Spring 2026 Tech Elective List

By utilizing this list, I acknowledge that:

- This list is *not* all-inclusive.
- Just because I *can* take a class, does not mean I *should* take a class.
- I am responsible for ensuring I meet pre-requisites.
  - Pre-requisites are enforced by the department offering the course
- Class schedules and offerings may change; classes may not be available when I register.

ABE 3340X-01 - Principles of Ecological Engineering

Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Introduction to principles of ecological engineering including ecosystems ecology, nutrient cycling, material and energy balances; emphasize the interaction of soil, water, plants, and microbes in ecosystems, the role of humans in ecosystems, and the application of ecological principles to design.

ABE 3800: Principles of Biological Systems Engineering

Credits: 3. Contact Hours: Lecture 2, Laboratory 3.
Prereq: ABE 3160

Engineering analysis of biological systems, through the study of mass, energy, and information transport. Quantification and modeling of biological interactions, biological activities and bioreactor operations. Includes laboratory experiences on biological materials characterization, unit operation for bioprocesses and fermentation for producing bioproducts.

ABE 4150: Agricultural & Biosystems Engineering Design I

Credits: 2. Contact Hours: Lecture 1, Laboratory 2.
Prereq: ABE 3160 (majors only)

Engineering design process with emphasis on team delivery of: clearly defined deliverables; criteria and constraints; wide-field ideation; discipline-appropriate analysis methods; identification and application of relevant standards.

ACCT 4610: Entrepreneurship and Accounting Information

(Dual-listed with ACCT 5610). (Cross-listed with ENTSP 4610).
Credits: 3. Contact Hours: Lecture 3.

Accounting information recording, dissemination, and use by entrepreneurs. Introduces pro forma financials, venture capital, private equity, and state and federal regulations for business creation and formation. Other topics include intrapreneurship, intellectual property, information privacy, cybersecurity, and internal controls, including managing the risk of embezzlement.

AERE 4450: Experimental Flow Mechanics and Heat Transfer

(Dual-listed with AERE 5450).
Credits: 3. Contact Hours: Laboratory 2, Lecture 2.
Prereq: ABE 3780 or AERE 3100 or ME 3350

Similitude and dimensional analysis. Measurement uncertainty analysis; Fluid mechanical apparatus: wind tunnel and water tunnels. Various experimental techniques widely used for fluid mechanics, aerodynamics, heat transfer, and combustion studies: Pressure gauge and transducers; Pitot tube; hot wire anemometry; Shadowgraph and Schlieren Photography; laser Doppler velocimetry; particle image velocimetry (PIV); advanced PIV techniques (stereo PIV, 3-D PIV, Tomographic PIV, Holograph PIV and microscopic PIV); laser induced fluorescence; pressure sensitive painting, temperature sensitive painting; molecular tagging velocimetry; molecular tagging thermometry. Extensive applications and laboratory experiments will be included.

AERE 4520: Introduction To Systems Engineering And Analysis
(Cross-listed with IE 4520).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification in an Engineering major OR graduate standing

Principles of systems engineering to include problem statement formulation, stakeholder analysis, requirements definition, system architecture and concept generation, system integration and interface management, verification and validation, and system commissioning and decommissioning operations. Introduction to discrete event simulation processes. Students will work in groups to propose, research, and present findings for a systems engineering topic of current relevance.

AGEDS 3880: Agricultural Mechanics Applications
Credits: 3. Contact Hours: Lecture 2, Laboratory 3.

Introduction to SMAW (Arc), GMAW (Mig), GTAW (Tig), Oxy-Fuel welding, Oxy-Fuel cutting, and Plasma cutting theories and applications. Emphasis will be on theoretical foundation of welding, safety, welding skill development, and management of equipment, and materials. Introduction to small engines and applications. Emphasis will be on theory of operating systems, maintenance, troubleshooting, failure analysis, and safety.

AGRON 3420: World Food Issues: Past and Present
(Cross-listed with ENVS 3420/ FSHN 3420).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification

Issues associated with global agricultural and food systems including ethical, social, economic, environmental, and policy contexts. Investigation of various causes and consequences of overnutrition/undernutrition, global health, poverty, hunger, access, and distribution. Meets International Perspectives Requirement.

AGRON 4500: Issues in Sustainable Agriculture
(Cross-listed with ENVS 4500).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification
Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of agricultural practices from the perspective of ethics and sustainable agriculture.

ARCH 3460: Building Science and Technology II
Credits: 3. Contact Hours: Lecture 3.
Prereq: ARCH 3450, ARCH 3450L, PHYS 1310 and PHYS 1310L; (MATH 1450 or satisfactory score of 79+ on math placement exam or MATH 1650); concurrent enrollment in ARCH 3460L

Second course in a sequence focused on architectural building technologies. Lectures and labs cover: environmental systems (heat transfer in the building envelope, passive heating and cooling, daylighting, thermal comfort, analytical guidelines and building energy calculation methods), materials & assemblies (building envelope systems, accessibility, egress, and material properties), and structural systems (structural system selection/comparison, and design and analysis of 'form-active' compression and tension structures) to understand impact of the built environment on human health, safety, and welfare at building scales.

ASTRO 3460: Introduction to Astrophysics
Credits: 3. Contact Hours: Lecture 3.
Prereq: (PHYS 2320 and PHYS 2320L) or PHYS 2420

An exploration of the universe beyond our Solar System, with emphasis on the astrophysics of stars and galaxies. Observable properties of stars, physics of stellar atmospheres and interiors. Birth, evolution and death of stars, to understand the past and future of our Sun, the Milky Way galaxy and the other galaxies in the universe. Basic concepts of cosmology, dark matter and dark energy. Use of computer models to calculate the structure and evolution of stars and protostars, and to analyze actual astronomical data obtained by professional astronomers.

BIOL 3140: Principles of Molecular Cell Biology
Credits: 3. Contact Hours: Lecture 3.
Prereq: BIOL 2110 and BIOL 2120

Integration of elementary principles of metabolism, bioenergetics, cell structure, and cell function to develop a molecular view of how the cell works.

BME 2200: Introduction to Biomedical Engineering
(Cross-listed with CHE 2200).
Credits: 3. Contact Hours: Lecture 3.
Prereq: BIOL 2120; (CHEM 1670 or CHEM 1770); (ABE 1600 or AERE 1600 or BME 1600 or CE 1600 or CHE 1600 or CPRE 1850 or EE 1850 or ENGR 1600 or IE 1600 or ME 1600 or SE 1850); MATH 1660; PHYS 2320

Engineering analysis of basic biology and engineering problems associated with living systems and health care delivery. The course will illustrate biomedical engineering applications in such areas as: biotechnology, biomechanics, biomaterials and tissue engineering, and biosignal and image processing, and will introduce the basic life sciences and engineering concepts associated with these topics.

CE 3060: Project Management for Civil Engineers
Credits: 3. Contact Hours: Lecture 2, Laboratory 3.
Prereq: Engineering Basic Program Courses

Project management, including work breakdown structures, cost estimating, scheduling, and project control. Civil engineering project life cycle, including planning, design, construction, and maintenance processes. Techniques in interpretation of contract documents, plan reading, and in estimating quantities.

CE 3260: Principles of Environmental Engineering
(Cross-listed with ENVE 3260).
Credits: 3. Contact Hours: Lecture 2, Laboratory 2.
Prereq: [CHEM 1670 or (CHEM 1770 and CHEM 1780)] AND MATH 1660 AND (credit or concurrent enrollment in ABE 3780)

Introduction to environmental problems, water quality indicators and requirements, potable water quality and quantity objectives, water sources and treatment methods; water pollution control objectives and treatment methods; survey of solid and hazardous waste management and air pollution control.

CE 3320: Structural Analysis I
Credits: 3. Contact Hours: Lecture 3, Laboratory 1.
Prereq: EM 3240

Loads, shear, moment, and deflected shape diagrams for beams and framed structures. Deformation calculations. Approximate methods. Application of consistent deformation methods to continuous beams and frames. Application of displacement or slope deflection methods to continuous beams and frames without sway. Influence lines for determinate and indeterminate structures. Computer applications to analyze beams and frames. Validation of computer results.

CE 3720: Engineering Hydrology and Hydraulics
Credits: 3. Contact Hours: Lecture 3.
Prereq: ABE 3780; (STAT 2310 or STAT 3050)

The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Design project required.

CE 4600: Foundation Engineering
Credits: 3. Contact Hours: Lecture 3.
Prereq: CE 3600

Fundamentals of foundation engineering. Exploration, sampling, and in-situ tests. Shallow and deep foundations. Settlement and bearing capacity analyses. Stability of excavations and earth retaining structures. Design project.

CHE 3810: Chemical Engineering Thermodynamics
Credits: 3. Contact Hours: Lecture 3.
Prereq: CHE 2020, MATH 2670, PHYS 2320, CHEM 3250 and Credit or concurrent enrollment in CHE 3100 and PHYS 2320L

Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, and chemical reaction equilibria.

CHEM 3260: Chemical Kinetics
Credits: 1. Contact Hours: Lecture 1.
Prereq: CHEM 1670, CHEM 1770, CHEM 1780 or CHEM 2010 and MATH 1660

Kinetic theory, rate laws, temperature dependence of rate constants, transition-state theory, reaction mechanisms, kinetic isotope effects, catalysts, Michaelis-Menten kinetics, and Marcus theory.

COMS 3210: Introduction to Computer Architecture and Machine-Level Programming
Credits: 3. Contact Hours: Lecture 3.
Prereq: Minimum of C- in (COMS 2280 and MATH 1650); (COMS 2300 or CPRE 2810); ENGL 2500

Introduction to computer architecture and organization. Emphasis on evaluation of performance, instruction set architecture, datapath and control, memory-hierarchy design, and pipelining. Assembly language programming.

COMS 4370: Computer Game and Media Programming
Credits: 3. Contact Hours: Lecture 3.
Prereq: COMS 3360

Video game programming using current game engine interfaces with real hardware. Particular attention is paid to the development environment, tool chains, 2D graphics, 3D graphics, controllers, memory management, and audio systems.

CONE 3800: Engineering Law
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification

Introduction to law and judicial procedure as they relate to the practicing engineer. Contracts, professional liability, professional ethics, licensing, bidding procedures, intellectual property, products liability, risk analysis. Emphasis on development of critical thinking process, abstract problem analysis and evaluation.

CPRE 2870: Cyber-Physical System Fundamentals
Credits: 3. Contact Hours: Laboratory 2, Lecture 2.
Prereq: ENGR 1600

Fundamentals of cyber-physical systems, including introduction to digital systems design, embedded platforms and programming, sensing and actuation, and performance analysis. Introduction to data communication concepts, including systems-level view of signal processing and electronic circuits, networking standards and protocols. Laboratory exercises with embedded circuits, signals, and measurement applications.

CPRE 3100: Theoretical Foundations of Computer Engineering
Credits: 3. Contact Hours: Lecture 2, Discussion 1.
Prereq: COMS 2280

Propositional logic and methods of proof; basic discrete structures; mathematical induction and recurrence relations; functions and relations; and counting; trees and graphs; applications in computer engineering.

CYBE 3310: Application of Cryptographic Concepts to Cyber Security
(Cross-listed with CPRE 3310).
Credits: 3. Contact Hours: Lecture 2, Laboratory 2.
Prereq: CPRE 2310 or CYBE 2310

Basic cryptographic underpinnings used in modern cyber security encryption suites. Encryption benefits to cyber security and its use in protocols. Topics include cryptographically secure hash functions and pseudorandom numbers, key distribution techniques, secure authentication including single sign on. Detection and prevention of security threats such as covert communication, malicious code, and other security threats in protocols are included. In addition to laboratory experiments and exercises, students complete a project focused on cyber security problem and solution. Graduation Restriction: Only one of CPRE/CYBE 3310 and CPRE 4310 may count towards graduation.

DS 3010: Applied Data Modeling and Predictive Analysis
Credits: 3. Contact Hours: Lecture 3.
Prereq: DS 2020 and STAT 1010, STAT 1040, STAT 1050, STAT 2010, STAT 2260, STAT 2310, STAT 3050, STAT 3220 or STAT 3300

Elements of predictive analysis such as training and test sets; feature extraction; survey of algorithmic machine learning techniques, e.g. decision trees, Naive Bayes, and random forests; survey of data modeling techniques, e.g. linear model and regression analysis; assessment and diagnostics: overfitting, error rates, residual analysis, model assumptions checking; communicating findings to stakeholders in written, oral, verbal and electronic form, and ethical issues in data science. Participation in a multi-disciplinary team project.

ECON 3010: Intermediate Microeconomics
Credits: 3-4. Contact Hours: Discussion 1, Lecture 3.
Prereq: ECON 1010 and ECON 2070 or MATH 1660

Theory of consumer and business behavior; optimal consumption choices and demand; theory of firm behavior; costs, production, and supply; competitive and imperfectly competitive markets; theory of demand for and supply of factors of production; general equilibrium analysis. Fall and spring require recitation and are 4 credits; summer is 3.0 credits.

ECON 3340: Entrepreneurship in Agriculture
Credits: 3. Contact Hours: Lecture 3.
Prereq: ECON 1010

Introduction to the process of entrepreneurship within the agricultural and food sectors. Emphasis on opportunity recognition and creation of concept for new startup ventures. Students will develop a business plan for a startup business or non-profit organization.

ECON 3370: Agricultural Marketing
Credits: 3. Contact Hours: Lecture 3.
Prereq: ECON 1010

Understanding of agricultural commodity markets for grain, livestock and dairy with emphasis on marketing decisions and risk management for farmers and processors. Hands-on applications of marketing and management tools via market simulations. ECON 2350 recommended.

ECON 3530: Money, Banking, and Financial Institutions
Credits: 3. Contact Hours: Lecture 3.
Prereq: ECON 1020
Theoretical and applied analysis of money, banking, and financial markets; interest rates and portfolio choice; the banking industry in transition; the money supply process; the Federal Reserve System and the conduct of monetary policy; macro implications of monetary policy; international finance.

ECON 3800: Energy, Environmental and Resource Economics
(Cross-listed with ENVS 3800).
Credits: 3. Contact Hours: Lecture 3.
Prereq: ECON 1010

Natural resource availability, use, conservation, and government policy, with emphasis on energy issues. Environmental quality and pollution control policies.

EE 3030: Energy Systems and Power Electronics
Credits: 3. Contact Hours: Lecture 3.
Prereq: MATH 2670; PHYS 2320 or PHYS 2320H; credit or concurrent enrollment in EE 2300

Structure of competitive electric energy systems. System operation and economic optimization. Mutual inductance, transformers. Synchronous generators. Balanced three-phase circuit analysis and power calculations. Network calculations and associated numerical algorithms. Two-port circuits. Voltage regulation. Resonance and power factor correction. DC and induction motors. Power electronic circuit applications to power supplies and motor drives.

EE 3110: Electromagnetic Fields and Waves
Credits: 4. Contact Hours: Lecture 4.
Prereq: EE 2010, MATH 2650, PHYS 2320, and Credit or concurrent enrollment in MATH 2670

Fundamentals and applications of electric and magnetic fields and materials. Electrostatics and magentostatics, potentials, capacitance and inductance, energy, force, torque. Uniform plane electromagnetic waves, Poynting vector. Transmission lines: transient and sinusoidal steady-state conditions, reflection coefficient.

EE 4180: High Speed System Engineering Measurement and Testing
(Cross-listed with CPRE 4180).
Credits: 4. Contact Hours: Lecture 3, Laboratory 2.
Prereq: (EE 2300 AND EE 3110) OR Graduate Standing

Measurement of high speed systems and mixed signal systems. Measurement accuracy and error. Network analysis and spectrum analysis used in high speed measurement and testing. Test specification process and parametric measurement. Sampling and digital signal processing concepts. Design for testability. Testing equipment. Applications.

EE 4250: Machine learning: A Signal Processing Perspective
(Dual-listed with EE 5250).
Credits: 3. Contact Hours: Lecture 2, Discussion 1.
Prereq: (EE 3220/STAT 3220 or STAT 3300; and MATH 2070 or MATH 4070/5070) OR Graduate Standing

Background material review (probability, calculus, linear algebra), Key machine learning tools and techniques. Supervised Learning: Linear Regression, Logistic Regression, Generative algorithms for classification (Gaussian & discrete-valued case; Naive Bayes assumption), Support Vector Machines, Decision trees; Unsupervised Learning: principal components analysis (PCA), robust PCA, clustering; Introduction to Deep Learning and Neural Networks; Basic Learning Theory and Bias-Variance Tradeoff; introduction to key Bayesian estimation concepts (MMSE estimation, Kalman filter, hidden Markov models).

EM 3270: Mechanics of Materials Laboratory
Credits: 1. Contact Hours: Laboratory 2.
Prereq: EM 3240

Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 3240. Use of strain measuring devices. Preparation of reports.

EM 3620: Principles of Nondestructive Testing
(Cross-listed with MATE 3620).
Credits: 3. Contact Hours: Lecture 3.
Prereq: PHYS 1320 OR PHYS 2320 or PHYS 2320H

Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of nondestructive tests, materials to which applicable, effects of material condition, types of defects detectable, calibration standards, and reliability safety precautions.

ENGR 4300: Entrepreneurial Product Engineering
(Cross-listed with IE 4300).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification

Process of innovative product development in both entrepreneurial and intra-preneurial settings. Define, prototype and validate a product concept based on competitive bench-marking, market positioning and customer requirement evaluation in a target market into a product design that is consistent with defined business goals and strategies. Combination of lecture, discussion, problem solving and case study review.

ENSCI 3600: Environmental Soil Science
(Cross-listed with AGRON 3600).
Credits: 3. Contact Hours: Lecture 3.

Application of soil science to contemporary environmental problems; comparison of the impacts that different management strategies have on short- and long-term environmental quality and land development. Emphasis on participatory learning activities. AGRON 1820 or ENSCI 2500 or GEOL 1010 recommended.

ENSCI 4040: Global Change
(Dual-listed with MTEOR 5040/ AGRON 5040/ ENSCI 5040). (Cross-listed with AGRON 4040/ MTEOR 4040/ ENVS 4040/ CLSCI 4040).
Credits: 3. Contact Hours: Lecture 3.

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

ENTSP 3130: Feasibility Analysis for New Ventures
Credits: 3. Contact Hours: Lecture 3.
Prereq: ENTSP 3100

Focuses on the knowledge and practical skills required for developing an idea for a new business venture, researching potential markets, analyzing competition, conducting formal feasibility analyses, and considering business plan implications. Includes discussion of basic business functions in terms of their application to conducting feasibility analyses and to exploiting related business opportunities.

FSHN 3050: Food Quality Management and Control
Credits: 2. Contact Hours: Lecture 2.
Prereq: 3 credits in statistics

Fundamentals of statistical decision-making processes and quality control procedures used in food quality assurance programs.

FSHN 3510: Introduction to Food Engineering Concepts
Credits: 3. Contact Hours: Lecture 3.
Prereq: (FSHN 2070; [MATH 1600 or MATH 1650]; [PHYS 1150, PHYS 1310, or PHYS 2310])

Methodology for solving problems in food processing and introduction to food engineering concepts including food properties, material and energy balances, sources of energy, thermodynamics, fluid flow, heat transfer, and mass transfer.

GEOL 4390: Seismic Methods in Geology, Engineering, and Petroleum Exploration
(Dual-listed with GEOL 5390/ CE 5390). (Cross-listed with CE 4390).
Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Physics of elastic-wave propagation. Seismic surveys in environmental imaging, engineering, and petroleum exploration. Reflection and refraction techniques. Data collection, processing, and geological interpretation. Field work with state-of-the-art equipment. Introductory geology, algebra, and trigonometry recommended.

HCI 5150: Statistical Natural Language Processing
(Cross-listed with ENGL 5150/ LING 5150).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Graduate Standing or Permission of Instructor

Introduction to computational techniques involving human language and speech in applications such as information retrieval and extraction, automatic text categorization, word prediction, intelligent Web searching, spelling and grammar checking, speech recognition and synthesis, statistical machine translation, n-grams, POS-tagging, word-sense disambiguation, on-line lexicons and thesauri, markup languages, corpus analysis, and Python programming language.

HCI 5200: Computational Analysis of English
(Cross-listed with ENGL 5200/ LING 5200).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Graduate Standing or Permission of Instructor

Concepts and practices for analysis of English by computer with emphasis on the applications of computational analysis to problems in applied linguistics such as corpus analysis and recognition of learner language in computer-assisted learning and language assessment.

HCI 5710: Augmented Reality
Credits: 3. Contact Hours: Lecture 3.
Prereq: Graduate Standing or Permission of Instructor

Fundamental technologies enabling augmented reality (AR) application development. Assessment and integration of the hardware and software systems necessary for AR including, tracking, image processing and rendering. Programming skills in C++ and GPU-based optimization are developed to enable evaluation of interaction devices and modalities afforded by AR.

HCI 5740: Computational Implementation and Prototyping in HCI
Credits: 3. Contact Hours: Lecture 3.
Prereq: Graduate Standing or Permission of Instructor

Fundamental concepts of software programming and the practical use of the Python programming language. Assignments include user interaction and interface design, information visualization, as well as other computational HCI tools. Intended for graduate students without prior background in software development. Requires programming during class lectures.

HCI 5840: Python Application Development in HCI
Credits: 3. Contact Hours: Lecture 3.
Repeatable.
Prereq: Department Permission for Course

Implement Python code and write design documents ("specs") and complement their code with sufficiently detailed documentation in development of a large Python project of the student's choosing. Typical development process: idea, specification, prototyping and implementation (including debugging, testing, refactoring) and documentation and result in a demo-able final product. Fulfills the implementation requirement of the HCI program.

IE 3050: Engineering Economic Analysis
Credits: 3. Contact Hours: Lecture 3.
Prereq: MATH 1660

Economic analysis of engineering decisions under uncertainty. Financial engineering basics including time value of money, cash flow estimation, and asset evaluation. Make versus buy decisions. Comparison of project alternatives accounting for taxation, depreciation, inflation, and risk.

IE 4300: Entrepreneurial Product Engineering
(Cross-listed with ENGR 4300).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Junior classification

Process of innovative product development in both entrepreneurial and intra-preneurial settings. Define, prototype and validate a product concept based on competitive bench-marking, market positioning and customer requirement evaluation in a target market into a product design that is consistent with defined business goals and strategies. Combination of lecture, discussion, problem solving and case study review.

IE 4370: Reliability and Safety Engineering
(Dual-listed with IE 5370).
Credits: 3. Contact Hours: Lecture 3.
Prereq: STAT 2310 or STAT 3050 or STAT 5101

Mathematical basics for dealing with reliability data, theory, and analysis. Bayesian reliability analysis. Engineering ethics in safety evaluations. Case studies of accidents in large technological systems. Fault and event tree analysis.

IE 4410: Industrial Engineering Design
Credits: 3. Contact Hours: Lecture 1, Laboratory 6.
Prereq: IE 2480, IE 2710, IE 3610; (credit or enrollment in IE 3410, IE 4130, AND IE 4480)

A large, open-ended design project conducted for a real-world business. Application of engineering design principles including problem definition, analysis, synthesis, and evaluation.

INDD 3300: Creative Thinking in Design
Credits: 3. Contact Hours: Lecture 3.

Human-centered design (HCD) methodology that integrates scientific principles and data analysis for solving complex design problems. Investigation of creative thinking strategies, facilitation techniques, and problem-solving processes. Emphasis on the cognitive science of creativity and its application in diverse design contexts.

INDD 4350: Strategic Design: Project Management
Credits: 3. Contact Hours: Lecture 3.

Review and development of executable strategies for entrepreneurial, commercial and business efforts. Focus on strategic thinking, economics of innovation, tactical approaches and effective measures in order to integrate a full cycle of product/service development. Advanced technical design processes, design management, decision-making and value proposition.

INDD 5300: Design Thinking
Credits: 3. Contact Hours: Lecture 3.
Prereq: Senior or Graduate classification or Permission of Instructor

Exploration of design thinking process, toolkits, and mindsets as creative problem solving approaches for systems, products, and processes, across diverse contexts. Strategies for problem-framing, creative solutions and co-evolution process, with a focus on collaborative and interdisciplinary design to investigate real-world problems and opportunities.

KIN 3550: Biomechanics
Credits: 3. Contact Hours: Lecture 3.
Prereq: PHYS 1150 or PHYS 1310; Junior Classification or Above

Mechanical basis of human performance; application of mechanical principles to exercise, sport and other physical activities.

MATE 3620: Principles of Nondestructive Testing
(Cross-listed with EM 3620).
Credits: 3. Contact Hours: Lecture 3.
Prereq: PHYS 1320 OR PHYS 2320 or PHYS 2320H

Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of nondestructive tests, materials to which applicable, effects of material condition, types of defects detectable, calibration standards, and reliability safety precautions.

MATE 4130: Materials Design and Professional Practice I
Credits: 3. Contact Hours: Lecture 3.
Prereq: Senior classification or above

Fundamentals of engineering team behavior and professional preparation; Materials selection and design. Alysis of design problems, development of solutions, selected case studies. Oral presentation skills. Preparations for continued project in MATE 4140. MATE 4130-4140 sequence is intended for students in their final two semesters before graduation.

MATH 2070: Matrices and Linear Algebra
Credits: 3. Contact Hours: Lecture 3.
Prereq: MATH 1660 or MATH 1660H

Systems of linear equations, determinants, vector spaces, linear transformations, orthogonality, least-squares methods, eigenvalues and eigenvectors. Emphasis on applications and techniques. Graduation Restriction: Only one of MATH 2070 and MATH 3170 may be counted toward graduation.

MATH 3850: Introduction to Partial Differential Equations
Credits: 3. Contact Hours: Lecture 3.
Prereq: MATH 2650 and one of MATH 2660, MATH 2670

Method of separation of variables for linear partial differential equations, including heat equation, Poisson equation, and wave equation. Topics from Fourier series, Sturm-Liouville theory, Bessel functions, spherical harmonics, and method of characteristics.

ME 3730: Science and Practice of Brewing
(Cross-listed with FSHN 3730).
Credits: 3. Contact Hours: Lecture 1.5, Laboratory 4.5.
Prereq: 21 years of age and one course from this list: BIOL 2110, BIOL 2120, CHEM 167, CHEM 1770, PHYS 2310, PHYS 2320

Introduction to brewing science and technology. Understanding the role of malts, hops, water, and yeast in production of ale and lager beers. Unit operations in brewing. Health, safety, and environmental sustainability in alcohol production and consumption. Weekly laboratory in practical aspects of beer production.

ME 4180: Mechanical Considerations in Robotics
(Dual-listed with ME 5180).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Credit or enrollment in ME 4210

Three-dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

ME 4190: Computer-Aided Design
Credits: 3. Contact Hours: Lecture 3.
Prereq: ME 3250

Theory and applications of computer- aided design. Computer graphics programming, solid modeling, assembly modeling, and finite element modeling. Mechanical simulation, process engineering, rapid prototyping and manufacturing integration.

ME 4260X: Mechanical Vibration
(Dual-listed with ME 5260X).
Credits: 3. Contact Hours: Lecture 3.
Prereq: EM 3240 and ME 3450 and (MATH 2660 or MATH 2670)

Elementary vibration analysis; single and multiple degree of freedom systems, energy methods; response to common transient, harmonic and random excitation sources; numerical methods of solution; eigenvalues and modal analysis; introduction to testing methods, data sampling and signal processing; vibration isolation, absorption and coupling minimization.

ME 4270: Vehicle Dynamics and Suspension Design
Credits: 3. Contact Hours: Lecture 3.
Prereq: ME 3450

Analysis and evaluation of the performance of cars, trucks and other surface vehicles. Computer simulation of ride, braking, and directional response. Considerations in the design and fabrication of suspension systems.

MGMT 3200: Corporate Entrepreneurship
(Cross-listed with ENTSP 3200).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Sophomore classification

Introduces entrepreneurial approaches aimed at the identification, development and exploitation of technical and organizational innovations, the management of new product or process developments, and the effective management of new ventures. Focuses on mid-size to large corporations, especially in the manufacturing and service industries. Develops an awareness and understanding of the range, scope, and complexity of issues related to the creation of a corporate environment that is supportive of entrepreneurial endeavors as well as the effective implementation of technological and organizational innovations in corporate settings.

MGMT 3700: Managing Organizations
Credits: 3. Contact Hours: Lecture 3.
Prereq: Sophomore classification

Introduction to management as a field and function within organizations. Provides an overview of what managers do in organizations, including how they deal with multiple stakeholders; make decisions about organizational goals, strategies, and structures that align with the external and internal environment; as well as how they lead and manage human resources effectively.

MGMT 3720: Ethical and Responsible Management
Credits: 3. Contact Hours: Lecture 3.
Prereq: Sophomore classification

Introduces the many aspects of ethical and responsible management in today's organization, including the ethical implications of business decision-making (and the implications of having multiple stakeholders); corporate social responsibility; ethical leadership and other leadership styles as they pertain to responsible management; and the role of corporate governance and ethical codes in developing and institutionalizing an ethical organization. Builds ethical decision-making strategies and awareness of one's own ethical leadership philosophy.

MGMT 3810: Managing Family Businesses
(Cross-listed with ENTSP 3810).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Sophomore classification

Introduction to the important role family businesses play in the domestic and global economies as well as the complex and unique challenges and opportunities encountered by such businesses and their family members and other employees. Explores best practices for successfully managing family businesses.

MICRO 3020: Biology of Microorganisms
Credits: 3. Contact Hours: Lecture 3.
Prereq: Credit or concurrent enrollment in BIOL 2110 or BIOL 2120; 3 credits of CHEM

Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on prokaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

MKT 3400: Principles of Marketing
Credits: 3. Contact Hours: Lecture 3.
Prereq: Credit or enrollment in ECON 1010

The role of marketing in society. Markets, marketing institutions, and marketing functions with emphases on product, price, marketing communication, and marketing channel decisions.

MKT 3420: Foundation Of Personal Selling
Credits: 3. Contact Hours: Lecture 3.
Prereq: Sophomore classification

The process of selling and how to sell effectively. Focus on selling in a business environment and applying to concepts to general interpersonal settings in personal life. Students will actively participate in class, collaborate with teammates to develop skills to sell ideas and become more effective in representing themselves and their company and its products and services. Develop skills necessary to build long-term, profitable relationships with clients.

MKT 4950: Live Cases in Marketing
Credits: 3. Contact Hours: Lecture 3.
Repeatable.
Prereq: MKT 3400

Teamwork with companies to solve their current marketing challenges. Opportunity to gain critical thinking skills, experience with quantitative analysis, client management experience, professional presentation skills, strategies for effective teamwork, practice giving and receiving feedback, and practical marketing experience. Experience will strengthen student resume, make connections with industry, and practice applying marketing concepts in real-world situations. The companies and challenges will be different each semester. Graduation Restriction: Only 3 credits of MKT 4950 may count as a MKT major or minor choice elective.

MS 3020: Applied Leadership
Credits: 3. Contact Hours: Lecture 3.
Prereq: Concurrent enrollment in MS 3020L

Prepares students to attend the Leadership Develop and Assessment Course at Fort Knox, Kentucky in which they will be assigned specific and situational tasks to accomplish by providing purpose, motivation, and direction to fellow students across the nation. Students will learn how to identify sixteen leadership dimensions in the under classmen and provide specific feedback on their leadership behaviors. Students will develop their oral communication skills about the plans developed by the class, through small group presentation settings. Students will develop methods of studying human behavior. Completion of the basic Military Science program required.

MTEOR 3010: General Meteorology
Credits: 4. Contact Hours: Lecture 4.
Prereq: MATH 1660, credit or enrollment in PHYS 2320

Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics.

MTEOR 4040: Global Change
(Dual-listed with MTEOR 5040/ AGRON 5040/ ENSCI 5040). (Cross-listed with AGRON 4040/ ENSCI 4040/ ENVS 4040/ CLSCI 4040).
Credits: 3. Contact Hours: Lecture 3.

Recent changes in global biogeochemical cycles and climate; models of future changes in the climate system; impacts of global change on agriculture, water resources and human health; ethical issues of global environmental change.

MTEOR 4320: Instrumentation and Measurements
Credits: 3. Contact Hours: Lecture 2, Laboratory 2.

Principles of meteorological sensing and data analysis. Thermometry, barometry, hygrometry, anemometry, precipitation measurements, radiometry, radar, remote sensing, visibility, and cloud height. Calibration and measurement uncertainties. Digital signal processing. Field trip to the National Weather Service. Labs emphasize dataloggers and modern weather stations. Introductory physics and calculus 1 recommended.

MUSIC 3460: Computer Music Programming Design
Credits: 3. Contact Hours: Lecture 3.
Prereq: MUSIC 2460 or Permission of Instructor

Programming and interface design for creative musical applications. Includes computer generation of music data, advanced MIDI data processing, practical projects in musical composition and performance using a visual programming language.

NREM 3130: Native Land, Water, and Resources
(Cross-listed with AMIN 3130).
Credits: 3. Contact Hours: Lecture 3.

Examines Native land rights, water rights, and natural resources. Topics may include Native relations to landscapes, cultural resources and infrastructure projects, land rights, water usage agreements, and resource policies as they apply to on- and off-reservation Native communities. AMIN 2100 recommended. Offered even-numbered years. Meets U.S. Cultures and Communities Requirement.

NREM 3450: Natural Resource Photogrammetry and Geographic Information Systems
(Cross-listed with ENSCI 3450).
Credits: 3. Contact Hours: Lecture 2, Laboratory 3.
Prereq: Junior classification

Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses.

NS 3300: Naval Ship Systems II (Weapons)
Credits: 3. Contact Hours: Lecture 3, Laboratory 3.
Prereq: PHYS 2310; Sophomore classification

Introduction to the theory and principles of operation of naval weapon systems. Included coverage of types of weapons and fire control systems, capabilities and limitations; theory of target acquisition, identification and tracking; basics of naval ordnance.

NS 4120: Leadership and Ethics
Credits: 3. Contact Hours: Lecture 3, Laboratory 3.
Prereq: NS 1110; (HIST 3890 or NS 2120); NS 2200; NS 2300; NS 3200; NS 3300; NS 4100

Basic background concerning the duties and responsibilities of the junior naval officer and division officer in the areas of integrity and ethics, human resources management, personnel management, material management, and the administration of discipline. Preparation for responsibilities encountered immediately upon commissioning.

PHYS 3220: Introduction to Modern Physics II
Credits: 3. Contact Hours: Lecture 3.
Prereq: PHYS 3210
Quantum statistics; lasers; physics of molecules. Properties of solids, including electron band structure, superconductivity and magnetism. Nuclear physics, including nuclear sizes and masses, stability, decay modes, reactions, fission and fusion. Elementary particles, including strangeness, charm, and quarks. Fundamental forces of nature.

PHYS 3610: Classical Mechanics
Credits: 3. Contact Hours: Lecture 3.
Prereq: MATH 2650; credit or concurrent enrollment in (MATH 2660 or MATH 2670); ([PHYS 2220 or PHYS 2220H] or [PHYS 2320 or PHYS 2320H; PHYS 2320L] or [PHYS 2420 or PHYS 2420H])

Newtonian mechanics including forced oscillations, central forces and orbital motion, collisions, moving frames of reference, Lagrange's equations.

SCM 3010: Supply Chain Management
Credits: 3. Contact Hours: Lecture 3.
Prereq: ECON 1010.

Introduction to a wide range of supply chain management (SCM) terminology, analytical tools, and theories as related to the supply chain operations reference model (SCOR). The SCOR model focuses on planning, sourcing, making, delivering, returning, and integrating key aspects within SCM. Using an analytical approach to solve real world problems, specific topics include: strategic sourcing, supply management, demand forecasting, inventory management, process management, logistics, process integration, and returns.

SCM 3400: Project Management
(Cross-listed with MIS 3400).
Credits: 3. Contact Hours: Lecture 3.
Prereq: Credit or enrollment in MIS 3010

Equips students to support team activities in the general project management environment and better manage their careers. Practical experience using project management techniques and tools. Course topics include project initiation and execution, risk assessment, estimating and contracts, planning, human factors, and standard methods.

SE 3090: Software Development Practices
(Cross-listed with COMS 3090).
Credits: 3. Contact Hours: Lecture 3, Discussion 1.
Prereq: Minimum of C- in (COMS 2280; MATH 1650)

Practical introduction to methods for managing software development. Software engineering concepts, practices and tools. Requirements analysis, structured and object-oriented design, coding, testing, and maintenance. Software process models, software tools and environments. Programming projects that provide exposure to information management techniques, client/server model, networking and communication.

SE 3190: Construction of User Interfaces
(Cross-listed with COMS 3190).
Credits: 3. Contact Hours: Lecture 3.
Prereq: COMS 2280

Overview of user interface design. Evaluation and testing of user interfaces. Review of principles of object orientation, object oriented design and analysis using UML in the context of user interface design. Design of windows, menus and commands. Developing Web and Windows-based user-interfaces. Event-driven programming. Introduction to Frameworks and APIs for the construction of user interfaces.

SE 3390: Software Architecture and Design
(Cross-listed with CPRE 3390).
Credits: 3. Contact Hours: Lecture 3.
Prereq: SE 3190

Modeling and design of software at the architectural level. Architectural styles. Basics of model-driven architecture. Object-oriented design and analysis. Iterative development and unified process. Design patterns. Design by contract. Component based design. Product families. Measurement theory and appropriate use of metrics in design. Designing for qualities such as performance, safety, security, reliability, reusability, etc. Analysis and evaluation of software architectures. Introduction to architecture definition languages. Basics of software evolution, reengineering, and reverse engineering. Case studies. Introduction to distributed system software.

SE 4120: Formal Methods in Software Engineering
(Dual-listed with COMS 5120). (Cross-listed with CPRE 4120/ COMS 4120).
Credits: 3. Contact Hours: Lecture 3.
Prereq: COMS 3110; (STAT 3050 or STAT 3300 or STAT 3410)

A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms and tools for automatic analysis of systems. Graduate credit requires in--depth study of concepts.

STAT 3010: Intermediate Statistical Concepts and Methods
Credits: 4. Contact Hours: Lecture 3, Laboratory 2.
Prereq: One of STAT 1010, 1040, 1050, 2010, 2260, 2310, 3050, 3220, 3300

Statistical concepts and methods used in the analysis of observational data. Analysis of single sample, two sample and paired sample data. Simple and multiple linear regression including polynomial regression and use of indicator variables. Model building and analysis of residuals. Introduction to one-way ANOVA, tests of independence for contingency tables, and logistic regression. Graduation Restriction: Credit for only one of the following courses may be applied toward graduation: STAT 3010, STAT 3260, STAT 5101.

STAT 3610: Statistical Quality Assurance
(Cross-listed with IE 3610).
Credits: 3. Contact Hours: Lecture 3.
Prereq: STAT 2310, STAT 3010, STAT 3260, or STAT 5101

Statistical methods for process improvement. Simple quality assurance principles and tools. Measurement system precision and accuracy assessment. Control charts. Process capability assessment. Experimental design and analysis for process improvement. Significant external project in process improvement.

TSM 3300: Agricultural Machinery and Power Management
Credits: 3. Contact Hours: Lecture 2, Laboratory 3.
Prereq: MATH 1450 or higher; TSM 2100

Selection, sizing, and operational principles of tractors and machinery systems. Cost analysis and computer techniques applied to planning and management of agricultural machine systems. Principles, operation, and application of agricultural machinery.

TSM 3700: Occupational Safety
Credits: 3. Contact Hours: Lecture 3.
Prereq: TSM 2700; Junior classification

Identifies safety and health risks in industrial work environments. Focus on how managers and supervisors meet their responsibilities for providing a safe workplace for their employees. Includes the identification and remediation of workplace hazards.

TSM 4430: Statics and Strength of Materials for Technology
Credits: 3. Contact Hours: Lecture 2, Laboratory 2.
Prereq: PHYS 1310 or above; MATH 1450 or higher

Application of standard analytic and computer based techniques of solving problems related to force and moments. The properties of materials and how to select appropriate materials for a particular design are reviewed.