Spring 2024 Potential Tech Electives

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-reqs are enforced by the department offering the course.
- Class schedules and offerings may change; classes may not be available when I register.

AER E 321: Flight Structures Analysis

(3-0) Cr. 3. F.S.
Prereq: E M 324, Credit or enrollment in MATH 266 or 267
Introduction to elasticity, airworthiness, and flight loads. Introduction to fatigue. Materials selection for flight applications. Thin walled cross-sections under bending, torsion, and shear loads using classical methods. Shear center. Column buckling. Matrix methods of structural analysis.

AER E 322: Aerospace Structures Laboratory

(1-2) Cr. 2. F.S.
Prereq: Credit or concurrent enrollment in AER E 321
Design of experiments. Data analysis. Strain gage installation. Measurement of stiffness/strength of aluminum. Analysis/fabrication/testing of riveted joints. Shear/bending measurements inbeam sections. Analysis/measurement of strains in frames. Buckling of columns. Stress concentration. Vibration testing of beams and plates. Fabrication/testing of composites.

AER E 351 Astrodynamics I

(Cross-listed with I E). Cr. 3. SS.
Prereq: M E 345
Introduction to astrodynamics. Two-body Keplerian satellite and planetary motion. Geocentric and extraterrestrial trajectories and applications. Ballistic missiles.

AER E 362: Aerospace Systems Integration

(3-0) Cr. 3. F.S
Prereq: ENGL 250, Junior standing in Aerospace Engineering or permission of instructor
Emphasis on impact of component interfaces in aerospace systems. Understand how changes in variables associated with individual components impact the performance of the aerospace system. Solving aerospace engineering problems and presenting solutions through reports. Specific integration challenges include: capturing implicit disciplinary interactions (e.g. structures/aerodynamics, propulsion/aerodynamics, etc.), propagating tolerances through the system (i.e. uncertainty modeling), balancing component attributes in the system objective.

AER E 423: Composite Flight Structures

(2-2) Cr. 3. S.
Prereq: E M 324; MAT E 273
Fabrication, testing and analysis of composite materials used in flight structures. Basic laminate theory of beams, plates and shells. Manufacturing and machining considerations of various types of composites. Testing of composites for material properties, strength and defects. Student projects required.

AER E 433: Spacecraft Dynamics and Control

(3-0) Cr. 3. F.
Prereq: M E 345
Three-dimensional rotational kinematics and attitude dynamics of a rigid body in space. Classical stability analysis of spinning spacecraft with or without energy dissipation. Attitude dynamics, stability, and control of spacecraft in a circular orbit in the presence of gravity-gradient torques. Introduction to spacecraft attitude determination and control systems (ADCS) with emphasis on modern attitude determination algorithms. Simulation of spacecraft attitude dynamics and control problems of practical interest using programming and analysis software.

AER E 452: Introduction To Systems Engineering And Analysis

(Cross-listed with I E). Cr. 3. SS.
Prereq: Junior Classification in an Engineering Major
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.

AER E 463: Introduction to Multidisciplinary Design Optimization

(Dual-listed with AER E 563). (3-0) Cr. 3. F.
Prereq: Senior classification in College of Engineering or Permission of Instructor
Introduction to the theory and methods of Multidisciplinary Design Optimization (MDO), including system coupling, system sensitivity methods, decomposition methods, MDO formulations (such as multi-discipline feasible (MDF), individual discipline feasible (IDF) and all-at-once (AAO) approaches, and MDO search methods.

AER E 480: Ultrasonic Nondestructive Evaluation

(Cross-listed with E M). (3-0) Cr. 3. S.
Prereq: E M 324, MATH 266 or MATH 267, PHYS 232 and PHYS 232L
Introduction to stress/strain, Hooke's law, and elastic wave propagation in two dimensions in isotropic media. Ultrasonic plane-wave reflection and transmission; and simple straight-crested guided waves. Transducer construction, behavior, and performance. Simple signal analysis and discrete signal processing. The last few weeks of the course are devoted to case studies.

A B E 342: Agricultural Tractor Power

(2-3) Cr. 3. S.
Prereq: CH E 381 or M E 231
Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms.

A B E 410: Electronic Systems Integration for Agricultural Machinery

(Dual-listed with A B E 510). Cr. 3. S.
System architecture and design of electronics used in agricultural machinery and production systems. Emphasis on information technology and systems integration for automated agriculture processes. Design of Controller Area Network (CAN BUS) communication systems and discussion of relevant standards (ISO 11783 and SAE J1939). Application of technologies for sensing, distributed control, and automation of agricultural machinery will be emphasized.

A B E 478: Wood Frame and Agri-Industrial Structures

(Dual-listed with A B E 578). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Prereq: E M 324
Design of light-framed wood structures using LRFD and ASD design procedures. Includes analysis of wind, snow, dead, and live loads. Applications include animal housing, greenhouses, and storage structures. Fasteners, laminated posts, truss design and use of National Design Specifications.

AGEDS 388: Agricultural Mechanics Applications

(2-3) Cr. 3. Repeatable, maximum of 2 times. F.S.SS.
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.

ARCH 335: Three-Dimensional Studio

(1-4) Cr. 3. Repeatable, maximum of 6 credits.
This course deals with three dimensional problems in visual invention, organization, and expression emphasizing creative manipulation of tools, materials, and techniques as means for three-dimensional thinking. Projects cover the additive (modeling), subtractive (carving), substitutional (casting) as well as constructive techniques.

ASTRO 346: Introduction to Astrophysics

(3-0) Cr. 3. S.
Prereq: PHYS 222 or (PHYS 232 and 232L) or PHYS 242
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.

B M E 220: Introduction to Biomedical Engineering

(Cross-listed with CH E). (3-0) Cr. 3. S.
Prereq: BIOL 212, ENGR 160 or equiv, MATH 166, CHEM 167 or CHEM 177, PHYS 232, PHYS 232L
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.

C E 332: Structural Analysis I

(2-2) Cr. 3. F.S.
Prereq: E M 324
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.

CHEM 326: Chemical Kinetics

Cr. 1. S.
Prereq: CHEM 167 or CHEM 177 or CHEM 178 or CHEM 201; MATH 166
Kinetic theory, rate laws, temperature dependence of rate constants, transition-state theory, reaction mechanisms, kinetic isotope effects, catalysts, Michaelis-Menten kinetics, and Marcus theory. CHEM 324 and CHEM 325 recommended.

CON E 380: Engineering Law

(3-0) Cr. 3. F.S.

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.

ECON 301: Intermediate Microeconomics

(3-0) Cr. 3-4. F.S.SS.

Prereq: ECON 101; ECON 207 or MATH 166

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 302: Intermediate Macroeconomics

(3-0) Cr. 3. F.S.

Prereq: ECON 101, ECON 102; MATH 160 or MATH 165

Theory of income, employment, interest rates, and the price level; fiscal and monetary policy; budget and trade deficits; money and capital inflows, interest rates, and inflation.

ECON 320: Labor Economics

(3-0) Cr. 3.

Prereq: ECON 101

Economic analysis of contemporary domestic and international labor market issues including labor supply and demand, unemployment, and employment in the U.S. and elsewhere; investments in and returns to education, training, health, immigration and migration; income inequality; labor productivity; out-sourcing and global competitiveness; work incentives; compensation including benefits; and labor policies such as minimum wages, over-time pay, discrimination, unions, and immigration. Examples drawn from the U.S. and other developed countries with reference to developing countries where relevant.
Meets International Perspectives Requirement.

ECON 321: Economics of Discrimination

(Cross-listed with WGS). (3-0) Cr. 3.

Prereq: ECON 101

Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination. Poverty measurement and antipoverty programs in the U.S.
Meets U.S. Diversity Requirement.

ECON 334: Entrepreneurship in Agriculture

(3-0) Cr. 3. F.S.

Prereq: ECON 101

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 344: Public Finance

(3-0) Cr. 3.

Prereq: ECON 101

The economic role of governments in market economies. Public goods, externalities, income distribution, and income maintenance programs. The effect of taxes on economic behavior, descriptions of the structure of the principal U.S. taxes, and current reform proposals.

ECON 353: Money, Banking, and Financial Institutions

(3-0) Cr. 3. F.S.
Prereq: ECON 101; ECON 102
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 355: International Trade and Finance

(3-0) Cr. 3.
Prereq: ECON 101; ECON 102
Explanations of causes of international trade and the impact of trade on welfare and employment patterns. Analysis of government policies towards trade, such as tariffs, quotas, and free trade areas. Theory of balance of payments and exchange rate determination, and the role of government policies. Examination of alternative international monetary arrangements.
Meets International Perspectives Requirement.

ECON 385: Economic Development

(Cross-listed with GLOBE). (3-0) Cr. 3.
Prereq: ECON 101; ECON 102
Current problems of developing countries, theories of economic development, agriculture, and economic development, measurement and prediction of economic performance of developing countries, alternative policies and reforms required for satisfying basic needs of Third World countries, interrelationships between industrialized countries and the developing countries, including foreign aid.
Meets International Perspectives Requirement.

E E 303: Energy Systems and Power Electronics

(3-0) Cr. 3. F.S.
Prereq: MATH 267; PHYS 232; credit or enrollment in E E 230
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.

E E 341: BioMEMs and Nanotechnology

(Cross-listed with B M E). (3-0) Cr. 3.
Prereq: B M E 220
Overview of Micro-Electro-Mechanical-System (MEMS) technologies for bioengineering, fundamentals of microfluidic device design, fabrication, and characterization, survey of microfluidic functional building blocks for lab-on-a-chip applications including mixers, valves, channels, and chambers. Topics of nanotechnology in bioengineering, nanoscale building block technologies for bioengineering including self-assembling, surface chemical treatment, nano-imprinting, nano-particles, nano-tubes, nano-wires, and stimuli-responsive biomaterials.

E E 351: Analysis of Energy Systems

(3-0) Cr. 3.
Prereq: PHYS 232
Energy-scientific, engineering and economic foundations. Energy utilization-global and national. Sectoral analysis of energy consumption. Relationship of energy consumption and production to economic growth and environment. Technology for energy production. Economic evaluation of energy utilization and production. Scientific basis for global warming. Environmental impact of energy production and utilization. Renewable energy.
Meets International Perspectives Requirement.

E M 327: Mechanics of Materials Laboratory

(0-2) Cr. 1. F.S.
Prereq: E M 324
Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports.

E M 362: Principles of Nondestructive Testing

(Cross-listed with MAT E). (3-0) Cr. 3. S.
Prereq: PHYS 132 and PHYS 132L or PHYS 232 and PHYS 232L
Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection, and other techniques. Physical bases of tests, materials to which applicable, types of defects detectable, calibration standards, and reliability safety precautions.

E M 362L: Nondestructive Testing Laboratory

(Cross-listed with MAT E). (0-3) Cr. 1. S.
Prereq: Credit or concurrent enrollment in E M 362 or MAT E 362
Application of nondestructive testing techniques to the detection and sizing of flaws in materials and to the characterization of material's microstructure. Included are experiments in hardness, dye penetrant, magnetic particle, x-ray, ultrasonic and eddy current testing. Field trips to industrial laboratories.

ENSCI 345: Natural Resource Photogrammetry and Geographic Information Systems

(Cross-listed with NREM). (2-3) Cr. 3. S.
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.

ENSCI 360: Environmental Soil Science

(Cross-listed with AGRON). (3-0) Cr. 3. S.
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 182 or ENSCI 250 or GEOL 101 recommended.

ENSCI 404: Global Change

(Dual-listed with ENSCI 504). (Cross-listed with AGRON, ENV S, MTEOR). (3-0) Cr. 3. F.S.
Prereq: Four courses in physical or biological sciences or engineering; junior standing
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.

ENSCI 411: Hydrogeology

(Dual-listed with ENSCI 511). (Cross-listed with GEOL). (3-2) Cr. 4. F.
Physical principles of groundwater flow, nature and origin of aquifers and confining units, well hydraulics, groundwater modeling, and contaminant transport. Lab emphasizes applied field and laboratory methods for hydrogeological investigations.

ENV S 324: Energy and the Environment

(Cross-listed with ENSCI, GEOL, MTEOR). (3-0) Cr. 3. S.
Prereq: CHEM 163 or CHEM 177, MATH 140
Exploration of the origin of Earth’s energy resources and the environmental and climatic impacts of energy acquisition and consumption. Renewable and non-renewable energy resources within an Earth-system context. Various environmentally-relevant topics such as water quality and availability, habitat destruction, greenhouse-gas emissions, and health and safety hazards to wildlife and human communities.

ENV S 342: World Food Issues: Past and Present
(Cross-listed with AGRON, FS HN, T SC). (3-0) Cr. 3. F.S.
Prereq: Junior classification
Issues in the agricultural and food systems of the developed and developing world. Emphasis on economic, social, historical, ethical and environmental contexts. Causes and consequences of overnutrition/undernutrition, poverty, hunger and access/distribution. Explorations of current issues and ideas for the future. Team projects.
Meets International Perspectives Requirement.

ENV S 363: U. S. Environmental History
(Cross-listed with HIST). (3-0) Cr. 3.
Prereq: Sophomore classification
Survey of the interactions of human communities with the North American environment. Focus on the period from pre-settlement to the present, with a particular concentration on natural resources, disease, settlement patterns, land use, and conservation policies.

ENV S 407: Watershed Management
(Cross-listed with ENSCI, NREM). (3-3) Cr. 4. S.
Prereq: 1 course in BIOL
Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

ENV S 424: Sustainable and Environmental Horticulture Systems
(Cross-listed with HORT). (3-0) Cr. 3. Alt. S., offered odd-numbered years.
Inquiry into ethical issues and environmental consequences of horticultural cropping systems, production practices and managed landscapes. Emphasis on systems that are resource efficient, environmentally sound, socially acceptable, and profitable.

ENV S 450: Issues in Sustainable Agriculture
(Cross-listed with AGRON). (3-0) Cr. 3. F.
Agricultural science as a human activity; contemporary agricultural issues from agroecological perspective. Comparative analysis of intended and actual consequences of development of industrial agricultural practices.

ENV S 484: Sustainable Communities
(Cross-listed with C R P). (3-0) Cr. 3. S.
Prereq: Junior classification
The history and theory of sustainable community planning. Procedural and substantive dimensions. Case studies of communities engaged in sustainability planning. Use and development of indicators.

FS HN 460: Global Nutrition and Health
(Dual-listed with NUTRS 560 FS HN 560). (3-0) Cr. 3.
An overview of global nutrition issues, including the sociocultural, biological, economic, and environmental context of nutrition related topics. The etiology, epidemiology, and program/policy responses to issues will be presented. Areas to be covered include childhood malnutrition, growth stunting, micronutrient deficiencies, parasites and nutrition, sanitation, and obesity and chronic disease incidence in developing countries. Participatory course, students will engage in a series of class activities, discussions, and presentations.

GEOL 439: Seismic Methods in Geology, Engineering, and Petroleum Exploration
(Dual-listed with GEOL 539). (Cross-listed with C E). (2-2) Cr. 3. Alt. S., offered even-numbered years.
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.

I E 305: Engineering Economic Analysis
(3-0) Cr. 3. F.S.SS.
Prereq: MATH 166
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.

I E 430: Entrepreneurial Product Engineering
(Cross-listed with ENGR). Cr. 3. F.Alt. S., offered irregularly.
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.

I E 437: Reliability and Safety Engineering
(Dual-listed with I E 537). (3-0) Cr. 3.
Prereq: STAT 231 or STAT 305 or STAT 587
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.

IND D 330: Creative Thinking in Design
(3-0) Cr. 3.
Exploration of strategies, methods, and processes associated with creative thinking skills and problem solving. Discussion of the nature of creativity and its implications in different contexts that cross content boundaries.

IND D 530: Design Thinking
(3-0) Cr. 3.
Prereq: Senior or graduate standing in any ISU program
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 355: Biomechanics
(3-0) Cr. 3. F.S.SS.
Prereq: PHYS 111 or PHYS 115
Mechanical basis of human performance; application of mechanical principles to exercise, sport and other physical activities.

MAT E 319: Mechanics of Structures and Materials
(3-0) Cr. 3. S.
Prereq: PHYS 231; credit or concurrent enrollment in MATH 166
Fundamentals of engineering mechanics as applied to materials. Forces and moments; stresses in loaded bodies; elasticity and stress analysis including stress / strain relationships. Only one of MAT E 319 or E M 324 may be used for graduation requirements.

MAT E 342: Structure/Property Relations in Nonferrous Metals

(3-0) Cr. 3. S.

Prereq: MAT E 215 or 273 or 392

Processing of metals and alloys to obtain desired mechanical properties by manipulation of their microstructure and composition of constituent phase(s). Relevance of defects to mechanical properties, plastic flow. Strengthening mechanisms in metals and alloys. Microstructure, heat treatment and mechanical properties of engineering alloys. Metal-matrix composites.

MAT E 350: Polymers and Polymer Engineering

(3-0) Cr. 3. S.

Prereq: MAT E 216 or MAT E 273 or MAT E 392

Fundamental concepts of soft matter, including polymer, colloid and surfactant. Their physical and chemical properties, rheology and production methods. Applications of polymers in the chemical industry. Related topics in surface, diffusion and stability.

MGMT 310: Entrepreneurship and Innovation

Can only be used in combination with ENTSP 313

(3-0) Cr. 3. F.S.

Prereq: Sophomore classification

Review of the entrepreneurial process with emphasis on starting a new business. How to analyze opportunities, develop an innovative product, organize, finance, market, launch, and manage a new venture. Deals with the role of the entrepreneur and the importance of a business plan. Speakers and field project.

MGMT 320: Corporate Entrepreneurship, Innovation and Technology Management

(Cross-listed with ENTSP).

Cr. 3. F.S.

Prereq: sophomore classification

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 in the context of mid-size to large corporations in manufacturing as well as in service industries. Development of 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 to gain insights concerning the effective implementation of technological and organizational innovations in corporate settings.

MGMT 370: Management of Organizations

(3-0) Cr. 3. F.S.SS.

Prereq: ECON 101 or ECON 102

A management functions approach is used to explain what managers do in organizations; how they deal with external constituents, how they structure their companies, and how they deal with employees. A contingency approach is used as a framework for understanding how to increase the effectiveness and efficiency of organizations in today's dynamic, highly competitive business environment.

MGMT 371: Organizational Behavior

(3-0) Cr. 3. F.S.

Prereq: Sophomore classification

The study of individual attributes, interpersonal relations, and employee attitudes in organizations. Instructional emphasis is placed on how management concepts such as reward systems, job design, leadership, teams, etc., can be used to manage employee attitudes and behavior.

MGMT 372: Ethical and Responsible Management

(3-0) Cr. 3. F.S.

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 381: Managing Family Businesses

(Cross-listed with ENTSP). (3-0) Cr. 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.

MGMT 414: International Management

(3-0) Cr. 3. F.S.

Prereq: Sophomore Classification

Explains complexities managers face when doing business in countries where political, legal, economic, and cultural systems are different and require making decisions about the change, innovation, or adaptation needed to successfully formulate strategies for entering and operating in international markets.

MKT 340: Principles of Marketing

(3-0) Cr. 3. F.S.SS.

Prereq: credit or current enrollment in ECON 101

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

MKT 342: Foundation Of Personal Selling

Cr. 3. F.S.

Prereq: Sophomore status or above

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 367: Consultative Problem Solving

(Cross-listed with MIS). Cr. 3. F.S.

Prereq: Sophomore and above

Consultative problem-solving approach to address complex problems in marketing and related fields. Topics include problem definition, issue tree dis-aggregation, hypotheses development and the Pyramid Principle. Development of skills such as formulating problems, structuring and prioritizing problems, synthesizing results and communicating intuition from quantitative analyses.

MATH 207: Matrices and Linear Algebra

(3-0) Cr. 3. F.S.SS.

Prereq: 2 semesters of calculus

Systems of linear equations, determinants, vector spaces, linear transformations, orthogonality, least-squares methods, eigenvalues and eigenvectors. Emphasis on applications and techniques. Only one of MATH 207 and MATH 317 may be counted toward graduation.

MATH 341: Introduction to the Theory of Probability and Statistics I

(Cross-listed with STAT). (3-2) Cr. 4. F.S.
Prereq: MATH 265 (or MATH 265H)
Probability; distribution functions and their properties; classical discrete and continuous distribution functions; multivariate probability distributions and their properties; moment generating functions; transformations of random variables; simulation of random variables and use of the R statistical package. Credit for only one of the following courses may be applied toward graduation: STAT 341, STAT 347, STAT 447, or STAT 588.

MATH 350: Number Theory

(Cross-listed with COM S). (3-0) Cr. 3. S.
Prereq: MATH 201 or COM S 230 or CPR E 310
Divisibility, integer representations, primes and divisors, linear diophantine equations, congruences, and multiplicative functions. Applications to cryptography. Additional topics, chosen at the discretion of the instructor.

MATH 365: Complex Variables with Applications

(3-0) Cr. 3. S.
Prereq: MATH 265
Functions of a complex variable, including differentiation, integration, series, residues, and conformal mappings.

MATH 385: Introduction to Partial Differential Equations

(3-0) Cr. 3. F.S.
Prereq: MATH 265 and one of MATH 266, MATH 267
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.

MATH 423: Mathematical Modeling in Biology

(Dual-listed with MATH 523). (3-0) Cr. 3. F.
Prereq: required: MATH 266 or equivalent, recommended: MATH 265 or equivalent
Introduction to mathematical techniques for modeling and simulation, parameter identification, and analysis of biological systems. Applications drawn from many branches of biology and medicine. Apply differential equations, difference equations, and dynamical systems theory to a wide array of biological problems.

MATH 481: Numerical Methods for Differential Equations

(Dual-listed with MATH 581). (Cross-listed with COM S). (3-0) Cr. 3. S.
Prereq: MATH 265 and either MATH 266 or MATH 267
First order Euler method, high order Runge-Kutta methods, and multistep methods for solving ordinary differential equations. Finite difference and finite element methods for solving partial differential equations. Local truncation error, stability, and convergence for finite difference method. Numerical solution space, polynomial approximation, and error estimate for finite element method. Computer programming required.

M E 416: Mechanism Design and Analysis

Cr. 3. S.
Prereq: M E 325
An introduction to the design and analysis of mechanisms and the use of prescribed design methodologies to identify design requirements and achieve desired motion profiles. Topics include fundamental mechanism kinematics; graphical and analytical mechanism synthesis methods; velocity and acceleration analysis; and the design of linkages, cams and gear trains. Significant amount of team-based problem solving and the development of physical and computational models to assist in the design process.

M E 418: Mechanical Considerations in Robotics

(Dual-listed with M E 518). (3-0) Cr. 3. S.
Prereq: Credit or enrollment in M E 421
Three dimensional kinematics, dynamics, and control of robot manipulators, hardware elements and sensors. Laboratory experiments using industrial robots.

M E 419: Computer-Aided Design

(3-0) Cr. 3. F.S.
Prereq: M E 325
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.

M E 425: Optimization Methods for Complex Designs

(Dual-listed with M E 525). (3-0) Cr. 3. F.
Prereq: M E 160, MATH 265
Optimization involves finding the 'best' according to specified criteria. Review of a range of optimization methods from traditional nonlinear to modern evolutionary methods such as Genetic algorithms. Examination of how these methods can be used to solve a wide variety of design problems across disciplines, including mechanical systems design, biomedical device design, biomedical imaging, and interaction with digital medical data. Students will gain knowledge of numerical optimization algorithms and sufficient understanding of the strengths and weaknesses of these algorithms to apply them appropriately in engineering design. Experience includes code writing and off-the-shelf routines. Numerous case-studies of real-world situations in which problems were modeled and solved using advanced optimization techniques.

M E 427: Vehicle Dynamics and Suspension Design

(3-0) Cr. 3. S.
Prereq: M E 345
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.

M E 437: Introduction to Combustion Engineering

(3-0) Cr. 3. S.
Prereq: Credit in M E 332 or equivalent.
Introduction to the fundamentals of combustion and the analysis of combustion systems for gaseous, liquid, and solid fuels-including biomass fuels. Combustion fundamentals are applied to the analysis of engines; turbines, biomass cookstoves; suspension, fixed-bed, and fluidized-bed furnaces; and other combustion devices.

M E 444: Elements and Performance of Power Plants

(3-0) Cr. 3. S.
Prereq: M E 332, credit or enrollment in M E 335
Basic principles, thermodynamics, engineering analysis of power plant systems. Topics include existing power plant technologies, the advanced energyplex systems of the future, societal impacts of power production, and environmental and regulatory concerns.

M E 448: Fluid Dynamics of Turbomachinery

(Cross-listed with AER E). (3-0) Cr. 3. S.
Prereq: AER E 311 or M E 335
Applications of principles of fluid mechanics and thermodynamics in performance analysis and design of turbomachines. Conceptual and preliminary design of axial and radial flow compressors and turbines using velocity triangles and through-flow approaches.

M E 475: Modeling and Simulation

(3-0) Cr. 3. S.
Prereq: M E 421, credit or enrollment in M E 436
Introduction to computer solution techniques required to simulate flow, thermal, and mechanical systems. Methods of solving ordinary and partial differential equations and systems of algebraic equations; interpolation, numerical integration; finite difference and finite element methods.

M S E 521: Mechanical Behavior and Manufacturing of Polymers and Composites

(Cross-listed with M E). (3-0) Cr. 3. S.
Prereq: M E 324, E M 324
Effect of chemical structure and morphology on properties. Linear viscoelasticity, damping and stress relaxation phenomena. Structure and mechanics of filler and fiber reinforced composites. Mechanical properties and failure mechanisms. Material selection and designing with polymers. Processing of polymer and composite parts.

M S E 552: Scanning and Auger Electron Microscopy

(Dual-listed with MAT E 452). (2-3) Cr. 3. F.
Prereq: PHYS 232
Characterization of materials using scanning electron microscope (SEM), electron microprobe, and auger spectrometer. Compositional determination using energy and wavelength dispersive x-ray and Auger spectroscopies. Specimen preparation. Laboratory covers SEM operation.

MTEOR 301: General Meteorology

(4-0) Cr. 4. S.
Prereq: MATH 166, credit or enrollment in PHYS 232
Global distribution of temperature, wind, and atmospheric constituents; atmospheric thermodynamics, radiative transfer, global energy balance, storms and clouds, introductory dynamics.

MTEOR 432: Instrumentation and Measurements

(2-2) Cr. 3. S.
Prereq: Credit or enrollment in MATH 266, PHYS 232
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.

MUSIC 346: Computer Music Programming Design

(3-0) Cr. 3. S.
Prereq: MUSIC 246 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 313: Native Land, Water, and Resources

(Cross-listed with AM IN). (3-0) Cr. 3. Alt. S., offered even-numbered years.
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. AM IN 210 recommended.

NREM 385: Natural Resource Policy

(Dual-listed with NREM 585). (3-0) Cr. 3. S.
Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance.

N S 330: Naval Ship Systems II (Weapons)

(3-0) Cr. 3. S.

Prereq: PHYS 221, 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.

PHYS 304: Thermal Physics

(3-0) Cr. 3. S.

Prereq: PHYS 222 or (PHYS 232 and PHYS 232L) or PHYS 242, MATH 266 or MATH 267

Concepts of temperature, entropy, and other characteristic thermodynamic functions, with application to macroscopic properties of matter. The laws of thermodynamics. Introduction to statistical mechanics, including quantum statistics. Application to black body radiation, crystalline vibrations, magnetic ions in solids, electronic heat capacity of metals. Phase transformations and chemical reactions.

PHYS 311: Intermediate Laboratory

Cr. 1-2. Repeatable. S.

Prereq: PHYS 322

Experiments in classical and modern physics performed independently by each student.

PHYS 361: Classical Mechanics

(3-0) Cr. 3. S.

Prereq: PHYS 222 or (PHYS 232 & 232L) or PHYS 242, MATH 265, credit/ enrollment in MATH 266 or MATH 267

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

SCM 301: Supply Chain Management

(3-0) Cr. 3.

Prereq: ECON 101 and STAT 226

Various supply chain activities and integration of supply chain management with supply and demand, both within and between firms. Exposure to a wide range of supply chain management terminology, analytical tools, and theories related to four key elements of supply chain management: purchasing, operations, distribution, and integration. Specific topics include strategic sourcing, supply management, demand forecasting, resource planning, inventory management, process management, logistics, location analysis, process integration, and performance measurement.

STAT 301: Intermediate Statistical Concepts and Methods

(3-2) Cr. 4. F.S.

Prereq: STAT 101 or STAT 104 or STAT 105 or STAT 201

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. Credit for only one of the following courses may be applied toward graduation: STAT 301, STAT 326, STAT 401, or STAT 587.

TSM 310: Total Quality Improvement

(3-0) Cr. 3. F.S.

Prereq: STAT 101 or STAT 104, junior classification

Introduction to the fundamental concepts of TQM - Deming style of management, statistical studies to understand the behavior of products, processes, or services, and how to define and document processes and customer focus. Introduction to continuous improvement tools and methods - emphasis on critical thinking and problem solving skills.

TSM 322: Preservation of Grain Quality

(3-0) Cr. 3. S.
Prereq: MATH 140 or higher
Principles and management for grain quality preservation: quality measurement; drying and storage; fans and airflow through grain; handling methods; insect pest control; and grain quality monitoring.

TSM 322L: Preservation of Grain Quality Laboratory

(0-3) Cr. 1. S.
Prereq: Credit or concurrent enrollment in TSM 322
Hands-on experiences in the principles and management for grain quality preservation: Quality measurement; drying and storage; fans and airflow through grain; handling methods; system planning; insect pest control; grain quality monitoring. Industry tour.

TSM 457: Feed Safety, Ingredient Quality and Analytics

(Dual-listed with TSM 557). Cr. 3. S.
Prereq: Junior classification
Concepts of feed and grain safety and quality, including hazards and risks associated with common feeds and feed ingredients. Methods to monitor, manage, and mitigate hazards and risks in the context of feed and grain industries. Government regulations applicable to feed and grain safety. Differences between safety and quality factors, how they are measured and then used for decision-making (marketing, processing, or safe-use).

TSM 370: Occupational Safety

(3-0) Cr. 3. F.S.
Prereq: TSM 270; Junior classification or waiver to use ME 270
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.