructor permission is required.

EFB 411 Rsrch Methds:Adirondack Ecosys (3)

Two hours of lecture/discussion and one three hour field trip per week. An introduction to biodiversity, forest and wildlife management, invasive species, climate science, and the role of humans in the context of the Adirondack Park. Biotic and abiotic drivers of the Adirondack ecosystem, field data collection methods and policy and sustainability are considered. Explores the role of science in natural resource decision-making and the uses and limitations of ecological data and planning tools. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus. Prerequisite(s): General Biology or equivalent coursework Co-requisites: EST 401, EST 402, EST 403, EST 404

EFB 412 Intro/Chemical Ecology (3)

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring. Prerequisite: Organic chemistry (one year). Note: Credit will not be granted for both EFB 412 and FCH 440.

EFB 413 Intro To Conservation Bio (3)

Two hours of lecture and one hour of discussion/recitation per week. As an introduction to the discipline of conservation biology, the course seeks to demonstrate how basic biological science can be integrated with social, economic and political perspectives to achieve the goals of biological conservation. Lectures will provide students with an understanding of processes that generate and erode biological diversity. Discussion/recitation exercises will provide students with hands-on experience and skill development in solving the sorts of complex problems typically encountered by conservation biologists. Fall.

EFB 414 Senior Synth/Cons Biol (3)

Three hours of discussion/seminar per week. Students research a topic in conservation biology, then practice critical thinking and discourse by presenting seminars and participating in discussions. The focus is on integrating knowledge from previous courses in biology, management, and policy for the wise use and conservation of biological diversity. Fall. Pre- or co-requisite: EFB 413.

EFB 419 Prob Solving/Conservation Biol (3)

Two hours of lecture/recitation and three hours of laboratory per week. "Hands-on" experience in problem-solving, using methods and concepts related to a wide range of biodiversity conservation issues. Includes management of genetic diversity, analysis and modeling of populations, ecosystem management, and the public policy process, and of methods of information management, analysis and communication used by conservation professionals. Spring. Prerequisite: EFB 413 or equivalent; major in Conservation Biology or permission of instructor.

EFB 420 Prof Internship/Envrn Biology (1-5)

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational

and professional goals. The internship may be paid or unpaid. The extent of the internship activities shall be commensurate with the credits undertaken. Tenure at outside institution under guidance of external supervisor. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student submitted to the faculty sponsor, and on an evaluation of the student's performance written by the site supervisor to the faculty sponsor. Grading Satisfactory/ Unsatisfactory. Fall, Spring, Summer. Prerequisite(s): Permission of Instructor.

EFB 422 Scientific and Research Diving (3)

This course combines foundational content, dry lab and pool training, and open water dives to equip students with the skills and knowledge to pursue a career in the aquatic sciences. Students will receive personalized training and hands-on learning, to master the skills and equipment used on research dives. The course will teach many scuba techniques applicable to scientific diving and situational and self awareness. Teamwork, situational awareness, communication, planning, and preparation will be practiced during a group field project. Additional fees to cover pool courses, equipment rentals, learning module materials and certification may apply. Fall. Prerequisites: EFB 322 Scuba Diving International Foundations

EFB 423 Marine Ecology (4)

Three hours of lecture and 3 hours of lab (labs, discussions, activities) per week. Introduction to marine organisms and systems, using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, interactive activities and lectures allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), the increasing human impacts on marine environments, and potential solutions. Spring, even years. Prerequisites: One year general biology and one semester general ecology or equivalents. Note: Credit will not be granted for both EFB 423 and EFB 623.

EFB 424 Limnology:Study Inland Waters (3)

Three hours of lecture per week, with some additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic). The course focuses on inland waters as integrated ecosystems and explores the effects of natural and anthropogenic perturbations on these systems. Fall. Prerequisites: Senior status, introductory courses in physics and chemistry, and EFB 320, or permission of instructor. Note: Credit will not be granted for both EFB 424 and EFB 624.

EFB 425 Forest Health Senior Synthesis (3)

One hour per week of lecture, six hours per week of field and laboratory. Examines the varied ecological roles and impacts of pests, pathogens, climate and disturbance in managed and unmanaged northern forests. Students learn to sample, identify, and study forest insects, pathogens and trees using inventory, survey, analytic methods, and independent research. Prerequisites: One year of General Biology, and one semester of organismal diversity (EFB202, EFB210, EFB211 or equivalent)

EFB 427 Plant Anatomy & Development (3)

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant anatomy by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves

hands-on activities using current techniques. Fall. Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

EFB 428 Mycorrhizal Ecology (3)

Two hours of combined lecture/discussion and 3 hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake, and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Fall, even years. Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

EFB 429 Plant Physiology (3)

Two hours of lecture per week and three hours of lab. A critical study of the physiological processes of plants including water relations, photosynthesis, mineral assimilation, hormones, and responses to the environment. Spring. Credit will not be granted for both EFB429 and EFB629. Prerequisites: One full year of biology (EFB101/102 and EFB 103/104). One full year of chemistry (FCH 150/151 and FCH 152/153).

EFB 434 Ecosystem Restoration Design (4)

A summer field course followed by a weekly seminar and workshop during the Fall. Will travel in Mesoamerica. Will examine degraded and restored ecosystems. Will travel on public transportation and stay in low-cost hostels. Will use contemporary problems as source material for course projects. Continuation of restoration project designs and analysis from the field trip will be part of the coursework after returning to Syracuse. The course will explore restoration strategies in many different ecosystems. Will consider restoration needs in less developed countries, and how that shapes design and evaluation. Course fee. Fall. Prerequisite: Permission of instructor.

EFB 435 Flowering Plnts:Div,Evol&Systm (3)

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globally distributed families with particular focus on flora of the Northeastern U.S. Fall. Prerequisite(s): General Biology I and II or equivalent and at least junior standing.

EFB 437 Plant Propagation (3)

Two hours of discussion and two hours of laboratory each week. Introduction to sexual (seed) and asexual (cuttings, budding, grafting, layering, tissue culture, etc.) techniques for reproducing plants. Laboratory and independent research projects will provide practical hands-on experiences. Spring. Prerequisite(s): EFB 101/102 and EFB 103/104 sequence or equivalent. Note: Credit will not be granted for both EFB 437 and EFB 637.

EFB 438 Ecolgy&Management of Waterfowl (3)

Three hours per week of lecture and discussion. An overview of the ecology of ducks, geese and swans from the perspective of life history events (i.e., breeding, migration, and wintering ecology). Contemporary strategies used in conservation of waterfowl populations and their habitats. Credit cannot be given for both EFB438 and EFB638. Prerequisites: General Ecology or permission of instructor

EFB 439 Forest Health Monitoring (3)

Three hours of lecture/discussion per week on theoretical and applied aspects of forest health monitoring including concepts, data acquisition, analysis, quality assurance, interpretation and reporting. Spring. Pre- or co-requisite(s): Courses in forest resources management, ecology, pathology and entomology.

EFB 440 Mycology (3)

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall. Note: Credit will not be granted for both EFB 440 and EFB 640.

EFB 444 Biodiversity&Geography/Nature (3)

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Fall, even years. Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

EFB 445 Plant Ecology & Global Change (3)

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on structure and function of terrestrial plant communities and ecosystems. Examined scales range from ecophysiological processes occurring in individual leaves to global patterns of primary productivity and biodiversity. Spring. Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

EFB 446 The Ecology Of Mosses (3)

Two hours of lecture and one three-hour laboratory or field trip per week. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring. Note: Credit will not be granted for both EFB 446 and EFB 646.

EFB 449 Wetlands Cons&Mgmt for Wldlife (3)

Three hours per week of lecture, discussion, and field demonstrations. Contemporary techniques in wetlands conservation and management with a focus on sustaining wetland-dependent wildlife. Includes a survey of conservation strategies used and stakeholders involved throughout North America and beyond. A half-day weekend field trip is required. Spring (even years). Credit will not be given for both EFB449 and EFB649. Prerequisites: General Ecology (EFB320 or equivalent) or permission of instructor.

EFB 453 Parasitology (3)

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Fall. Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

EFB 462 Animal Physiol:Envrn&Ecol (4)

Three hours of lecture and discussion per week and three hours of laboratory exercises. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size and physiological constraints on animal life history. Spring. Prerequisites: One year of general biology. Note: Credit will not be granted for both EFB 462 and EFB 662.

EFB 463 Ecotoxicology (3)

Three hours of lecture and discussion per week. Introduction to principles of ecotoxicology and to contemporary scientific research. For students in natural or social sciences of environmental relevance. Topics include chemical fate in animals, and effects on individuals, populations, and ecosystems. Credit will not be given for both EFB463 and EFB663. Two semesters of General Biology; two semesters of General Chemistry; General Ecology

EFB 480 Prin Of Animal Behavior (3)

Three hours of lecture/discussion per week. Basic principles of animal behavior and the scientific process, including genetic, neural and physiological basis of behavior, behavioral ecology and behavioral responses to a changing environment. Proximate and ultimate mechanisms controlling the behavior of animals including humans. Fall. Prerequisite(s): EFB 101 or equivalent.

EFB 482 Ornithology (4)

Three hours of lecture and discussion, 3 hours of laboratory/field trip per week including weekend field trip experiences. Study of the evolution, ecology, behavior, taxonomy, populations, and breeding biology of the birds of North America. The course also offers exposure to the life histories and current topics of conservation and management of birds worldwide. Lecture, laboratory, and field trips. Spring. Prerequisites: General Ecology

EFB 483 Mammal Diversity (4)

Three hours of classroom instruction and three hours of laboratory per week. Describes the evolutionary development, ecology and diversity of mammals world-wide and within New York State. Laboratory exercises and discussions complement lectures, providing hands-on experience in identification, adaptive morphology, and techniques in field mammalogy. Fall. Prerequisites: Junior standing in EFB.

EFB 484 Winter Ecology (3)

Field and lecture course. This lecture and field course explores adaptations of animals and plants for surviving the winter in northern latitudes. The course presents species identification, natural history, behavior, ecology and winter strategies. One hour per week of asynchronous on-line instruction, plus ten-days of field instruction during one weekend in February and during March break in the Adirondack Mountains of New York. Credit will not be given for both EFB 484 and EFB 684. Travel, course and lodging fees will be applied. Spring. Prerequisites: General Ecology (EFB320) or Natural Resources Ecology (FOR232) required. Permission of instructor required.

EFB 485 Herpetology (3)

Two hours of lecture and three hours of laboratory per week. An introduction to the structure, function, ecology, behavior, development and distribution of amphibians and reptiles as they relate to the systematics of the various groups. Fall.

EFB 486 Ichthyology (3)

Two hours of lecture and three hours of laboratory per week. An introduction to the anatomy, physiology, ecology, behavior and taxonomy of fishes. Spring.

EFB 487 Fisheries Science & Mgt (3)

Three hours of lecture per week. Introduction to biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, bioenergetics, population sampling, growth, mortality, production, exploitation, ecological effects, and approaches to fisheries management. A practicum (EFB 488) is optional. Fall. Prerequisite: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted for both EFB 487 and EFB 687.

EFB 488 Fisheries Science Practicum (1)

Three hours of laboratory per week with 2 weekend field trips. Practical experience in fisheries science, including introduction to collecting techniques, data collection, analysis, and use of models. A nominal fee is charged to defray costs on weekend trips. Designed as a complement to EFB 487. Fall, even years. Co-requisite: EFB 487 (may be taken in a previous year).

EFB 491 Applied Wildlife Science (3)

Two hours of discussion and three hours of laboratory per week, plus a field project and professional experience. Practical experience with tools used to monitor and manage wildlife populations. Designed for biology students wishing to pursue careers as wildlife biologists. Spring. Prerequisite: EFB 390.

EFB 492 Sr Synthesis/Aquatic&Fish Sci (1)

One hour of seminar per week. Students will develop a synthesis by defining a scientific hypothesis on an aquatic topic of interest, gathering/analyzing data from the literature or elsewhere, interpreting findings, and presenting their work both orally and in a written technical report. That synthesis will relate to prior coursework and current issues in aquatic sciences. Spring. Prerequisite: Senior standing in the Aquatic and Fisheries Science major.

EFB 493 Wildlife Habitats & Populatns (4)

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts, including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall. Prerequisites: EFB 491 or permission of instructor. Note: Credit will not be granted for both EFB 493 and EFB 693.

EFB 494 Forest Health Capstone (1)

One hour of discussion or seminar per week. This course integrates student internships (EFB 420) or research experiences (EFB 498) with broader issues in forest health through readings and discussions of current literature and oral presentations. Students present a 1 hr seminar that details their internship or research experiences during the previous summer, and that relates this work to prior coursework and current issues in forest health. Fall. Prerequisite(s): EFB 420 or EFB 498

EFB 495 Undergrad Exp/Coll Teach (1-3)

An opportunity for qualified, senior undergraduate students to gain experience in fully supervised, college-level teaching of the type they can expect to perform in graduate school. Students assist the instructor in the preparation and presentation of laboratory or recitation material in an undergraduate course. A maximum of 6 credit hours of EFB 495, and 3 credit hours relating to any single assisted course, may apply toward graduation requirements. Fall and Spring. Prerequisites: Previous completion of the course being assisted (with a grade of B or higher), a GPA at ESF of 3.0 or higher, and permission of instructor.

EFB 496 Topics/Envrn&Forest Bio (1-3)

Experimental, interdisciplinary or special coursework in biology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit. Fall, Spring, Maymester or Summer. For sections taught during Maymester or summer session, appropriate tuition and fees apply in addition to travel and lodging costs.

EFB 497 Seminar (1)

One hour of presentations and discussion per week. A topic in environmental and forest biology will be emphasized and its importance to contemporary issues will be addressed. Fall or Spring.

EFB 498 Independent Research/Envrn Bio (1-5)

Independent research by advanced undergraduate student in topic related to environmental biology, conducted at SUNY-ESF or outside institution. EFB-based faculty member serves as student's research sponsor; EFB-based faculty member or scientist at outside institution serves as research supervisor. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Final written report to academic sponsor serves as basis for grade. Fall, Spring, Summer. Prerequisite: Permission of instructor.

EFB 500 Forest Biology Field Trip (1-3)

A five- to 10-day trip to: 1) agencies engaged in biological research, management and administration; or 2) regions or areas of unusual biological interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Tuition charges will apply to sections offered during Maymester and summer sessions. Fall, Spring, Maymester or Summer.

EFB 502 Ecology & Mgt/Invasive Species (3)

Three hours of discussion/lecture per week. Explores the growing problem of invasive species as a leading threat to global biodiversity. Topics include: invasion pathways and mechanisms, community resistance, biological control, effects on ecosystems, law and policy as management tools, prediction and risk assessment, and interactions with anthropogenic environmental change. Spring.

EFB 504 Plant-Herbivore Interactions (3)

Three hours of lecture/discussion per week. Introduction to major plant defensive strategies and counter-adaptation by herbivores. Costs and consequences of herbivory and evaluation of contemporary plant defense models. Direct and indirect linkage of plant-herbivore interactions with higher trophic levels, and effects on population and community dynamics. Plant-herbivore interactions and anthropogenic global change. Fall (Even years). Prerequisite(s): Introductory courses in ecology and evolution.

EFB 518 Systms Ecology: Eco Mdlng&Dsgn (3)

Three hours of lecture per week. Survey of systems ecology literature and techniques for ecological modeling and design. Students will develop computer simulations of natural and human systems. They will explore how ecological modeling can contribute to disciplines such as landscape architecture, ecological engineering and ecosystem restoration. Spring Prerequisite: one course in ecology.

EFB 523 Tropical Ecology (3)

One lecture (1.5 hr) per week coupled with a period of intensive hands-on field study over spring break in a tropical country. Principles of tropical ecology, nature conservation, and sustainable resource management are presented in class and during field trips to a variety of tropical terrestrial and aquatic ecosystems such as tropical montane and lowland rain forest, cloud forests, paramo, tropical dry forests, white-water rivers, and lagoons. Comparisons with north temperate ecosystems are made. Counts as Field-Experience Directed Elective in EFB. Spring. Appropriate fees apply in addition to travel and lodging costs. Prerequisite: One year of college biology and a general ecology course.

EFB 525 Limnology Practicum (2)

Three hours of field work or laboratory analysis each week. Two additional field trips on weekends; time outside of class devoted to an independent project. Students will become proficient in standard field and laboratory analyses used in limnology; field trips to diverse local aquatic habitats; development of an independent project. Fall. Prerequisites: EFB 424, 624 or equivalent must be taken concurrently or previously.

EFB 542 Freshwater Wetland Ecosys (3)

Three hours of lecture per week. An examination of the structure and function of various freshwater wetlands. Ecologic principles that broadly apply to all wetland ecosystems are examined and contrasted with terrestrial systems. The effect of management activities on, and the management potential of, wetlands are also examined. Spring. Prerequisite: EFB 320.

EFB 551 Forest Entomology (3)

Two hours of lecture and three hours of laboratory per week. Diversity, ecology and integrated management of insect pests of forested ecosystems. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental and Forest Biology and Forest Resources Management. Fall, even years. Note: Credit will not be granted for both EFB 351 and EFB 55l.

EFB 552 Entomology (3)

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern United States. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental Biology and Forest Health. Fall, even years. Note: Credit will not be granted for both EFB 352 and EFB 552.

EFB 554 Aquatic Entomology (3)

Two hours of lecture, three hours of laboratory/field work per week and a weekend field trip. An introduction to the identification, life histories and ecology of aquatic insects, with emphasis on genera found in the Northeastern United States. Includes a consideration of the functional role of

insects in aquatic systems, and current avenues of research. Intended for seniors and graduate students pursuing interests in entomology, fisheries and wildlife, forestry, limnology and general ecology. Fall. Prerequisite: One course in entomology or permission of instructor.

EFB 566 Systematic Entomology (3)

Two hours of lecture and three hours of laboratory per week. Lectures introduce the identification and classification of the important orders and families of insects, along with the concepts and practice of sys-tematics. In laboratories students become familiar with pertinent taxonomic literature and keys, based in part on a required collection. Fall. Prerequisite: EFB 351 or EFB 352.

EFB 570 Insect Physiology (3)

Two hours of lecture and three hours of laboratory per week. Study of the life processes in insects; introduction to modern physiological instrumentation and laboratory methods. Spring. Prerequisite: EFB 325.

EFB 600 Toxic Health Hazards (4)

Three hours of lecture and one hour discussion/seminar per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Additional reading assignments and discussions. Fall. Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

EFB 601 Molecular Biol Techniques (3)

Two hours lecture and three hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall. Prerequisites: One year of Introductory Biology, one year of Introductory Chemistry, Genetics. Note: Credit will not be granted for both BTC 401 and EFB 601.

EFB 602 Microbial Ecology (2)

Two hours of lecture per week. This course focuses on microbes in their environment including the environmental factors that shape microbial communities and how microbes, in turn, change their environment. An in-depth survey of contemporary topics in microbial ecology including nutrient limitations; carbon, nitrogen, sulfur, and metal cycling; microbial degradation of recalcitrant compounds; microbial influence on climate; and methods in microbial ecology including metagenomics and fluorescent microscopy. Spring (odd years). Credit will not be given for both 402 and 602. Prerequisites: EFB 303, a similar microbiology course, or instructor permission is required.

EFB 605 Indigenous Issues&the Envrnmnt (3)

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring. Note: Credit will not be granted for both EFB 305 and EFB 605.

EFB 611 Topics in Envrnmntl Toxicology (3)

Three hours of lecture, discussion or seminar per week. In-depth exploration of selected contemporary topics of environmental toxicology in areas such as toxic hazards of societal importance, pollutant monitoring and remediation, fate and ecological impacts of environmental pollutants, biological basis of toxic hazards, and ecological and human risk assessment and regulations. A major term paper and oral presentation required. Spring. Prerequisite: EFB 400, EFB 600 or an introductory course in toxicology.

EFB 612 Intro/Chemical Ecology (3)

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring. Note: Credit will not be granted for both EFB 612 and EFB 412/ FCH 440.

EFB 623 Marine Ecology (5)

Three hours of lecture and 3 hours of lab (labs, discussions, activities) per week. Introduction to marine organisms and systems, using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, interactive activities and lectures allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), the increasing human impacts on marine environments, and potential solutions. Graduate students will meet in a separate laboratory and seminar section each week, have small group discussions of course topics, and present a short topical talk on a synthesis paper to the entire class. Spring, even years. Prerequisites: One year general biology, and one semester general ecology. Note: Credit will not be granted for both EFB 423 and EFB 623.

EFB 624 Limnology:Study Inland Waters (3)

Three hours of lecture per week, with additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic); effects of natural and anthropogenic perturbations are explored. Students develop a case study or exercise on a limnological issue. Fall. Prerequisites: Introductory courses in physics, chemistry, and ecology, or permission of instructor. Note: Credit will not be granted for both EFB 424 and EFB 624.

EFB 625 Plant Biotechnology (3)

Two hours of lecture and three hours of laboratory per week. Transgenic plants are currently being produced to improve agriculture, pharmaceuticals, and remediate environmental problems. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, literature review, and a detailed laboratory project. Spring. Prerequisites: EFB 307 and EFB 325 or equivalents. Note: Credit will not be granted for both BTC 425 and EFB 625.

EFB 626 Plant Tissue Culture Methods (3)

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. In addition to the scheduled lab exercises, an independent micropropagation or transformation project will be required. Fall. Prerequisite: Permission of instructor. Note: Credit will not be granted for BTC 426 and FOR/EFB 626.

EFB 627 Plant Anatomy & Development (3)

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant structure by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves hands-on activities using current techniques. Students will give oral presentation on a topic relevant to the course. Fall. Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

EFB 628 Mycorrhizal Ecology (3)

Two hours of combined lecture/discussion and three hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Students will present and lead discussions on papers from the primary literature. An independent project is required. Fall, even years. Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

EFB 629 Plant Physiology (3)

Two hours of lecture per week and three hours of lab. A critical study of the physiological processes of plants including water relations, photosynthesis, mineral assimilation, hormones, and responses to the environment. Spring. Credit will not be granted for both EFB429 and EFB629. Prerequisites: One full year of biology (EFB101/102 and EFB 103/104). One full year of chemistry (FCH 150/151 and FCH 152/153).

EFB 634 Ecosystem Restoration Design (4)

A summer field course followed by a weekly seminar and workshop during the Fall. Will travel in Mesoamerica. Will examine degraded and restored ecosystems. Will travel on public transportation and stay in low-cost hostels. Will use contemporary problems as source material for course projects. Each student will work individually with the instructor to develop an approach to explore a novel research direction for ecosystem restoration. Continuation of restoration project project designs and analysis from the field trip will be part of the coursework after returning to Syracuse. The course will explore restoration strategies in many different ecosystems. Will consider restoration needs in less developed countries, and how that shapes design and evaluation. Course fee. Fall. Prerequisite: Permission of instructor.

EFB 635 Flowering Plnts:Div,Evol&Systm (3)

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globally-distributed families with particular focus on flora of the Northeastern U.S. Students prepare professional presentations and lead discussion on current research issues in flowering plant diversity, evolution, and systematics. Fall. Prerequisite(s): General Biology I and II or permission of instructor.

EFB 637 Plant Propagation (3)

Two hours of discussion and two hours of laboratory each week. Two field trips. Introduction to sexual (seed) and asexual (cuttings, budding, grafting, layering, tissue culture, etc.) techniques for reproducing plants. Development, delivery and evaluation of lecture content, active-learning classroom activity, and laboratory content will introduce students to digital instructional

technologies and techniques. Spring. Prerequisite(s): Permission of the instructor. Note: Credit will not be granted for both EFB 437 and EFB 637.

EFB 638 Ecolgy&Management of Waterfowl (3)

Three hours per week of lecture and discussion. An overview of the ecology of ducks, geese and swans from the perspective of life history events (i.e., breeding, migration, and wintering ecology). Contemporary strategies used in conservation of waterfowl populations and their habitats. Credit cannot be given for both EFB438 and EFB638. Prerequisites: General Ecology or permission of instructor

EFB 640 Mycology (3)

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall. Note: Credit will not be granted for both EFB 440 and EFB 640.

EFB 644 Biogeography (4)

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Students design and conduct independent biogeographic study utilizing information available in the literature. Fall, even years. Prerequisite: General ecology or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

EFB 645 Plant Ecology & Global Change (3)

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on the structure and function of terrestrial plant communities and ecosystems. Global change impacts are examined across a wide range of spatial and temporal scales, from ecophysiological processes occurring at the scale of a leaf, to global patterns of primary productivity and biodiversity. Spring. Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

EFB 646 The Ecology Of Mosses (3)

Two hours of lecture per week and one three-hour laboratory or field trip. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring. Note: Credit will not be granted for both EFB 446 and EFB 646.

EFB 649 Wetlands Cons&Mgmt for Wldlife (3)

Three hours per week of lecture, discussion, and field demonstrations. Contemporary techniques in wetlands conservation and management with a focus on sustaining wetland-dependent wildlife. Includes a survey of conservation strategies used and stakeholders involved throughout North America and beyond. Practice in project development and supervision. A half-day weekend field trip is required. Spring (even years) Credit will not be given for both EFB449 and EFB649. Prerequisites: General Ecology or permission of instructor

EFB 650 Landscape Ecology (3)

Two hours of lecture/discussion and three hours of laboratory experience per week. Landscape Ecology focuses on spatial patterning - its development and relevance to ecological processes. Course introduces the foundations, issues, and analytical tools in Landscape Ecology through

discussion of literature, GIS exercises, and an independent research project. Fall (even years). Prerequisites: Introductory course in Geographic Information Systems, or equivalent.

EFB 653 Parasitology (3)

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Students write a review paper and present on a parasitic disease. Fall. Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

EFB 654 Intro to R & Reproducble Rsrch (2)

Two hours of lecture/computer lab per week. Focuses on building foundational R skills for students without a background in computer science or engineering. The basics of R are covered: operators, data classes/structures, data import/export, plotting data, summarizing data, and merging data. Intermediate-level topics are also covered including conditionals, loops, and custom functions. Students will apply learned skills to original, student-provided data for the final project. Spring. Students are responsible for providing an original dataset to use in the class.

EFB 662 Animal Physiol:Envrn&Ecol (3)

Three hours of lecture, discussion and exercises per week, and an independent project. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size, and physiological constraints on animal life history. Fall and Spring. Note: Credit will not be granted for both EFB 462 and EFB 662.

EFB 663 Ecotoxicology (3)

Three hours of lecture and discussion per week. Introduction to principles of ecotoxicology and to contemporary scientific research. For students in natural or social sciences of environmental relevance. Topics include chemical fate in animals, and effects on individuals, populations, and ecosystems. Credit will not be given for both EFB463 and EFB663. Two semesters of General Biology; two semesters of General Chemistry; General Ecology

EFB 681 Aquatc Ecosys Restore/Enhance (2)

One and three-quarter hours of lecture and discussion per week and three field experiences. Guiding principles for ecological restoration of freshwater aquatic ecosystems focusing on effects of nutrient loading, sedimentation, flow alteration, and habitat loss. Factors leading to loss of aquatic resources and effectiveness of techniques to restore habitat and fauna are analyzed. Student presentation of a relevant topic and field excursions to perturbed areas and recent restoration projects are required. Fall, odd years. Prerequisites: none. Directed toward graduate students in areas involving aquatic sciences and management.

EFB 684 Winter Ecology (3)

Field and lecture course. This lecture and field course explores adaptations of animals and plants for surviving the winter in northern latitudes. The course presents species identification, natural history, behavior, ecology and winter strategies. One hour per week of asynchronous on-line instruction, plus ten-days of field instruction during one weekend in February and during March break in the Adirondack Mountains of New York. Credit will not be given for both EFB 484 and

EFB 684. Travel, course and lodging fees will be applied. Spring. Prerequisites: General Ecology (EFB320) or Natural Resources Ecology (FOR232) required. Permission of instructor required.

EFB 687 Fisheries Science & Mgt (3)

Three hours of lecture per week. Introduction to the biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, population growth, mortality, production, exploitation, and management. Critical synthesis project required. Fall. Prerequisites: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted for both EFB 487 and EFB 687.

EFB 692 Ecol And Mgt Of Waterfowl (3)

Three hours of lecture per week. A detailed examination of waterfowl ecology and management. The course is structured around the annual cycle, focusing on strategies of survival and reproduction; management aspects are treated throughout the course. Fall and Spring. Prerequisite: EFB 482.

EFB 693 Wildlife Habitats & Populatns (4)

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall. Note: Credit will not be granted for both EFB 493 and EFB 693.

EFB 696 Topics/Envrn&Forest Bio (1-4)

Experimental, interdisciplinary or special coursework in biology for graduate students. Subject matter and method of presentation varies from semester to semester. Fall, Spring, and Summer.

EFB 796 Topics/Envrn&Forest Bio (1-4)

Special instruction, conference, advanced study, and research in selected subject areas. A written report required. Check Schedule of Courses for details. Fall and Spring.

EFB 797 Seminar/Envrn&Forest Bio (1)

Seminar discussions of subjects of interest and importance in environmental and forest biology. Seminar offerings are available in most subdisciplinary areas. Check Schedule of Courses for details. Fall and Spring.

EFB 798 Resrch Prob/Env&For Bio (1-12)

Individual advanced study of selected special problems in environmental and forest biology. Offered by arrangement with individual faculty. A written report required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring.

EFB 898 Professional Experience (1-12)

Professional experience which applies, enriches and/or complements formal coursework. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Graded on an "S/U" basis. Fall, Spring and Summer.

EFB 899 Masters Thesis Research (1-12)

Investigation leading to the completion of a research-oriented thesis or to an application-oriented project. Graded on an "S/U" basis. Fall, Spring and Summer.

EFB 999 Doctoral Thesis Research (1-12)

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

EHS - ENVIRONMENTAL HEALTH

EHS 150 US History & Envirnmntl Health (3)

Environmental health is the science of maintaining and improving human health by identifying, evaluating, and protecting against hazardous agents in the environment. This course will examine the impact the environment has had on human health and society over the course of US History. Students will examine how changes in medicine, awareness, social values, and economic factors contributed to major socio-political events, and how those events in turn affected human health and the environment. Case studies will focus on examining a particular historical event/ period through a subfield of Environmental Health, and these events/time periods will be taught chronologically, supplemented by earlier and concurrent instruction in US History. This unique lens will give students another look at US History, and how deeply connected human health, society, and history have always been, as well as looking forward to challenges we may face, and how to continue improving the way we interact with the env

EHS 250 Foundations/Envrn Health (2)

One hour of lecture/discussion per week. Introduction to environmental health concepts. Course will introduce students to environmental risk, epidemiology, toxicology, policy, and regulation; agents of disease and human health risks including vector-borne pathogens, toxic metals, pesticides, and radiation. Course will also cover applications of environmental health with a focus on water and air quality, food safety, waste management and occupational health. Fall. Prerequisites: One year each of Biology with lab (EFB 101 and 102, EFB 103 and 104), General Chemistry with lab (FCH 150 and 151, FCH 152 and 153) and Calculus (APM 105 and 106).

EHS 320 Disease Prevention (3)

Two 50 minute lectures per week. History of infectious diseases, control measures, new and emerging diseases, prediction and monitoring of known and infectious diseases. Examination of the intersections of public and environmental health, disease control and prevention, and historical and emerging diseases, and tracking and prediction of outbreaks. Spring. Prerequisites: EHS 250 and EFB 303. Note: Credit will not be granted for both EHS 520 and EHS 320

EHS 350 Environmental Health Managemnt (3)

Three 50 minute lectures per week. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and environmental safety. Spring. Prerequisites: EHS 250 and EWP 190 or the equivalent. Note: credit will not be granted for both EHS 350 and EHS 550.

EHS 360 Environmental Sampling Methods (3)

Two 50 minute lectures and one 3 hour lab per week. Overview of different methods used for sampling air and water quality, soils, environmental microbes, and non-chemical environmental stressors (i.e. radiation, temperature, stress, noise) with an emphasis on their impact on human health. Spring. Credit will not be granted for both EHS 360 and EHS 560. Pre-requisites: EHS 250, FCH 150, and 152 or equivalents. Co- or pre-requisite: APM 391.

EHS 420 Prof Internship/Env Health (1-5)

40 hours of work with the sponsor per credit. Full or part time position as an employee or volunteer in a profession setting with an environmental health focus. Internship will be structured in collaboration between ESF faculty advisor and on-site supervisor. Requires a plan outlining learning goals and objectives, supervisors assessment and final report by student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, Summer

EHS 440 Occupational Health and Safety (3)

Three 50 minute lectures per week. In-depth examination of workplace environmental health issues. Topics include safety issues, ergonomics, fire protection, hazardous materials, and terrorism preparedness. Overview of legislation of these issues, as well as managing in workplace. Spring. Credit will not be granted for both EHS 640 and EHS 440. Pre or co-requisite of EHS 250 and pre or co requisite of EHS 350 or equivalent.

EHS 480 Hazardous Waste Management (3)

Two 80 minute lectures per week. In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. Fall. Pre and co-requisite(s): Pre or co-requisite of EHS250 and prerequisite of one year of Organic Chemistry (FCH 221/222 and 223/224 or equivalent). Note: Credit will not be granted for both EHS 680 and EHS 480

EHS 520 Disease Prevention (3)

Two 50 minute lectures per week plus one hour of recitation. History of infectious diseases, control measures, new and emerging diseases, prediction and monitoring of known and infectious diseases. Examination of the intersections of public and environmental health, disease control and prevention, and historical and emerging diseases, and tracking and prediction of outbreaks. Spring. Permission of instructor required. Credit will not be granted for both EHS 520 and EHS 320.

EHS 550 Environmental Health Managemnt (4)

Three 50 minute lectures per week plus a one hour recitation. Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste containment and remediation, air pollution control, and control of environmental hazards in specific or specialized environments. Understanding the laws and regulations governing these practices, and current protocols to maintain public and environmental safety. Be familiar with past and ongoing issues in environmental health, and discuss the efficacy of current regulations in depth through regularly scheduled student presentations. Spring. Permission of instructor required. Note: Credit will not be granted for both EHS 350 and EHS 550.

EHS 560 Environmental Sampling Methods (4)

Two 50 minute lectures, one 50 min recitation, and one 3 hour lab per week. Overview of different methods used for sampling air and water quality, soils, environmental microbes, and non-chemical environmental stressors (i.e. radiation, temperature, stress, noise) with an emphasis on their impact on human health. Spring. Credit will not be granted for both EHS 360 and EHS 560

EHS 640 Occupational Health and Safety (4)

Three 50 minute lectures per week plus one hour recitation. In-depth examination of workplace environmental health issues. Topics include safety issues, ergonomics, fire protection, hazardous materials, and terrorism preparedness. Overview of legislation of these issues, as well as managing in workplace. Spring. Permission of instructor required. Note: Credit will not be granted for both EHS 640 and EHS 440

EHS 680 Hazardous Waste Management (4)

Three 50 minute lectures per week plus a one hour recitation. In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. Fall. Permission of instructor required. Credit will not be granted for both EHS 680 and EHS 480.

ENS - ENVIRONMENTAL SCIENCE

ENS 132 Orientation Seminar:EnvSci (1)

One hour of lecture or discussion each week. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options within the Environmental Science program. Fall.

ENS 200 Climate Chng Sci&Sustainablty (1)

Climate Change Science and Sustainability is an introduction to climate science, the evidence of modern climate change, and an evaluation of some of the proposed solutions. The course integrates NASA and other web-based climate change media and products with outside readings.NASA's spatial and temporal climate change resources are the basis for most learning activities, which will enable students to continue their exploration of personal and societal climate change solutions.

ENS 232 Prof Development Env Science (1)

One hour of lecture, discussion, or activity each week. This course will continue to guide and support Environmental Science students in both personal and professional growth. Course topics include time management and study skills, choosing an "option area", research methods, (literature review, field skills, project development), finding and solidifying experiential learning opportunities (e.g., internships, research projects), current topics/issues in Environmental Science, and effective interaction for group work. Spring. Prerequisite: ENS 132 or equivalent.

ENS 250 Fndtns of Environmental Health (3)

Three hours of lecture/discussion per week. Introduction to environmental health. Foundations in environmental risk, epidemiology, toxicology, policy, and regulation. Agents of disease include vector-borne pathogens, toxic metals, pesticides, and radiation. Applications of environmental

health focus on water and air quality, food safety, waste management and occupational health. Spring. (Course description may be revised prior to registration.)

ENS 260 Environmental Sampling Methods (3)

Principles of water, soil, and air sampling to detect and quantify environmental contaminants, including sampling techniques, statistical considerations, and data analysis, interpretation, and reporting. (Course description may be revised prior to registration.)

ENS 296 Spec Topics/Envrnmntl Science (1-3)

One to three hours of class meetings per week. Special topics of current interest to lower division undergraduate students in environmental science. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring. Permission of the instructor.

ENS 350 Environmental Health Mgt (3)

Principles of communicable disease and contamination control, food protection, vector control, water supply safety, wastewater and solid and hazardous waste renovation, air pollution control, and controlling environmental hazards in special environments. (Course description may be revised prior to registration.) Prerequisite: One year biology, one year chemistry, calculus I & II.

ENS 420 Internship in Env Science (1-5)

Full or part time position as an employee or volunteer in a professional setting with an environmental science focus. Internship will be structured in collaboration between ESF faculty advisor and on-site supervisor. Requires initial plan outlining learning goals and objectives, supervisor's assessment and final report by student to be graded by faculty advisor. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, Summer. Prerequisite: Permission from instructor.

ENS 460 Renewable Energy Capstone (2)

One half hour meeting per week. Students will synthesize information from courses in the Renewable Energy minor by performing research and preparing a scientific report on topics related to renewable energy and energy. The research will consist of literature review/analysis, modeling, field work or laboratory research. Spring. Prerequisite: ENS 450

ENS 470 Environmental Risk Assessment (3)

Three hours of lecture per week. Identification of environmental hazards to human and other life forms; application of statistical tools and methods required for quantifying risk and their applicability and limitations; regulatory requirements governing risk assessment reporting; and effective public communication of environmental risks. Fall. Prerequisite: APM 106, APM 391, EFB 103, FCH 152

ENS 480 Hazardous Materials Management (3)

In-depth examination of hazardous wastes from source to disposal and chemical fate; covers medical, nuclear, agricultural, industrial sources and reduction, prevention, containment, transportation, remediation. History, risk assessment, regulation and safety are included. (Course description may be revised prior to registration.) Prerequisite: One year Biology, One year Chemistry, Calculus I & II

ENS 494 Capstone Seminar (1)

1 hour of lecture/discussion per week. Support and instruction for completion and presentation of the senior synthesis project for Environmental Science. Topics include research skills and literature review, data analysis, scientific writing including editing, and oral presentation. Research or internship must be nearly or fully completed.

ENS 498 Resrch Prob/Envrn Science (1-5)

Independent research in topics in environmental science for undergraduate students. Selection of subject area determined by the student in conjunction with an appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and/or Summer. Prerequisite(s): Consent of instructor.

ENS 519 Spatial Ecology (3)

Two hours of classroom instruction and three hours of laboratory, field trip, workshop, or group studio per week. Geographical modeling is the simulation of natural systems in a spatial context, interfacing the traditional tools of ecological modeling with those of Geographic Information Systems. Students in this course learn the fundamentals of ecological modeling and develop a spatial model using GIS tools to address their own research questions. Spring. Prerequisites: EFB 518 or computer programming course; GIS course. Co-requisite: GIS course (if not already completed).

ENS 596 Spec Topics/Envrn Science (1-3)

Experimental or special coursework in Environmental Science for beginning graduate students, fifth year, and seniors with appropriate academic background. Subject matter and methods will vary. Fall or Spring.

ENS 601 Water Resources Mgt (3)

Three hours of lecture and discussion per week. This course provides an introduction to interdisciplinary water management. It draws upon subject matters from many areas, including water policy, planning, economics, hydrology, law, engineering and water quality. Fall.

ENS 607 Wetland Practicum (2-3)

Two hours of lecture and three hours of group learning per week. Provides students with a working knowledge of wetland management, emphasizing wetland delineation, functional assessment and mitigation with module problems with reports required for each module. Two credits for completion of two modules; three credits for completion of three modules. Fall.

ENS 696 Specl Topics/Env Sci&Pol (1-3)

Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate students not covered in regularly scheduled courses. Fall and Spring.

ENS 796 Adv Topics/Env Sci&Policy (1-3)

Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest, in fields of interest to environmental studies faculty and graduate students. Fall and Spring.

ENS 797 Envrn Science Seminar (1-3)

Discussion of current topics and research related to environmental science. Fall and Spring.

ENS 798 Problems/Envrn Science (1-12)

Individualized, special study of environmental science and policy subjects and issues. Comprehensive oral or written report required for some problems. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer.

ENS 898 Professional Experience (1-12)

Professional experience which applies, enriches and/or complements formal coursework. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Graded on an "S/U" basis. Fall, Spring and Summer.

ENS 899 Masters Thesis Research (1-12)

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

ENS 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

ERE - ENVIRONMENTAL RESOURCES ENGINEERING

ERE 132 Intro/Envrnmntl Resrces Engr (1)

Three hours of lab per week. Introduction to department and campus resources available to ensure academic success for ERE majors. Introduction to engineering science and design as a profession through readings, assignments, presentations, discussion, and field trips. Fall.

ERE 133 Intro to Engineering Design (3)

Two hours of lecture and three hours of group instruction per week. An introduction to the engineering profession, including design, communication, ethical and professional behavior, teamwork and data analysis. Learning is reinforced through study, conduct and critique of design exercises related to environmental resources engineering. Spring.

ERE 275 Ecological Engineering (3)

Two hours of lecture and one hour of group instruction per week. Theory and practice of ecological engineering with strong focus on sustainability and design, monitoring, and construction of ecosystems and the built environment. Key concepts, empirical models, and case studies, including applications of water/wastewater treatment, air resources and solid waste management. Spring. Prerequisites: one semester of calculus, biology, and chemistry. ERE students only or by permission of instructor.

ERE 311 Ecological Engr in the Tropics (3)

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe

degradations, and develop sustainable restoration designs. Spring. Prerequisite(s): one course in calculus, biology, and chemistry. Note: Credit will not be granted for both ERE 311 and ERE 511.

ERE 335 Numerical & Computing Methods (3)

Three hours of lecture/discussion per week. Introduction to numerical and computing methods for engineers. Writing computer code to analyze and solve engineering problems using state-of-the-art software packages. Fall. Prerequisite: MAT 485.

ERE 339 Fluid Mechanics (4)

Three hours of lecture per week plus one lab session. An introduction to fluid mechanics within the context of civil and environmental engineering. This includes hydrostatics, Bernoulli's Equation, control volume analysis, drag, dynamic similitude, pipe flow, and open channel flow with some brief coverage of hydraulic machines and flow in porous media. Fall. Prerequisites: APM206 and GNE172 or equivalents

ERE 340 Engr Hydrology&Hydraulics (4)

Three hours of lecture and lab per week. Covers watershed hydrology and analysis of rainfall, evapotranspiration, infiltration, and runoff processes as well as hydraulic processes involved with pipe networks, open-channels with flow controls, and groundwater systems. Spring. Prerequisites: Fluid mechanics. Note: Credit will not be granted for both ERE 340 and ERE 540

ERE 351 Basic Engr Thermodynamics (3)

Three hours of lecture per week. Principles of energy conservation and conversion: first and second laws. Relation to PVT behavior, property functions, equilibria and heat and mass transfer, and applications to energy and power systems. Introduction to engineering problem analysis and computer methods. Spring.

ERE 365 Principles of Remote Sensing (4)

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring. Prerequisite: ERE 371 Surveying for Engineers. Note: Credit will not be granted for both ERE 365 and ERE 565.

ERE 371 Surveying For Engineers (3)

Two hours of lecture and three hours of lab per week. The principles of plane surveying and position determination for engineers. Subject matter areas include introduction to the theory of measurement and errors, reference surfaces, coordinate systems and datums, horizontal and vertical measurements, traversing and computations, the analysis and treatment of systematic and random errors, foundations of global positioning systems. Laboratory fieldwork and computations culminate in a topographic map. Fall. Prerequisite: Calculus.

ERE 380 Energy Systems Engineering (3)

Three hours of lecture per week. Covers fundamentals of thermodynamics and power needed for engineering systems analysis and applies methods such as life cycle analysis, sustainability analysis, and environmental impact analysis to non-renewable and renewable energy systems. A portion of the class is spent on open-ended problem solving and engineering design. Spring. Prerequisite: Physics II, Calculus II, ERE 275 Ecological Engineering

ERE 405 Sustainable Engineering (3)

Three hours of lecture/discussion per week. Will explore and attempt to develop solutions to societal and environmental problems in a changing world that is facing climate change, premium fuel depletion, and regional water shortages. Evaluation of system sustainability using a multidisciplinary framework. Introduction to sustainability metrics, including emergy evaluation and life cycle assessment. Application of emergy evaluation. Spring.

ERE 412 River Form and Process (3)

Two hours of lecture and 3 hr of laboratory per week. Theories of river classification are presented and tested using field gathered data. Classified river form and suggested evolution sequences are used to discuss governing fluvial processes. Computational river hydraulics is used to estimate sediment transport, and a design sequence is employed to consider issues of channel stability and restoration. 612 students will perform the additional work of writing a 15 page research paper. Fall. Prerequisites: Physical or engineering hydrology Note: Credit will not be granted for both ERE 412 and ERE 612.

ERE 430 Engr Decision Analysis (3)

Three hours of lecture per week. Classical engineering economics: time value of money, nominal and effective interest, and present worth, annual worth, rate of return, and benefit-cost ratio comparison techniques. Identification and evaluation of alternative investment and borrowing decisions, including the role of inflation, depreciation, taxes and uncertainty. Investment theory including the potential risks and rewards associated with investments options. Simulation and optimization techniques to aid in management decisions. Spring.

ERE 440 Water and Wastewater Treatment (3)

Three hours of lecture per week plus two laboratory exercises and one field trip. Design principles and practice of unit operations and processes for water and wastewater treatment. Study of the engineering concepts and design procedures for water and wastewater treatment. Fall. Prerequisite(s): ERE275 Ecological Engineering; ERE 339 Fluid Mechanics Note: Credit will not be granted for both ERE 440 and ERE 640.

ERE 444 Hydro-Meteorology (3)

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring. Prerequisites: Physics 1, Calculus II, permission of instructor.

ERE 445 Hydrologic Modeling (3)

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses. Spring. Prerequisite(s): Introductory computer programming, Probability and Statistics, one year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

ERE 465 Environmental Systems Engrng (3)

Mathematical models of environmental systems are presented and combined with optimization procedures, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to the planning, design, and sustainable management of complex environmental systems. Students will be exposed to a variety of optimization algorithms for a wide range of environmental applications. Fall. Prerequisite(s): APM206 Corequisite(s): APM395

ERE 468 Solid & Hazardous Waste Engr (3)

Three hours of lecture and discussion. Introduction to solid and hazardous waste regulations. Analysis and design of solid and hazardous waste management systems, including generation, storage, transport, recycling, biological, physical, chemical and thermal treatment; energy recovery; land disposal; environmental protection systems and monitoring. Field trips. Fall. Pre- or Co-requisites: ERE 340 and ERE 440. Note: Credit will not be granted for both ERE 468 and ERE 568.

ERE 475 Ecological Engr/Water Quality (3)

Three hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. Fall. Prerequisite(s): ERE 440/643 or equivalent. Note: Credit will not be granted for both ERE 675 and ERE 475.

ERE 480 Fate & Trnsprt of Contaminants (3)

Three hours of lecture per week. The fundamental physical, chemical, and biological principles of fate and transport of contaminants. Application of the fundamental principles to analyze complex contamination problems in surface waters, subsurface environment, atmosphere, and engineered environments. Contemporary contamination issues. Prerequisites: Calculus II (APM 206), General Chemistry II (FCH 152), and Ecological Engineering (ERE 275), or equivalent. Note: Credit will not be granted for both ERE 480 and ERE 580.

ERE 485 Fundamentals/Engineering Prep (1)

Discussion of content and administration of the Fundamentals of Engineering (FE) Exam, a comprehensive review of FE-type problems, and a targeted review of specific topics on the FE Exam. Spring. Prerequisite(s): Senior standing or consent of instructor.

ERE 488 Engineering Project Management (1)

Project management strategies for the engineering profession. Readings, exercises and discussion emphasizing professional responsibility and ethical practices; project management; technical communication and teamwork. Team-based scoping and planning of engineering design projects. Fall. Prerequisite: Senior status ERE students only.

ERE 489 Env Res Engr Plan&Design (3)

Two hours of lecture and three hours of laboratory. A capstone course to integrate engineering coursework with the engineering design process to solve interdisciplinary environmental problems. Semester-long project provides experience in problem analysis, teamwork, project management, engineering ethics, and professional communication. Spring. Prerequisites: Senior standing in Environmental Resources Engineering, ERE 488.

ERE 496 Special Topics (1-3)

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

ERE 498 Rsrch/Env Resources Engr (1-3)

Independent research in topics in environmental resources engineering for the highly motivated undergraduate student. Selection of subject area determined by the student in conference with appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring. Prerequisite: Permission of instructor.

ERE 508 Water-An Incredible Journey (3)

Three hours of lecture/discussion per week. Content covers the origin of water on Earth, physical and chemical characteristics of water, global distribution of water, historical development of drinking water supply systems, potable water treatment technology, water resources management strategies, global potable water quality challenges, impact of climate change on water resources, role of water in controlling and determining the quality of human health, and the solar system and exoplanet search for water. Spring. Prerequisites: General Chemistry I and II

ERE 511 Ecological Engr in the Tropics (3)

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe degradations, and develop sustainable restoration designs. ERE 511 students will perform the additional work of writing a 15-page research paper. Spring. Prerequisites: 1 course in calculus, biology, and chemistry. Note: Credit will not be granted for both ERE 311 and ERE 511.

ERE 519 Green Entrepreneurship (3)

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success factors and key start-up issues unique to science and technology firms. Spring. Pre- or Co-requisites: FOR 207 Introduction to Economics or equivalent; or permission of instructor.

ERE 520 Wastewater Resource Recovery (2)

Two hours of lecture, presentations and discussion per week. Introduction to technologies for recovery of bio-energy and nutrients from liquid wastes as well as the principles and applications of laboratory methods used in development and assessment of wastewater resource recovery processes. Presentation and discussion of experimental results for comprehensive analysis of anaerobic digesters. Spring. Prerequisites: One of ERE 480; FCH 510; and FCH515.

ERE 521 Wastewater Rsrce Recovery Lab (1)

Three hours of laboratory exercises per week on average. Conduct experiments for comprehensive analysis of anaerobic digesters, including feedstock and digestate characterization, biogas monitoring, analysis of anaerobic digestion kinetics, and recovery of

ammonia and phosphate in digestate. Student groups prepare for presentations in ERE 520 class. Spring. Co-requisites: ERE 520.

ERE 527 Stormwater Management (3)

Three hours of lecture per week. One Saturday field trip. Techniques for urban stormwater and erosion control and analysis of associated water quality impacts. Review of applicable regulations and design standards. Students will engage in individual and team-oriented activities such as lecture, discussion, observation, computation, reading and writing. In addition, students are required to participate in a Saturday field trip where examples of stormwater management facilities will be reviewed. Students will, in small teams, generate a design for a stormwater management alternative at a local site. Fall. Prerequisite: ERE 340 or equivalent as determined by instructor.

ERE 530 Numerical & Computing Methods (3)

Three hours of lecture/discussion per week. Programming skills and computing techniques using state-of-the-art software packages. Applications of programming and computing methods for solving geospatial, ecological, and/or water resource engineering problems. Fall. Prerequisite(s): Differential Equations.

ERE 533 Ecological Modeling (3)

Three hours of lecture, discussion and experimentation per week. Development, use, and interpretation of mechanistic numerical models applied to ecological systems. Students will develop a model on a topic of their choice throughout the semester. Fall. Prerequisite: ERE 335 or equivalent coding class

ERE 540 Engr Hydrology&Hydraulics (3)

Three hours of lecture per week. Covers watershed hydrology and analysis of rainfall, evapotranspiration, infiltration, and runoff processes as well as hydraulic processes involved with pipe networks, open-channels with flow controls, and groundwater systems. Problem sets, modeling exercises and a research project report are required. Spring. Prerequisites: Fluid Mechanics. Note: Credit will not be granted for both ERE 340 and ERE 540

ERE 545 Environmental Soil Physics (3)

2 hours lecture, 3 hours lab per week. Soil water content and potential, steady water flow in saturated soil, heat flow in soil, transient water flow. Field methods to obtain data for analysis and modeling. Application of analytical and numerical solutions to describe heat and water fluxes in the soil-plant-atmosphere continuum, unsaturated zone hydrology, and solute transport. Fall. Prerequisite: PHY 211, APM 485, ERE 339, or equivalent.

ERE 551 GIS for Engineers (3)

Two hours of lecture and three hours of laboratory per week. Introduction to fundamental concepts in geographic information systems (GISs) with a focus on engineering applications. Fundamental concepts and development of geographic information systems including models and georeferencing systems used to represent and characterize spatial data. Data processing including collection and preprocessing, data management, spatial analysis and manipulation, and data output. Necessity and utility of spatial data in engineering design analysis. Fall. Prerequisite: Calculus. Co-requisite: ERE 371 or equivalent.

ERE 553 Intro to Spatial Information (1)

Three hours of lecture per week for the first third of the semester. An introduction to spatial terminology and methods for determining and expressing position. Examination of accuracy and precision in the context of horizontal measurements. Issues with subsequent use of measurements for producing maps and performing analysis. Fall.

ERE 555 RADAR Remote Sensing (3)

ERE 555 Radar remote sensing. Two hours of lecture and three hours of lab per week. Theory and applications of Synthetic Aperture RADAR (SAR) Remote Sensing and advanced Polarimetric SAR (PolSAR) for environmental monitoring. Fundamental concepts of SAR imaging systems such as target and sensor parameters, geometric correction, and scattering mechanisms, and advanced topics of Polarimetric SAR such as polarization descriptor and scattering operators, speckle noise filtering, Polarimetric decomposition, PolSAR image supervised and unsupervised classification. Selected real-world applications of PolSAR data for land cover mapping (e.g. agriculture, forest, wetlands, and water bodies), sea and ocean surface, and sea ice detection and discrimination. Spring. Prerequisite: ERE 365 or equivalent.

ERE 556 UAV Photogrmmtry&Remote Sensng (3)

Two hours of lecture and discussion, and three hours of lab per week. Introduction to Unmanned Aerial Vehicles (UAV) with focus on data processing and photogrammetric analysis. Introduction to UAV systems including types and classification, regulatory issues, sensors and platforms. Data collection and processing including mission planning, photogrammetric triangulations and bundle adjustment, sensor positioning and orientation, 3D surface reconstruction and image matching, robotic mapping and ortho generation. Emerging UAV trends and technologies such as power and payload issues as well as outlook and societal, technological, regulatory, and market challenges. Spring. Prerequisite: Completion of an introductory geospatial course, ERE 365, ESF 300, or FOR 557, or equivalent.

ERE 564 i-Tree Tools Practicum (3)

Three hours of lecture and field demonstration per week. Use i-Tree models to complete an urban forest inventory, an assessment of associated ecosystem services, and engineering designs for improved sustainability. Forest structure data are obtained from field visits and remotely sensed or archived products. Models simulate structure-function relations using governing scientific principles in order to estimate forest services such as filtering air pollution, sequestering carbon dioxide, managing storm water, mitigating the urban heat island, and improving building energy use efficiency. Prerequisites: General biology I, general chemistry I, Precalculus

ERE 565 Principles of Remote Sensing (4)

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring. Prerequisite: ERE 371 Surveying for Engineers or permission of instructor. Note: Credit will not be granted for both ERE 365 and ERE 565.

ERE 566 Intro/Global Positioning Sys (1)

Three hours of lecture per week for the last third of the semester. An introduction to the theory and practice of performing global positioning system (GPS) measurements. Comparison of accuracy potential for different GPS equipment and techniques. Exploration of error sources that reduce the accuracy of GPS measurements. Collection of GPS data. Fall.

ERE 568 Solid & Hazardous Waste Engr (3)

Three hours of lecture and discussion. Introduction to solid and hazardous waste regulations. Analysis and design of solid and hazardous waste management systems, including generation, storage, transport, recycling, biological, physical, chemical and thermal treatment; energy recovery; land disposal; environmental protection systems and monitoring. Field trips. Fall. Prerequisites: ERE 440 and ERE 340 Note: Credit will not be granted for both ERE 468 and ERE 568.

ERE 570 Hydrology in a Chng Climate (3)

Three hours of lecture/discussion per week. Drawing on a growing body of academic literature focused on better understanding the degree of uncertainty in future climate, this class provides the technical background to interpret and apply predictions of future climate changes (as primarily related to hydrology) in different locales and at different scales. Specific topics include: frequency analysis under non-stationary conditions, misconceptions in linkages between hydrology and climate, accessing and manipulating climate model files (netcdf), and strategies for decision making under uncertainty. Spring. Prerequisite: basic programming knowledge and prior hydrology/water resources class

ERE 575 Ecological Engr/Water Quality (3)

Three hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. Prerequisite: ERE 275 Ecological Engineering or equivalent

ERE 580 Fate&Transport of Contaminants (3)

Three hours of lecture per week. The fundamental physical, chemical, and biological principles of fate and transport of contaminants. Application of the fundamental principles to analyze complex contamination problems in surface waters, subsurface environment, atmosphere, and engineered environments. Graduate students will write a research paper on contemporary contamination issues. Prerequisite: Calculus, General Chemistry, and Introduction to Ecological/ Environmental Engineering, or equivalent. Note: Credit will not be granted for both ERE 480 and ERE 580.

ERE 612 River Form and Process (3)

Two hours of lecture and 3 hr of laboratory per week. Theories of river classification are presented and tested using field gathered data. Classified river form and suggested evolution sequences are used to discuss governing fluvial processes. Computational river hydraulics is used to estimate sediment transport, and a design sequence is employed to consider issues of channel stability and restoration. 612 students will perform the additional work of writing a 15 page research paper. Fall. Prerequisites: Physical or engineering hydrology Note: Credit will not be granted for both ERE 412 and ERE 612.

ERE 621 Spatial Analysis (3)

Three hours of lecture and discussion per week. Spatial statistics and modeling as applied to various data formats: single point data, continuous data and area data. First and second order effects, complete spatial randomness, tessellation, kernel, covariograms and variograms, kriging, distance measures, correlation/correlogram. Fall. Prerequisite(s): APM 391, ERE 335 or permission of instructor.

ERE 622 Digital Image Analysis (3)

Three hours of lecture and discussion per week. Elements of digital image processing and analysis systems: Digital image representation, visual perception, sampling and quantization, pixel connectivity, Fourier transforms, image enhancement, filtering, image segmentation, edge detection, thresholding, representation schemes, descriptors, morphology, recognition and interpretation. Spring. Prerequisite(s): APM 391, ERE 335 or permission of instructor.

ERE 640 Water and Wastewater Treatment (3)

Three hours of lecture per week plus two laboratory exercises and one field trip. Design principles and practice of unit operations and processes for water and wastewater treatment. Study of the engineering concepts and design procedures for water and wastewater treatment. Fall. Prerequisite(s): General chemistry, microbiology, water quality, and fluid mechanics or hydraulics Note: Credit will not be granted for both ERE 440 and ERE 640.

ERE 644 Hydro-Meteorology (3)

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring. Prerequisites: Physics, Calculus II, permission of instructor

ERE 645 Hydrologic Modeling (3)

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses. Spring. Prerequisite(s): Introductory computer programming, Probability and Statistics, 1 year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

ERE 665 Environmental Systems Engrng (3)

Mathematical models of environmental systems are presented and combined with optimization procedures, decision theory, uncertainty analysis, and engineering economics to develop integrated approaches to the planning, design, and sustainable management of complex environmental systems. Students will evaluate and present a variety of optimization algorithms for a wide range of environmental applications. Fall. Prerequisite(s): APM206 Corequisite(s): APM395

ERE 674 Meth/Ecol Treatment Analysis (3)

Two hours of lecture/seminar/discussion and three hours of lab per week. Introduction to the components and design principles of engineered ecosystems for water quality improvement. Common lab exercises for a comprehensive analysis of an engineered ecosystem, including water quality, reaction kinetics, hydraulic characteristics, vegetation, soil and gravel, and microbial community. Discussion on experimental procedures and data analysis. Spring.

ERE 675 Ecological Engr/Water Quality (3)

Three hours of lecture/seminar/discussion per week. Design and analysis of ecological treatment systems for water quality improvement. Hands-on construction, operation and/or monitoring of engineered ecosystems through group project activities beyond class meeting times in on-campus labs and a greenhouse. Focusing on constructed wetlands, with minor topics selected by students. This course is differed from ERE 475 by conducting a group project to address treatment mechanisms and synthesize experimental results and other groups' operational data. Fall. Prerequisite(s): ERE 440/643 or equivalent. Note: Credit will not be granted for both ERE 475 and ERE 675.

ERE 692 Remote Sensing of the Envrnmnt (3)

Three hours of lecture/discussion per week. Understanding of various remote sensing systems, their applications, and advanced digital image processing techniques. Analysis of satellite and airborne-acquired remote sensing data. Spring. Prerequisite(s): ERE 365 or equivalent introduction to remote sensing.

ERE 693 GIS-Based Modeling (3)

Three hours of lecture/discussion per week. Geographical, temporal, environmental modeling concepts using GIS-based modeling languages and techniques. Various modeling concepts and techniques including spatial interpolation, suitability/capability modeling, hydrologic modeling, diffusion modeling, calibration, optimization, accessibility modeling, and rainfall-runoff modeling. Fall. Prerequisite(s): ERE 551 or equivalent.

ERE 697 Intro Engineering Project Mgt (1)

An introduction to Engineering Project Management focused on the definition of a project and project management, a projects' relationship and value within an organization, the standardized project management lexicon, the role/responsibilities and characteristics of an effective project manager (including items such as professional duty, ethics, communication, collaboration, etc), and an overview of the project management process - initiating, planning, executing, monitoring and controlling, and closeout. Prerequisite: Bachelor of Science (B.S.) degree in Engineering

ERE 698 Prncpls&Pract/Engr Prjct Mgt (2)

A continuation of study of project management process functions including: project initiation, resource planning and scheduling, cost estimating, risk registry, procurement, monitoring and control, and project closeout. Course also covers project management functions including: quality, health and safety, stakeholder and supply chain management, and management of change. Effective roles and responsibilities will be explored related to ethics, collaboration, leadership, communication, and the project management function in digital/virtual environments and a cross-cultural, global setting. Prerequisite: ERE 697 - Introduction to Engineering Project Management.

ERE 699 Engineering Planning & Design (6)

An intensive, project-team design experience with analysis of real world, interdisciplinary problems and development of design solutions. Projects will address problem framing, stakeholder analysis, conceptual and detailed engineering design, options analysis, and life-cycle financial analysis culminating in written and oral reports supporting the selected project design. Utilization of sound project management skills including engineering ethical, political, health & safety, manufacturability and sustainability considerations, along with collaborative teamwork, and professional communication. Prerequisite: ERE 698 - Principles and Practices of Engineering Project Management.

ERE 797 Resrch Methods/Env&Res Engr (1-3)

One to three hours of discussion/seminar per week. Introduction to research facilities, opportunities, and responsibilities of graduate scholarship. Discussion of ERE research topics, including journal reading, proposal formulation, funding, and engineering tools. Use of scholarly resources including e-journals, web, proposal development, and presentations. Fall and Spring.

ERE 798 Resrch/Env Resources Engr (1-12)

Independent research topics in Environmental Resources Engineering. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Credit hours to be arranged.

ERE 897 Professional Experience (1)

Individual and/or small-group professional mentoring/advising with the ERE M.E. Program Director focusing on professional development, aligned with individual student academic/ professional goals. Students will develop an Individualized Study Plan (ISP) that will serve as a charter between the student and the Program Director specifying metrics and milestones to be achieved throughout the semester including creation of a Professional Development Plan. Prerequisite: Bachelor of Science (B.S.) degree in Engineering.

ERE 898 Prof Exp/Synthesis Eng (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Prerequisite: Approval of proposed study plan by advisor, Department, and any sponsoring organization.

ERE 899 Masters Thesis Research (1-12)

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

ERE 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

ESF - COLLEGE-WIDE

ESF 109 Honors Sem/Envrn Sci &Forestry (1)

One hour of lecture/discussion per week. Sequential presentations by ESF faculty and staff members. Exploration of science, engineering, design, management and social science applied to regional, national and global issues. A written report and presentation is required. Fall. Prerequisite: Admission to the lower division Honors Program.

ESF 122 Ecology/Economic Process (3)

An approach to economics as a natural, rather than a social science. Examination of the ecology of human-dominated ecosystems including cities, agricultural areas, and fisheries. Review of basic ideas of value, classical, neoclassical, and biophysical economics. Examines an alternative model emphasizing analysis of energy and material flows and their control. Case studies will focus on the developing economies of the tropics. Prerequisite(s): High School Living Environment (Biology) Co-requisite(s): High School Economics

ESF 200 Information Literacy (1)

One hour of lecture/discussion per week, in-person or online. Introductory course for students of all levels and all curricula to the basic research process for information retrieval and management. Explore the breadth of value and complexity of academic publications, grey literature, and Indigenous Knowledge. Students will build understanding of systems of information and knowledge creation and oppression and practice skills to recognize authority, validity, and bias in those systems. Students will gain practical experience with the use of information in creating new knowledge and participating ethically in communities of learning.

ESF 209 Honors Sem:Envrn Sci&Forestry (1)

One hour of presentation and discussion per week. Sequential presentations by students, or faculty, or both. Exploration of science, engineering, design, management and/or social science applied to regional, national and global environmental issues. A presentation and/or a written report may be required. Fall. Prerequisite: Admission to the lower division Honors Program.

ESF 296 Spec Topics/Envrn Sci & Fsty (1-3)

One to three hours of class meetings per week. Special topics of current interest to students campus wide; or an experimental course in its first iteration. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring. Permission of the instructor

ESF 300 Intro/Geospatial Info Tech (3)

Two hours of lecture and three hours of laboratory per week. A theoretical and practical course providing an introduction to the uses and limitations of geospatial information technologies, including geographic information systems (GIS), global positioning systems (GPS) and remote sensing, for environmental science and natural resources management applications. Fall and Spring.

ESF 321 Study Abroad (1-25)

Local registration placeholder for various study abroad programs. Fall and/or Spring and/or Summer.

ESF 496 Spec Topics/Envrn Sci & Fsty (1-3)

One to three hours of class meetings per week. Special topics of current interest to students campus wide; or an experimental course in its first iteration. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

ESF 499 Honors Thesis/Project (1-5)

Guided independent study in a topic related to the student's undergraduate major, resulting in a thesis/project. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Students will give an honors presentation of their work. Fall and Spring.

ESF 503 Sem/Univ Outreach&Public Svc (1-3)

One- to three-credit seminar examines processes and strategies designed to enhance the scholarship and practice of university-based outreach and public service with an emphasis on relationships with K-12 schools and community organizations. Spring.

ESF 696 Spec Topics/Envrn Sci & Fsty (1-3)

One to three hours of class meetings per week. Special topics of current interest to students campus wide; or an experimental course in its first iteration. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring. Permission of the instructor

ESF 797 Grad Seminar on Info Resources (1)

One hour of lecture/discussion per week. Searching for and evaluating information resources. Using citation management software. Preparing to write the research proposal and write and defend subsequent thesis/dissertation.Student presentations on information tools, thesis/dissertation research topics, formation of problem statement. Fall.

ESF 899 Master's Degree in Progress (0)

Master's research, writing, and/or defense of thesis. (S/U) Summer only.

ESF 999 Doctoral Degree in Progress (0)

Doctoral research, writing, and/or defense of dissertation. (S/U) Summer only.

EST - ENVIRONMENTAL STUDIES

EST 132 Orientation Seminar:EST (1)

One hour of lecture, discussion and/or exercises per week. Introduction to campus resources available to ensure academic success. Introduction to Environmental Studies as a field of inquiry, and the three option areas that the department offers. Fall.

EST 133 Intro to Environmental Studies (3)

Three hours of lecture, discussion and analytical activities per week. Gateway course for EST majors. Introduction to the study of environmental problems in the social sciences and humanities. Topics: pollution, conservation, preservation, human health, ecosystem health, limits to growth, sustainability, ecosystems, population, energy, risk and traditional knowledge. Fall.

EST 135 Intro to Climate Justice (3)

Two hours of lecture and one hour seminar per week. An introduction to the concept of climate justice - an area of scholarship, policy and activism that investigates the unequal impacts of climate change and the ways to address them. The course provides an overview of the key theories and approaches to studying (via research) and pursuing (via activism) climate justice, which are underpinned by real-world examples ranging from Syracuse and CNY to global issues. Assignments include reaction papers, a group poster presentation, and a final project with a flexible, written or non-written format. Upon the completion of the course, students will be able to interpret climate change as a quintessentially social - and not just an environmental - issue, and suggest potential ways to rectify climate injustices in different social settings. Spring.

EST 140 Int/Native People,Land,Cult (3)

Three hours of lecture/discussion per week. Introductory survey of the history, geography, economy, and culture of Native Americans from prehistory to present, with special attention to the Great Lakes region/upstate New York and environmental topics. Draws on texts, films, guest speakers, and other resources. Spring.

EST 200 Cultural Ecology (3)

Three hours of lecture/discussion/oral presentations per week. Students develop skills and fluency in preparing, delivering and evaluating multicultural and traditional environmental management and decision-making. Emphasis is on situations encountered in the environmental professions. Case studies pose ethical questions, which challenge students to apply theory and analysis to each case. Topics also include interactions of culture and environment, relationship between traditional and scientific knowledge and co-management as multicultural decision making. Self-evaluation and peer evaluations are emphasized. Fall or Spring.

EST 201 Am Hist:Recnstructn to Present (3)

Three hours of lecture/discussion per week. History of changes occurring in America post 1865 including land use, government, economic and international relations. Spring.

EST 202 Am Hist:Discovery to Civil War (3)

Three hours of lecture/discussion per week. A survey of American history considering the origin and development of American institutions and ideals, from the discovery of the New World through the Civil War. Students are introduced to works of major historians and to various interpretations of American history.

EST 203 Introduction To Sociology (3)

Three hours of lecture per week. General introductory principles and methods of sociology including group dynamics and development, different structural arrangement of social groups, community development and adjustment processes, relationships with the natural environment. Spring.

EST 204 Diversity&Knowledge of the Env (3)

Three hours of lecture and discussion or online. This interdisciplinary course provides a in-depth understanding of non-western perspectives of environmental knowledge. The course is focused on what it means to study the environment at ESF in the context of Syracuse, New York and the Onondaga Nation of the Haudenosaunee Confederacy. The course seeks to increase student competency to interrogate place, histories, and power dynamics, as well as socialization and agency in times of climate change. It will cultivate analytical skills, and develop student ability to analyze power relationships and carry out an (eco)systemic analysis. The course also explores how issues of the environment are connected with issues of society and place. Throughout this course, students will read about issues that join personal life with the political and economic lives of others, in the US and globally. In addition, the course will provide context for the recent diversity efforts on ESF and SU campuses and be

EST 205 Identity, Culture, & the Env (3)

Two hours of lecture and one hour of seminar per week. This course explores ways in which popular culture—including social media, art, craft, and fashion and affinity group activism—frames identity, power, and social structures in the U.S. Uses foundations of cultural studies and sociology to examine how institutional and societal structures in the U.S. lead to inequities across groups and shape individual meaning making and re/actions to systems of power, privilege, oppression, and opportunity. Fall and Spring.

EST 220 Urban Ecology (3)

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

EST 221 Intro/American Government (3)

Three contact hours per week. Describes American political system and its roles and functions in society. Examines how political processes change over time, including the role of rhetoric and argumentation in policy development. Explores critical analysis of political phenomena. Fall.

EST 231 Environmental Geology (3)

Three hours of lecture and discussion per week. Environmental Geology is an applied field of study that uses geological information to assist in resolving human conflicts related to land use issues, environmental damage, and resource use. Topics include natural resources, energy, environmental pollution, waste disposal, geological hazards and climate change. Spring.

EST 245 Foundations/Envrn Communicatn (3)

Three hours of lecture/discussion per week. Survey of environmental communication, including nature represention in popular culture, and the role of mass media on public perceptions of environmental issues. Topics also include strategic communication, public participation in environmental decision-making, and environmental risk perception. Exposure to communication theory and social scientific and humanities-based approaches. Fall.

EST 255 Research Methods/Envrn Studies (3)

Three hours of lecture, discussion and analytical activities per week. An introductory methods course focused on research techniques used in environmental and natural resources social science research. This course reviews quantitative and qualitative methodologies for environmental studies research including but not limited to questionnaires, in-depth interviews, rhetorical critiques and content analyses. Spring. Pre- or Co-requisite: EWP 290

EST 296 Spec Topics/Envrn Studies (1-3)

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

EST 301 Leadership Through Mentoring (1)

Biweekly meetings with instructors and with first-year student groups. Advanced leadership training for students in the ESF Peer Mentoring Program. Use of online resources to augment person-to-person interactions and group meetings. Fall. Prerequisites: Upper division class standing, participation in the Peer Review Mentoring Program, and successful completion of Orientation Leader training.

EST 312 Sociology of Natural Resources (3)

Three hours of lecture per week. The concepts and principles of sociology as applied to natural resource questions. Concepts of community, forest dependent communities, shared identity and social structures of resource based groups. The forest as an integrated social and biological community. Spring

EST 321 Government & Environment (3)

Three contact hours per week. Examines the relationship between government and the environment, primarily in the U.S. Introduces environmental policy, including the policy making process. Reviews legal framework and current issues in several thematic areas (e.g., air, water, hazardous waste, and endangered species protection). Spring

EST 333 Inquiry-Based Science Educatn (3)

An online asynchronous course that engages future science teachers in the methods, learning theories, practices, and instructional approaches relevant to science education. Students learn strategies, master techniques, and gain practice-based experience in the promotion of inquiry-based, learner-centered classrooms. They design equitable and authentic science learning experiences for diverse student populations. Students create lessons reflecting educational standards, while using impactful approaches to enhance the learning environment. Spring. Credit will not be granted for both EST 333 and EST 533.

EST 353 Envrn Psychology (3)

Three hours of lecture per week. Overview of theory, research, and methods in environmental psychology and sustainable behavior. Explores the role of human behavior as a root cause of environmental degradation and examines the contribution of individual and societal processes. The cognitive-behavioral perspective is emphasized in understanding these issues. Fall, odd years.

EST 361 History/Am Envrn Movement (3)

Three hours of lecture and discussion per week. The historic and cultural origins and evolution of this complex, multifaceted social phenomenon called the environmental movement and its influence on public policies, values and lifestyles. The events, personages, philosophies and historical/cultural processes that marked and continue to drive various, competing attitudes toward nature, even within the United States environmental movement. Fall.

EST 366 Attitudes,Values & Envrn (3)

Three hours of lecture per week. Historical roots of environmental attitudes, values, and ethics with special emphasis on how individual attitudes impact environmental issues. Perspectives on man's relationship and responsibility to nature. Value implications of ecological principles and concepts. Examples of current environmental issues are examined in this context. Fall, even years. Prerequisites: Junior status or permission of instructor.

EST 370 Intro/Pers Env Interp Methods (3)

Two hours of lecture and 2 hours of recitation per week. One required Saturday field trip. Personal interpretation teaches a variety of face-to-face techniques used to connect the public with environmental science by providing an introduction to history of interpretation, popular interpretive and environmental education activities and curriculum, evaluation of programs, and lesson plans. Explores and illustrates the research and philosophy of environmental interpretation. Fall. Prerequisite(s): EFB 320, junior or senior standing, or permission of instructor Note: Credit will not be granted for both EST 370 and EST 570.

EST 388 Psych Principles/Risk Comm (3)

Three hours of lecture and discussion per week. Presents socio-psychological principles and theoretical underpinnings guiding the applied social science approach to environmental

risk communication issues. Three overlapping themes will be considered and linked: how communities cope with environmental hazards, how risk information is cognitively processed and evaluated and how risk communication influences perception, evaluation and behavior. Spring, even years.

EST 390 Social Processes & Envrn (3)

Three hours of lecture/discussion per week. Explores alternative ways of explaining the relationship between social processes and environmental conditions. Analyzes classical and modern social theories and applies their insights to questions of human-environment interaction. Introduces qualitative social science research methods and the social construction of environmental meaning. Fall or Spring.

EST 395 Public Communcatn/Science&Tech (3)

Three hours of lecture/discussion per week. Survey of public communication of science and technology (PCST). Considers the structure, meanings, and implications of PCST, including contexts in which it occurs. Topics also include motivations and constraints of those who produce PCST, and function of PCST in contemporary society. Exposure to communication theory and social scientific research methods and analysis. Spring. Prerequisite(s): EST 245 and junior standing, or permission of the instructor.

EST 400 Senior Paper (3)

Individual study of an environmental topic resulting in a formal report that meets the requirements for an environmental studies synthesis experience. These requirements are identified in course meetings. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Enrollment is restricted to environmental studies seniors. Fall and Spring.

EST 401 Envrn Ethics&Culture/ADK Park (3)

Introduction to the ethics of land-use conflicts in the Adirondacks, NY. This course links the philosophical history of ethics with contemporary principles of environmental ethics and advocacy. Topics include agency, ethics, value theory, morality and responsibility in the context of ongoing regional debates. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus. Prerequisite(s): none. Co-requisites: EFB 411, EST 402, EST 403, EST 404.

EST 402 Divrs Perspctvs:Experience ADK (3)

Two hours of lecture and three hours per week of immersion in Adirondack issues including introduction to diverse stakeholders and perspectives through non-governmental, agency, and community meetings; interaction with an array of regional experts through special panel discussions; and field trips to and private tours of historic and cultural sites and institutions. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus. Prerequisite(s): none. Co-requisites: EFB 411, EST 401, EST 403, EST 404.

EST 403 Sustainable Devl:ADK Park Stdy (3)

A place based study of the concepts of sustainable development and their application. Students will learn of the role of historical precedence and current context in approaching planning and policy for a sustainable future. The course will combine lecture, discussion, student led seminars and writing that illustrates both skills in analysis and synthesis. Class will meet once a week for

three hours for fourteen weeks at the ESF Newcomb campus, and may require occasional field trips. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus. Prerequisites: none. Co-requisites: EFB 411, EST 401, EST 402, EST 404.

EST 404 Past Exp/Synthesizing ADK Park (3)

Three hours of lecture/seminar/discussion per week. Synthesis of experiences, content and insights gained during the "Sustaining the Adirondack Park" residential semester, including Capstone research and production of an independent position paper and collaborative comprehensive management plan. Requires concurrent registration with other Sustaining the Park courses. Fall, Newcomb Campus. Prerequisite(s): none. Co-requisites: EFB 411, EST 401, EST 402, EST 403.

EST 407 Assessment for Env Programs (3)

Three hours of lecture per week. This course utilizes systems thinking to identify, critique, and develop innovative approaches and frameworks for evaluation of environmental education and messaging programs. Students will discuss and conduct program evaluation, assessments of knowledge, skills, attitudes and beliefs, program structuring, and theme development. Students will also explore creative approaches such as goal-oriented design, spontaneous interpretation and evaluation, non-verbal communication, and alternative assessments. The course places specific emphasis on planning and evaluation as strategic, interrelated and cyclical activities. Spring.

EST 415 Environmental Justice (3)

Three hours of seminar/discussion per week. This course introduces students to the unique environmental vulnerabilities that marginalized communities are at heightened exposure to, within a multitude of contexts, including: toxics siting, public health disparities and food access. It examines political and economic conditions that promote environmental inequality and explores the history of environmental exploitation of vulnerable populations. Additionally, it evaluates contemporary issues along with community and public responses to threats.

EST 426 Community Plng&Sustainability (3)

Three hours of lecture and demonstration per week. Presents ecological planning and development concepts and theory guiding local and global initiatives for sustainable development. Overlapping themes are considered and linked: the relationship between landscape patterns reflecting wealth, poverty and environmental quality; the role of efficiency in reducing environmental impacts; and the questions of environmental equality, and the quality of development. Fall.

EST 427 Environmental &Energy Auditing (3)

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring. Note: Credit will not be granted for both EST 427 and EST 627.

EST 444 Creative Responses to the Env (3)

Online asynchronous format. Future environmental leaders and educators learn to draw from informal and formal education theory to inspire creativity and facilitate learning. Students

produce audience-centered creative media such as videos, podcasts, children's books, performance pieces, musical compositions, and film scripts, drawing on environmental themes reflecting environmental education pedagogy. Fall.

EST 450 Sustainable Enterprise (3)

Three hours of classroom/presentation per week. Economic, social, and environmental dimensions of sustainability and their interdependence. Influences on organizations to adopt sustainable approaches to operations and activities. Tools to validate organizational sustainability. Transdisciplinary emphasis. Fall. Note: This course is cross-listed at SU School of Management as LPP/SHR 450.

EST 460 Land Use Law (3)

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring. Prerequisites: EST 221 or permission of the instructor. Note: Credit will not be granted for both EST 460 and EST 660.

EST 470 H2O in Middle East:Issues&Opps (3)

Three hours of lecture/discussion per week. Seminar on water issues and initiatives in Israel, Jordan, and the Palestinian Territories. Participants explore a variety of perspectives on the biophysical, historical, and sociocultural roots of transboundary and other water-related issues in the region, as well as an array of top-down (technological, managerial) and bottom-up (community-based, participatory) approaches to developing solutions. Designed for students interested in environmental and natural resource policy, water resources, international relations, conflict resolution, and related fields. Each week, students write short commentaries on required readings; the essays serve as starting point for class discussion. Over the course of the semester, students develop and submit a research paper on a related topic. Spring. Note: Credit will not be granted for both EST 470 and 670.

EST 471 Non-Personal Envrn Interp Meth (3)

Three hours of lecture per week. Applications of environmental interpretation theory and methods applied to nature center programming, science education, and various fields of resource management emphasizing procedures for creating non-personal interpretive media (e.g., brochures, wayside exhibits, etc.). Focus on service-learning through involvement with an outside interpretive agency. Spring. Prerequisite(s): EST 370 or permission of instructor. Note: Credit will not be granted for both EST 471 and EST 671.

EST 472 Natural Hist Museums&Modrn Sci (3)

Three hours lecture per week and one week field trip. Examination of the major roles of contemporary natural history museums as places of research and public education. Emphasis on research, exhibits, collections and programs. Organized instructional visit to natural history museums during a 1-week trip. Travel expenses apply. Prerequisite(s): EST 471 or permission of the instructor

EST 474 Adv Interp&Envrnmntl Education (3)

Three hours of lecture, discussion, and practical exercises per week. This course provides in-depth experience in planning and implementing environmental education and interpretation (EE&I)

programs. Students may receive their Certified Interpretive Guide credential from the National Association for Interpretation. Learners will practice engagement with EE&I community partners, such as parks, nature centers, zoos, non-profit organizations and historical sites. With these partners, students will design and offer EE&I programs and lessons. Advanced readings from the research-based literature will offer critical examination of challenges in EE&I, including climate change education, and diversity, equity, and inclusivity in EE&I. Spring. Prerequisite(s): EST 370 and junior or senior status; or permission of instructor. Note: Credit will not be granted for both EST 474 and 674.

EST 491 Env Studies Field Trip (1-3)

A five- to 10-day trip to visit with: 1) agencies, organizations, or institutions engaged in environmental research, education, communication interpretation, management, or administration; or 2) regions or areas of unusual environmental interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Tuition charges will apply to sections offered during Maymester or other summer sessions. Instructor permission required. Fall, Spring, or Summer.

EST 492 Undergrad Exp/Coll Teach (1-3)

This course is an opportunity for qualified undergraduate students to gain experience in fully supervised, college-level teaching of the type they can expect to perform in graduate school. Students assist the instructor in the preparation and delivery of course materials and preparing laboratories (when applicable). A maximum of 6 credit hours of EST 492, and 3 credit hours relating to any single assisted course, may apply toward graduation requirements. (Fall and Spring). Prerequisites: Previous completion of the course being assisted (with a grade of B or higher), a GPA at ESF of 3.0 or higher, and permission of instructor. Prerequisite: Previous completion of the course being assisted (with a grade of B or higher), a GPA at ESF of 3.0 or higher, and permission of instructor.

EST 493 Envrn Comm Workshop (3)

Three hours of cooperative learning activities, lecture and discussion per week. A workshop format on a specified environmental program or issue introduces the theories and skills of alternative dispute resolution approaches, public participation structures and dynamics, public policy decision making and implementation, risk communication, leadership styles, and small group dynamics. Spring. Prerequisite: Senior status or permission of instructor.

EST 494 Sr. Seminar in Envrn Studies (1)

Two-hour seminar every two weeks. For all seniors in Environmental Studies. Students will prepare portfolios and give capstone presentations on their senior synthesis project and develop career goals and plans. Spring. Prerequisites: Limited to graduating seniors in the Department of Environmental Studies.

EST 495 Sel Readng/Envrn Studies (1-3)

An in-depth and independent exploration of selected readings from the environmentally related literature. Emphasis is placed on gaining insights and understanding from the readings, rather than producing an extensive bibliography. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Approval of study plan by instructor.

EST 496 Spec Topics/Envrn Studies (1-3)

Special topics of current interest to undergraduate students in environmental studies and related fields. A detailed course subject description will be presented as the topic area is identified and developed. Fall, Spring and Summer. Prerequisite: Permission of instructor.

EST 498 Intro Research Problems (1-3)

Guided individual study of an environmental topic. Emphasis is on the study procedure and the methods employed. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Approval of study plan by instructor.

EST 499 Envrn Studies Internship (1-12)

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisites: Environmental Studies senior status and written approval of an internship contract by major professor, curriculum director and field supervisor.

EST 533 Inquiry-Based Science Educatn (3)

An online asynchronous course that engages future science teachers in the methods, learning theories, practices, and instructional approaches relevant to science education. Students learn strategies, master techniques, and gain practice-based experience in fostering inquiry-based, learner-centered classrooms. They also design equitable and authentic science learning experiences for diverse student populations. Students design lessons reflecting educational standards, while using creative approaches to enhance the learning environment. They conduct research, describe, critique, and make recommendations for improving an existing science program. Spring. Credit will not be granted for both EST 333 and EST 533.

EST 550 Envrn Impact Analysis (3)

Three hours of lecture per week. The law, administration and natural/social science basis of the environmental impact assessment process in the federal government and New York state. Fall. Prerequisite: Graduate matriculation or permission of instructor.

EST 555 Public Relations Mgt/Env Profs (3)

Explores the public relations profession from a management perspective. Includes foundations of ethics, law, and theory. Focuses on public relations functions relative to culture and society. Examines professional communication processes and practices. Provides practice in public relations skills of preparing audience-centered materials and managing media relations. Offered online. Fall or Spring. Prerequisite: Graduate students status or permission of instructor.

EST 570 Intro/Pers Env Interp Methods (3)

Two hours of lecture and 2 hours of recitation per week. One required Saturday field trip. Personal interpretation teaches a variety of face-to-face techniques used to connect the public with environmental science by providing an introduction to history of interpretation, popular interpretive and environmental education activities and curriculum, evaluation of programs, and lesson plans. Explores and illustrates the research and philosophy of environmental interpretation. Discuss interpretive research, plan and lead lectures, and mentor/ evaluate

undergraduates. Fall. Prerequisite(s): Graduate standing, or permission of instructor Note: Credit will not be granted for both EST 370 and EST 570.

EST 573 Electrn Tech/Interp&Envrn Educ (3)

Three hours of lecture per week. Explores research and practice in the use of electronic technologies in interpretive fields and environmental science fields. Demonstrates techniques used to engage the public with cultural and natural resources. Even years. Spring. Prerequisite(s): EST 370 or EST 570; junior, senior, or graduate standing.

EST 600 Foundations/Envrnmntl Studies (3)

Three hours of lecture/discussion per week. Examines frameworks for understanding and solving environmental problems. Familiarizes students with the epistemological foundations of environment-society relations. Considers multiple methodological and analytical strategies. Uses a case study method to exemplify key principles. Fall. Prerequisites: Undergraduate courses in general ecology, environmental science and policy or communication theory.

EST 603 Research Methods and Design (3)

Three hours of lecture/discussion per week. Comprehensive survey of research methods and design for Environmental Studies. Topics covered include the scientific method; research design; quantitative, qualitative, and mixed research methods; sampling; data collection techniques; data analysis and interpretation; research ethics; and research proposal development. Fall.

EST 604 Survey Research Methods (3)

Three hours of lecture and discussion per week. Provides a critical overview of survey methods used to study human dimension of environmental problems. Explores fundamental theories, techniques, and applications of environmentally related social survey research processes. Design of original survey research and critical assessment of existing research. Spring. Prerequisite: Undergraduate basic statistics course.

EST 605 Qualitative Methods (3)

Three hours of lecture and discussion per week. Survey of the generally recognized paradigms and methods that qualitative researchers use to better understand, evaluate, and perhaps influence complex social phenomenon. Research proposal, pilot study, final report and oral presentation required. Spring.

EST 606 Envrn Risk Perceptn/Comm&Pol (3)

Online. Scientific and technological advancements entail both benefits and risks. How people perceive those benefits and risks will influence their acceptance or rejection of specific advances. In this research seminar you will learn about the factors that influence people's perception of risk, science and environmental change, and learn how communication shapes the possibilities for dialog and decision making. In this course you will be part of a research team, defining and carrying out a research project. Spring.

EST 608 Env Adv Camp & Conflict Res (3)

Online. Addresses complex dynamics, strategies, and tactics of (1) organized campaigns by grassroots to international organizations to advocate for particular environmental policy, and (2) processes that seek to resolve, manage, or prevent environmental conflicts when appropriate.

The course includes synchronous and asynchronous discussions, readings, simulation activities, case study assessments, and semester-long research projects. Fall.

EST 609 Collaborative Governance Proc (3)

Intensive study in early January. Introduces the evolution of innovative multi-stakeholder processes that characterize collaborative governance (CG). Distinguishes CG from traditional public involvement and dispute resolution approaches, and explores its challenges and opportunities. Provides knowledge and introductory tools to design and be more productive participants in collaborative processes. Spring.

EST 612 Environmntl Policy &Governance (3)

Online. Three hours of lecture and related activities. Examination of the dynamic relationships present in the creation and implementation of environmental policies. Considers the roles of the state, the private sector, and nongovernmental organizations. Explores background and implications of recent trends in environmental governance. Spring

EST 613 Urbanization & the Environment (3)

This course provides a foundation for researching and writing about the social, political, economic, and material aspects of urban infrastructures and networks, resource development, urban environmental governance and decision-making as well as the practices of urban planners, engineers, and scientists in shaping urban space and processes. Spring.

EST 615 Environmental Justice (3)

Online. This course provides legal, policy and management tools to understand and advance environmental justice. The approach is interdisciplinary and includes analytical tools used in geography, environmental and public health, policy and law, and critical race theory. The course will expose students to the unique environmental vulnerabilities that marginalized communities are at heightened exposure to, including toxics siting, public health disparities and food access, while featuring pathways towards building sustainable and just societies. Fall.

EST 616 Global Persp on Env Justice (3)

Online. This course examines environmental and social justice conflicts from a global/ international perspective. We discuss distributional justice issues of hazardous waste sites around the world and related procedural injustices in siting, operation, and human rights concerns. Through case studies and research, students analyze crucial processes and relations generating environmental inequalities at different scales and investigate how economies' extractive activities generate conflicts and resistance across the world. Learning activities include participating on a course discussion board, conducting interviews, engaging in media analyses, peer review, mini group projects, journal reflections, and a final presentation. Spring.

EST 617 Measuring Envrnmntl Inequality (3)

Online. This graduate-level, seminar-style course focuses on how environmental inequalities are operationalized and measured in research and public policy contexts. The methods of measuring environmental inequality are based on what is necessary to move toward a world with socially and environmentally equitable outcomes: engagement with and cultivation of community capacity to understand and respond to environmental concerns; collaboration based on morally and empirically sound principles; and making a visible and positive difference for communities. Utilizing synchronous and asynchronous methods, this course reviews contributions by

community-based and thought leaders; frameworks for structuring and maintaining community ties; and ethical considerations for working with indigenous and other historically colonized communities. It offers examples of operationalization with a focus on public health research. Spring.

EST 624 Nature,Recreation and Society (3)

Three hours of lecture/discussion per week. Introduces students to the theoretical underpinnings of tourism studies, and how "naturalness" contributes to the generation of environmental meaning. The course will examine linkages between society, recreation, tourism, and nature, and will attend to such concepts as sense of place, experience, power, and perception as they relate to nature and recreation. These concepts provide useful entry points into more critical investigations of tourism and recreation practices and motivations, and serve as points of departure for conversations about eco-imperialism, green-washing, and the marginalization and dispossession of local populations. Discussion related to the aforementioned critical investigations will be paired with attention to the experiential side of recreation, tourism, and nature. That is, how the act of pursuing nature and related natural adventure contributes to the development of identity, our knowledge of the reciprocal

EST 627 Environmental &Energy Auditing (3)

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring. Note: Credit will not be granted for both EST 427 and EST 627.

EST 635 Pub Part&Decision Making (3)

Online. Three hours of lecture/discussion, groupwork, and related learning activities. Provides a student with fundamental theories and techniques for developing and applying citizen participation strategies as they relate to environmental decision-making. Spring

EST 640 Envrn Thought and Ethics (3)

Online. 3 hours of lecture and discussion. Concepts and tools of environmental philosophy and ethics, with a focus on application to current issues in environmental problem-solving. Special attention to the role of language in questions of environmental ethics and decision making. Fall.

EST 645 Mass Media&Envrn Affairs (3)

Three hours of discussion per week. Introduces the mass media's role in environmental affairs. Relationships between media organizations, technology, content, and audiences frame examination of how nature and environmental issues and problems are engaged by the media and with what consequences. News and current affairs, advertising and entertainment genres are considered. Fall.

EST 650 Envrn Perception&Human Behavr (3)

Three hours of lecture and discussion per week. Application of environmental perception and human behavior paradigms and theories in understanding the causes and potential solution strategies to environmental issues. Interdisciplinary approach utilizes concepts, theories and research from disciplines including environmental psychology, sociology, anthropology,

and risk perception to understand the myriad influences on human behavior as it relates to environmental impacts. Spring.

EST 652 Managing Sustainability (3)

Three hours of lecture, discussion, and/or field trips per week. Dynamics and interdependence of economic, social, and environmental systems. Sustainable management frameworks, tools, and metrics. Local, national, and international implications. Relevance of technology, ethics, law, and policy. Interdisciplinary emphasis. At least 1X Fall or Spring.

EST 660 Land Use Law (3)

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York, in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring.

EST 670 H2O in Middle East:Issues&Opps (3)

Three hours of lecture/discussion per week. Seminar on water issues and initiatives in Israel, Jordan, and the Palestinian Territories. Participants explore a variety of perspectives on the biophysical, historical, and sociocultural roots of transboundary and other water-related issues in the region, as well as an array of top-down (technological, managerial) and bottom-up (community-based, participatory) approaches to developing solutions. Designed for graduate students in environmental and natural resource policy, water resources, international relations, conflict resolution, and related fields. Each week, graduate students write short critical commentaries on required readings; the essays serve as starting point for class discussion. Over the course of the semester, students develop and submit a research paper on a related topic. Spring. Note: Credit will not be granted for both EST 670 and 470.

EST 671 Non-Personal Envrn Interp Meth (3)

Three hours of lecture per week. Applications of environmental interpretation theory and methods applied to nature center programming, science education, and various fields of resource management emphasizing procedures for creating non-personal interpretive media (e.g., brochures, wayside exhibits, etc.). Focus on service-learning through involvement with an outside interpretive agency. Submit an interpretive article for publication, read and hold online discussions of research on hon-personal interpretation, and evaluate local interpretive media. Spring. Prerequisite(s): EST 570 or permission of instructor. Note: Credit will not be granted for both EST 471 and EST 671.

EST 674 Adv Interp&Envrnmntl Education (3)

Three hours of lecture, discussion, and practical exercises per week. This course provides in-depth experience in planning and implementing environmental education and interpretation (EE&I) programs. Students may receive their Certified Interpretive Guide credential from the National Association for Interpretation. Learners will serve as facilitative leaders for team engagement with EE&I community partners, such as parks, nature centers, zoos, non-profit organizations and historical sites. With these partners, students will design and offer EE&I programs and lessons. Students will prepare case studies to present advanced readings from the research-based literature regarding critical challenges in EE&I, including climate change education, and diversity, equity, and inclusivity in EE&I. Spring. Prerequisite(s): EST 570 and graduate standing; or permission of instructor. Note: Credit will not be granted for both EST 474 and 674.

EST 690 Internat'l Env Policy Consult (3-4)

Group research practicum. An innovative, collaborative, applied course and practicum in environmental policy consultation at the global level. May be linked via digital/ online technology with students in a parallel course at another, international institution. Students engage in a semester-long, consultancy project with an international organization engaged in environmental policymaking. Client organization and topic may vary annually. Students learn group consulting skills including issue definition and stakeholder identification; proposal preparation, team building and leadership skills; data collection, analysis and interpretation; report writing and presentation skills. Students fulfill the client's Terms of Reference, producing and delivering contributions towards final, agreed-upon deliverables. Fall or Spring. Instructor's permission required.

EST 691 Env Studies Field Trip (1-3)

A five- to 10-day trip to visit with: 1) agencies, organizations, or institutions engaged in environmental research, education, communication interpretation, management, or administration; or 2) regions or areas of unusual environmental interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Tuition charges will apply to sections offered during Maymester or other summer sessions. Instructor permission required. Fall, Spring, or Summer.

EST 695 Environmental Journalism (3)

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Spring.

EST 696 Spec Topics/Envrn Studies (1-3)

One to three hours of lecture and discussion per week. Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate students not covered in regularly scheduled courses. Fall and Spring.

EST 702 Env&Nat Res Prog Eval (3)

Three hours of lecture and discussion per week. The systematic analysis of public environmental programs with an emphasis on the evaluation of resultant environmental outcomes. Topics include evaluation contexts, objective setting, environmental monitoring, and analysis of agency organization and procedures. Spring.

EST 705 Environmental Policy Analysis (3)

Three hours of lecture/discussion per week. This course covers current and classic literature in environmental policy analysis, as well as a variety of approaches to policy analysis that are relevant for working through complex environmental issues. While tools and methods for policy analysis will be treated, the overall intention of the course is to provide students with the scholarly background to think analytically, critically, and creatively across a variety of environmental policy contexts. Fall. Prerequisite(s): A graduate-level course in environmental policy.

EST 708 Environment and Society (3)

Three hours of seminar/discussion per week This course is an advanced graduate seminar that covers social theory related to the environment. Students will be exposed to foundational literature in environmental sociology in the first part of the course, after which other social science literatures will be explored that analyze the relationship between environment and society, such as Political Ecology, Environment and Citizenship, Environmental Governance, Geographies of Energy, Sustainability Indicators and Standards, Ecological Modernization, and Environmental Justice, among others. Environmental issues and scholarship from both industrialized and developing country contexts, and that represent a variety of social science disciplinary perspectives, will be discussed. Spring. Prerequisite(s): EST 600 or consent of instructor.

EST 759 Sustainability-Driven Enterprs (3)

Three hours of project meetings and/or workshops per week. CAS in Sustainable Enterprise capstone. Sustainable approaches to complex organizational challenges, opportunities: organizational, industry, stakeholder analysis, sustainability objectives, strategies, and metrics. Multidisciplinary team consulting project. At least 1X Fall or Spring. Prerequisites: EST 652/ECS 650/BUA 650 and ECS 651/BUA 651

EST 770 Regen Approaches Sust Futures (3)

Three hours of seminar per week. A transdisciplinary approach to understand the interface of human and ecological systems, includes concepts and methods of ecologists, economists, and social scientists. Focus is on historical, conceptual and epistemological foundations. Draws on contemporary economic and policy thought, evolutionary biology, ecology, systems theory, social psychology, and environmental ethics. Spring.

EST 796 Adv Topics/Envrn Studies (1-3)

One to three hours of classroom instruction per week. Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest to environmental studies faculty and graduate students. Fall and Spring.

EST 797 Envrn Studies Seminar (1-3)

One to three hours of classroom instruction/discussion per week. Discussion of current topics and research related to environmental studies. Fall and Spring.

EST 798 Problems/Envrn Studies (1-3)

One to three hours of supervised individual activity per week. Individualized, special study of environmental studies subjects and issues. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Comprehensive oral or written report required for some problems. Fall, Spring and Summer.

EST 898 Professional Experience (1-12)

Variable number of hours of professional experience per week. Professional experience which applies, enriches and/or complements formal coursework. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Graded on an "S/U" basis. Fall, Spring, and Summer.

EST 899 Masters Thesis Research (1-12)

One to 12 hours of supervised individual activity per week. Research and independent study for the master's degree and thesis. Fall, Spring, and Summer.

EST 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

EWP - ENVIRONMENTAL WRITING PROGRAM

EWP 190 Writing And The Envrnment (3)

Three hours of lecture, discussion, and workshops per week. Introduction to the conventions and skills of academic writing and oral communication, including critical thinking and reading, summary, research, analysis, informed argument, information literacy, oral response to texts and topics, and synthesis. The course includes frequent informal writing and oral communications assignments and formal writing projects requiring revision.

EWP 220 Public Presentation Skills (2-3)

Development of skills and fluency needed by environmental professionals in preparing,delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall/Spring

EWP 222 Presentation Skills/Managers (2)

Three hours of lecture/discussion per week for 10 weeks. Development of skills needed by managers in preparing, delivering, and evaluating oral presentations for the professional workplace. Includes instruction on preparation and implementation of effective visual aids. Strategies for facilitating small group discussions and developing listening skills are emphasized. Fall.

EWP 290 Research Writing & Humanities (3)

Three hours of discussion and group work per week. Intended for students who have had an introductory writing course. Students will examine the views of nature and the environment as they are expressed by selected writers, poets, and essayists. Frequent informal and formal writing assignments, research and documentation, and an oral presentation are required. With an emphasis on critical writing, critical thinking, and critical reading, students will learn the literacy expectations of their disciplines. Spring. Prerequisite(s): EWP 190 or equivalent.

EWP 296 Spec Topics/Wrt,Lit&Pub Presnt (1-3)

Experimental, interdisciplinary or special course work at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

EWP 300 Survey/Environmental Writing (3)

Three hours of classroom instruction per week. Students will explore forms of environmental writing including but not limited to journalism, poetry, memoir, field notes, historical research, natural histories and polemics. Students will analyze these writings rhetorically and create a range of texts including creative pieces, factually-based reporting, nature writing, and writing about science. Fall/Spring. Prerequisites: EWP 190 and EWP 290.

EWP 311 Urban Environmental Literature (3)

Three hours of discussion and lecture per week. A writing-intensive literature course designed to develop reading, writing, and critical thinking skills. We will be reading contemporary urban-based nature literature, both prose and poetry, and analyzing those works through the lens of ecocritcism. Spring.

EWP 350 Eco-Cinema:Perspct&Pract (3)

Three hours of lecture/discussion and two-hour film screening each week. Environmental films are interpreted from cultural, historical, and political perspectives. The artistic process in filmmaking is emphasized. Students produce a short film or slide show with an environmental theme. Fall. Prerequisites: EWP 190 and EWP 290 or Equivalent

EWP 390 Literature of Nature (3)

Three hours of discussion and lecture per week. Examination of views of nature and the environment as seen through works of 19th and 20th century writers, poets, and essayists. Readings, discussions, and written assignments explore aesthetics, socio-political climate, and prevailing attitudes toward the environment that formed the backdrop for readings. Fall and Spring.

EWP 401 Capstone Experience (3)

Experiential learning for the Environmental Writing & Rhetoric (EWR) minor through a writing project based on a) a community-based internship b) tutoring or completing special project in the Writing Resource Center, or c) an independent creative writing project. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring. Prerequisites: Student must be registered for the EWR minor.

EWP 407 Writing/Env & Sci Professionls (3)

Three hours of lecture, discussion, and workshops per week. Focuses on principles and practice of writing skills required of environmental and science professionals. Emphasizes proficiency in determining purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely, and effectively. Fall and Spring. Prerequisite: EWP 290 and junior or senior status

EWP 420 Advanced Public Presntatn Skls (3)

Three hours of lecture/discussion/student presentations per week. Emphasizes both theory and practice in effectively delivering, interpreting, and responding to public presentations. Social, cultural, and political dimensions of public address are examined. Issues of diversity and power are discussed. Small group communication is viewed as a site for creative problem-solving. Audience analysis, adaptation, strategic arrangement, and concept development are explored. Fall and Spring. Prerequisite(s): EWP 220 or permission of instructor.

EWP 444 Prof Writing/Paper&Bioproc Eng (2)

Two hours of lecture, discussion, and workshops per week for 10 Weeks. Emphasizes writing practices required of paper and bioprocess engineers, including proposals and technical reports. Develop proficiency in determining the purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Fall.

EWP 450 Digital Storytelling (3)

Three hours per week. Lecture, practice, application of technical skills for shooting photographs and video, recording audio, digital communication skills and storytelling techniques. Design and production of digital media, including videos and podcasts, script writing and storyboarding for digital products that tell science and environmental stories. Fall and Spring.

EWP 490 Contemporary Literature/Nature (3)

Three hours of discussion and lecture per week. This writing-intensive literature course takes an ecocritical approach to nature literature, both poetry and prose, written by contemporary authors. Coverage includes ecofeminism, science literature, and native American literature. Spring.

EWP 494 Creative Non-Fiction/Sciences (3)

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring. Prerequisite: EWP 190. Note: Credit will not be granted for both EWP 494 and EWP 694.

EWP 495 Environmental Journalism (3)

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Fall.

EWP 496 Special Topics (1-3)

Special topics of current interest to undergraduate students in writing, literature, and public presentation skills. A detailed course description will be presented as the topics area is identified and developed. Fall and Spring.

EWP 498 Independent Study (1-3)

Guided individual study of a topic in composition, literature and public presentation skills. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring.

EWP 597 Graduate Scholarly Writing (3)

Students learn advanced writing principles to produce a proposal, thesis, dissertation, or manuscript. Topics include the writing process, use of sources, and graphics. Scholarly writing style and mechanics are discussed with emphasis on organization, clarity, and conciseness. Spring.

EWP 620 Adv Public Pres Skls/Envrn Prf (3)

Three hours of lecture per week. Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall/Spring.

EWP 694 Creative Non-Fiction/Sciences (3)

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring. Note: Credit will not be granted for both EWP 494 and EWP 694.

FCH - CHEMISTRY

FCH 110 Survey of Chemical Principles (3)

Three hours of lecture per week. An introduction to chemistry organized around physical and chemical properties of matter. Emphasizes the atomic structure of elements, bonds in chemical compounds, atomic ratios in molecules as the basis for the stoichiometry of reactions, ionic and organic compounds, chemical reactivity, kinetics and thermodynamics. Fall.

FCH 111 Survey/Chemical Principles Lab (1)

FCH 111. Survey of Chemical Principles Laboratory. (1) Three hours of laboratory per week. Basic and applied laboratory techniques will be emphasized through experiments dealing with: the density of solids and liquids, stoichiometry, calorimetry, chemical reactivity, gas laws, kinetics, acid/base chemistry, and organic chemistry. Fall. Corequisite: FCH110

FCH 132 Orientation Seminar:FCH (1)

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success. Introduction to chemistry as a field of inquiry. Introduction to laboratory safety. Fall.

FCH 150 General Chemistry I (3)

Three hours of lecture per week. This first semester general chemistry course is organized around the physical and chemical properties of matter. It introduces the atomic structure of elements, the kinds of bonds in chemical compounds, how atomic ratios in molecules form the basis for the stoichiometry of reactions, begins a treatment of thermodynamics and discusses the principles of chemical reactivity. Fall. Prerequisite(s): APM 104 (may be taken concurrently) or equivalent (ex. Precalculus).

FCH 151 General Chemistry I Lab (1)

Three hours of laboratory per week. Basic laboratory techniques will be emphasized through experiments dealing with the density of solids and liquids, atomic ratios and mass combining ratios, atomic structure and the periodic table, calorimetry, chemical reactivity, geometric structure of molecules, formation of coordination compounds, and paper chromatography. Fall. Corequisite: FCH 150.

FCH 152 General Chemistry II (3)

Three hours of lecture. The second course in general chemistry continues the development of chemical reactivity by focusing on chemical kinetics and chemical equilibrium. Aqueous phase processes are emphasized and are applied to precipitation and solubility equilibria, acid/base dissociation phenomena, and fundamental electrochemical reactions. Spring. Prerequisite: FCH 150 and APM 104 (or equivalent (minimum Precalculus)).

FCH 153 General Chemistry II Lab (1)

Three hours of laboratory per week. Concepts of chemical kinetics and equilibrium processes will be reinforced through experiments in titrimetric analyses, determinations of Ka and Ksp values, investigation of rate constants and reaction orders, buffer preparations, oxidation/reduction reactions and qualitative analyses. Spring. Prerequisites: FCH 150, FCH 151. Co-requisite: FCH 152.

FCH 210 Elements Of Organic Chem (4)

Three hours of lecture and four hours of laboratory per week including pre-laboratory instruction. Nomenclature, preparation, and important reactions of functional groups and classes of organic compounds including examples relevant to biology. Isomerism and stereochemistry topics of biomolecules. Quantitative study of weak acids and weak bases. Laboratory techniques include compound manipulations, extractions, distillations, chromatography, synthesis, and calculation of yields. Spring. Prerequisite: One year of General Chemistry.

FCH 221 Organic Chemistry 1 (3)

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 223, this course provides a full survey of common classes of carbon compounds. Fall. Prerequisite: FCH 150, FCH 151, FCH 152, FCH 153.

FCH 222 Organic Chemistry Lab 1 (1)

Four hours of laboratory including pre-laboratory instruction per week. Laboratory safety. Melting and boiling points, distillation, recrystallization, thin-layer and column chromatography, isolation of natural products, organic synthesis and spectroscopy. Fall. Co-requisite: FCH 221.

FCH 223 Organic Chemistry II (3)

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 221, this course provides a full survey of common classes of carbon compounds. Spring. Prerequisite: FCH 221.

FCH 224 Organic Chemistry Lab II (1)

Four hours of laboratory including pre-laboratory instruction per week. Continuation of FCH 222. Simple physical and instrumental techniques applied to organic chemistry. Gas chromatography, polarimetry, spectroscopy. Introduction to classical literature synthesis. Topics from natural products chemistry including chemical ecology, biomimetic synthesis, and the synthesis of an anticancer drug from birch bark. Spring. Prerequisite: FCH 222. Co-requisite: FCH 223.

FCH 232 Career Skills for Chemists (1)

One hour of lecture per week. The objective of this course is to introduce a variety of important skills required for student success and, ultimately, career development as a practicing chemist. These skills include: Information literacy (library literature searching), communication (writing, presenting), ethics in science and academic integrity, finding employment and internships (resume and letter writing, interviewing skills). In addition, student will learn more about the B.S. Chemistry curriculum to set the stage for their choice of an "option" (Biochem, Polymer Chem, Environmental Chem. or ACS certified option) within the Chemistry Major. Fall

FCH 290 Chem Teach Asst Exp/Undergrads (1-3)

Undergraduate students will gain experience with the management, evaluation and assessment of undergraduate courses in chemistry. Assistants will assist the instructor with course activities and mentor students on how to succeed in the respective course. Teaching Assistant responsibilities vary by section and instructor. Fall and Spring. Prerequisite(s): Consent of Instructor.

FCH 296 Special Topics in Chemistry (1-3)

Experimental, interdisciplinary or special course work at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall and Spring.

FCH 325 Organic Chemistry III (4)

Two hours of lecture, one six-hour laboratory per week. Classical and recent literature synthesis or organic compounds, employing advanced techniques. Fall. Prerequisite: Two semesters of elementary organic chemistry.

FCH 360 Physical Chemistry I (3)

Three hours of lecture per week. An introduction to the properties of gases and liquids, the laws of thermodynamics, phases, phase transitions, solutions and colligative properties, electrochemistry, and reaction equilibria. Fall. Prerequisite(s): MAT 295 and 296, and PHY 211 and 212, or their equivalents.

FCH 361 Physical Chemistry II (3)

Three hours of lecture per week. Includes discussion on principles of quantum mechanics, chemical kinetics, and basic spectroscopy. Spring. Prerequisite: FCH 360.

FCH 380 Analytical Chemistry I (2)

Two hours of lecture per week. This course will cover how to use basic statistics to report analytical data, evaluate data for quality, and identify common types of error; the underlying theoretical principles and important practical applications of chemical equilibrium in acid/base, complexometric, redox, and precipitation titrations; and solution behavior using electrochemical methods including potentiometry and ion-selective electrodes. Fall.

FCH 381 Analytical Chemistry II (3)

Two hours of lecture and one three-hour laboratory per week. Theory and practice of technology applications to UV/VIS, AAS, AES, XES, ASV, GLC and HPLC. Spring. Prerequisites: Two years of undergraduate chemistry and FCH 380, FCH 361 taken concurrently or permission of instructor.

FCH 382 Analytical Chemistry I Lab (1)

One three hour laboratory per week. Laboratory experiments will focus on: analyzing and interpreting the results of a chemical analysis and effectively communicate these results in written reports and other formats; and accurately and precisely using volumetric methods of chemical analyses to determine the concentrations of analytes in a solution. An emphasis will be placed on making serial dilutions, creating buffers, and performing titrations. Fall. Pre-requisite: General Chemistry I & II. Co-requisite: FCH 380.

FCH 390 Drugs From The Wild (3)

Three hours of lecture and discussion per week. This course is designed to give students a comprehensive understanding of the variety of medicinal agents available from natural sources. Economic and societal aspects will be explored as well as scientific ones. In addition to curative agents, discussions will include toxic substances, folk medicinal (including herbal) preparations, and the so-called "recreational drugs." Spring, odd years. Prerequisites: Introductory courses in chemistry and biology.

FCH 399 Intro/Atmospheric Sciences (3)

Three hours of lecture and discussions per week. Atmospheric composition, mass and structure; solar radiation and the global energy budget; atmospheric moisture budget, cloud and precipitation; photolysis, gas-phase oxidation, aqueous chemistry, and gas-to-particle conversion; physical and chemical mechanisms driving environment phenomena such as acid rain, the greenhouse effect, the ozone hole, remote and urban air pollution, and haze. Prerequisite(s): General physics I, 1 year each of general chemistry and calculus. Co-requisite(s): General physics II.

FCH 410 Inorganic Chemistry (3)

Three hours of lecture and/or studio per week. This course serves as an introduction to the bonding, structure and reactivity of transition metals and main group elements. Topics will include but are not limited to covalent molecular structures, coordination chemistry, organometallic chemistry, catalysis, bioinorganic chemistry and solid state materials. The studio component focuses on the inorganic chemistry of artistic materials and traditional inorganic chemistry experiments. Fall. Prerequisite: One year of general chemistry, one year of organic chemistry.

FCH 430 Biochemistry I (3)

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. Credit will not be granted for both FCH 430 and FCH 530. Fall. Prerequisites: FCH150, FCH151, FCH221, FCH223 or equivalents.

FCH 431 Biochemistry Laboratory (3)

Two hours lecture and 6 hours of laboratory per week on the basic techniques used in biochemical research with an emphasis on proteins and enzymes. Techniques include spectrometry, chromatography, electrophoresis, amino acid analysis, coupled assays, and the isolation and characterization of enzymes. Credit cannot be given for both FCH 431 and FCH 531. Fall. Prerequisites: FCH150, FCH152,FCH221, and FCH223 or equivalents.

FCH 432 Biochemistry II (3)

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis. Credit will not be given for both FCH 432 and FCH 532. Spring. Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH430 or equivalents.

FCH 495 Intro/Professional Chem (1)

The professional chemist's relationship with industry, government and universities. Employment opportunities for the chemist, professional organizations and unions will be discussed. The selection of a senior research topic and a literature survey will be required. Fall. Prerequisite: Senior status.

FCH 496 Special Problems In Chem (1-3)

An opportunity for a special problem, technique development, independent or unstructured study in an area related to the chemical profession. The work may be technical, professional, or interdisciplinary. Advisors outside this department may be solicited. A brief proposal must be presented for approval with specific arrangements outlined including faculty advisor and objectives of the study. Students shall report their activities to their instructor on a weekly basis for the duration of the course. A written report will be expected. Fall and Spring. Prerequisite: Upper-division status.

FCH 497 Undergraduate Seminar (1)

One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

FCH 498 Introduction To Research (1-5)

3-4 hours per credit per week of laboratory and library research and report writing. Solution of a selected research problem using specialized techniques. A written report on data, procedures, results and conclusions. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring. Prerequisites: None. This course is the Senior Research requirement for all FCH undergraduates, of which five (5) credits are required in total.

FCH 502 Research Ethics (1)

One 55 minute class meeting per week. Discussions on the ethical responsibilities of being a scientific researcher. These in-depth discussions will focus on the following topics: conflicts of interest, safe laboratory practices, policies regarding human subjects and animal work, mentor/mentee responsibilities, peer review, research misconduct, responsible authorship and publication, and data sharing and ownership. Spring.

FCH 510 Environmental Chemistry I (3)

Three hours of lecture per week. Introduction to the processes that control chemical behavior in aquatic environments, including precipitation, dissolution, gas exchange, acid-base, oxidation-reduction, complexation and adsorption reactions. Emphasis will be on explanation and prediction of chemical behavior. Examples will be from the areas of fresh and marine waters, groundwater, wastewater, and geo-chemistry. Spring. Prerequisites: An introductory course in physical chemistry is required.

FCH 511 Atmospheric Chemistry (3)

Three hours of lecture/discussion per week. Graduate-level course in atmospheric chemistry. Atmospheric structure and composition. Catalytic cycles of ozone destruction and formation. Kinetic analysis of atmospheric reactions in gas and aqueous phase. Aerosols. Global climate change. Oxidation of sulfur oxides and nitrogen oxides. Fall. Prerequisite: One year of undergraduate physical chemistry or permission of instructor.

FCH 515 Meth/Envrn Chem Analysis (3)

One hour of lecture and six hours of laboratory per week. An introduction to sampling, analytical and quality control procedures necessary to obtain reliable water quality data. All analyses will be performed on a single aquatic system with the purpose of developing a final report characterizing the water quality of that system. Fall. Prerequisite: A course in quantitative chemical analysis.

FCH 520 Marine Biogeochemistry (3)

Three hours of lecture per week. Advanced level course for seniors and graduate students. Biogeochemistry of major ocean systems including coastal and pelagic environments. Chemical, biological, and geological approaches to understanding the functioning of the ocean will be covered. Fall (Even years only). Prerequisite(s): FCH 150, 152; EFB 101, 103; APM 205, 206 or equivalent.

FCH 524 Topics Nat Product Chem (3)

Three hours of lecture and discussion per week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

FCH 525 Oceanography (3)

Three lecture hours per week. Advanced-level course intended for seniors and entry-level graduate students. The four main oceanographic disciplines will be covered including physical, chemical, biological and geological oceanography. This course will highlight the interdisciplinary nature of oceanography and its importance in earth system dynamics such as energy and climate. Spring. Prerequisite(s): FCH 150, 152; EFB 101, 103; PHY211, 212 or equivalent.

FCH 530 Biochemistry I (3)

Three hours of lecture per week. General biochemistry with emphasis on the chemistry of amino acids, proteins, and nucleic acids. The first half of the course will cover the chemistry of amino acids, proteins, and protein structure. The second half of the course will be an introduction to nucleic acid structure and function. This course requires critical review of current topics in Biochemistry not required in FCH 430. Fall. Prerequisite: FCH150, FCH151, FCH221, FCH223 or equivalents.

FCH 531 Biochemistry Laboratory (3)

Two hours lecture and 6 hours of laboratory per week on the basic techniques used in biochemical research with an emphasis on proteins and enzymes. Techniques include spectrometry, chromatography, electrophoresis, amino acid analysis, coupled assays, and the isolation and characterization of enzymes. This course requires critical review of current topics in Biochemistry not required in FCH 431. Fall. Prerequisites: FCH150, FCH152, FCH221, and FCH223 or equivalents. Co-requisite: FCH530 or permission of instructor.

FCH 532 Biochemistry II (3)

Three hours of lecture per week. Topics discussed are: Biochemistry of metabolism, sugars, polysaccharides, glycolysis, pentose phosphate pathway, glycogen formation, gluconeogenesis, glyoxylate shunt, TCA cycle, electron transport and oxidative phosphorylation, fats, fatty acid metabolism, amino acid metabolism, purine and pyrimidine metabolism, and photosynthesis.

This course requires critical review of current topics in Biochemistry not required in FCH 432. Spring. Prerequisites: FCH150, FCH151, FCH221, FCH223, and FCH530 or equivalents.

FCH 550 Polymer Sci:Synth&Mech (3)

Three hours of lecture per week. Introduction to the synthesis of polymers and the mechanism of polymerization processes. Fundamental principles of polymer chemistry. Step-growth polymerization and network formation (theory of gelation). Chain-growth homopolymerization and copolymerization by radical-, ionic-, and coordination type catalysts. Synthesis of block and graft copolymers. Structure of polymers and their application. Polymers and the environment, polymer recycling. Fall. Prerequisites: One year of organic chemistry and one year of physical chemistry.

FCH 551 Polymer Techniques (3)

Two hours of lecture/discussion and four hours of laboratory per week; laboratory reports, final exam. Twelve experiments covering the main topics of polymer synthesis (four weeks), molecular weight determination (four weeks), and characterization (four weeks) are selected from areas such as the following: free-radical solution, bulk and emulsion polymerizations; ionic and condensation polymerizations, copolymerization and reactivity ratio determination; osmometry, viscometry, light scattering, gel permeation chromatography, polarized light microscopy, X-ray diffraction, differential scanning calorimetry, thermogravimetric analysis, dynamic mechanical analysis, stress-strain analysis; nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy, ultraviolet/visible spectroscopy. The lecture component will include discussions of the laboratory activities as well as related topics such as the preparation of monomers, safe handling methods for monomers, polymers, solv

FCH 552 Polymer Sci:Prop&Tech (3)

Three hours of lecture per week. Introduction to physical chemistry, physics, processing and technology of synthetic polymers. Polymer solutions, including molecular weight determinations, chain statistics, and thermodynamics. Polymer solid states, including rubber elasticity, viscoelasticity, the glassy state and the crystalline state. Properties, processing, and technology of films, fibers, elastomers, and composites. Spring. Prerequisites: One year of organic chemistry and one year of physical chemistry.

FCH 560 Chromatog/Separation Tech (3)

Three hours of lecture and discussion per week. A course designed to give the student a thorough understanding of analytical and isolation chemistry by modern chromatographic, distributive and molecular sieving techniques. The chemistry of the systems discussed will be stressed as well as the important physical aspects. Spring of even years. Prerequisites: Two semesters each of organic and general chemistry.

FCH 584 Spectro ID/Organic Compounds (3)

Three hours of lecture and discussion per week. The first-half semester will deal with common classes of organic compounds; the second-half semester will deal with more complex structures and introduce 2-dimensional NMR techniques. The use of complementary information from mass, infrared, nuclear magnetic resonance and ultraviolet spectrometry will be applied to identification of organic natural products. Fall. Prerequisites: One year of Organic Chemistry.

FCH 610 Air Quality (3)

Three hours of lecture and discussion per week. Pollution emissions; atmospheric photochemistry; dynamic/physical mechanisms; dynamic/physical-chemistry interactions; measurement campaigns; major chemical and meteorological databases; numerical modeling tools (box models, meteorological models, photochemical models); model uncertainties and evaluation; model application. Spring. Prerequisite: FCH 511 Atmospheric Chemistry or by instructor's permission

FCH 620 Chemical Kinetics (3)

Three hours of lecture/discussion per week. Graduate course in chemical kinetics. Building rate laws and analyzing experimental data. Transition state and RRKM theories. Kinetics in the aqueous phase and on surfaces. Kinetic modeling of complex reaction systems. Analysis of published papers in chemical kinetics. Spring of alternating years. Prerequisites: 1 year undergraduate physical chemistry.

FCH 630 Plant Biochemistry (3)

Three hours of lecture and discussion per week. Includes the biochemistry of photosynthetic electron transport and phosphorylation, photosynthetic carbon fixation, photorespiration, nitrogen fixation, nitrate reduction, photochrome, and plant hormones. The economic, ecological and environmental aspects of plant biochemistry will also be discussed. Spring. Prerequisites: FCH 530, FCH 532.

FCH 650 Stat Phys&Chem/Macromolecule (3)

Three hours of lecture per week. Topics to be discussed are chain statistics, polymer thermodynamics, scaling theory, colloidal particles, viscoelasticity and the glass transition. Spring, even years. Prerequisites: FCH 360 and FCH 552 or equivalent; consent of instructor.

FCH 796 Special Topics In Chem (1-3)

Lectures, conferences and discussion. Advanced topics in physical chemistry, organic chemistry or biochemistry. Fall and Spring.

FCH 797 Graduate Seminar (1)

Presentation and discussion of a selected topic in chemistry. Topics to be selected by participating faculty each semester. Fall and Spring.

FCH 798 Research In Chemistry (1-12)

Independent research in chemistry. One written report required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer.

FCH 898 Professional Exprnce/Synthesis (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, or Summer. Pre- or co-requisite(s): Matriculation in Department of Chemistry MPS degree program. Department chair approval required.

FCH 899 Masters Thesis Research (1-12)

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

FCH 997 Seminar (1)

Seminars scheduled weekly; an average of 20 to 30 seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

FCH 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

FOR - FORESTRY (RESOURCES MANAGEMENT)

FOR 110 Environmental Physics (3)

Three hours of lecture per week. Introduction to principles of physics using examples from the natural environment and coupled human-natural systems.

FOR 132 Orientation Seminar: SRM (1)

Thirteen hours of lecture and six hours of field time. An introduction to forest and natural resource management and related career paths. Indoor and outdoor lectures expand student awareness of ESF's educational opportunities, properties, and faculty in FNRM. Fall.

FOR 205 Principles of Accounting (3)

Three hours of lecture per week. Principles and methods used in financial and managerial accounting. Includes interpretation and effective use of financial statements through study of the accounting model, the measurement processes, data classification and terminology. Fall and Spring.

FOR 207 Introduction To Economics (3)

Three hours of lecture per week. Coverage of basic theory in microeconomics and macroeconomics. Application of theory and economic models to problems at the firm and national policy levels. Exploration of topics in money and banking, globalization and economic development. Fall and Spring.

FOR 232 Natural Resources Ecology (3)

Three hours of lecture/discussion per week for the first 12 weeks. Then 1.5 hours of lecture/discussion per week plus a 4.25-hour field trip for the last four weeks. The course provides an introduction to basic principles of ecology as they relate to terrestrial and freshwater ecosystems, and to natural resources. General topics for study include consideration of the physical environment, primary net production and energy flow through trophic levels, genetics and adaptation, ecosystem structure and function, competition and community dynamics, characteristics of freshwater ecosystems, and biogeochemical cycling and human impacts from local to global levels. Spring. Prerequisites: EFB 101/EFB 102 General Biology I w/lab, or equivalent (organismal biology).

FOR 296 Spec Topics-Res.Mgt/Fsty (1-3)

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester. Fall or Spring.

FOR 298 Research Internship in SRM (1-3)

Students will participate in research projects consistent with their educational and professional goals. A faculty member in the Department of Sustainable Resources Management will serve as the student's faculty sponsor. The student in consultation with the faculty sponsor will prepare a study plan outlining the educational goals of the apprenticeship. Students shall report their activities to their instructor on a weekly basis for the duration of the course. The faculty sponsor will generate a performance assessment and record of activities at the end of the apprenticeship. Grading Satisfactory/Unsatisfactory. Fall, Spring, Summer. Prerequisite(s): Permission of Instructor

FOR 304 Adirondack Field Studies (4)

Four-week field course with five hours of lecture and 30 hours of field laboratory per week. Introduction to silvics, forest ecology and natural and cultural history as a basis for understanding forest vegetation and other natural resources. Principles and methods for the measurement of spatial and vegetative attributes of forested landscapes. Course stresses development of field ability in common plant identification, overland navigation and timber, tree, forest and habitat measurements, and synthesis of field data. Summer.

FOR 313 Tree Structure and Function (3)

Three hours of lecture/discussion per week, including regular observations of trees near campus. Students will learn the fundamental biology of the structure and physiological function of trees, to prepare them to understand how and why trees are managed for human uses. Fall. Prerequisite-introductory biology.

FOR 321 Forest Ecology & Silviculture (3)

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Survey of forest tree and stand ecology (silvics) and silviculture concepts, applications and implications for treatment of forest stands for various values. Experiential learning emphasized through a strong field component of assessing vegetation, site quality and land use history variables, and treatment alternatives to create different forest conditions. For students outside forest resources management curriculum; not open to students taking FOR 332 and FOR 334. Fall. Prerequisite: Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521.

FOR 322 Nat Res Measuremnts & Sampling (3)

Two hours of lecture and three hours of laboratory. Principles and methods used in the measurement and quantitative analysis of natural resources, including vegetation, water, soils, recreation and wildlife. The application of sampling designs for estimating populations and inventory planning, and statistical analysis for quantifying sampling error. Fall. Prerequisite(s): FOR 304 or equivalent; APM 391 or equivalent

FOR 323 Forest Biometrics (3)

Three hours lecture per week. Statistical techniques for analyzing problems in forest resource management including hypothesis testing, analysis of variance, simple and multiple linear regressions, and weighted least squares regression. Spring. Prerequisite: APM 391 or equivalent.

FOR 330 Studies in Silviculture (3)

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and

development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

FOR 332 Forest Ecology (4)

Three hours of lecture/discussion and three hours of laboratory per week. Structure, function and dynamics of forest ecosystems at multiple scales, from trees to landscapes, including human interactions. Topics include ecophysiology, disturbance, succession, carbon and nutrient cycling, forest management, invasive species and climate change. Field data collection and analysis. Fall. Prerequisite(s): FOR 232, or EFB 101 and 102, or equivalent by permission of instructor.

FOR 333 Natural Resrc Managerial Econ (3)

Three hours of lecture per week Every natural resources manager must answer the question of how to use economic information to make better business and management decisions daily. Solutions require identifying alternative means of achieving given objective(s), then selecting the alternative that accomplishes this in the most resource efficient manner. Mandatory one-day weekend or two-day overnight weekend field trip. Required for Forest Resources Management, Natural Resources Management, and Sustainable Energy Management degree programs. This is a shared resource course with FOR533. Spring. Prerequisites: FOR 207 Introduction to Economics (or equivalent) and Principles of Accounting or Finance (or equivalent); or permission of the instructor. Note: Credit will not be granted for both FOR 333 and FOR 533.

FOR 334 Silviculture (4)

Three hours of lecture and three hours of lab per week. The practice of silviculture in managing stands to serve various landowner interests. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios, and to learn and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Fall. Note: Credit will not be granted for both FOR 334 and FOR 534.

FOR 338 Meteorology (3)

Three hours of lecture/discussion per week. This is a shared resource course with FOR 538. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and microscale phenomena. Students will learn how to access weather data on the Internet and use the data to forecast weather. At the microscale, emphasis is on describing conditions and projecting change. Spring. Note: Credit will not be granted for both FOR 338 and FOR 538.

FOR 340 Watershed Hydrology (3)

Three hours of lecture per week. Principles of physical hydrology, including the basic principles of watershed hydrology, from the relationship between watershed hydrology and the global water cycle, to the specifics of groundwater flow, stream flow generation, and water quality management at the watershed scale. Spring. Prerequisites: FOR345 - Introduction to Soils Note: Credit will not be granted for both FOR 340 and FOR 540.

FOR 345 Introduction to Soils (3)

Two hours of lecture and three hours of lab per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall. Prerequisite or Co-requisite: 1

semester of Introductory Chemistry. Note: Credit will not be granted for both FOR 345 and FOR 545.

FOR 360 Principles of Mgmt/Envrn Prof (3)

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modern management and administration, with an emphasis on the four functions of management: leading, planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Fall. Note: Credit will not be granted for both FOR 360 and FOR 560.

FOR 370 Forest Mgmt Dec Mkng&Plng (3)

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Spring. Prerequisites: FOR 322 and FOR 334. Note: Credit will not be granted for both FOR 370 and FOR 570.

FOR 372 Fund/Outdoor Recreation (3)

Three hours of lecture/discussion per week. Introduction to the programs and practices of federal, state and local agencies and private organizations involved in planning, administration and management of outdoor recreation areas. Emphasis is placed on common resource and social problems faced by area managers, and how they integrate solutions into their plans. Spring.

FOR 373 Sustainable Harvesting Pract (3)

Two hours of lecture and three hours of lab per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Fall. Prerequisite: FOR 322 or FOR 334 or permission of instructor.

FOR 402 Prof Forestry Mentoring Prog (1)

One-hour session per week supplemented by a one-day internship with a professional forester. Sessions will focus on contemporary issues in forestry including a historical perspective of the forestry profession, what it means to be a forester today, the role of certification and licensing, and professional ethics. It will serve to increase the professionalism of the forestry students. Fall. Prerequisites: Junior status or permission of instructor.

FOR 403 Humans & the Envrn/New Zealand (4)

Three and one-half week study-abroad program examines the natural and cultural history and resource management of New Zealand's South Island. Through class lecture/discussion and field excursions, students obtain an understanding of integrated resource management and sustainability in protected areas. Spring.

FOR 404 Ecotourism Abroad (3)

Five 1-hour lectures plus 9- to 10-day field trip. This service learning course introduces students to the field of ecotourism through a short-term study abroad program held during spring break. Students will travel to several ecotourism destinations within a selected country, meet with destination managers, and complete a service learning project related to ecotourism. Additional fees required to cover cost of travel and lodging during field portion of course. Spring

FOR 411 Analytical&Tech Wrtng/Resrc Mg (3)

Three hours of lecture per week. Research, summary, and evaluation of scholarly and grey literature. Application of decision making process and written recommendation. Introduction to argument. Composition of a technical report related to management major. Proposal writing and development of brochures, posters, and/or presentations for defined audiences. Fall and Spring. Prerequisites: EWP 290 or equivalent, and junior or senior status in FNRM

FOR 421 Prctical Ethics for Rsrce Mgrs (3)

Introduction to the history and practical function of ethics in the context of resource management professions with a special emphasis on forestry. Particular attention will be paid to establishing an ethically sound position, aligning competing values and priorities among interested parties, and effectively communicating management decisions. Delivered online with one field trip to ESF's Huntington Wildlife Forest. Fall and Spring. Prerequisite: Senior status or permission of the instructor required.

FOR 433 Advanced Silviculture (3)

Two hours of lecture and three hour field/computer exercises. Advanced study of silviculture in managing stands to serve a variety of landowner objectives. Enhanced problem solving skills related to stand analysis and prescription making. Field and computer exercises provide practical experience in implementing and evaluating silvicultural prescriptions. Spring. Prerequisite: one prior course in silviculture.

FOR 442 Watershed Ecology & Management (3)

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Fall. Note: Credit will not be granted for both FOR 442 and FOR 642.

FOR 458 Advanced Topics in GIS (3)

Two hours of lectures and three hours of labs per week. Lecture, demonstration, discussion, and lab exercises. Apply advanced geoprocessing techniques in resource analysis and modeling. Students complete a capstone project. Fall. Prerequisite(s): ESF300 or equivalent.

FOR 465 Natural Resources Policy (3)

Three hours of lecture/discussion per week. Examination of US and NYS government roles in natural resource policy, and how government policies influence the management of public and private lands. Analysis of institutions, participants, and drivers of public lands, forest, water, wetlands, wildlife, fisheries, and fire policies. Fall.

FOR 475 Recreation Behavior &Managemnt (3)

Three hours of lecture per week and a one-day field trip. Applies sociological and psychological concepts to: 1) individual preferences for recreation activities and settings, 2) description of recreation visitor behavior, 3) sources of management problems, 4) developing direct and indirect visitor management strategies, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. A one-day field trip is required. Fall. Prerequisite: FOR 372 or equivalent, enrollment in the Natural Resource Management major or Recreation Resources and Protected Area Management minor, or permission of instructor.

FOR 476 Ecotourism and Nature Tourism (3)

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs are discussed, as are related environmental, social, and economic impacts. One-day field trip. Fall. Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

FOR 478 Wilderness & Wildlands Mgt (3)

Three hours of lecture per week. One, two-day, overnight field trip. Review of the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes stewardship and management for protection of natural resources and human values. Concepts include carrying capacity, preservation of ecological conditions and processes, visitor management, dispersed recreation management, human values and benefits, and planning frameworks. Fall. Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

FOR 480 Urban Forestry (3)

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources. Fall. Prerequisite: Junior or senior status in any Forest and Natural Resources Management programs or permission of instructor for juniors and seniors in other programs. Note: Credit will not be granted for both FOR 480 and FOR 680.

FOR 481 Introduction to Arboriculture (3)

Two hours of lecture and one three-hour laboratory per week. Overview of the practice of arboriculture. Emphasis will be on site evaluation for species selection, planting, pruning, fertilization and removal of trees in an urban environment. Spring. Prerequisite: Botany or Ecology.

FOR 485 Business and Managerial Law (3)

Three hours of lecture/discussion per week. An introduction to the law governing business and management. Examination of sources of law, court systems and trials, constitutional foundations, criminal law, contracts, employer and employee law, business organization law, torts, personal property and motor vehicle law, landlord and tenant law, home ownership law, and wills and estates. Spring.

FOR 487 Environmental Law and Policy (3)

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Fall. Prerequisite: Junior or Senior standing. Note: Credit will not be granted for both FOR 487 and FOR 687.

FOR 489 Natural Resources Law & Policy (3)

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Spring. Prerequisites: Junior or senior standing. Note: Credit will not be granted for both FOR 489 and FOR 689.

FOR 490 Integrated Resources Mgt (3)

One hour of lecture, three hours of laboratory, and three hours of supervised work per week. This capstone course emphasizes the assimilation, integration, and interpretation of the biophysical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. A written comprehensive management plan, also presented orally in the field and classroom, provides the central vehicle by which students demonstrate their abilities as future natural resource managers. Spring. Prerequisite: Senior status in Forest and Natural Resources Management.

FOR 492 Capstone Rsrch in Frst Eco Sci (3)

Weekly one-on-one meetings with instructor, and independent student research. A semester of student-led, faculty-mentored independent research in forest ecosystem science, ecosystem stewardship, or a related topic. As the first of the two-course capstone sequence for the B.Sc. in Forest Ecosystem Science, this semester of original research provides the basis for broader social-ecological synthesis in the form of an ecosystem stewardship plan (FOR 493). A brief (one-page) research prospectus approved by the faculty mentor and degree coordinator is required. Open to Forest Ecosystem Science majors only. Fall and spring, depending on section (instructor-specific). Prerequisites: Upper-division standing; APM 391; completed research prospectus

FOR 493 Capstone Synth in ForEco Stwrd (3)

Weekly one-on-one or group meetings with instructor, independent student work. Synthesis and application of independent research (FOR 492) through development of an ecosystem stewardship plan or strategy that addresses real-world challenges and opportunities to sustainability. FOR 493 is the second course in the capstone sequence for the B.Sc. in Forest Ecosystem Science, which culminates in a written report or article and oral or multimedia presentation. Open to Forest Ecosystem Science majors only. Fall and spring. Prerequisites: FOR 492 or by permission of FES Curriculum Coordinator

FOR 495 Undergrad Teaching Assistance (1-3)

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. Fall and Spring. Prerequisite: Permission of instructor. Prior completion of course to be assisted with grade of B or better.

FOR 496 Special Topics in SRM (1-3)

Experimental and developmental courses in new areas of resource management/forestry or areas not covered in regularly scheduled courses. Topics may include but are not limited to the biological, physical, and social dimensions and the many and varied resources of forest lands and forestry. Specific detailed course descriptions for each course taught under the FOR 496 designation are available for student perusal. Fall, Spring and Summer.

FOR 498 Independent Study in SRM (1-6)

Independent research or study in resource management/forestry for selected undergraduate students. Selection of subject area, nature of the research or study, and number of credit hours determined by student in conference with appropriate faculty member; initiative in taking FOR 498 rests with the student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Final written report is required for record. Fall, Spring and Summer. Prerequisite: Cumulative GPA of at least 2.50 and approval of the adviser and instructor.

FOR 499 Internship in Sust Rsrces Mgmt (1-12)

Full- or part-time engagement as volunteer or employee working for off-campus resource management/forestry/renewable energy organization under guidance of external supervisor. Students shall report their activities to their instructor on a weekly basis for the duration of the course and final written report is required for record. Junior or senior status, cumulative GPA of at least 2.5, and written approval of a study plan by faculty advisor and field supervisor must be submitted prior to its commencement. Fall, Spring and Summer. Prerequisite: Junior or Senior status. Must have a cumulative GPA of at least 2.5. Professor consent is required to register for this course.

FOR 501 Intro/Envrnmntl Resources Mgmt (2)

Two-week, field-based examination of forest, water, wildlife, recreation, and mineral resources and their management in New York State and surrounding states, framed by public administration, political science, economic, human dimension, and biophysical concepts. Emphasis is on experiential learning via a series of field trips. Fall (mid-August). Prerequisite(s): Enrollment in the ERM MPS degree program.

FOR 519 Green Entrepreneurship (3)

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success factors and key start-up issues unique to environmental science and technology firms. Spring. Prerequisite(s): FOR 207 Introduction to Economics or equivalent; or permission of instructor.

FOR 521 Forest Ecology & Silviculture (3)

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Study of the conceptual underpinnings and application of forest ecology via explorations of the environmental complex and silvicultural systems. Experiential learning is emphasized through a strong field component of assessing vegetation, site and land use history variables, and treatment alternatives to create different forest conditions. Provides a study of trees as individuals and communities, and how we can manipulate them both using planned methods and techniques to affect sustained production of a wide variety of forest ecosystem

benefits, services, and values. Fall. Prerequisite(s): Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521. Not open to students taking FOR 534.

FOR 522 Forest Mensuration (3)

Two hours of lecture and three hours of laboratory per week. Principles and methods used in the measurement of standing trees, forest stands, forest products and growth. The application of sampling designs and analysis for forest valuation and inventory planning. Graduate students will be required to complete two additional term projects in addition to those required of undergraduate students. Fall. Prerequisites: FOR 304 or equivalent. Co-requisites: APM 391 or equivalent. Note: Credit will not be granted for both FOR 322 and FOR 522.

FOR 523 Tropical Ecology (3)

Preparatory lectures(1.5 hr/wk) coupled with intensive spring break field study on a tropical island in the Caribbean. Principles of tropical ecology, resource management, and island biogeography are presented. Field trips to a variety of tropical ecosystems including rain forest, coral reefs, crater lakes, montane rain forest with comparison to north temperate ecosystems. Additional fee covers costs of travel, lodging. Spring. Prerequisite(s): General Ecology

FOR 524 Forest Biometrics (3)

Three hours of lecture per week. Statistical methods and techniques including hypothesis testing, analysis of variance, simple and multiple linear regressions used for analyzing forest resource management problems and developing forest growth and yield models. Graduate students will be required to write a research paper in addition to those required of undergraduate students. Spring. Prerequisite: APM 391 or equivalent. Note: Credit will not be granted for both FOR 323 and FOR 524.

FOR 530 Studies in Silviculture (3)

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

FOR 532 Forest Ecology (4)

Four hours of lecture/discussion and three hours of laboratory per week. Structure, function and dynamics of forest ecosystems at multiple scales, from trees to landscapes, including human interactions. Topics include ecophysiology, disturbance, succession, carbon and nutrient cycling, forest management, invasive species and climate change. Field data collection and analysis. Fall. Prerequisite(s): Undergraduate coursework in biology/ecology; or by permission of instructor

FOR 533 Natural Resrc Managerial Econ (3)

Every natural resources manager must answer the question of how to use economic information to make better business and management decisions daily. Solutions require systematically analyzing economic tools and models to identify alternative means of achieving given objective(s), then selecting the alternative that accomplishes this in the most resource efficient manner. Mandatory one-day weekend or two-day overnight weekend field trip. Required in the Master of Forestry degree program. This is a shared resource course with FOR333. Spring. Note: Credit will not be granted for both FOR333 and FOR533. Prerequisites: FOR207 Introduction to Economics

(or equivalent), Precalculus or Calculus (or equivalent), and Principles of Accounting or Finance (or equivalent); or permission of the instructor

FOR 534 Silvicultural Practice (4)

Three hours of lecture and three hours of laboratory per week. The practice of silviculture in managing stands to serve various landowner interests, and explore the conceptual framework for those practices. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios and to learn and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Laboratory projects include reports that explore the conceptual and technical rationale for silvicultural decisions. Fall. Note: Credit will not be granted for both FOR 334 and FOR 534.

FOR 535 Advanced Forest Soils (3)

Three hours of lecture/discussion per week concerning the current state-of-the-art in forest soils. Effect of intensive forest management on soil, soil-site-species relationships, forest fertilization tree nutrition. Application of forest soils information to silviculture. Spring. Prerequisite: FOR 332 or beginning courses in soils and silviculture.

FOR 538 Meteorology (3)

Three hours of lecture/discussion per week. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and micro-scale phenomena. Students will learn how to access weather data on the Internet and use that data to forecast weather. At the micro-scale, emphasis is on describing conditions and projecting change. Fall. Note: Credit will not be granted for both FOR 338 and FOR 538.

FOR 540 Watershed Hydrology (3)

Three hours of lecture per week. This course provides students with a detailed understanding of watershed hydrology, water quality and water management at the watershed scale, and offer the students the opportunity to gain in depth knowledge on one topic of particular interest to them through completion of a term project, and the development of a teaching/research presentation and interactive discussion with students in the class. Spring. Prerequisites: FOR345 - Introduction to Soils Note: Credit will not be granted for both FOR 340 and FOR 540.

FOR 545 Introduction to Soils (3)

Two hours of lecture and three hours of laboratory per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall. Prerequisite or Co-requisite: one semester of Introductory Chemistry or permission of instructor. Note: Credit will not be granted for both FOR 345 and FOR 545.

FOR 546 For Soil Genesis,Class&Mapping (3)

Three hours of lecture per week during the first two-thirds of the semester. The last third of the semester is devoted to fieldwork and production of a soil map. Models of soil genesis, application of the U.S. system of soil taxonomy, and soil mapping. Spring. Prerequisite: Introductory course in soil science.

FOR 557 Fundamentals of GIS (3)

Three hours of lecture/discussion/recitation per week. Fundamental concepts of Geographic Information Systems (GIS); raster and vector data models and geodatabase design; common raster and vector data analysis tools used in the fields of forest and natural resources management, environmental science,conservation biology, ecology, and landscape architecture; cartographic model construction; and map design. Completion of an independent project is required. Fall

FOR 560 Principles of Mgmt/Envrn Prof (3)

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modem management and administration, with an emphasis on the four functions of management: leading. planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Fall.

FOR 570 Forest Mgmt Dec Mkng&Plng (3)

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Sensitivity analysis of parameters used in forest management planning. Spring. Prerequisites: FOR 322/522 and FOR 334/534 or permission of the instructor. Note: Credit will not be granted for both FOR 370 and FOR 570.

FOR 573 Sustainable Harvesting Pract (3)

Two hours lecture and three hours of laboratory per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Emphasis on application of knowledge, requiring a written report with a problem-solving focus. Fall. Prerequisite: FOR 322 and FOR 334 or permission of instructor. Note: Credit will not be granted for both FOR 373 and FOR 573.

FOR 635 For Soils/Their Analyses (3)

One hour of lecture, one hour of recitation, four hours of field and laboratory study of forest soils, emphasizing plant-soil relationships per week. Stress on quantification of plant-soil diagnostic techniques and their interpretation. Spring (odd years). Prerequisite: FOR 446. Note: Background in physical and biological sciences recommended.

FOR 642 Watershed Ecology & Management (3)

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Students will apply course concepts to an independent research project. Fall. Note: Credit will not be granted for both FOR 442 and FOR 642.

FOR 659 Advanced GIS (3)

Two hours of lectures and three hours of labs week. Lecture, demonstration, discussion, and lab exercises. Students learn to apply and evaluate advanced geoprocessing techniques in resource analysis and modeling. Students complete and present a capstone project. Spring. Prerequisite(s): FOR557 or equivalent

FOR 665 Natural Resources Policy (3)

Three hours of lecture per week. Analysis and application of political, policy formation, and policy administration theories to natural resources. Examination of drivers of U.S. natural resources policies. Analysis of private lands, public lands, forest, wildlife, endangered species, water, fire, and certification policies. Focus is on U.S. natural resources policies. Spring. Prerequisite: graduate standing.

FOR 670 Resource & Envrn Economics (3)

Three hours of lecture per week. An introductory course in resource and environmental economics. Apply economic theories and models to analyze decisions concerning the use of forest, marine, and water resources and to analyze policy tools for mitigating pollution created as a result of production and consumption. Fall. Prerequisite: A course in economics.

FOR 676 Ecotourism and Nature Tourism (3)

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs. Environmental, social, and economic impacts. One-day field trip. Graduate level readings, assignments, and exams. Fall. Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

FOR 678 Wilderness & Wildlands Mgt (3)

Three hours of lecture per week and one, two-day, overnight field trip. Reviews the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes the use of wilderness research information for adaptive management approaches to stewardship of and planning for protection of natural resources and human values. Fall. Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

FOR 680 Urban Forestry (3)

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources, development of a research paper on urban forestry. Fall. Prerequisite: Permission of instructor. Note: Credit will not be granted for both FOR 480 and FOR 680.

FOR 687 Environmental Law & Policy (3)

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Analysis and application of primary and secondary legal sources to business and management problems. Fall. Note: Credit will not be granted for both FOR 487 and FOR 687.

FOR 689 Natural Resources Law & Policy (3)

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Analysis and application of natural resources law research and commentary. Spring. Note: Credit will not be granted for both FOR 489 and FOR 689.

FOR 690 Integrated Resources Mgmt (3)

One hour of lecture, three hours of laboratory and three hours of supervised work per week.This capstone course emphasizes the assimilation, integration and interpretation of the biophysical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. The final deliverable is a written management plan. Spring.

FOR 692 Capstone/Resources Management (3)

Students will integrate and apply their knowledge of resources management to practical problems of their own design in their areas of interest, in consultation with clients whom they identify to be in need of their professional services. Class sessions include opportunities to develop advanced knowledge and professional skills, such as research, analysis, management, and communication. Final project outcomes are delivered through written reports and oral presentations. Course should be taken in the student's final fall semester. Fall.

FOR 694 Writing/Scientific Pubs (3)

Three hours of lecture and discussion per week. Students will improve their skills in technical reporting by preparing a manuscript suitable for submission to a scientific journal. Topics include selection of an appropriate journal, design of effective figures and tables, sequential preparation of sections of the manuscript, writing tips, peer review and ethical issues. Spring.

FOR 696 Spec Topics/Frst & Nat Res Mgt (1-3)

Experimental and developmental courses in new areas of forestry and natural resources management not covered in regularly scheduled courses. A course syllabus will be available to students and faculty advisors prior to registration.

FOR 770 Ecological Economics & Policy (3)

Three hours of seminar per week. A transdisciplinary approach to understand the interface of human and ecological systems, includes concepts and methods of ecologists, economists, and social scientists. Focus is on historical, conceptual and epistemological foundations. Draws on contemporary economic and policy thought, evolutionary biology, ecology, systems theory, social psychology, and environmental ethics. Spring. Prerequisite: Graduate coursework in ecology or economics; doctoral student standing, or permission of instructor.

FOR 796 Spec Topics/Forst Res.Mgt (1-3)

Lectures, seminars, and discussion. Advanced topics in resource management and policy. Check schedule of classes for details of subject matter. Fall and/or Spring.

FOR 797 Seminar (1-3)

Group discussion and individual presentation of topics of current interest to forest and natural resources management. Fall and Spring.

FOR 798 Rsrch Prob/Fsty & Nat Res Mgt (1-12)

Special investigation and analysis of forest and natural resources management topics. A study plan and a final written report are required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring.

FOR 898 Prof Exp/Intern (1-6)

Professional experience/internship which applies, enriches, or complements formal coursework. All professional experiences/internships must have a signed experience/internship agreement on record with the advisor. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Graded on an "S/U" basis. Fall, Spring, and Summer.

FOR 899 Master's Thesis Research (1-12)

Investigation leading to the completion of a Master's thesis. Graded on an "S/U" basis. Fall, Spring, and Summer.

FOR 999 Doctoral Thesis Research (1-12)

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

FTC - FOREST TECHNOLOGY

FTC 101 Trig for Nat Res Tech (3)

Forty hours of lecture and sixteen hours of recitation conducted over a four-week period. A review of selected geometry and algebra topics, and an introduction to trigonometry and its applications. Emphasis on pythagorean theorem, quadratic equations, rectangular coordinate systems, right triangle trigonometry, oblique triangle trigonometry, the Law of Sines, the Law of Cosines and the graphing of trigonometric functions. Graphic calculator required. Summer.

FTC 105 Tree & Forest Biology (4)

A four-week summer program having 45 hours of lecture and 45 hours of lab. An introduction to the biology of trees and the diversity of animal life commonly found in forests. Field labs concentrate on biological relationships in Adirondack forests. Summer.

FTC 200 Dendrology (3)

Thirty eight hours of lecture, and forty hours of field laboratory. Characteristics, distribution, and uses of tree species in North America. Identifying plant species using common and scientific names, from leaf, twig, fruit, or bark samples. Habitats, species associates, and succession of plants, including some invasive species. Fall.

FTC 202 Intro To Surveying (3)

Twenty eight hours of lecture and 72 hours of laboratory and field exercises. The course is an introduction to the theory and practice of plane surveying. Emphasis is on developing individual skills and techniques through small crew projects where it is necessary to handle typical surveying equipment in actual field situations. Lecture topics include the theory of measurements and

errors, field record keeping procedures, mathematics for plane surveying, introduction to field problems, introduction to map use and preparation, concepts of land tenure systems and basic computer aided drafting. Students tour the various offices found at the County courthouse and participate in a research exercise. Field projects include traversing using common forester's and surveyor's tools and instruments, mapping including field and office procedure, and proficiency projects in handling various surveying instruments. Fall.

FTC 204 Intro/Nat Res Measurements (4)

Forty-five hours of lecture and sixty hours of field/laboratory. A study of the tools and techniques used to measure primary forest products and inventory and/or measure natural resources, such as timber, water, biomass, carbon stocks, wildlife habitat, recreation use and impact, and plant diversity. Professional presentation of forest inventory data in the form of technical reports. Basic forest sampling methods are used and compared, and associated statistical methods are learned and applied. Fall.

FTC 205 Comp-Aided Draftng&Dsgn I (2)

Eighteen hours of lecture and 36 hours of laboratory time. An introductory course in computer aided drafting. Emphasis is on developing individual skills and techniques for making professional quality drawings and maps. Topics include the drawing, editing, layer management, dimensioning, survey computations, data reduction, contouring and Geographic Information Systems. Fall. Prerequisite(s): FTC 202 - Introduction to Surveying

FTC 206 Forest Ecology (4)

Fifty-one hours of lecture and fifty-six hours of laboratory and field. Study of interactions between forest vegetation and the environment. Considers how sunlight, moisture, soils and climate impact species presence, composition and growth. Human dimension of forest ecology, including critical thinking and evaluation of environmental issues. Fall.

FTC 207 Communications and Safety (3)

Twenty six hours lecture and fifty eight hours laboratory provides students with technical competence. Students develop study skills, handwriting skills, computer skills and communication skills including how to use library services. A resume and cover letter will be prepared for use in the job search process. Students receive training on the proper use and maintenance of forest hand tools and chainsaws. Students receive advanced training in the use and maintenance of chainsaws, and skidding equipment. First Aid and CPR/AED are covered as well as wilderness first aid. Prepares students for living in remote areas. Fall

FTC 208 Remote Sensing and GIS (3)

Thirty hours of lecture and forty-five hours of laboratory. This course is an introduction to the use of remote sensing and geographic information systems in the field of natural resources. Students practice interpretation of aerial photographs and digital imagery to measure horizontal distances and azimuths and calculate ground area. Acquisition, creation and basic analysis of spatial data are also emphasized. Fall.

FTC 209 Timber Harvesting (2)

Eighteen hours of lecture and thirty six hours of laboratory or field instruction. Student learns basic harvesting methods with northeastern United States emphasis and its relationship to other forest uses. Student understand the role of best management practices in timber harvesting. A

technical competence in timber sale contract administration and basic timber appraisal is gained. Fall. Co-requisite(s): FTC 204, FTC 207.

FTC 210 Wildlife Techniques 1 (1)

Eight hours of lecture and eighteen hours field and laboratory time. Part 1 of an introduction to standard methods and techniques for surveying, measuring, and monitoring wildlife populations are discussed, demonstrated, and practiced. Identification of mammals and birds by sight and sound. Fall. Prerequisites: FTC 200, FTC 202, and FTC 204.

FTC 211 Silviculture (3)

Thirty hours lecture and seventy five hours field lab. Regeneration and tending of forest stands. Physical and chemical treatments used for growing forests in the northeastern states. Introduction to silviculture in the southern and western states. Methods for quantifying and predicting forest growth. Marking timber stands for harvesting. Establishing new stands. Spring. Prerequisites: FTC 200, FTC 204, and FTC 206.

FTC 212 Adirondack Cultural Ecology (1)

Twenty two hours of lecture and twenty eight hours of field laboratory. Development of the Adirondack Park as influenced by the exploitation and eventual conservation of the region's natural resources. An historical review and contemporary assessment of the political, economic, and sociologic issues that define and influence Adirondack culture. Guest speakers, public meeting attendance, and field trips within the Park reinforce cultural history and emphasize the role of individuals, organizations, and agencies in managing the unique blend of public and private lands that comprise the Park. Spring.

FTC 213 For Inventory Practicum (2)

Six hours of lecture and sixty four hours of field/laboratory. A practical field problem requiring students to use professional methods of collecting, analyzing, and presenting forest inventory data. Inventory of the timber/biomass resource and the development of a forest type map are emphasized. Spring. Prerequisites: FTC 200, FTC 202, FTC 204, and FTC 208.

FTC 214 Leadership & Orgnztnl Perfrmnc (2)

Twenty-two hours of lecture and twenty-four hours of laboratory time. Provides students with technical competence and decision-making abilities. Students learn about company and agency organization; the selection, placement, training, and evaluation of workers; managing crews and the techniques of foremanship; and human relations in the workplace, with emphasis on the special personnel problems of the forest and surveying industries. Spring. Prerequisite(s): FTC 207 Communications and Safety

FTC 217 Wildland Firefighting & Ecol (2)

Twenty-five hours of lecture and sixteen hours of laboratory and field. An introduction to fire science. Learn basic principles of fire ecology, behavior, danger rating and control. Practical experience conducting a prescribed burn. Spring. Prerequisite(s): FTC 200, FTC 204, FTC 206, FTC 210.

FTC 219 Intro to Forest Recreation (1)

Fourteen hours of lecture and twenty hours field and laboratory time. A study of forest-recreation resources, their importance to humans, and of the basic history, laws and principles underlying

forest-recreation management in the United States. The technical aspects of recreation management are emphasized, as is the study of public-land management, including wilderness. Spring. Pre-requisites: FTC 207.

FTC 221 Natural Resources Management (3)

Thirty-five hours of lecture and thirty hours of laboratory and field. Addresses common issues in organizing a forest property to meet stakeholder goals. Techniques of growth and resource measurement, monitoring, and evaluation are emphasized. Examples and case studies of forest management and production activities are presented. A final project involves the application of knowledge accumulated at the ESF Ranger School in a management plan for an assigned forest property. Spring. Prerequisites: FTC 204, FTC 206 and FTC 208.

FTC 225 Timber Transportn&Utilization (2)

Twenty-two lecture hours and thirty laboratory hours. Students gain knowledge of forest road maintenance. Differences in wood structure of various tree species are studied in the laboratory, students learn how to identify tree species by wood characteristics. Spring. Prerequisite(s): FTC 200, FTC 206, FTC 207

FTC 234 Wildlife Conservation (3)

Thirty-eight hours of lecture and twenty hours field and laboratory time. An introduction to the history and evolution of wildlife-related policies and laws, and to the biological, ecological, economical and sociological principles underlying wildlife management and conservation efforts in the United States. Terrestrial vertebrate animals serve as the basis of discussions and case studies. Students improve their communication skills by presenting papers and speeches on wildlife-related topics. Spring. Prerequisite: FTC 206.

FTC 236 Env Interp Principles&Technque (3)

Thirty three hours of lecture and thirty six hours field and laboratory time. Introduction to the history, theory and basic personal and non-personal methods of environmental interpretation. Exploration of the relationship between interpretation and nature recreation and the use of interpretation programs to informally educate the public about environmental and natural resource issues. Principles of interpretation are emphasized and applied to course projects. Students deepen understanding of course material and improve their communication skills by preparing and presenting both personal and non-personal interpretive programs. Spring. Pre-requisites: FTC 200, FTC 202, FTC 204, and FTC 206

FTC 237 Intro/Water & Soil Resources (4)

Forty-eight hours of lecture and forty hours of laboratory and field exercises. Introduction to watershed ecology and soil science. Interactions among upland, riparian, lacustrine and wetland systems, including the hydrologic cycle, water balance equation and water quality assessments. Study and measurement of soil physical, chemical and biological characteristics and processes. Recognize soil and water resource management and protection issues associated with multiple uses of forest lands. Spring. Prerequisites: FTC 202, FTC 206, and FTC 208.

FTC 238 Forest Insects and Disease (3)

Thirty-five hours of lecture and twenty-six hours of laboratory and field. An introduction to forest insects and diseases. Explore ecological roles and identify selected insects and pathogens based

on morphology, signs and symptoms. Discuss integrated pest management and other control measures. Spring. Prerequisites: FTC 200, and FTC 206.

FTC 239 GIS Practicum (1)

Six hours of lecture and twenty-eight hours of laboratory. Development of an independent project utilizing Geographic Information Systems, including acquisition, manipulation, and creation of geospatial data. Plan, conduct, and present a geospatial analysis project on a topic of choice within field of study. Spring. Prerequisites: FTC 202, and FTC 208.

FTC 240 Wildlife Techniques 2 (1)

Ten hours of lecture and eighteen hours field and laboratory time. Part 2 of an introduction to standard methods and techniques for surveying, measuring, and monitoring wildlife populations are discussed, demonstrated, and practiced. Identification of birds, amphibians, and reptiles by sight and sound. Spring. Prerequisite(s): FTC 200 (Dendrology), FTC 202 (Introduction to Surveying), FTC 204 (Introduction to Natural Resources Measurements), and FTC 210 (Wildlife Techniques 1)

FTC 251 Adv Survey Measure&Comp (4)

Thirty hours of lecture and eighty-five hours of field and laboratory time. Advanced survey measurements and computational techniques including traverse calculations, rectangular coordinates, statistical analysis of surveying data, state plane coordinates, meridian determination, partition of land, trigonometric leveling and horizontal control are explored. Students will make the necessary surveying measurements in the field and be expected to complete various surveying measurements using a calculator and computer. Spring. Prerequisite: FTC 202. Co-requisite: FTC 257.

FTC 253 Survey Law (3)

Thirty five hours of lecture and 30 hours of laboratory time. The course is a study of courthouse real property research, property boundary determination by various methods, case and statute law as it relates to real property and land surveying, legal research and the liability and professionalism of the practicing land surveyor. Spring. Prerequisite: FTC 202.

FTC 255 Boundary Surveying (3)

Thirty hours of lecture and forty-five hours of field and laboratory time. A study of the procedures necessary to conduct a retracement survey including preliminary office procedures, field practices, and preparation of final survey documents. Students will complete a retracement survey and use the compiled data in a mock trial. Spring. Prerequisite: FTC 202. Co-requisite: FTC 253.

FTC 256 Subdivision Surveys (2)

Twenty hours of lecture and 30 hours of laboratory time. An introduction to the preparation of a multi-lot subdivision of a parcel of real estate. Development of a subdivision in relation to topography, zoning requirements, utility services, existing and proposed roads or streets and client requests. Students learn to design minor storm drain facilities in relation to the subdivisions. The student will incorporate all of the above while using survey software. Spring. Prerequisite: FTC 202. Co-requisite: FTC 259.

FTC 257 Construction&Topo Surveys (3)

Twenty-five hours lecture and sixty hours field and laboratory. A study of the various methods and techniques used to perform construction and topographic surveys and develop topographic maps. Theory, mathematics, and layout of circular, spiral and vertical curves. Layout of various construction projects including buildings, roads, pipelines and bridges will be discussed. Earthwork, staking and cross-section calculations will also be covered. Students complete a topographic mapping project and develop maps using appropriate surveying and mapping software. Spring. Co-requisites: FTC 252 and FTC 259.

FTC 259 Cmptr-Aided Draftng & Dsgn II (2)

Eighteen hours of lecture and seventy hours of laboratory time. An additional course in computer aided drafting and design. Emphasis is on developing individual skills and techniques for making professional quality drawings, maps and plats. Topics include the drawing, editing, layer management, dimensioning, survey computations, data reduction, surface modelling and GIS. Spring. Prerequisite(s): FTC 202 - Introduction to Surveying, FTC 205 Computer aided Drafting and Design I.

FTC 298 Independent Study (1-6)

Independent study in forest technology to apply, enhance or supplement forest technology or related natural resource education. Objectives and scope of the project are negotiated in a learning contract between the student and instructor(s), with course admission based on permission of the instructor(s). Limited to those who have attended the complete regular SFT program, or those who have graduated from another forest technology program or a related natural resource program, or to students enrolled in any ESF program other than SFT. A maximum of six credit hours may be taken by any student in total. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Semesters as arranged. Fall, Spring or Summer.

GNE - GENERAL ENGINEERING

GNE 160 Comp Methods/Engrs&Scientists (3)

Two hours lecture and three hours laboratory per week. Introduction to algorithm design, programming structures, and data structures. Engineering calculation software including programming languages, spreadsheets, and simulation software. Application of computing methods to engineering problems and data analysis. Spring.

GNE 171 Engr Mechs - Dynamics (2)

Two hours of lecture per week. Kinematics and kinetics of particles and rigid bodies; rectangular, normal and tangential, radial and transverse components; translation and rotation; force and acceleration; impulse; momentum; work and energy; impact. Spring. Prerequisites: Statics and Calculus II.

GNE 172 Statics and Dynamics (4)

Four hours of lecture per week. This course provides fundamental principles, methods and applications of engineering mechanics. Development and discussion of analytic models for rigid-body mechanics are used to apply theories. Rigid bodies of a practical nature and at rest or in motion are covered. Fall. Prerequisites: Algebra, derivative and integral calculus.

GNE 271 Statics (3)

Three hours of lecture per week. Covers fundamentals of analysis of static systems including equilibrium of rigid bodies, distributed loads, and trusses. A portion of the class is spent on open-ended problem solving and engineering design. Fall. Prerequisite: Physics I (Mechanics) and Calculus II

GNE 273 Mechanics of Materials (3)

Three hours of lecture per week. Theories of stress, deformation and stability of common structural materials subjected to various force systems. Spring. Prerequisites: Integral calculus and statics.

GNE 330 Prof Engineering Skills Sem (0.5)

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. Fall and Spring.

GNE 410 Structures (4)

Three hours of lecture, three hours of computation laboratory and discussion per week. Engineering principles in the analysis, planning design and construction of components and framed structures under various types of loadings. The proportioning of wood, steel and composite members and the design of statically determinate structural systems. Emphasis is placed on the relationship between theoretical stress analysis and codes and specifications for appropriate materials and structural design practices. Fall. Prerequisite(s): GNE 273 and scientific computing.

GNE 461 Air Pollution Engr (3)

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall. Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

GNE 530 Prof Engineering Skills Sem (0.5)

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. A project is required. Fall and Spring.

GNE 661 Air Pollution Engr (3)

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall. Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

LSA - LANDSCAPE ARCHITECTURE

LSA 132 Orientation Seminar:LSA (1)

One hour of lecture, discussion and/or exercises per week. Occasional field trips. Orientation to campus resources available to ensure academic success. Introduction to the professional culture and some topics of interest to landscape architects. Fall.

LSA 182 Drawing Studio (3)

Six hours of studio and one hour of lecture per week. This drawing course introduces the students to materials, techniques and components of drawing, architectural elements and figure drawing. Fall and Spring. Prerequisite: Landscape architecture students or permission of instructor.

LSA 201 Landscape Representation I (3)

Three hours of lecture per week. Introduction to graphic communication for landscape architecture. Course engages students in a range of graphic investigations in analog and digital media, modeling, and graphic imaging software. Emphasis is on the development of graphic representation skills for the communication of design ideas. Spring.

LSA 205 Art,Culture&Landscape I (3)

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their cultural contexts from prehistory to the Renaissance. Spring.

LSA 206 Art,Culture&Landscape II (3)

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their relation to cultural contexts from the Renaissance to the present day. Fall.

LSA 212 Place/Culture/Design (3)

Three hours of lecture/discussion per week. The course uses an interdisciplinary approach and social justice lens to critically analyze the cultural processes, practices, and systems that (unequally) shape places. These understandings are applied in the context of environmental and landscape planning and design professions. Field trips may be scheduled. Fall and Spring.

LSA 220 Intro/Landscape Architect (3)

Three hours of lecture per week. LSA 220 presents an overview and introduction to the profession of landscape architecture. It presents a survey of the development of the profession in the United States and how the profession responds to societal needs in providing services to various public and private clients. Emphasis is placed on understanding the significance of environmental, socio/cultural, physical/visual, and aesthetic factors in developing intervention strategies and designs. Contemporary landscape architectural issues, practitioners and work are presented. Fall.

LSA 222 Photogrphy, Envirnmnt, & You (3)

Three hours of lecture. Photography is used across all of the environmental science and design fields to communicate about our work, research, and findings. Yet photography is seldom formally taught as skill that must be learned in order to use it effectively. This course fills this

gap by teaching working methods from photography within the contexts of daily applications for environmental science and design. This course combines fundamental photography lessons in composition with critical discussions about the application of photography within the contexts of studying landscape, environment, nature and wilderness. Lecture, reading, discussion and field work convey content. Open to all experience levels. Fall.

LSA 226 Foundation Design Studio I (4)

Seven hours of studio and one hour of lecture per week. This course introduces students to skills, techniques, and ways of thinking that are fundamental to landscape architectural design, preparing students for future studio courses by emphasizing making, precision, experimentation, iteration, and judgment. Students develop an awareness of the built environment and learn to communicate design ideas. Instructional methods involve individual and small group desk critiques, plus substantial out-of-class work by each student. Spring. Prerequisite: LSA 182 or permission of instructor.

LSA 227 Foundation Design Studio II (4)

Seven hours of studio and one hour of lecture per week. This course aims to help students refine their design sensibilities, including fieldwork observation and recording, critical design and spatial thinking, and graphic representation skills in the elaboration of small scale landscape architecture projects. Project assignments will identify key issues of conceptual and practical concern to landscape designers and build comprehensively toward a final, synthetic body of work. Instructional methods involve individual and small group desk critiques, plus substantial out-of-class work by each student. Fall Prerequisite: LSA 226

LSA 233 Plants in the Landscape (3)

Two hours of lecture and three hours of field identification lab per week. Course provides an introduction to the identification, site requirements, natural and cultural history, community ecology, and landscape value of native and exotic woody and herbaceous plant materials typical of landscape architectural practice. Field identification labs include on-campus site walks and trips to local gardens, arboreta and natural areas to demonstrate the use of plants in designed and ecological settings. Fall.

LSA 300 Digital Methods & Graphics I (3)

Three hours of lecture per week. Through active participation, students learn to produce 2D digital graphics and documents (posters, reports, presentations and e-docs). Content includes image processing and vector drawing; document assembly for print, viewing and electronic distribution; and general concepts of digital workflow management. Credit will not be given for both LSA 300 and LSA 500. Fall. Prerequisite: Undergraduate standing in Landscape Architecture, Natural History and Interpretation or permission.

LSA 301 Landscape Representation II (3)

Three hours of lecture per week. This course introduces modeling strategies to address landscape specific-phenomena, provoked by an examination of the unique temporal, spatial, and speculative representative methods which are instigated by digital media. Coursework will focus on the fundamental relationship between landform and the dynamic landscape processes embodied within terrain, inviting students to invent and implement experimental computation workflows. 2D and 3D visualization technologies used in this course include: GIS-based mapping, typological diagramming, and rendered perspective. Digital fabrication technologies used in this course

include: laser cutting, CNC routing, and 3D printing. Fall Credit will not be given for both LSA 301 and LSA 501. Prerequisite: LSA 201

LSA 305 History/Landscape Arch I (3)

Three hours of lecture per week. This course offers a survey of landscape architecture and urban design in the context of the cultural history of the western world. Prior to taking this class, students should have passed at least one semester of college-level art (LSA 206) or architectural history.

LSA 311 Natural Proc-Design&Plan (3)

Three hours of lecture per week. An overview of basic principles and processes of physical and biological landscape systems with respect to their roles in landscape design and planning. Emphasizes landform, soil, slope, hydrology, climate, energy and general ecological issues as common elements influencing landscape design and the land use decision-making process. Sources and uses of environmental data are discussed. Fall. Note: Credit will not be granted for both EST 311 and LSA 311.

LSA 321 Ecol Appl/Plng & Design (3)

Three hours of lecture per week. Overview of basic principles and processes of biophysical landscape systems as well as concepts from ecology and landscape ecology with respect to their roles in sustainable landscape design and planning. Emphasis on applying theory to guide socio-ecological resilient planning and design decision making. Spring Prerequisite(s): Junior standing in the Bachelor of Landscape Architecture program or permission of the instructor.

LSA 322 Landscape Systems I (3)

Three hours of lecture/discussion per week. Overview of basic principles and processes of biophysical landscape systems as well as concepts from ecology and landscape ecology with respect to their roles in sustainable landscape design and planning. Emphasis on applying theory to guide socio-ecological resilient planning and design decision making. Spring.

LSA 323 Landscape Systems II (3)

Two hours of lecture and three hours of lab. Advanced methods for regional-scale landscape planning using geographic information system (GIS) technology to apply ecological principles, land use analysis and landscape planning frameworks. Fall.

LSA 326 Land Arch Dsgn Studio I (5)

Seven hours of studio and one hour of lecture per week. This course will instruct those enrolled in the processes of measuring various physical qualities of a site or landscape, and then how to apply knowledge of ecology, natural processes, and human behavior and culture to assess the viability of potential design uses and forms. The material addressed will include land measurement and measurement systems, physiography and landform, soils, hydrology, climate, and plant, animal and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural and cultural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their use in land use and site design decision-making. Occasional local field trips will be utilized. Fall. Prerequisites: LSA 182, LSA 226, LSA 227 and LSA 311 (or their equivalent) with grades of "C" or better, or permission of instructor.

LSA 327 Land Arch Dsgn Studio II (5)

Seven hours of studio and one hour of lecture per week. This course addresses intermediate to advanced level site design, including skill development, theory and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation of concept and form expression in small-scale site design. Focus is on the form implications of applying specific materials, plantings and structural systems through design development and detailing. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses $300-$400). Prerequisite: LSA 326 with a minimum grade of "C" or better, or permission of instructor. Co-requisite: LSA 342.

LSA 333 Plant Materials (2)

One hour of lecture followed by three hours of field identification lab per week. Course provides an introduction to the identification, site requirements, natural and cultural history, community ecology, and landscape value of native and exotic woody and herbaceous plant materials typical of landscape architectural practice. Field identification labs include on-campus site walks and trips to local gardens, arboreta and natural areas to demonstrate the use of plants in designed and ecological settings. Fall.

LSA 342 Land Arch Construct Tech (4)

Three hours of lecture and three hours of studio/laboratory per week. Lectures, project, and assigned readings. This course provides an introduction to important site construction basics, including landscape grading and landform manipulation. Topics addressed will include appropriate slopes for various site uses, surface and subsurface drainage, principles of cut/fill analysis, pedestrian and vehicular circulation design, horizontal and vertical road alignment, storm water management, and soil erosion control. Appropriate methods and technologies will be demonstrated through studio projects and exercises. Spring. Prerequisite: College math (with algebra and trigonometry), LSA 326, or permission of instructor.

LSA 343 Landscape Materials&Structures (3)

Three hours of lecture and discussion per week. This course introduces the properties of various "hardscape" design materials used in landscape architectural construction, as well as the appropriate structural systems and design detailing typical for design elements. Occasional local field trips. Spring.

LSA 422 Land Arch Dsgn Studio III (5)

Seven hours of studio and one hour of lecture per week. This course introduces and applies concepts urban and regional planning, environmental planning, and landscape ecology, in the context of large-scale landscape architectural, community, and urban design. Emphasis will be placed upon the application of appropriate technologies and strategies to foster environmentally and economically sustainable community forms, as well as greater environmental and social equity. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses $300-$400). Fall. Prerequisites: LSA 327 with a minimum grade of "C" or better, or permission of instructor.

LSA 423 Land Arch Dsgn Studio IV (5)

Seven hours of studio and one hour of lecture per week. LSA 423 addresses the final refining stages of small-scale site design, design detailing, precise layout and grading, selection of individual plant specimens and other materials, and the production of "working drawings" or contract documentation. Projects will include development of a complete set of working

"contract documents," including layout plans, grading plans, planting plans and design details and specification. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses $300-$400). Spring. Prerequisite: LSA 422 with a minimum grade of "C" or better, or permission of instructor.

LSA 424 Prep:Off-Camp Des Studio (1)

One hour of lecture and discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students will tentatively select topics, form off-campus groups and be assigned a faculty advisor. Fall. Prerequisite: Senior BLA standing, or permission of instructor.

LSA 425 Orient:Off-Camp Dsgn Studio (3)

Three hours of lecture and/or discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students undertake a detailed literature review, identify and refine research/study methods and prepare a detailed study proposal, including logistical details for LSA 460 (Off-Campus Design Thesis Studio). Spring. Prerequisite: LSA 424 and senior BLA standing, or permission of Off-Campus Program Director.

LSA 433 Planting Design&Practice (3)

Two hours of lecture and three hours of lab/studio exercises per week. This course provides foundations for the selection, specification, and arrangement of plants in landscape architectural design. Plants are addressed as a critical medium and as central characters to explore contemporary landscape representation, design, and construction. Students study botanical, horticultural, and ecological aspects of plants and plant communities, including form, expression, environmental responses, and time-based cycles of phenology, ephemerality, and maintenance. Projects help fortify links between design intent and spatial expression to reinforce conceptual approaches to planting design that account for plants' aesthetic, experiential, and infrastructural roles. Fall. Prerequisite: LSA 333 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

LSA 451 Comprehensive Land Plan (3)

Three hours of lecture per week. Introduction to the planning process including survey and analysis techniques, the comprehensive plan, political context, and land use controls. Selected functional planning areas such as land use, environmental, growth management, regional planning, and economic development planning. Legal and historical basis. Spring. Prerequisite: LSA 311 or permission of instructor. Note: Credit will not be granted for both LSA 451 and LSA 651.

LSA 455 Prof Prac/Lndscpe Arch (3)

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations, and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing, and continuing education. Spring. Prerequisites: Upper division standing in landscape architecture or permission of the instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

LSA 458 Off-Camp:Adv Visit,Wkly Rpts (4)

Twelve hours of individual field study per week conducted in an international or domestic location. Short field studies executed through on-site observation, sketching and analysis exercises. Study progress is communicated through weekly reports to an advisor and presented during the advisor's visit, the fifth week of the Off-Campus semester. Summer or Fall. Prerequisites: LSA 423 and LSA 425 with a minimum grade of “C”. Co-requisites: LSA 459, LSA 460.

LSA 459 Off-Camp:Dsgn Journal/Proj Ntb (4)

Twelve hours of individual field study per week conducted in an international or domestic location. Field observations and travel experiences documented through daily graphic and narrative entries in a design journal/sketchbook. Thesis project studies and research documented through daily entries in a project notebook. Summer or Fall. Prerequisites: LSA 423 and LSA 425 with a minimum grade of “C”. Co-requisites: LSA 458, LSA 460.

LSA 460 Off-Camp:Thesis Project (7)

Twenty-one hours of individual field research and studio per week conducted in an international or domestic location. The completion of a thesis project as delineated in a proposal prepared by the student and approved by the Off-Campus faculty advisor in LSA 425. Summer or Fall. Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 458 and LSA 459.

LSA 461 Off-Camp Final Present Sem (1)

One hour of seminar per week. Seminar time devoted to individual presentations and critique. Content focuses on individual projects undertaken as a component of LSA 460. Spring. Prerequisite: LSA 460.

LSA 470 Thematic Land Dsgn Studio (6)

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Spring. Prerequisite: LSA 423 or permission of the instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

LSA 480 Seminar:Urban Design (3)

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion and presentations, papers, and a three-day field trip. Fall. Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

LSA 481 Cultural Land Preservatn (3)

Two hours of presentation and one hour of discussion per week. The course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. Philosophy, history, and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance, and integrity and treatment of cultural resources will be explored. Limited enrollment. Spring.

LSA 495 Undergrad Exp/College Teaching (1-3)

Undergraduate Experience in College Teaching. An opportunity for 4th year senior or 5th year students to gain experience in fully supervised, college-level teaching similar to what they can expect to perform as a graduate teaching assistant. Students assist the course instructor in the preparation and presentation of studio or lecture material in an undergraduate course. A maximum of 6 credit hours of LSA 495 and 3 credit hours relating to any single assisted course. Fall, Spring, Summer. Prerequisite(s): 4th year senior or 5th year standing, a grade of B or higher in course being assisted, consent of instructor and minimum cumulative GPA of 3.0.

LSA 496 Spec Topics/Lndscpe Arch (1-6)

One to three hours of class meetings per week. Special topics of current interest to undergraduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring. Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

LSA 498 Intro Research Problems (1-3)

Guided study of a selection of problems relating to landscape architecture and environmental design. Emphasis on study procedure and methods employed. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Permission of instructor.

LSA 499 Undergrad Land Arch Internship (1-12)

Supervised office or field experience in a professional working environment. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisites: BLA students only with an approved internship proposal.

LSA 500 Digital Methods & Graphics I (3)

Three hours of lecture per week. Through active participation, students learn to produce 2D digital graphics and documents (posters, reports, presentations and e-docs). Content includes image processing and vector drawing; document assembly for print, viewing and electronic distribution; and coordination of workflow in team-based production settings. Prerequisite: Graduate standing in Landscape Architecture, Environmental Interpretation or permission. Note: Credit will not be given for both LSA 300 and LSA 500. Fall.

LSA 501 Landscape Representation II (3)

Three hours of lecture per week. This course introduces modeling strategies to address landscape specific-phenomena, provoked by an examination of the unique temporal, spatial, and speculative representative methods which are instigated by digital media. Coursework will focus on the fundamental relationship between landform and the dynamic landscape processes embodied within terrain, inviting students to invent and implement experimental computation workflows. 2D and 3D visualization technologies used in this course include: GIS-based mapping, typological diagramming, and rendered perspective. Digital fabrication technologies used in this course include: laser cutting, CNC routing, and 3D printing. Credit will not be given for both LSA 301 and LSA 501. Prerequisite: LSA 500

LSA 552 Graphic Communication (3)

Two three-hour studios and one one-hour lecture per week. Studio time devoted to demonstrations, exercises, and projects focusing on sketching, drafting, drawing construction and rendering techniques used in the landscape architecture field. Introduction to drawing reproduction and technologies. Emphasis on skill development, use of graphics in the design process. Drawings, examinations and a final project constitute basis for grades. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

LSA 577 Cultural&Hist Perspctvs in VRM (3)

Online synchronous. Three hours of lecture and discussion per week. Survey of historical context and cultural influences in visual resource management. Course discussions will explore the role of environmental and cultural ethics, and community engagement in assessment, protection and management of visual resources. Through case studies, students will examine past and present priorities in visual resource management. Fall semester; Spring and Summer as needed.

LSA 578 The Reg&Ethical Context of VRM (3)

Online synchronous. Three hours of lecture and discussion per week. This class covers the legal and regulatory framework that governs visual resource management methods and the application of these methods to the assessment of proposed projects. Students will gain an overview of current regulations and learn how to satisfy legal and ethical requirements in a variety of situations. Case studies that present visual impact projects across an array of scales and contexts will serve as a framework for studying the application of methods, assessments, and outcomes. Fall semester; Spring and Summer as needed.

LSA 579 Visual Resrce Mgt Sys&Methods (3)

Online synchronous. Three hours of lecture and discussion per week. This class covers the methods and systems used in the compilation of visual impact assessments. Students will learn to identify landscape features that contribute to the prediction of changes to scenic beauty that may result from management and/or development activities. Case studies will explore the application of visualization methods that illustrate proposed project alternatives, evaluate the expected visual change caused by a project, assess public reaction to the expected change, identify visual impacts, and recommend measures to avoid, minimize or mitigate adverse visual impacts. Students will gain experience in each of these methods through class assignments. Spring semester; Fall and Summer as needed.

LSA 581 Intro/Hist Presrv&Cultrl Lndsc (3)

An introduction to historic preservation planning (heritage conservation), a multi-disciplinary practice that seeks to sustain physical resources in the environment that convey history and define a sense of place. The course focuses on the application of historic preservation to natural and cultural resources as embodied in landscapes. Five main topics are covered: 1. Introduction to cultural landscapes and history of historic preservation as part of the American conservation movement; 2. Historic preservation laws, regulations, policies, and incentive programs; 3. Overview of advocacy organizations; 4. Inventory and evaluation of historic resources using the National Register of Historic Places and National Park Service cultural landscape program methods; and 5. Design guidelines for the treatment of historic resources using the Secretary of the Interior's Standards. Weekly readings and a semester project are required. Fall.

LSA 596 Spec Topics/Lndscpe Arch (1-3)

Experimental or special coursework in landscape architecture for graduate and undergraduate students. Subject matter and method of presentation vary from semester to semester. Fall and Spring. Prerequisite: Permission of instructor.

LSA 600 Design Studio I (4)

Nine hours of studio and one hour of lecture/discussion per week. The first in a sequence of studios focusing on the concepts, skills and methods of design. This course introduces students to the basic vocabulary of theoretical design principles, to the application and operation of these in the physical environment, and to the development of three-dimensional spatial concepts in community scale patterns. The requirements for the course include readings, examinations, field trips, design exercises and projects. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

LSA 601 Design Studio II (4)

Five hours of studio and one hour of lecture per week. The second in a sequence of studios applying the concepts, skills and methods of design in a critical analysis of various natural and human systems in community scale environments. Concentration is on the evaluation of options concerning a variety of land use activities, with special emphasis on landscape analysis and the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises and projects. Spring. Prerequisites: Graduate status in landscape architecture and LSA 600, LSA 552, or permission of instructor.

LSA 605 History of Landscape Arch (3)

Three hours of lecture per week. Historical study and style analysis of Western culture on environmental design, and changing attitudes and relationships to the environment. Non-Western influences on Western culture. Study of historical personalities as well as periods that are of environmental concern up to the modern period. Additional readings and a supplementary research/writing component. Spring. Note: Credit will not be granted for both LSA 405 and LSA 605.

LSA 611 Natural Factors Analysis (3)

Two hours and 40 minutes of lecture and one hour of discussion per week. This course addresses basic principles and processes of physical landscape systems with respect to their roles in landscape design and planning. Sources and uses of environmental data are discussed and illustrated. An emphasis is placed on landform, soil, slope, hydrology, climate and general ecological issues as common elements influencing landscape design and the land use decision making process. Fall. Prerequisite: Graduate status in landscape architecture or permission of instructor.

LSA 615 Site Construction (3)

One hour of lecture and six hours of studio per week. This course provides an introduction to important site construction basics, including landscape grading and landform manipulation to achieve appropriate slopes for use and positive surface drainage, principles of cut/fill analysis and subsurface drainage, horizontal and vertical alignment for road design, storm water management, and soil erosion control. Appropriate analysis methods and technologies will be employed through studio projects and exercises. Spring. Prerequisite: Graduate status in landscape architecture, concurrent enrollment in LSA 601 or permission of instructor.

LSA 620 Design Studio III (4)

One hour of lecture and nine hours of studio per week. This course is the third in a sequence of landscape architectural design studios. It focuses on advanced issues in site design and on the integration of project programming and design development into the design process. Concentrations include detailed designing for site layout, grading, storm water management, interior and exterior planting, site furnishing, and site lighting. Design exploration and project communication techniques are pursued such as CAD, reprographics, and computer-based visual simulation. Course requirements include readings, field trips, exercises, and design projects. Fall. Prerequisites: Graduate status in landscape architecture, LSA 601, LSA 611, LSA 615, or permission of instructor.

LSA 625 Orient/Experientl Studio (2)

This course includes two hours of lecture and discussion per week. It is an exploration of cultural, logistical and academic issues relevant to a research, internship or self-directed study experience abroad. The format also includes research and readings. Open to MLA and MS candidates. Spring.

LSA 632 Plants and Landscapes (2)

Five hours of instruction per week for eight weeks. This course provides an introduction to the identification and use of native and exotic plants typical of landscape architectural practice. It also introduces students to a range of landscape contexts ranging from natural areas to urban settings and establishes a foundation for the discussion of the social, historical and ecological themes and issues of each. Field trips required. Fall. Prerequisite: Entering MLA status or permission of the instructor.

LSA 633 Planting Design&Practice (3)

Two hours of lecture and three hours of lab/studio exercises per week. This course provides foundations for the selection, specification, and arrangement of plants in landscape architectural design. Plants are addressed as a critical medium and as central characters to explore contemporary landscape representation, design, and construction. Students study botanical, horticultural, and ecological aspects of plants and plant communities, including form, expression, environmental responses, and time-based cycles of phenology, ephemerality, and maintenance. Projects help fortify links between design intent and spatial expression to reinforce conceptual approaches to planting design that account for plants' aesthetic, experiential, and infrastructural roles. Fall. Prerequisite: LSA 632 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

LSA 640 Research Methods (3)

Three hours of seminar per week. Students learn skills for: (1) performing scholarly activities associated with learning what is known about topics, (2) using accepted methods for producing new knowledge which possesses qualities of validity and reliability, and (3) preparing documents which meet expectations for academic rigor. Parallels between scholarship, research and design are emphasized. Spring. Prerequisite(s): Graduate standing in DLA graduate programs in Landscape Architecture or permission of the instructor.

LSA 645 Construct Document Studio (3)

Six hours of studio and one hour of lecture per week. This course covers the production of traditional contract documents for bidding and construction of landscape architectural projects. Taught as a shared resource with LSA 445, students enrolled in LSA 645 participate in a separate studio section. Spring. Note: Credit will not be granted for both LSA 445 and LSA 645.

LSA 650 Behavr Factor/Comm Desgn (3)

Three hours of lecture and discussion per week. An introduction to the contribution of the behavioral sciences to community design and planning is provided. Readings and discussions concern both theoretical and methodological aspects. Case studies are used to illustrate a variety of current behavioral science applications. Course assignments familiarize the student with basic behavioral science methods including questionnaires, observations and interviews. A final project provides an opportunity to synthesize course materials. Fall or Spring. Prerequisite: Graduate status in landscape architecture or permission of instructor.

LSA 651 Comprehensive Land Plan (3)

Three hours of lecture per week. Survey of urban planning and design and environmental management in terms of contemporary challenges; legal, technological, administrative and political processes; human and ecological processes; the role of design; case studies, and current and projected best practices. Lectures, readings, discussions and presentations. Required field trip. Spring. Note: Credit will not be granted for both LSA 451 and LSA 651.

LSA 655 Prof Prac/Lndscpe Arch (3)

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing and continuing education. Students enrolled in LSA 655 will also produce a graduate project portfolio. Spring. Prerequisite: Graduate status in landscape architecture or permission of instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

LSA 670 Thematic Land Dsgn Studio (6)

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Additional readings and a supplementary research/writing component. Spring. Prerequisite: LSA 423 or permission of instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

LSA 680 Seminar:Urban Design (3)

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion, oral presentations, papers and a three-day field trip. This course fulfills the seminar requirement for students in the Community Design and Planning area of study. Fall. Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

LSA 681 Cultural Land Preservatn (3)

Two hours of presentation and one hour of discussion per week. This course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. The philosophy, history and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance and

integrity, and treatment of cultural resources will be explored. A major research project and presentation are required. Spring.

LSA 696 Spec Topics/Lndscp Arch (1-6)

One to three hours of class meetings per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Additional readings, supplementary research and writing assignments. Fall and Spring. Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

LSA 697 Topics+Issues/Land Arch (1)

Two hours of lecture and discussion every other week. Topics for discussion are selected to acquaint the entering graduate student with a generalized view and current issues facing landscape architects. Fall. Pre- or co-requisite: Audit LSA 220 and graduate status in landscape architecture or permission of instructor.

LSA 699 Land Arch Internship (1-12)

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisites: Fast Track BLA/MS status and written approval of an internship contract by major professor, curriculum director and field supervisor.

LSA 700 Design Studio V (4)

One hour of lecture and nine hours of studio per week. This studio requires the integration of design/planning processes, research methods and information, and technical skills through focus on large-scale, community-based or multicommunity-based projects. Studio work will require individual and teamwork, as well as consideration of multidisciplinary contributions and interdisciplinary work. This studio is the final studio for all MLA students. Fall. Prerequisite: LSA 621 or permission of instructor.

LSA 760 Off-Camp Experient Studio (12)

This course involves research, internship or self-directed study abroad with faculty guidance. Activities include field analysis, research, documentation, or directed fieldwork based on faculty-approved student proposals. Immersion in the host culture is a required aspect of this course. A final report is required. The course is open to MLA and MS candidates. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Summer and Fall. Prerequisites: LSA 625 and LSA 799 with a grade of B or better. Note: Credit will not be granted for both LSA 460 and LSA 760.

LSA 796 Topics In Landscape Arch (1-3)

One to three hours of lecture per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Prerequisite: Permission of instructor.

LSA 798 Research Problem (1-12)

Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Permission of instructor.

LSA 799 Capstone/Thesis Prop Dev (3)

One hour of lecture/seminar and two hours of tutorial per week. Students develop and defend a proposal for their MLA capstone projects or MS thesis. Fall or Spring. Prerequisite: LSA 640 or permission of instructor.

LSA 800 Capstone Studio (6)

One hour of lecture/seminar and 15 hours of studio per week. Students complete an academic landscape architecture investigation or professional-level project. Public presentations and comprehensive project documentation are required. Grades on an "S/U" basis. This is the final MLA studio prior to graduation. Fall or Spring. Prerequisite: LSA 799.

LSA 898 Professional Experience (1-12)

A supervised external professional work experience that satisfies Option 2 of the master's study integration requirement. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Graded on an "S/U" basis. Fall, Spring and Summer. Prerequisites: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

LSA 899 Masters Thesis Research (1-12)

Research and independent study for the master's degree and thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

MCR - MICROSCOPY

MCR 480 Fundamentals of Microscopy (3)

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy, atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall. Note: Credit will not be granted for both CME 480 and CME 680

MCR 484 Scanning Electron Microscopy (3)

Two hours of lecture/three hours of laboratory/ demonstration per week. Theory and operation of the scanning electron microscope, awareness of specimen preparation techniques, digital imaging, and interpretation of micrographs. Fall.

MCR 485 Trans Electron Microscopy (3)

Two hours of lecture/ three hours of laboratory/ demonstration per week. Theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Spring.

MCR 570 Med&Industrl Apps/Electron Mic (3)

Three hours of lecture/demonstration per week. Scanning and transmission electron microscopy applications in the medical, petroleum, polymer, solar, forensic, glass, pulp and paper and other industries. Sample preparation; image collection, interpretation and analysis. Safety, calibration, and quality control techniques. Spring.

MCR 580 Microtechnique of Wood (3)

Three hours of laboratory per week. Instruction on the use of the sliding mcirotome to slice thin sections of wood for light microscopy and for sample surface preparation of wood for scanning electron microscopy. Care of the microtome blade, staining of wood sections and preparation of micrsocope slides. Fall or Spring

MCR 585 Light Microscopy/Rsrch Appl (3)

Two hours of lecture/three hours of laboratory per week. Principles of light microscopy and photomicrographic digital imagery using Spot camera and Image Pro 7.0 software. Extensive laboratory component. Spring. Prerequisite: Permission of instructor

MCR 590 IT100 for Exp. Users (1)

Operation and theory of the IT100LA scanning electron microscope restricted to users with prior experience on a scanning electron microscope, and tailored to specific research needs of the user. Spring/Fall. Prerequisites: MCR 484, MCR 783 or equivalent prior SEM experience. Professor consent is required to register for this course.

MCR 680 Fundamentals of Microscopy (3)

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy,atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall.

MCR 682 TEM for Nanoparticle Rsrch (2)

Two hours of lecture/laboratory/demonstration plus two hours of individual laboratory per week. Theory and operation of the transmission electron microscope, specimen preparation for nanaopartical imaging, photographic technique and interpretation of micrographs. Fall or Spring.

MCR 683 Operation/Trans Electron Micro (3)

Two hours of lecture/ 3 hours of demonstration/laboratory per week. Theory and operation of the transmission electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs.

MCR 685 Trans Electron Microscopy (5)

Two hours of lecture/two hours of laboratory/ demonstration/four to six hours of individual laboratory per week. The theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. Preparation of a portfolio of biological and non-biological specimens demonstrating a variety of techniques. Spring.

MCR 783 Operation/Scan Electron Micro (3)

Two hours of lecture/three hours of demonstration/ laboratory per week. Theory and operation of the scanning electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs. Fall.

PSE - PAPER SCIENCE AND ENGINEERING

PSE 200 Intro to Papermaking (3)

Three hours of lecture per week. Historical and commercial consideration of the paper industry. Topics include wood handling, pulping, stock furnish, stock preparation and paper machine operation. Introductory discussions of papermaking technology, materials and paper making processes including environmental aspects. Fall.

PSE 201 Art &Early History/Papermaking (3)

Two hours lecture per week and three hours of studio. This papermaking course provides a historical (Asia - far east) and artistic perspective in both lecture and studio formats. History lectures will include the influence of paper in non-western cultures as a practical medium for human communication and as a versatile medium for expression of various paper art forms. Studio sessions will vary but generally will focus on historical papermaking by hand using non-western techniques and those paper art forms of far eastern origin. More modern techniques in the creation of paper art forms will also be explored in studio sessions. Spring

PSE 202 Pulp&Paper Lab Skills (1)

Three hours of laboratory per week provide a working knowledge of fundamental papermaking concepts. "Survival" skills learned enable students to perform well in subsequent PSE courses as well as summer employment. Operations and skills include: pulp preparation and analysis, papermaking, paper testing, report writing and team work. Spring. Pre- or co-requisite: PSE 200 (concurrent registration).

PSE 223 Intro to Lignocellulosics (4)

Three hours of lecture and three hours of laboratory per week. Topics included: structure and chemistry of lignocellulosic materials such as wood, including bark, agriculture residues, and grasses; major (cellulose, hemicelluloses, lignin) and minor constituents (extractives, proteins, ash); biosynthesis, distribution, structure, properties, conversion into energy, chemicals, and other products. Spring. Pre-requisite: One semester of organic chemistry.

PSE 296 Special Topics in Engineering (1-3)

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

PSE 304 Professional Internship (1)

Twelve weeks full time employment approved by the department with an industrial or research partner acquired through on-campus interviews or other means. The student and the supervisor set goals and expectations for the internship. The students and supervisors also provide feedback on the performance of the student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Summer.

PSE 305 Professional Co-op (1)

A semester of full-time employment approved by the department with an industrial or research partner acquired through on-campus interviews or other means. The student and the supervisor set goals and expectations for the co-op. The students and supervisors also provide feedback on the performance of the student. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall and Spring.

PSE 306 Professional Synthesis (1)

Students will develop a synthesis of their work experience from either PSE 304 or PSE 305 and present their results both orally and in a written report. Fall or Spring.

PSE 350 Fiber Processing (3)

Two hours of lecture, three hours of laboratory per week. Discussion of the principles of operation and the basic chemistry used in pulping, bleaching, and deinking processes. Transport and physical operations involved in fiber procurement, preparation, pulping, dispersion, washing, screening and refining are presented. Principles of operation of pulp mill equipment are reviewed and demonstrated in the laboratory. Spring. Prerequisites: PSE 200, PSE 223 or FCH 223. Note: Credit will not be granted for both PSE 350 and PSE 550.

PSE 436 Pulp & Paper Unit Operations (3)

Two hours of lecture and three hours of laboratory per week. Applications of momentum, heat, and mass transfer to operations in the pulp and paper industry. Topics include pulp flow, heater and heat exchanger design, black liquor evaporation, humidification, steam systems, paper and pulp drying, gas absorption, pulp washing, leaching, and extraction. Laboratory exercises include paper drying, pulp washing and cleaning, heat exchanger operations, and gas absorption for liquor preparation. Spring. Prerequisites: PSE 361, PSE 370, PSE 371, BPE 335.

PSE 437 Equip Troubleshooting&Maintenc (3)

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall. Note: Credit will not be granted for both PSE 437 and PSE 637.

PSE 438 Biorenew Fibrous&Nonfibrs Prod (3)

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of lignocellulosic products. Topics cover fibrous products including different paper grades, nanocellulose and cellulose derivatives, and nonfibrous products including products of enzymatic and/or chemical conversion of biomass constituents. Spring and/or Fall. Prerequisite(s): PSE 465 Fiber and Paper Properties and/or PSE 223 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

PSE 450 Pulping & Bleaching Processes (3)

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring. Prerequisites: PSE 350. Note: Credit will not be granted for both PSE 450 and PSE 650.

PSE 456 Management in Industry (3)

Three hours of lecture per week. Discussion of published approaches to managerial excellence are supplemented with current reports from periodicals, newspapers, and business and human resource oriented websites to prompt discussion of underlying principles of good management. Examples of good and bad results from published examples are used to prompt discussion of current issues in management around the world. Current and retired business managers are invited to guest lecture and share their experience with the students. The correlation between excellent business results and excellence in management of people is included and discussed. Spring. Note: Credit will not be granted for both PSE 456 and PSE 656.

PSE 462 Papermaking Processing I (3)

One hour of lecture, six hours of laboratory per week. Laboratory and pilot-scale study of the papermaking process and paper grade development from customer specifications. Emphasis is on raw material selection, stock preparation, paper machine operations, evaluation of the finished product, and engineering analysis of the stock and paper machine systems. Results are presented in written reports and student seminars. Fall. Prerequisites: PSE 200, PSE 370, PSE 465.

PSE 465 Fiber & Paper Properties (4)

Three hours of lecture and three hours of laboratory per week. Evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, non-fibrous paper additives, and paper. The interrelationships between papermaking fibers, nonfibrous additives, and manufacturing methods, and their effects on the final quality of paper are discussed in correlation with different test methods. Fall. Prerequisite: PSE200 Introduction to Papermaking

PSE 466 Paper Pigment & Barrier Coatng (3)

Three hours of lecture per week. Discussion and study of surface sizing, various pigment coating formulations, and introduction to polymers used in barrier coating. Study of equipment used in coating operations, fundamental principles, and parameters which control their use and the effects on final paper properties. Spring or Fall. Prerequisite: PSE465 Fiber and Paper Properties

PSE 467 Papermaking Wetend Chem (3)

Three hours of lecture per week. Provides the student with the fundamental principles of colloid and surface chemistry as they relate to the interaction of papermaking materials and chemical additives in the wet end of a paper machine system. The topics of retention of fine solids and dewatering are addressed in detail. Application of the various topics presented during the course are made during a pilot paper machine trial. Spring. Note: Credit will not be granted for both: PSE 467 and BPE 310.

PSE 468 Papermaking Processes (6)

One hour of lecture, fifteen hours of laboratory per week. Laboratory study of the papermaking process, with emphasis on operation of the semi-commercial Fourdrinier paper machine. Emphasis is on the fundamentals of pulping, stock preparation, paper machine operation, evaluation of the finished product, and the collection and analysis of data to develop material and energy balances. Results of each paper machine run are evaluated in seminar-type discussions. Spring. Prerequisites: PSE 300, PSE 370, PSE 465. Note: Credit will not be granted for both PSE 468 and PSE 668.

PSE 469 Functional and Nano Additives (3)

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall. Pre- or co-requisites: PSE 465. Note: Credit will not be granted for both PSE 469 and PSE 669.

PSE 478 Papermaking Processing II (2)

Six hours of laboratory/discussions/seminars per week. Semi-commercial study of papermaking processes, continuing the work of PSE 462. Emphasis on the scale-up of paper machine operations based on previous laboratory and pilot scale results, and engineering analysis of the stock and paper machine systems through detailed mass and energy balances. Results are presented in written reports and student seminars. Spring. Prerequisites: PSE 200, PSE 370, PSE 465, PSE 462 (or permission of the instructor).

PSE 481 Engineering Design (3)

Three hours of lecture per week. Design-project procedure; data sources and development. Application of simulation and computer-aided design to process synthesis and plant layout. Formulation and solution of original design problems. Fall. Prerequisites: PSE 371, PSE 372, PSE 480. Pre- or co-requisite: BPE 335.

PSE 492 Research Practice (3)

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics, with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in-depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall. Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 498 in Spring for research project execution.

PSE 496 Special Topics (1-3)

Lectures, conferences and discussions. Specialized topics in chemistry, chemical engineering and physics as well as topics pertaining to management as related to the pulp, paper, paperboard and allied industries. Fall and Spring.

PSE 498 Research Problem (1-4)

The student is assigned a research problem in pulping, bleaching, refining, additives, quality control of paper or paper products, or chemical engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research technique rather than on the results of commercial importance. The information obtained from the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer.

PSE 550 Fiber Processing (3)

Two hours of lecture, three hours of laboratory per week. Discussion of the principles of operation and the basic chemistry used in pulping, bleaching, and deinking processes. Transport and physical operations involved in fiber procurement, preparation, pulping, dispersion, washing, screening and refining are presented. Principles of operation of pulp mill equipment are reviewed and demonstrated in the laboratory. Each student will conduct independent study of at least one facet modern pulping processes and equipment and present results during a lecture or laboratory session. Spring. Prerequisites: PSE 200, PSE 223 or FCH 223. Note: Credit will not be granted for both PSE 350 and PSE 550.

PSE 552 Fiber Matrls Recylng&Processes (3)

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Topics include advanced process operation and calculations for deinking, dispersion, washing, cleaning and bleaching of recycled fiber raw materials including related chemistry used in the paper processing industry. Spring and or Fall.

PSE 561 Engr Thermodynamics (3)

Three hours of lecture per week. Principles of classical thermodynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; solutions and mixtures; equations of state. Compressible flow. Electrolyte solutions. Thermodynamic analysis of processes and systems via case studies and computer simulation. Compressible flow and /or thermodynamics of electrolyte solutions. Fall. Credit will not be granted for both PSE 361 and PSE 561 Prerequisites: Physics and Calculus

PSE 570 Prin Mass/Energy Balance (3)

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Computer simulation of steady and non-steady state process systems. Fall. Prerequisites: Physics, Calculus, and General Chemistry. Note: Credit will not be granted for both PSE 370 and PSE 570.

PSE 571 Fluid Mechanics (3)

Three hours of lecture per week. Fluid statics. Principles of mass, energy and momentum balance. Bernoulli's equation. Application to pipe flows, flow measurement and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the pulp and paper industry (pulps, black liquor, etc.) Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Analysis of some papermaking operations such as drainage, dewatering, vacuum dewatering and wet pressing. Fall. Prerequisites: Physics, Chemistry, Calculus. Note: Credit will not be granted for both PSE 371 and PSE 571.

PSE 596 Special Topics (1-3)

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

PSE 637 Equip Troubleshooting&Maintenc (3)

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in

troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall. Note: Credit will not be granted for both PSE 437 and PSE 637.

PSE 638 Biorenew Fibrous&Nonfibrs Prod (3)

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of biorenewable products for graduate students. Topics include fibrous products such as different paper grades; printing and writing paper, paper board, tissue, and specialty papers, and nanocellulose and cellulose derivatives and nonfibrous products such as hemicelluloses, lignin, pectins, extractives and products of enzymatic and chemical conversion of carbohydrates. Independent academic research component required. Spring and/or Fall. Prerequisite(s): PSE 465 Fiber and paper Properties and/or, PSE 223 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

PSE 650 Pulping & Bleaching Processes (3)

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring. Prerequisite(s): Organic, physical and analytic chemistry. Note: Credit will not be granted for both PSE 450 and PSE 650.

PSE 656 Management in Industry (3)

Three hours of lecture per week. Discussion of published approaches to managerial excellence are supplemented with current reports from periodicals, newspapers, and business and human resource oriented websites to prompt discussion of underlying principles of good management. Examples of good and bad results from published examples are used to prompt discussion of current issues in management around the world. Current and retired business managers are invited to guest lecture and share their experience with the students. The correlation between excellent business results and excellence in management of people is included and discussed. Students will critically review selected literature and present their findings. Spring. Note: Credit will not be granted for both PSE 456 and PSE 656.

PSE 662 Papermaking Processes I (3)

One hour of lecture, six hours of laboratory per week. Laboratory and pilot-scale study of the papermaking process and paper grade development from customer specifications. Emphasis is on raw material selection, stock preparation, paper machine operations, evaluation of the finished product, and engineering analysis of the stock and paper machine systems. Results are presented in written reports and student seminars. Students will engage in independent research projects related to the papermaking process. Fall. Prerequisites: PSE 570, PSE 665.

PSE 665 Fiber & Paper Properties (4)

Three hours of lecture and three hours of laboratory per week. Advanced science course in evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, nonfibrous paper additives, and paper. The interrelationships between fibers and nonfibrous paper additives, and manufacturing methods, and their effects on the final paper quality of paper are discussed. Independent academic research required. Fall. Prerequisite: PSE202 Introduction to Papermaking Note: Credit will not be granted for both PSE 465 and PSE 665.

PSE 666 Paper Pigment & Barrier Coatng (3)

Three hours of lecture per week. Advanced course in materials and processes used in surface sizing, pigment coating, and barrier coating for graduate students. Study of equipment used in coating operations, fundamentals and parameters, which control their use and effects on final paper properties. Independent literature research with report and presentation on a selected topic. Spring and/or Fall. Prerequisite: PSE 465 Fiber and Paper Properties. Note: Credit will not be granted for both PSE 466 and PSE 666.

PSE 667 Colloid&Interface Sci App (3)

Three hours of lecture per week. Provides the student with the fundamental principles of Colloidal and Interface Science as it relates to the interaction of papermaking materials and chemical additives in the wet end of a paper machine system. The topics of retention of fine solids and dewatering are addressed in detail. Spring. Pre- or co-requisite: Physical chemistry.

PSE 668 Papermaking Processes (6)

One hour of lecture and fifteen hours of laboratory per week. Study of the papermaking process from theoretical and practical standpoints featuring the operation of the pilot paper machines. Emphasis is on the fundamentals of stock preparation and paper machine operations, papermaking process and product design, evaluation of the finished product, and the collection and analysis of process data. An independent project is required in conjunction with the undergraduate paper machine runs. Spring. Pre- or co-requisite(s): PSE 300, PSE 370, PSE 665. Note: Credit will not be granted for both PSE 468 and PSE 668.

PSE 669 Functional and Nano Additives (3)

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall. Pre- or co-requisites: PSE465 Note: Credit will not be granted for both PSE 469 and PSE 669.

PSE 677 Process Control (3)

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, LaPlace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Process identification using numerical techniques and MATLAB. Fall. Prerequisite: Differential Equations. Note: Credit will not be granted for both PSE 477 and PSE 677.

PSE 678 Papermaking Processes II (2)

Six hours of laboratory/discussions/seminars per week. Semi-commercial study of papermaking processes, continuing the work of PSE 662. Emphasis on the scale-up of paper machine operations based on previous laboratory and pilot scale results, and engineering analysis of the stock and paper machine systems through detailed mass and energy balances. Results are presented in written reports and student seminars. Spring. Prerequisites: PSE 570, PSE 665, PSE 662 (or permission of the instructor)

PSE 792 Research Practice (3)

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics. with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall. Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 798 in Spring for research project execution.

PSE 797 Seminar (1-3)

Discussion of assigned topics in the fields related to Paper Science Engineering. Spring and Fall.

PSE 798 Resrch/Paper Science Engr (1-12)

Independent research topics in Paper Science Engineering. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Credit hours to be arranged.

PSE 898 Prof Experience/Synthesis (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, or Summer. Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

PSE 899 Masters Thesis Research (1-12)

Research and independent study for the master's thesis. Fall, Spring or Summer. Credit hours to be arranged.

PSE 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral dissertation. Fall, Spring or Summer. Credit hours to be arranged.

RMS - RENEWABLE MATERIALS SCIENCE

RMS 132 Intro/Renewable Mat Science I (1)

One hour lecture or three-hour lab/field trip per week. Introduction to renewable materials and their utilization as fields of enquiry and as career paths. Introduction to campus resources available to ensure campus success. Credit will not be granted for more than one of BPE 132, PSE 132, or RMS 132.

RMS 133 Intro/Renewable Mat Science II (1)

One hour of lecture or three-hour workshop per week. Introduction to the tools needed for successful learning about renewable materials science, such as the scientific method, calculations, basic statistics, problem solving, ethics, professional responsibility, and internship and co-op requirements. Credit will not be granted for more than one of BPE 133, PSE 133 or RMS 133. Fall.

RMS 200 Renewable Mat&Comp/Lignocell (3)

Two hours of lecture and three hours of laboratory per week; this is an introductory modular course in renewable materials; structure and composition of lignocellulosics/wood; production, properties and use of wood products and wood composites; pulp, paper, packaging, and lignin products; polymers: natural and synthetic. Fall. Prerequisites: Two semesters of General Chemistry Lecture and Lab, Calculus I and II, Two semesters of General Physics and Lab Co-requisite: Organic Chemistry I Lecture and Lab

RMS 322 Wood Machining (3)

Two hours of lecture and three hours of laboratory/discussion per week. Evaluate principles involved in machining wood for production and use as products. Study reasons for and methods of various machining operations. Evaluate relations between the substrate, the surface created, chip formation and the cutting tool. Fall.

RMS 335 Trsprt Properties of Materials (3)

Two lectures/one laboratory per week. Transport phenomena applied to wood and paper. Discussions and demonstrations of the movement of gases and liquids through wood (seasoning and preservation) and paper (drying) and transport of fibers in suspension (pulp slurries). Topics include conduction, convective heat and mass transfer, diffusion in both steady-state and transient situations. Discussion of specific industrial examples. Spring. RMS 387, RMS 388, PSE 370

RMS 376 Decay of Wood Products (3)

Three hours of lecture/laboratory/demonstration per week. Degradation of wood by fungi and other biological agents. Emphasis on the effects of decay on wood properties, methods of decay detection in wood products and decay prevention. Spring. Prerequisite: RMS 387

RMS 387 Renewable Mat/Sustainable Cons (3)

Three hours of discussion, lecture and demonstration per week. Properties and uses of wood and other renewable materials as a major construction materials. Identification and knowledge of the major wood species and their applications in construction. Fall.

RMS 388 Wood and Fiber Ident Lab (2)

Six hours of laboratory per week. Wood and papermaking fiber identification using both gross and microscopic features. Fall.

RMS 422 Composite Mat/Sustainable Cons (3)

Two hours of lecture, three hours of laboratory per week. Properties, manufacture, and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Spring. Prerequisite(s): GNE 271, Statics and CME 387, Renewable Materials for Sustainable Construction

RMS 465 Renewable Materials & Surfaces (3)

Study bulk and surface properties of porous materials, including structure, morphology, mechanical, optical, thermal and moisture equilibrium and dynamics. Applications to wood products and wood composites, pulp/paper/packaging products; natural and synthetic polymers. Fall. Pre-requisites: RMS 200 or by instructor’s permission

RMS 468 Product Design:Timber or Paper (3)

Independent study. The student demonstrates mastery of RMS principles by producing a new application of those principles to the design and construction of a prototype model. Fall. Senior standing in Renewable Materials Science or permission of instructor

RMS 481 Capstone Project/Senior Thesis (3)

Independent study. Demonstrate mastery of RMS program content by undertaking a project following consultation with the instructor. Required elements are: creative and critical thinking and an ability to analyze data collected/generated by the student, leading to a conclusion that is presented in a written and oral technical report. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Senior standing or permission of instructor. Spring. Senior standing in Renewable Materials Science or permission of instructor

RMS 496 Special Topics (1-3)

Lectures, readings, problems and discussions. Topics in renewable materials science as agreed upon with adviser. Fall, spring or summer. (1-3)

RMS 498 Rsrch Probs/Renew Mats Science (1-4)

Independent work on a research project in renewable materials science as agreed upon with adviser. A literature review, suitable research plan, execution of the research plan, collection of data and presentation in a written report is required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. (1-4).

RMS 587 Renewable Mat/Sustainable Cons (3)

Three hours of discussion, lecture and demonstration per week. Properties and uses of wood and other renewable materials as major construction materials. Identification and knowledge of the major wood species and their applications in construction. Evaluation of current practices and materials. Fall.

RMS 596 Special Topics in RMS (1-3)

Lectures, conferences, discussions and laboratory. Topics in Renewable Materials Science not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

RMS 622 Composite Mat/Sustainable Cons (3)

Two hours of lecture, three hours of laboratory per week. Properties, manufacture, and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Evaluation of current practices and materials. Spring. Prerequisite(s): GNE 271, Statics, and RMS 387 or RMS 587, Renewable Materials for Sustainable Construction

RMS 796 Advanced Topics in RMS (1-3)

Lectures, conferences, discussions and/or laboratory. Advanced topics in renewable materials science. Fall and/or Spring. Prerequisite: Permission of instructor

RMS 798 Rsrch/Renewable Mat Sci (1-12)

Independent research topics in renewable materials science. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring or Summer. Credit hours to be arranged

RMS 898 Professional Experience (1-6)

A supervised, documented professional work experience in the Master of Professional Studies degree program. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, or Summer. Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

RMS 899 Master's Thesis Research (1-12)

Research and independent study for the master's thesis. Fall, Spring or Summer. Credit hours to be arranged.

RMS 999 Doctoral Thesis Research (1-12)

Research and independent study for the doctoral dissertation. Fall, Spring or Summer. Credit hours to be arranged.

SRE - SUSTAINABLE RENEWABLE ENERGY

SRE 150 Intro to Sust Energy Managemnt (1)

1 hour lecture per week. An introduction to the Sustainable Energy Management major and employment opportunities, sustainable energy information resources, and the ESF Syracuse campus's sustainable energy resources and conservation efforts.

SRE 225 Physics of Energy (3)

Three hours of lecture per week. Introduction to the principles of physics and their application in conventional and sustainable energy systems. This course covers the fundamentals of mechanical, chemical, electrical, thermal, and nuclear energy, including efficiency of energy conversions. Fall. Prerequisite: APM 103 or equivalent and enrollment in the Sustainable Energy Management major, or permission of instructor

SRE 298 Rsrch Apprntceshp/Sus Enrg Mgt (1-3)

Students will participate in research projects consistent with their educational and professional goals. A faculty member in the Department of Sustainable Resources Management will serve as the student's faculty sponsor. The student, in consultation with the faculty sponsor, will prepare a study plan outlining the apprenticeship's educational goals. The faculty sponsor will generate a performance assessment and record of activities at the end of the apprenticeship. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Grading Satisfactory/Unsatisfactory. Fall, Spring, Summer. Instructor permission required

SRE 325 Energy Systems (3)

Three hours of lecture per week. The Energy Systems course provides an interdisciplinary overview of human-dominated energy systems. A variety of topics will be covered to introduce students to fossil fuel-based, renewable, and other energy systems, including: energy supply and consumption, extractive approaches, resource demands, environmental impacts and energy security, and quantitative methods related to energy metrics. Students will use systems thinking to evaluate existing and emerging energy systems. The course involves occasional field trips. Fall.

Prerequisites: SRE 225 or equivalent introductory physics course, and FCH 110 and FCH 111 or equivalent one semester of introductory chemistry with lab. Note: Credit will not be granted for SRE 325 and SRE 525.

SRE 335 Renewable Energy (3)

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy generation and supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of technological, economic and environmental impacts. Spring. Prerequisites: PHY 211, EFB 200, SRE 225 or equivalent one semester of introductory physics. FCH 110 and FCH 111, or equivalent one semester of introductory chemistry with lab. SRE 325 or instructor permission. Note: Credits will not be granted for SRE 335 and 535

SRE 337 Energy Resource Assessment (3)

Three hours of lecture or two hours of lecture and three hours of field visits per week. Evaluation of energy pathways employed in the Northeast U.S. Primary emphasis on the following topics: the economic, environmental, and technical tradeoffs of utility-scale energy pathway; assessments of the economic viability of utility-scale energy pathways.

SRE 416 Sustainable Energy Policy (3)

Three hours of lecture per week. Evaluation of the sustainable energy field as it relates to policy. Primary emphasis on the following topics: policy concerns that motivated the development and expansion of sustainable energy, a history of the policy interactions between sustainable energy pathways, and controversies that have arisen from these interactions and their effects. Prerequisite: SRE 325, SRE 335. Corequisite: SRE 422

SRE 419 Energy Pol Assessmnt Methodlgs (3)

Three hours of lecture per week. This course covers the primary methodologies employed to conduct assessments of energy policies and policy proposals, including techno-economic assessment, deterministic analysis, and stochastic analysis. Students will learn how to select the methodology that is most appropriate for an analytical scenario, conduct assessments using the available methodologies, and select the policies or policy proposals that are most effective at achieving a desired energy policy outcome. Spring. Prerequisites: SRE 335, SRE 416, or FOR333

SRE 422 Energy Markets and Regulation (3)

Three hours of lecture/discussion concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall. Prerequisites: SRE 325 Energy Systems Note: Credits will not be granted for SRE 422 and SRE 622.

SRE 441 Biomass Energy (3)

Three hours of lecture per week. Production and use of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass sources, their conversion to different forms of energy and end products, and an assessments of sustainability. Field trips to regional biomass facilities. Spring. Prerequisites: SRE 325, SRE 335 or consent of instructor

SRE 450 Sustainbl Energy Capstone Plng (1)

One hour group meeting every two weeks, with supervised individual activity per week. This course will afford the student an opportunity to select a topic, in conjunction with the instructor, for detail investigation in Capstone II. Each student will work individually with the instructor to arrive at a feasible project. Prerequisites: SRE 325, SRE 335 Corequisite: SRE 422

SRE 454 Sustainble Energy Fin&Analysis (3)

Three hours of lecture/discussion per week. Focus on issues concerning renewable energy finance and analysis. Topics include: the adoption and financing of renewable energy project within the context of overall economics of energy markets, financial analysis of renewable energy projects, the role of tax and subsidies in promoting the adoption of renewable sources of energy. Prerequisite(s): FOR205 Principles of Accounting (or equivalent) and FOR333 Natural Resources Managerial Economics (or equivalent) or permission of the instructor

SRE 479 Life Cycle Assessment (3)

Three hours of lecture per week. Life cycle assessment (LCA) is a tool used across fields to determine the cradle-to-grave environmental impacts of products and systems. The course will cover how to perform an LCA and how to evaluate LCA results. Students will conduct in groups a full life cycle assessment with a literature review, sensitivity analysis, and uncertainty analysis using available data and impact assessment methods. Fall. Prerequisites: A college-level statistics course, junior or senior standing, or instructor permission.

SRE 481 Advanced Life Cycle Assessment (3)

Three hours of lecture per week. This course covers advanced topics in LCA, focusing on modeling approaches and methods. Topics include advanced life cycle impact assessment methods, consequential and attributional modeling approaches, modeling end-of-life, dynamic LCA, organizational and territorial LCA, and Life cycle management. Spring Credit will not be given for both SRE 481 and SRE 681 Prerequisites: SRE 479 or Instructor's Permission

SRE 491 Sustainable Energy Mgt Capstne (3)

Three hours of lecture/discussion per week. This capstone course emphasizes the assimilation, integration, and interpretation of the physical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. A written comprehensive energy resource plan, also presented orally, provides the central vehicle by which students demonstrate their abilities as future energy resource managers. Spring. Prerequisites: SRE 325, SRE 335, SRE 422, and FOR 333, or Permission of Instructor

SRE 495 Undergrad Exp/College Teaching (1-3)

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. A maximum of 6 credit hours of SRE 495, and 3 credit hours relating to any single assisted course, may apply toward graduation requirements. Fall and Spring. Prerequisite: Prior completion of course to be assisted with grade of B or better. Professor consent is required to register for this course.

SRE 496 Special Topics/Sust Energy Mgt (1-3)

Experimental and developmental courses in new areas of sustainable energy management or areas not covered in regularly scheduled courses. Topics may include but are not limited to the biological, physical, and social dimensions and the many and varied renewable energy resources. Specific detailed course descriptions for each course taught under the SRE 496 designation are available for student perusal. Fall, Spring and Summer.

SRE 498 Ind Study/Sustainable Energy (1-6)

Independent research or study in sustainable energy management/forestry for selected undergraduate students. Selection of subject area, nature of the research or study, and number of credit hours determined by student in conference with appropriate faculty member; initiative in taking SRE 498 rests with the student. Final written report is required for record. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Cumulative GPA of at least 2.50 and approval of the adviser and instructor. Professor consent is required to register for this course.

SRE 499 Internship/Sustainable Energy (1-12)

Full- or part-time engagement as volunteer or employee working for off-campus resource management/forestry/renewable energy organization under guidance of external supervisor. Record of activities and final written report is required for record. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring and Summer. Prerequisite: Junior or Senior status. Must have a cumulative GPA of at least 2.5. Professor consent is required to register for this course.

SRE 525 Energy Systems (3)

Three hours of lecture per week. The Energy Systems course provides an interdisciplinary overview of human-dominated energy systems. A variety of topics will be covered to introduce students to fossil fuel-based, renewable, and other energy systems, including: energy supply and consumption, extractive approaches, resource demands, environmental impacts and energy security, and quantitative methods related to energy metrics. Students will use systems thinking to evaluate existing and emerging energy systems. The course involves occasional field trips. Students taking SRE 525 will be required to complete additional work and held to higher expectations than those taking SRE 325. Fall. Prerequisites: Undergraduate courses in introductory physics and introductory chemistry. Note: Credits will not be granted for SRE 325 and SRE 525.

SRE 535 Renewable Energy (3)

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy generation and supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of technological, economic and environmental impacts. Students taking SRE 535 will be required to complete additional work and held to higher standards than those taking SRE 335. Spring. Prerequisites: Graduate standing or instructor permission. Note: Credits will not be granted for SRE 335 and 535.

SRE 537 Energy Resource Assessment (4)

Three hours of lecture per week. One week of field visits to utility-scale energy facilities during the week following the end of finals. Evaluation of energy pathways employed in the Northeast U.S. Primary emphasis on quantification and comparison of the economic, environmental, and technical tradeoffs of utility-scale energy pathways. Critical analysis and assessment of the

economic viability of utility-scale energy pathways. Spring semester. Prerequisite: Graduate standing of instructor permission. Note: Credit will not be granted for both SRE 337 and SRE 537.

SRE 619 Energy Pol Assessmnt Methodlgs (3)

Three hours of lecture per week. This course covers the primary methodologies employed to conduct assessments of energy policies and policy proposals, including techno-economic assessment, deterministic analysis, and stochastic analysis. Students will learn how to select the methodology that is most appropriate for an analytical scenario, conduct assessments using the available methodologies, and select the policies or policy proposals that are most effective at achieving a desired energy policy outcome. Graduate students will be expected to further compare and contrast the different methodologies available, identify the appropriate methodology for a policy question and justify its use, and quantify the effectiveness of the solution to the policy question in a separate term paper. Spring. Prerequisite: Graduate standing

SRE 622 Energy Markets and Regulation (3)

Three hours of lecture/discussion concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall. Prerequisites: SRE 325 Energy Systems or equivalent or permission of instructor Note: Credits will not be granted for SRE 422 and SRE 622.

SRE 641 Biomass Energy (3)

Three hours of lecture per week. Production and use of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass sources, their conversion to different forms of energy and end products, and an assessment of source sustainability. Field trips to regional biomass facilities. Spring. Note: Credit will not be granted for SRE 441 and SRE 641

SRE 650 Climate&Sust Science&Practce I (3)

Full days - Four days at start of the semester, third Friday each month during. This course develops a strong foundation for emerging leaders working in climate change mitigation and adaptation fields with a focus on four key areas: (1) Climate Science and Policy, (2) Equity and Environmental Justice, (3) Project Planning, Management, and Analysis, and (4) Professional & Strategic Communications. Through hands-on problem-based learning, guest speakers, in-house experts, and breakout sessions, students will gain the tools, knowledge, and critical thinking skills to tackle the climate crisis as young climate protection professionals. Co-requisites: SRE 898

SRE 660 Climate&Sust Science&Prctce II (3)

One full day a month, 9:00AM – 5:00 PM, two full days mid semester. Through a variety of lectures, readings, speakers and hands-on workshops, students will develop a deeper working knowledge in four key areas: (1) Clean Technologies and Applications, (2) Corporate Sustainability Reporting, (3) Project Finance and Green Economy, and (4) Career Planning and Job Search. Students will learn to use climate-relevant tools and methods, applying them to real-world projects, including energy assessments, carbon inventories, climate action plans, and quantitative analysis. Spring. Prerequisite: SRE 650; Co-requisites: SRE 898

SRE 679 Life Cycle Assessment (3)

Three hours of lecture per week. Life cycle assessment (LCA) is a tool used across fields to determine the cradle-to-grave environmental impacts of products and systems. The course will cover how to mathematically define the life cycles of products and systems, perform an LCA, and interpret LCA results and evaluate them within the context of the scientific literature. Students will individually conduct a full life cycle assessment with a literature review, sensitivity analysis, and uncertainty analysis using available data and impact assessment methods. Fall. Prerequisites: A college-based statistics course or instructor permission.

SRE 681 Advanced Life Cycle Assessment (3)

Three hours of lecture per week. This course covers advanced topics in LCA, focusing on modeling approaches and methods. Topics include advanced life cycle impact assessment methods, consequential and attributional modeling approaches, modeling end-of-life, dynamic LCA, organizational/territorial LCA, and Life cycle management. Spring. Credit will not be given for both SRE 481 and SRE 681 Prerequisite: SRE 479/679 or Instructor's Permission

SRE 796 Special Topics in Sust Energy (1-3)

Lectures, seminars, and discussion. Advanced topics in sustainable energy and its management. Fall and/or Spring.

SRE 797 Seminar (1-3)

Group discussion and individual presentation of topics of current interest to sustainable energy. Fall and Spring

SRE 798 Research Probs in Sust Energy (1-12)

Special investigation and analysis of sustainable energy topics. A study plan and a final written report are required. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, and Summer

SRE 898 Prof Experience/Internship (1-12)

Professional experience/internship which applies, enriches, or complements formal course work. All professional experiences/internships must have a signed experience/internship agreement on record with the advisor. Graded on an "S/U" basis. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, and Summer

SRE 899 Master's Thesis Research (1-12)

Investigation leading to the completion of a Master's thesis. Graded on an "S/U" basis. Fall, Spring, and Summer.

SRE 999 Doctoral Thesis Research (1-12)

Investigation leading to the completion of a doctoral thesis. Graded on an "S/U" basis. Fall, Spring, and Summer.

SUS - SUSTAINABILITY MANAGEMENT

SUS 296 Special Topics in Sust Mngmnt (1-3)

Online asynchronous. Experimental and developmental courses in new areas of sustainability management not covered in regularly scheduled courses. A detailed course description will be presented as the topic areas is identified and developed. Fall, Spring and Summer.

SUS 300 Sus Systems: Eco, Econ, & Soc (3)

Online This course defines sustainability and sustainable development, introduces the United Nations Sustainable Development Goals and helps the student begin to understand the complex interactions between the environment, the economy, and society, and their implications for sustainable development. Fall, with Spring and Summer as needed Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 310 Human & Soc Dim Sustainability (3)

Online SUS 310: Human and Social Dimensions of Sustainability; Online; This course explores how social systems and systems of governance, individual and collective human behaviors, attitudes, values, and ethics influence sustainability. It considers examples of the forces and factors which may or may not foster sustainable human and natural communities and ecosystems. In essence, this course seeks to define "what is a sustainable society?" Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 320 Eco. Dim. Of Sustainability (3)

Online This course will expand on the interconnected nature of biophysical systems and cycles, and human dependence upon the sustainable use of resources in these systems. Our atmosphere, water, mineral, energy, and biological resources are all limited in ways which demand understanding and stewardship to sustain human and natural communities. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 330 Intro Sustain. Data Analysis (3)

Online This course will introduce students to various types of metrics and analyses to assess sustainability outcomes/results. The course provides students with an overview of analytical methods and tools including spreadsheets and statistics. Specific examples of how these methods and tools are applied to sustainability solutions are included. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 335 Applied Stats for Sustainablty (3)

Online asynchronous. This course introduces students to many commonly used statistical tests that allow them to answer questions about the population with which they are working. Students will be able to estimate population values, determine if there have been significant changes to the variables you are studying, compare these population values between groups, and create models that will help you to track and predict changes within your population. Fall, with Spring and Summer as needed

SUS 340 Principles Sustainable Dvlpmnt (3)

Online Concepts of sustainable development, specifically focusing on the drivers of change and the roles and limitations of the private and governmental sectors in supporting sustainable

alternatives. Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 350 Intro. Spatial Analysis & GIS (3)

Online SUS 350: Introduction to Spatial Analysis & Geographic Information Systems; Online; This course will introduce students to various types of spatial analyses, and provide students with an overview of GIS technology and applications, including the uses and limitations of geospatial data, remote sensing, and GIS software & associated tools. Specific examples of how GIS may be applied to sustainability solutions are included. Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 355 Con Bio & Landscape Ecology (3)

Online. This course introduces essential concepts in conservation biology, focusing on a system that has created a global crisis for people, wildlife, and ecosystems. We will study the principles underlying older and newer approaches to conservation biology, as well as explore evidence that may illuminate when, and under what conditions, approaches to each may be successful. The paradigm is shifting towards the integration of human communities in the management and conservation of protected areas, and the valuation of ecosystem services. Innovative ways are needed to integrate human communities with conservation efforts, while adding value to ecosystem services. Through this lens we will assess the relationship of people and protected areas, investigate the role economics and politics plays in decision making, and debate the costs and benefits of a new paradigm shift away from traditional conservation. Fall, with Spring and Summer as needed

SUS 360 Climate Change&Sustainability (3)

Online This course will introduce the basic science of climate change and the social, economic, and environmental implications of climate change. Students will compare climate model projections, and evaluate various climate adaptation and mitigation strategies in global, regional and local environments. Pre-requisites: SUS 330: Introduction to Sustainability Data Analysis or equivalent, or permission of program advisor Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 375 Environmental Economics (3)

Online. This course provides an introduction to the basic principles of environmental economics. It seeks the application of economic theory and models to examine how environmental resources are managed, the way people make decisions that lead to environmental destruction and/or environmental improvements. Topics covered include the current state of the environment, economic incentives, market failures, economic valuation, environmental policy analysis in the United States and global environmental issues. Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor is required.

SUS 400 Analysis Sustainable Systems (3)

Online This course will introduce students to analysis methods and tools used by private and public sector organizations to determine the effectiveness and sustainability potential of products and systems. (e.g., Life Cycle Assessment ecological models, economic models, energy and sustainability audit). Pre-requisites: SUS 330: Introduction to Sustainability Data Analysis or

equivalent. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 410 Sustainable Urbanism (3)

Online This course will discuss the unique ecological, economic and social considerations of the human nature dimension in urban and regional environments, and explore best practices for fostering sustainability in these settings. Specific topics include transportation, food systems, urban wildlife and green infrastructure. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 415 Sustainable Agriculture (3)

Online asynchronous. This course examines the social, economic, and environmental dimensions of sustainable agriculture and the emerging global challenges and constraints on modern (conventional) farming. Students examine farming systems and approaches worldwide to improve sustainability, including integrated crop management, conservation agriculture, organic farming, regenerative, and permaculture among others. The course emphasizes the principles and practices of sustainable agriculture and drivers and constraints affecting the adoption of ecologically based farming practices. Students assess agricultural operations concerning crops, animals, soil, and pest management. Spring, with Fall and Summer as needed

SUS 420 Sust Enrgy: Tech,Systms&Policy (3)

Online This course explores concepts and various technologies in sustainable energy production, consumption, storage, environmental and social impact, and explores the ways in which these relate to sustainability. Topics cover a wide range of energy systems, including nuclear, fossil fuels, wind, solar, biofuels, and biomass. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 430 Managerial Ecnmcs for Sustblty (3)

Online Every manager of a for-profit or not-for-profit organization must answer the question: "How do we use economic information to make better business and resource management decisions given a sustainability objective?" These decisions require identifying alternative means of achieving given sustainability and other objective(s) and then selecting the alternative that accomplishes the stated objective(s) in the most resource efficient manner given the goals of the organization. Pre-requisites: SUS 330: Introduction to Sustainability Data Analysis and an Introduction to Economics class, or permission of program advisor. Fall, with Spring and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 440 Env Justice:Pol, Law & Society (3)

Online This course examines political, economic and social conditions that promote environmental inequality and explores the modern history of environmental exploitation of marginalized populations in the U.S. This course introduces students to the principles of environmental justice. Students will evaluate relevant environmental law and policy, examine prominent case studies related to the environmental justice literature and movement and apply appropriate tools to assess environmental inequality. Pre-requisites: SUS 350: Introduction to Spatial Analysis & Geographic Information Systems or equivalent, or permission of Sustainability Management program advisor. Spring, with Fall and Summer as needed. Note: Enrollment in the

Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 450 Civic Engagement&Particip Plng (3)

Online This course entails an analysis of civic engagement and participatory planning processes. Students will identify the purposes and best practices for empowering communities and organizations to participate in the informed design and management of sustainability projects and processes. Students will examine social theories and evaluate the dynamics, strategies and motivations of various stakeholders such as government institutions, public and private organizations, and individual participants. Students will apply skills and knowledge to create a planning process around a sustainability topic of their choice. Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management major, or permission of Sustainability Management program advisor, is required.

SUS 480 Sustainability Mngmnt Capstone (3)

Online This course will focus on the application of learned knowledge to sustainability management problems and workplace skills. Spring, with Fall and Summer as needed. Note: Enrollment in the Sustainability Management Program, or permission of Sustainability Management program advisor, is required. This course should be taken during a student's final semester of enrollment in the Sustainability Management program.

SUS 499 Internship/Sustainability Mgmt (1-12)

Online. Supervised office or field experience in a professional working environment. Students shall report their activities to their instructor on a weekly basis for the duration of the course. Fall, Spring, and Summer. Note: Enrollment in the sustainability management major and permission of Sustainability Management program coordinator are required.