

Fall 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.

[AERE 4260: Design of Aerospace Structures](#)

(Dual-listed with AERE 5260). Cr. 3.

Prereq: EM 3240

Detailed design and analysis of aerospace vehicle structures. Material selection, strength, durability and damage tolerance, and validation analysis. Design for manufacturability.

[AERE 4330: Spacecraft Dynamics and Control](#)

(3-0) Cr. 3.

Prereq: ME 3450

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.

[ABE 3250: Biorenewable Systems](#)

(Cross-listed with TSM). (3-0) Cr. 3. F.

Prereq: CHEM 1630 or higher; MATH 1400 or higher

Converting bio-renewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

[ABE 3880: Sustainable Engineering and International Development](#)

(Cross-listed with C E, E E). Cr. 3.

Prereq: Junior classification in an Engineering Major

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

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[ABE 4130: Fluid Power Engineering](#)

(Cross-listed with ME). Cr. 3.

Prereq: Credit or concurrent enrollment in (ABE 3780 or ME 3350); (ABE 2160 or M E 2700)

Fundamental fluid power principles, symbols and schematics. Hydraulic fluid properties. Function and performance of components such as connections and fittings, filtration, pumps, valves, actuators, hydrostatic transmissions. Hydraulic system dynamics. Modeling and simulation of circuits. Analysis and design of hydraulic systems. Hydrostatic transmission design. Hands-on construction of circuits, measurement of system variables, and electrohydraulic control.

[AFAS 3410: Air Force Leadership Studies I](#)

(3-0) Cr. 3. F.

Presents the complex issues of leadership and management in the U.S Air Force; a large and diverse organization. The theoretical aspects of leadership, management, communications, motivation and problem-solving are examined and studied against the backdrop of the U.S. Air Force.

[AFAS 4410: National Security Studies](#)

(3-0) Cr. 3. F.

Traces constitutional roots of authority and responsibilities to the Air Force officer, to include development of national security and strategy that defines US military policy and priorities. Applies legislation, joint doctrine, and relationships of operational and administrative authority concepts in the US military in the context of regional studies.

[AGEDS 3880: Agricultural Mechanics Applications](#)

(2-3) Cr. 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 ENV S, FS HN). Cr. 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 3510: Turfgrass Establishment and Management](#)

Cr. 3

Principles and practices of turfgrass propagation, establishment, and management. Specialized practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests.

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[AGRON 404: Global Change](#)

(Dual-listed with AGRON 5040). (Cross-listed with ENSCI, ENV S, MTEOR). Cr. 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.

[AGRON 4520: Intro GIS for Geoscientists](#)

(Dual-listed with AGRON 5520). (Cross-listed with ENSCI, GEOL). Cr. 3.

Introduction to geographic information systems (GIS) using ArcGIS Pro with particular emphasis on geoscientific data. Teaches typical GIS operations and analyses in the geosciences to prepare students for practical use of GIS in industry and academia. Includes a class project for GEOL 552. Sophomore classification or above recommended.

[ASTRO 3420: Introduction to Solar System Astronomy](#)

Cr. 3.

Prereq: PHYS 2220 or (PHYS 2320 and 2320L) or PHYS 2420

An introduction to the physics of the Solar System and the planetary systems discovered around other stars. General characteristics of planetary systems: dynamics, thermodynamics, internal and surface structure of planets and minor bodies, physics of their atmosphere. Discovery techniques and characterization of extrasolar planets, and planetary systems formation models. "Grand tour" of the Solar System, using data and imagery from probes and telescopes that have visited these worlds. The origin and evolution of life on Earth, and the ongoing search for life in the Solar System and elsewhere in the universe.

[ASTRO 3440L: Astronomy Laboratory](#)

Cr. 3.

Prereq: PHYS 2220 or (PHYS 2320 and 2320L) or 2420

Experiments in optical astronomy. Observational techniques, ranging from stellar photometry to CCD imaging. Data processing and analysis techniques. Astronomical software packages and online databases and resources. Available instruments include a variety of small telescopes and astronomical CCD cameras.

[BIOL 3140: Principles of Molecular Cell Biology](#)

Cr. 3.

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

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BME 4400: Biomedical Applications of Chemical Engineering

(Dual Listed BME 4400, CHE 4400, CHE 5400) Cr. 3

Applications of material and energy balances, transport phenomena, chemical reaction engineering, and thermodynamics to problems in biomedical engineering and applied physiology; survey of biomedical engineering; biomaterials; biomedical imaging.

BME 4500: Biosensors

3 Cr.

Overview of biosensors and bioanalytical challenges; designing for performance including various analytical problems, ion-selective membranes, characteristics of enzymes and basics of bioaffinity sensing; fundamentals of bioselective layers including depositing films and membranes, surfaces for immobilization and bioselective agents; survey of different biosensing technologies including electroanalytical, biomembrane, optical, and acoustic-wave based sensors.

CE 3320: Structural Analysis I

Cr. 3.

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 3820: Design of Concretes

Cr. 3.

Prereq: CE 2740

Physical and chemical properties of bituminous, portland, and other cements; aggregate properties and blending; mix design and testing of concretes; admixtures, mixing, handling, placing and curing; principles of pavement thickness design.

CE 3880: Sustainable Engineering and International Development

(Cross-listed with ABE, E E).Cr. 3.

Prereq: Junior classification in an Engineering Major

Multi-disciplinary approach to sustainable engineering and international development, sustainable development, appropriate design and engineering, feasibility analysis, international aid, business development, philosophy and politics of technology, and ethics in engineering. Engineering-based projects from problem formulation through implementation. Interactions with partner community organizations or international partners such as nongovernment organizations (NGOs). Course readings, final project/design report.

Meets International Perspectives Requirement.

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ECON 3010: Intermediate Microeconomics

Cr. 3-4.

Prereq: ECON 1010; (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 3130: Economics of Sports

Cr. 3.

Prereq: ECON 1010

Application of economics to issues in sports, including franchising; rival leagues and barriers to entry; cooperative, competitive, and collusive behavior; player productivity and compensation; contracts, unions, and discrimination; antitrust, taxation, and subsidies. Economic concepts include supply and demand, costs, competition, time value of money, labor economics, pricing, public finance, production, game theory, risk analysis, and industrial organization.

ECON 3210: Economics of Discrimination

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

Prereq: ECON 1010

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.

ECON 3320: Cooperatives

Cr. 3.

Prereq: ECON 1010

Survey of cooperative business structure, including historical developments in the United States, principles of cooperation, state and federal authorization for cooperative activity, economic motivations and foundations, governance, marketing and pricing strategies, and financing, capitalization and taxation considerations. Students will learn how the cooperative model is applied in a variety of markets.

ECON 3340: Entrepreneurship in Agriculture

Cr. 3.

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 3440: Public Finance

Cr. 3

Prereq: ECON 1010

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.

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[ECON 3530: Money, Banking, and Financial Institutions](#)

Cr. 3.

Prereq: ECON 1010; 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.

[EE 3030: Energy Systems and Power Electronics](#)

Cr. 3.

Prereq: MATH 2670; PHYS 2320; 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](#)

Cr. 4.

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

[EE 3140: Electromagnetics for non Electrical Engineers](#)

Cr. 3.

Prereq: PHYS 2320 or equivalent

Conceptual study of electromagnetism and its application in engineering and related fields. EM fundamentals, EM spectrum, radiation, radiating systems, wireless, modern concepts of physics, quantum computing, transmission lines, high speed effects, waveguides, GPS and other related phenomena will be discussed and explained with the application in mind.

[EE 3210: Communication Systems I](#)

Cr. 3

Frequency domain analysis, spectral filtering, bandwidth. Linear modulation systems. Angle modulation systems. Phase locked loop, super-heterodyne receiver. Sampling and pulse code modulation. Digital data transmission, line coding, pulse shaping, multiplexing.

[EE 4510: Engineering Acoustics](#)

(Cross-listed with EM, ME). Cr. 3.

Prereq: (MATH 2660 or MATH 2670); PHYS 2310; PHYS 2310L

The basics of acoustic wave propagation in fluids with an emphasis on sound propagation in air. Topics include transmission and reflection of sound at a boundary; role of acoustic sources in directing sound fields; diffraction of sound around solid objects; reverberation of sound in a room; and the measurement of sound fields.

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[EEOB 5420: Introduction to Molecular Biology Techniques: Proteomics](#)

(Cross-listed with B M S, BBMB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). **Cr. 1.**
Repeatable.

Includes: two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

[EDADM 5410: Principles of Inclusive Educational Leadership](#)

Cr. 3

Basic principles of educational organizations, including an understanding of organizational behavior and theoretical approaches to administration. Exploration of substantive elements related to school reform, such as the change process, current issues in education, and developing a shared vision and mission around inclusive leadership.

[EDADM 5510: Supervision for Learning Environments](#)

Cr. 3

Study of effective classroom instructional practices that reflect current principles of learning. Understanding and practice of supervisory techniques that support teachers in improving the teaching and learning process, including skills in observational data collection, data analysis, collaboration, and conferencing skills.

[EDADM 5540: Leading School Reform](#)

Cr. 3

Study of principles of transformational leadership and collaborative decision-making skills. Leadership activities that facilitate the development of a school culture that embraces change and school reforms that result in high quality schools dedicated to improved student achievement.

[EDADM 5590: Curriculum Leadership](#)

Cr. 3

Analysis of PK-12 school curricula (hidden, explicit, and null), including current and historical curriculum and instructional issues; design, development, and evaluation of instructional materials. Promoting a vision of learning and instructional program conducive to student learning and staff professional growth. Examining the role curricula play in maintaining and advancing bodies of thought, norms, and historic attitudes. Draws on critical curriculum leadership theories to promote socially just curriculum leadership.

[EM 3270: Mechanics of Materials Laboratory](#)

Cr. 1.

Prereq: EM 3240

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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 MAT E). Cr. 3.

Prereq: PHYS 1320 or PHYS 2320

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.

ENGR 3500: Dean's Leadership Seminar

Cr. 1

Understanding the complexities of leadership in building an organization, decision-making styles, communication, managing change, building trust, shared responsibility leadership, creating legacy, prioritizing, effective use of authority, conflict, ethics, integrity, transparency, accountability. Selection based on demonstrated commitment to leadership development.

ENGR 4300: Entrepreneurial Product Engineering

(Cross-listed with IE). Cr. 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 3010: Natural Resource Ecology and Soils

Cr. 4

Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes.

ENSCI 3120 and Lab: Ecology

Cr. 4

Lab is required to take the course.

Fundamental concepts and principles of ecology dealing with organisms, populations, communities, and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

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[ENSCI 4040: Global Change](#)

Cr. 3

(Cross Listed AGRON, ENSCI 5040, ENVS. MTEOR 5040)

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 4150: Paleoclimatology](#)

Cr. 3

Introduction to mechanisms that drive climate, including the interplay between oceanic and atmospheric circulation and fluctuation in Earth's orbital parameters. Examination and analysis of past climate records ranging from historical documentation to ecological and geochemical proxies (e.g. tree ring analysis; O and C isotopes of skeletal carbonates and soils). Dating methods used to constrain and correlate climatic periods; utility of computer models to reconstruct past climates and predict future climate change. Emphasis placed on paleoclimatology and paleoecology of the late Quaternary (last ~1 million years). Offered even-numbered years.

[ENVS 3420: World Food Issues: Past and Present](#)

Cr. 3

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

[ENVS 3450: Population and Society](#)

Cr. 3

Human population growth and structure; impact on food, environment, and resources; gender issues; trends of births, deaths, and migration; projecting future population; population policies and laws; comparison of the United States with other societies throughout the world.

[FSHN 3010: Nutrigenomics: From Basic Science to Translational Impact](#)

(2-0) **Cr. 1.**

Introduction to the concepts of nutrigenomics and nutrigenetics and how it affects consumers of food, as well as the implications for human diseases. The potential impact of personalized nutrition and full genome sequencing on health maintenance, chronic disease prevention, and the ethical implications of this knowledge will be explored.

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[GEOL 3150: Mineralogy and Earth Materials](#)

Cr. 3.

Prereq: Credit or concurrent enrollment in CHEM 1630 or CHEM 1670 or CHEM 1770

Introduction to mineral classification, elementary crystal chemistry, crystal growth and morphology, mineral stability, and mineral associations. GEOL 100 or GEOL 101 or GEOL 201 or equivalent recommended

[GEOL 3150L: Laboratory in Mineralogy and Earth Materials](#)

(0-3) Cr. 1.

Prereq: Credit or concurrent enrollment in CHEM 1630 or CHEM 1670 or CHEM 1770

Mineral identification methods, especially hand-specimen identification. GEOL 1000 or GEOL 1010 or GEOL 2010 or equivalent recommended.

[GEOL 3160: Optical Mineralogy](#)

Cr. 1.

Prereq: Credit or concurrent enrollment in CHEM 1630 or CHEM 1670 or CHEM 1770

Laboratory problems in mineral-identification methods utilizing optical microscopic techniques. GEOL 1000 or GEOL 1010 or GEOL 2010 or equivalent recommended.

[GEOL 4260: Stable Isotopes in the Environment](#)

Cr. 3. (Dual-listed with GEOL 5260). (Cross-listed with ENSCI).

Introduction to the theory, methods and applications of stable isotopes. Primary focus on the origin, natural abundance, and fractionation of carbon, hydrogen, oxygen, nitrogen isotopes. Applications of isotopic occurrence for elucidation of physical, chemical, biological, and environmental processes. Effects of plant physiology, photosynthesis, trophic structure, diffusion, evaporation, chemical precipitation, soil and atmospheric processes, and environmental factors on isotope abundance.

[GEOL 4790: Surficial Processes](#)

Cr. 3. (Dual-listed with GEOL 5790). (Cross-listed with ENSCI).

The study of physical processes that shape Earth's surface. Topics include weathering, sediment transport, and landform genesis with emphasis on fluvial, glacial, hillslope, eolian, and coastal processes. Applications to engineering and environmental problems. Laboratory includes topographic map interpretation and local field trips.

[GEOL 4890: Survey of Remote Sensing Technologies](#)

Cr. 3. (Dual-listed with GEOL 5890). (Cross-listed with E E, ENSCI, MTEOR, NREM).

Electromagnetic-radiation principles, active and passive sensors, multispectral and hyperspectral sensors, imaging radar, SAR, thermal imaging, lidar. Examples of applications. Also offered online S.

[HORT 3510: Turfgrass Establishment and Management](#)

Cr. 3

Principles and practices of turfgrass propagation, establishment, and management. Specialized

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practices relative to professional lawn care, golf courses, athletic fields, highway roadsides, and seed and sod production. The biology and control of turfgrass pests.

IE 3050: Engineering Economic Analysis

Cr. 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). Cr. 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.

INDD 3200: Design Research Methods

(3-0) Cr. 3.

Qualitative and quantitative methods with an emphasis on contextual user-centered research. Integration of user data collection, visualization, and synthesis as a source for design.

INDD 5300: 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 3550: Biomechanics

Cr. 3.

Prereq: PHYS 1150 or PHYS 1310

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

MATE 3620/MATE 3620L: Principles of Nondestructive Testing

(Cross-listed with EM). (3-0) Cr. 3. S.

Prereq: PHYS 1320 or PHYS 2320

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

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defects detectable, calibration standards, and reliability safety precautions.

MGMT 3200: Corporate Entrepreneurship

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

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

Cr. 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 3710: Organizational Behavior

Cr. 3.

Prereq: Sophomore classification

Introduction to the attitudes and behaviors of individuals and groups in organizations, as well as their antecedents: e.g., individual characteristics, interpersonal processes, manager and leader influences, and organizational characteristics and practices. Builds awareness of one's own and others' characteristics, attitudes, behaviors, and interpersonal and decision-making skills to improve as an employee and a manager.

MGMT 3720: Ethical and Responsible management

Cr. 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). 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

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their family members and other employees. Explores best practices for successfully managing family businesses.

MKT 3400: Principles of Marketing

Cr. 3.

Prereq: credit or current 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

Cr. 3.

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 3670: Consultative Problem Solving

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

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 3730: Introduction to Scientific Computing

Cr. 3.

Prereq: MATH 2650

Vector and matrix programming and graphing in MATLAB for scientific applications. Polynomial interpolation and approximation. Systems of linear equations and numerical linear algebra. Numerical differentiation and integration. Root-finding methods for solving nonlinear equations and optimization in one and several variables. Fast Fourier transform. Emphasis on effective use of mathematical software and understanding of its strengths and limitations.

MATH 3850: Introduction to Partial Differential Equations

Cr. 3.

Prereq: MATH 2650; (MATH 2660 or 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.

M E 2800X. Design and Analysis of Cyber-Physical Systems

Cr. 3.

Prereq: ENGR 1600 or equivalent; PHYS 2210 (Or PHYS 2310 and PHYS 2310L).

Introduction to the basic concepts of cyber-physical systems (CPS); physical and cyber

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considerations and constraints for design, analysis, performance monitoring and control of human-engineered physical systems; basic concepts of sensing, information processing and feedback actuation. Substantial hands-on computer programming activity relevant to CPS applications.

M E 3730. Science and Practice of Brewing

(Cross-listed with FS HN 3730X). Cr. 3.

Prereq: CHEM 1670 or CHEM 1770 and PHYS 2210 or PHYS 2310 or BIOL 2110 or BIOL 2120; or permission by the instructor; 21 years of age for all students.

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.

M E 4110: Automatic Controls

Cr. 3.

Prereq: M E 3700 or (credit or concurrent enrollment in M E 4210)

Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.

M E 4120: Ethical Responsibilities of a Practicing Engineer

Cr. 3.

Prereq: Credit or concurrent enrollment in M E 3250

The study of ethics in engineering design and the engineering profession. A comprehensive look at when ethical decisions must be made and an approach to make them. The approach takes into account moral, legal, technical, experiential, and standards to aid in ethical decision making. Each area will be studied through lectures, debates, guest speakers, class discussion, and case studies.

ME 4130: Fluid Power Engineering

Cr. 3

Fundamental fluid power principles, symbols and schematics. Hydraulic fluid properties. Function and performance of components such as connections and fittings, filtration, pumps, valves, actuators, hydrostatic transmissions. Hydraulic system dynamics. Modeling and simulation of circuits. Analysis and design of hydraulic systems. Hydrostatic transmission design. Hands-on construction of circuits, measurement of system variables, and electrohydraulic control.

ME 4170: Advanced Machine Design

(Dual-listed with ME 5170). Cr. 3.

Prereq: MAT E 2730; ME 3250

Stress life, strain life, and fracture mechanics approaches to fatigue life and design with metals, polymers and ceramics. Introduction to material selection in design of machine components. Thermal and structural considerations in design of machine components and hybrid materials. Course project and relevant literature review required for graduate credit.

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ME 4190: Computer-Aided Design

Cr. 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 4330: Alternative Energy

Cr. 3.

Prereq: CHEM 1670; PHYS 2320; PHYS 2320L

Basic principles, performance, and cost analysis of alternative energy systems including biofuels, bioenergy, wind, solar, fuel cells, storage and other alternative energy systems. Performance analysis and operating principles of systems and components, and economic analysis for system design and operation will be taught. Emphasis is on alternative energy technologies needed to meet our future energy needs at various scales ranging from household to city to national levels.

ME 4410: Fundamentals of Heating, Ventilating, and Air Conditioning

Cr. 3.

Prereq: ME 3320 (Note the change to an earlier pre-req course.)

Space conditioning and moist air processes. Application of thermodynamics, heat transfer, and fluid flow principles to the analysis of heating, ventilating, and air conditioning components and systems. Performance and specification of components and systems.

ME 4490: Internal Combustion Engines

Cr. 3.

Prereq: ME 3320

Basic principles, thermodynamics, combustion, and exhaust emissions of spark-ignition and compression-ignition engines. Laboratory determination of fuel properties and engine performance. Effects of engine components and operating conditions on performance. Written reports required.

ME 4510: Engineering Acoustics

Cr. 3. (Cross-listed with EE, EM).

Prereq: (MATH 2660 or MATH 2670); PHYS 2310; PHYS 2310L

The basics of acoustic wave propagation in fluids with an emphasis on sound propagation in air. Topics include transmission and reflection of sound at a boundary; role of acoustic sources in directing sound fields; diffraction of sound around solid objects; reverberation of sound in a room; and the measurement of sound fields.

MICRO 3020: Biology of Microorganisms

Cr. 3

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.

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[MSE 5100: Fundamentals of Structure and Chemistry of Materials](#)

Cr. 3.

Prereq: MATH 1650, PHYS 2210, and CHEM 1670

Geometric and algebraic representations of symmetry. Pair distribution function. Structure, chemistry, and basic properties of covalent, ionic, and metallic solids, glasses and liquids, and polymers. Interactions of materials with particles and waves. Relationships between direct and reciprocal spaces. The kinematical theory of diffraction, with an introduction to the dynamical theory.

[MSE 5200: Thermodynamics and Kinetics in Multicomponent Materials](#)

Cr. 3

A review of the fundamental principles of heat, work, basic thermodynamic relations, and criteria for equilibrium. Analytical treatments for the thermodynamic description of multicomponent chemical solutions and reacting systems are developed and employed to predict phase equilibria in materials systems. Builds on the thermodynamic construction to treat the kinetics of chemical reactions and phase transformations. Topics include general first order and second order transitions, along with chemical diffusion. Detailed examples involving nucleation and diffusion limited growth, spinodal decomposition, martensitic transformations, magnetic and electric transitions, and glass formation will be considered.

[MSE 5500/5500L: Nondestructive Evaluation](#)

Cr. 4

Prereq: lab required

Principles of five basic NDE methods and their application in engineering inspections. Materials behavior and simple failure analysis. NDE reliability, and damage-tolerant design. Advanced methods such as acoustic microscopy, laser ultrasonics, thermal waves, and computed tomography are analyzed. Computer-based experiments on a selection of methods: ultrasonics, eddy currents, x-rays are assigned for student completion.

[NREM 3010/3010L: Natural Resource Ecology and Soils](#)

Cr. 3

Prereq: lab required

Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes.

[NREM 3900: Fire Ecology and Management](#)

Cr. 3.

Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types.

Fall 2024 Potential Tech Electives

NREM 4460: Integrating GPS and GIS for Natural Resource Management

(Dual-listed with NREM 5460). (Cross-listed with ENSCI). Cr. 3.

Prereq: 12 credits in student's major at 3000 level or above

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

N S 3200: Naval Ship Systems I (Engineering)

Cr. 3.

Prereq: PHYS 2310; PHYS 2310L; Sophomore classification

An introduction to naval engineering with emphasis on the equipment and machinery involved in the conversion of energy for propulsion and other purposes aboard the major ship types of the U.S. fleet. Basic concepts of the theory and design of steam, gas turbine, diesel, and nuclear propulsion. Introduction to ship design, stability, hydrodynamic forces, compartmentalization, electrical and auxiliary systems.

NS 4100: Naval Operations and Seamanship

Cr. 3.

Study of tactical naval operations; employs practical use of maneuvering boards together with shiphandling principles to arrive at tactical shipboard maneuvering solutions. Study also of naval command and control, communications, and the Naval Warfare Doctrine.

PHYS 3100: Electronic Instrumentation for Experimental Physics

Cr. 4.

Prereq: MATH 1660; ([PHYS 2220 or PHYS 2220H] or [PHYS 2320 or PHYS 2320H; PHYS 2320L] or [PHYS 2420 or PHYS 2420H])

Common electrical instruments; power supplies; transducers; passive and active devices, analog integrated circuits, including filters and amplifiers; digital integrated circuits; signal transmission and enhancement.

PHYS 3210: Introduction to Modern Physics I

Cr. 3.

Prereq: Credit or concurrent enrollment in (MATH 2660 or MATH 2670); ([PHYS 2220 or PHYS 2220H] or [PHYS 2320; PHYS 2320L] or [PHYS 2420 or PHYS 2420H])

Quantum nature of matter: photons, de Broglie's postulate: wave-like properties of matter; Bohr's model of hydrogen atom; Schrodinger equations in one dimension: energy quantization; detailed solutions for potential steps, barriers and wells; one-electron atoms, spin and magnetic interactions; ground states, optical and x-ray excitations of multi-electron atoms.

Fall 2024 Potential Tech Electives

PHYS 3210L: Introductory Laboratory in Modern Physics I

Cr. 1.

Prereq: Credit or concurrent enrollment in PHYS 3210

Experiments related to the foundations of modern physics. The dual wave and particle character of electrons and photons, statistics, interferometry and x-ray spectroscopy.

PHYS 3640: Electricity and Magnetism I

Cr. 3.

Prereq: (MATH 2660 or MATH 2670); ([PHYS 2220 or PHYS 2220H] or [PHYS 2320 or PHYS 2320H; PHYS 2320L] or [PHYS 2420 or PHYS 2420H])

Static electric and magnetic fields, potential theory; electromagnetism, Maxwell's equations.

SE 3290: Software Project Management

Cr. 3

Process-based software development. Capability Maturity Model (CMM). Project planning, cost estimation, and scheduling. Project management tools. Factors influencing productivity and success. Productivity metrics. Analysis of options and risks. Version control and configuration management. Inspections and reviews. Managing the testing process. Software quality metrics. Modern software engineering techniques and practices

SE 3390: Software Architecture and Design

Cr. 3

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.

STAT 3010: Intermediate Statistical Concepts and Methods

Cr. 4.

Prereq: STAT 1010 or STAT 1040 or STAT 1050 or STAT 2010 or STAT 2260 or STAT 2310 or STAT 3050 or STAT 3220 or STAT 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. **Credit for only one of the following courses may be applied toward graduation: STAT 3010, STAT 3260, STAT 4010, or STAT 5870.**

Fall 2024 Potential Tech Electives

[TSM 3250: Biorenewable Systems](#)

Cr. 3

Converting biorenewable resources into bioenergy and biobased products. Biorenewable concepts as they relate to drivers of change, feedstock production, processes, products, co-products, economics, and transportation/logistics.

[TSM 3350: Tractor Power](#)

Cr. 3

Theory and construction of tractor engines, mechanical power trains and hydraulic systems. Introduction to traction, chassis mechanics, and hydraulic power.

[TSM 3700: Occupational Safety](#)

Cr. 3

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 3720: Legal Aspects of Occupational Safety and Health](#)

Cr. 2

A review of the common legal issues facing safety practitioners in the workplace. Includes OSHA, EPA and DOT regulations; workers' compensation, as well as common liability issues.

[TSM 3760: Fire Protection and Prevention](#)

Cr. 3.

An overview of the current problems and technology in the fields of fire protection and fire prevention, with emphasis on industrial needs, focusing on the individual with industrial safety responsibilities.

[TSM 4330: Precision Agriculture](#)

(Dual-listed with TSM 5330). Cr. 3.

Prereq: Junior classification

Geographic information systems (GIS) and global positioning systems (GPS). Hardware systems for precision farming emphasized. Autosteering and automatic implement control systems. Collection and management of yield data. Sampling strategies for precision farming. Introduction to building fertilizer prescriptions and recommendations. Economic benefits of precision farming systems.

Fall 2024 Potential Tech Electives

[TSM 4550: Feed Processing and Technology](#)

(Dual-listed with TSM 5550). Cr. 3.

Prereq: Junior classification

Introduction to formula feed manufacturing and the animal feed industry. Overview of feed ingredients and formulation, understanding and operation of feed production processing equipment including principles of conveying, grinding, mixing, conditioning, pelleting, and other processing techniques, and the formulation of concentrates, premixes, and rations. Students will become knowledgeable about the manufacturing of various animal feed types such as pelleted and extruded feed, aqua (fish) feed, liquid feeds, poured and pressed blocks, steam flaked feed, and pet food, and their effect on animal performance and health. Students will gain hands-on experience in feed manufacturing during weekly lab sessions at a full-scale university owned feed mill and grain science complex.