



SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

COURSE LISTING FOR COLLEGE OF SOCIAL SCIENCE

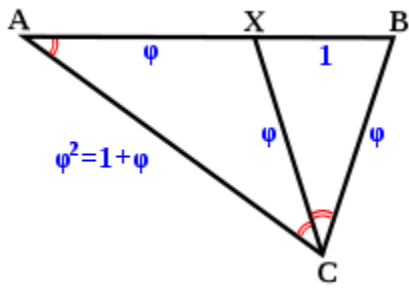


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Courses used to meet University requirements cannot be used to meet this requirement.

MTH 1825, MTH 100E, MTH 103A, MTH 103E, and MTH 290 may not be used for this requirement.

NOTE: Some majors have specific STEM courses listed for the degree. Students should consult with the Academic Advisors to ensure all degree requirements are completed.

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Anthropology - ANP		
ANP 202	Biocultural Evolution	Nature and function of culture from hominid origins to present.
ANP 203	Introduction to Archaeology	Theory, methodology, and techniques of archaeology. Applications to questions about past human behavior. History and concepts of archaeology as an anthropological subdiscipline.
ANP 206	Introduction to Physical Anthropology	Problems, data, and methods of physical anthropology. Human genetics, hominid evolution, primate studies, human osteology, and human diversity.
ANP 440	Hominid Fossils	Theories of human evolution during the past five million years fossil evidence.
ANP 441	Osteology and Forensic Anthropology	Human bone and skeletal biology and analysis. Methods of forensic anthropology. Analysis of skeletal remains, forensic pathology, and forensic archaeology.
ANP 443	Human Adaptability	Human adaptation to physical, biological and social environments. Adaptive models from ecology, demography, genetics, physiology, nutrition and medicine. Theoretical and methodological issues in human adaptation studies across various populations.
ANP 463	Laboratory Methods in Archaeology	Preparation and preservation of archaeological data. Conservation, cleaning, cataloguing, and classification. Analysis of lithics, ceramics, faunal and floral remains, metals, and glass.
ANP 464	Field Methods in Archaeology	Field research. Survey, excavation, mapping, data recording, and field laboratory procedures.

Animal Science - ANS		
ANS 305	Applied Animal Behavior	Techniques for assessing health and welfare of domestic animals based on their behavior.
ANS 415	Growth and Musculoskeletal Biology	Principles of growth in mammalian and avian species. Regulation of bone, cartilage, connective tissue, fat, and muscle metabolism. Extracellular matrix proteins and their function. Introduction to musculoskeletal diseases.
ANS 427	Environmental Toxicology and Society	Impact of environmental chemicals on health and modern society. Cellular and organ functions and their interface with the environment. Limitations of scientific investigation and environmental regulations.

Human Anatomy - ANTR		
ANTR 211	Human Tissues and Cells for Medical Illustrators	Elementary structure and function of human tissues, cells, and representative biomolecular classes. Virtual histology laboratory.
ANTR 350	Human Gross Anatomy for Pre-Health Professionals	Survey of human systemic gross anatomy with clinical illustrations. Structural basis of organ system physiology. Introduction to medical terminology and clinical language.
ANTR 355	Human Gross Anatomy Laboratory	Introductory, structured laboratory survey of human regional gross anatomy using prosections, medical imaging, and multimedia for students in allied medical fields. Correct usage and pronunciation of medical terminology.
ANTR 440	Human Anatomic Variation	Human anatomical variation including developmental, pathological and accidental.

Astronomy and Astrophysics - AST		
AST 101	The Celestial Clockworks	Relationship between ancient skylore and timekeeping. Establishment of a calendar and celestial navigation. Development of the Greek horoscope as a time recorder and coordinate system.
AST 207	The Science of Astronomy	In-depth study of one topic in astronomy with emphasis on key discoveries. Topics may be cosmology, the solar system, and the life of stars.
AST 208	Planets and Telescopes	Origin and nature of the solar system. Planets of the solar system and other star systems. Determination of time and celestial coordinates. Astronomical instruments and observational methods.

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AST 301	Junior Research Seminar	Preparation and presentation of a review paper on a current topic in astronomy or astrophysics.
AST 304	Stars	Physical processes that determine the structure and evolution of stars. Observations of stars and star clusters. Spectra of stars.
AST 308	Galaxies and Cosmology	The Milky Way. Structure and content of galaxies. Active galaxies and quasars. The expanding universe. Modern cosmological models.
AST 410	Senior Thesis	Design and execute an original experiment or computation. A written and oral report of the research is required.

Biomedical Laboratory Diagnostics - BLD

BLD 204	Mechanisms of Disease	Pathophysiological mechanisms of diseases. Selected applications to organ system pathology.
BLD 213L	Clinical Laboratory Methods	Lab safety and standards of good laboratory practice including specimen handling and processing. Application of technologies and techniques to the performance of clinical diagnostic testing.
BLD 214L	Biomedical Laboratory Research Techniques	Basic techniques, skills and safety in biomedical research. Ethical conduct of research and regulatory principles such as Good Laboratory Practice. Maintaining a research notebook for legal and intellectual property purposes. Offered second half of semester.
BLD 302	Clinical Chemistry	Correlation of common medical laboratory testing and associated disease states, including comprehensive metabolic panel, lipid panel, thyroid panel, urinalysis and drugs of abuse screening.
BLD 313	Quality in Clinical Laboratory Practice	Concepts and principles of clinical laboratory analysis and the statistical evaluation of the data produced as related to quality.
BLD 314L	Advanced Clinical Laboratory Methods	Diagnostics assays across various disciplines within the clinical laboratory including hematology, immunohematology, coagulation, urinalysis, and molecular diagnostics. Data interpretations and
BLD 324	Hematology and Hemostasis	Physiology and biochemistry of normal hematologic and hemostatic systems. Principles of diagnostic assays to detect diseases affecting those systems.
BLD 324L	Introductory Laboratory in Hematology, Hemostasis and Urinalysis	Routine laboratory assays used to assess the health of the hematological, hemostatic, and urinary systems.
BLD 365	Medical Microbiology	Laboratory diagnosis, disease and epidemiology of the most common bacterial, viral, fungal and parasitic pathogens and concepts in infectious disease control, prevention and treatment.
BLD 365L	Medical Microbiology Laboratory	Practical experience in safely and accurately performing standard clinical microbiology tests to diagnose disease-causing microbes.
BLD 366	Infectious Diseases of East Africa	Biology and laboratory diagnosis of the most common infectious disease of the region. Health disparities and healthcare system organization.
BLD 402	Advanced Clinical Chemistry	Differences in clinical laboratory testing results between normal and diseased populations. Metabolic and endocrine systems, acquired and inherited diseases, therapeutic drug monitoring and toxicology.
BLD 416	Clinical Chemistry	Correlation of laboratory test results with normal physiology and biochemistry and with disease states. Metabolic and endocrine systems. Acquired and inherited diseases. Therapeutic drug monitoring, and toxicology.
BLD 424	Advanced Hematology and Hemostasis	Etiology and pathogenesis of diseases of the hematologic and hemostatic systems including anemias, leukemias, and hemophilias. Diagnostic testing for such diseases.
BLD 424L	Advanced Hematology, Hemostasis and Urinalysis Laboratory	Specialized and advanced assays used in the diagnosis of diseases of the hematological, hemostatic, and urinary systems.
BLD 430	Molecular Diagnostics	Concepts and principles of molecular analysis applied to medical diagnostics and related applications.
BLD 430L	Molecular Diagnostics Laboratory	Molecular technologies with emphasis on clinical and diagnostic applications.
BLD 434	Clinical Immunology	Concepts of innate and adaptive immunity. Immunodeficiency and autoimmunity. Principles and applications of immunoassays in medical laboratories.
BLD 435	Immunohematology	Principles and practice of transfusion medicine including blood typing. Offered first ten weeks of semester.

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BLD 435L	Immunohematology Laboratory	Methods of blood typing and pre-transfusion testing.
BLD 439	Histocompatibility and Immunogenetics	The theory and principles of histocompatibility and immunogenetics as applied to transplant medicine.
BLD 446	Immunobiology of Neoplasia	The biology of neoplastic cells (cancers, leukemias, lymphomas), the immune response to neoplasias, and immunotherapy of cancer.
BLD 447	Immunomodulation and Immunotherapy	Current applications of Immunology understanding in the immunomodulation and immunotherapy of infectious disease, immunodeficiencies, autoimmune disease, and cancers.
BLD 450	Eukaryotic Pathogens	Medically important fungi and parasites. Host-parasite relationships, life cycles, culture, identification, and associated diseases.
BLD 452L	Immunodiagnosics Laboratory	Performance of immunopurifications, in vitro diagnostic assays and basic flow cytometry. Data analysis and quality control evaluation.
BLD 460	Advanced Molecular Diagnostics	Common and specialized molecular diagnostic technologies applied to medical diagnostics and related applications.
BLD 465	Advanced Medical Microbiology	Advanced laboratory diagnosis, epidemiology, and prevention of infectious diseases using an anatomical system specimen approach to study a comprehensive set of human pathogens and microbiota.
BLD 465L	Advanced Medical Microbiology Laboratory	Practical experience in safely and accurately performing standard clinical microbiology tests to process clinical specimens, identify pathogens and perform and interpret susceptibility testing.
BLD 471L	Advanced Clinical Chemistry Laboratory	Application and integration of theory and technical skills in clinical chemistry and biochemistry.
BLD 472	Advanced Clinical Chemistry	Theoretical aspects of clinical chemistry, chemical and biochemical reactions, statistical analysis, and pathophysiologic relationships. Integration of cognitive material with clinical laboratory test results.
BLD 473L	Advanced Clinical Hematology and Body Fluids Laboratory	Application and integration of theory and technical skills in hematology, hemostasis, and body fluid analysis.
BLD 474	Advanced Clinical Hematology and Body Fluids	Theoretical aspects of advanced hematology, hemostasis and body fluid analysis. Integration of cognitive material with clinical laboratory test results.
BLD 475L	Advanced Clinical Immunology and Immunohematology Laboratory	Application and integration of theory and technical skills in immunology and immunohematology.
BLD 476	Advanced Clinical Immunology and Immunohematology	Theoretical aspects of immunology and immunohematology. Integration of cognitive material with clinical laboratory test results.
BLD 477L	Advanced Clinical Microbiology Laboratory	Application and integration of theory and technical skills in clinical microbiology and infectious disease.
BLD 478	Advanced Clinical Microbiology	Theoretical aspects of clinical microbiology and infectious disease. Integration of cognitive material with clinical laboratory test results.

Biochemistry and Molecular Biology - BMB

BMB 161	Cell and Molecular Biology	Macromolecular synthesis. Energy metabolism. Molecular aspects of development. Molecular genetics.
BMB 171	Cell and Molecular Biology Laboratory	Principles and applications of common techniques used in cell and molecular biology.
BMB 181H	Honors Cell and Molecular Biology	Physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.
BMB 191H	Honors Cell and Molecular Biology Laboratory	Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation; biochemistry, molecular biology and genetics.

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BMB 200	Introduction to Biochemistry	Introductions to the major classes of biomolecules and the metabolism of these molecules.
BMB 400	Introduction to Bioinformatics	Managing and analyzing biological data with bioinformatic tools, basic programming, and statistics.
BMB 401	Comprehensive Biochemistry	Structure and function of major biomolecules, organization and regulation of metabolic pathways. Special emphasis on eukaryotic systems and the biochemical basis of human disease.
BMB 461	Advanced Biochemistry I	Structure, function, and biophysical properties of biomolecules in a wide variety of organisms. Emphasis on proteins and carbohydrates including enzyme catalysis and kinetics, the central metabolic pathways, and photosynthesis.
BMB 462	Advanced Biochemistry II	Continuation of BMB 461. Structure, function, and biophysical properties of lipids and nucleic acids including membrane lipid metabolism, signaling and metabolic regulation, DNA replication and repair, transcription, translation, and regulation of gene expression.
BMB 471	Advanced Biochemistry Laboratory	Biochemical methods and principles used in the study of enzymes (proteins), carbohydrates, lipids, and cell organelles.
BMB 472	Advanced Molecular Biology Laboratory	Methods of molecular biology and the underlying principles on which these methods are based.
BMB 490	Biochemistry Research	Participation in laboratory research projects.
BMB 495	Undergraduate Seminar (W)	Extension and synthesis of concepts of biochemistry. Relationships to societal issues.
BMB 499	Senior Thesis (W)	Laboratory research culminating in a thesis.

Biomedical Engineering - BME

BME 425	Biomaterials and Biocompatibility	Materials science of human implants. Design requirements imposed by the human body, and need for bodily protection.
BME 444	Biosensors for Medical Diagnostics	Biosensors, their components, properties, and associated electronics for applications in medical diagnostics.
BME 494	Biofluid Mechanics and Heat Transfer	Applications of fluid mechanics, heat transfer, and thermodynamics to biological processes, including blood flow in the circulatory system, heart function, effects of heating and cooling on cells, tissues, and proteins. Pharmacokinetics.
BME 495	Tissue Mechanics	Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.
BME 497	Biomechanical Design in Product Development	Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.

Biological Science - BS

BS 161	Cell and Molecular Biology	Macromolecular synthesis. Energy metabolism. Molecular aspects of development. Molecular genetics.
BS 162	Organismal and Population Biology	Biological diversity and organismal biology. Principles of evolution, transmission genetics, population biology, community structure, ecology.
BS 171	Cell and Molecular Biology Laboratory	Principles and applications of common techniques used in cell and molecular biology.
BS 172	Organismal and Population Biology Laboratory	Nature and process of organismal biology including experimental design, statistical methods, hypothesis testing in genetics, ecology, and evolution.
BS 181H	Honors Cell and Molecular Biology	Physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.
BS 182H	Honors Organismal and Population Biology	Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.

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BS 191H	Honors Cell and Molecular Biology Laboratory	Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation; biochemistry, molecular biology and genetics.
BS 192H	Honors Organismal and Population Biology Laboratory	Nature and process of organismal biology, including experimental design and statistical methods, hypothesis testing, genetics, ecology, and evolution.

Civil Engineering - CE		
CE 221	Statics	Vector description of forces and moments. Two- and three- dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames, and machines. Coulomb friction.
CE 273	Civil and Environmental Engineering Measurements	Measurements, surveying and error analysis with applications to civil and environmental engineering problems
CE 274	Graphics for Civil and Environmental Engineers	Basic operations in CAD software with applications in civil and environmental engineering
CE 280	Principles of Environmental Engineering and Science	Physical, chemical and biological processes related to environmental science and engineering. Environmental systems analysis with application to air, water and soil. Analysis of environmental problems and development of engineering solutions.
CE 305	Introduction to Structural Analysis	Theory of structural analysis for statically determinate structures. Qualitative structural analysis and behavior. Load estimation and placement. Introduction to structural analysis computer software. Introduction to statically indeterminate structures.
CE 312	Soil Mechanics	Engineering properties of soil and their measurement. Effective-stress concept. Permeability and seepage. Compaction. Consolidation, shear strength, and stress-strain behavior.
CE 321	Introduction to Fluid Mechanics	Fluid properties, fluid statics, fluids in motion. Conservation of mass, energy, and momentum. Dimensional analysis and similitude. Internal and external flows. Applications.
CE 337	Civil Engineering Materials	Common civil engineering construction and paving materials: aggregates, inorganic cements, asphalts, concretes, wood, and steel. Composition, structure, physical and mechanical properties, tests, and production mix design.
CE 341	Transportation Engineering	Overview of transportation system issues and problems. Fundamentals of highway design and operations. Planning and evaluation of transportation system alternatives.
CE 371	Sustainable Civil and Environmental Engineering Systems	Principles and tools of sustainable design and engineering economics in Civil and Environmental Engineering.
CE 372	Risk Analysis in Civil and Environmental Engineering	Applications of probability, statistics, uncertainty and risk analysis to topics in civil and environmental engineering, characterization of system safety, and comparison tests for engineering quality control and environmental analyses.
CE 400	Structural Mechanics	Matrix methods of structural analysis. Flexibility method. Direct stiffness method for plane structures. Elastic supports, inclined supports, member releases and non-prismatic members. Application software.
CE 405	Design of Steel Structures	Design of steel beams, columns, tension members and connections. Stability and plastic strength.
CE 406	Design of Concrete Structures	Design of reinforced concrete beams, slabs, columns and footings.
CE 407	Materials Engineering: Properties, Selection and Processing	General families of materials, materials design process for civil and environmental engineering problems, structural materials properties, processing methods and environment, microstructure of materials, structural materials selection by utilizing bubble charts.
CE 418	Geotechnical Engineering	Shallow foundation design: bearing capacity, stress distribution, and settlement analysis. Pile foundations. Design of retaining structures, including rigid walls, braced excavations, and sheet-pile walls. Stability of slopes and embankments.
CE 421	Engineering Hydrology	Hydrologic design of storm water systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy's law, flow nets, well hydraulics, design of capture wells.

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CE 422	Applied Hydraulics	Fundamentals of open-channel flow. Rapidly and gradually varied nonuniform flow analysis. Confined flows past submerged bodies, in pipe networks, and in turbo machinery. Design applications.
CE 431	Pavement Design and Analysis	Highway and airfield pavement structural design. Performance measures. Failure mechanisms. Popular thickness design procedures. Design considerations for surface friction, pavement joints, and drainage.
CE 432	Pavement Rehabilitation	Engineering concepts and information needed to rehabilitate pavements. Network and project survey and evaluation: design of rigid and flexible overlays, other methods of rehabilitation, selection of rehabilitation alternatives. Initial and life cycle cost analysis of various rehabilitation alternatives.
CE 444	Principles of Traffic Engineering	Driver and vehicle characteristics affecting traffic flow and safety. Speed, density, capacity relationships. Signal control in street networks. Freeway management systems. Risk management and liability.
CE 448	Transportation Planning	Transportation planning process and procedures. Estimation of travel demand using traditional models of trip generation, trip distribution, modal split, and traffic assignment. Use of "quick-response" procedures. Traffic impact of new facilities.
CE 449	Highway Design	Geometric design of highways. Operation, capacity, safety, and geometric features. Alignment, drainage and pavement design. Use of CAD systems in preparing contract plans.
CE 461	Computational Methods in Civil Engineering	Theoretical, numerical, and computational methods for civil engineering problems. Physical modeling, numerical techniques, and programming methods. Focus on civil engineering dynamics, solving systems of differential equations, and visualizing the results.
CE 471	Construction Engineering - Equipment, Methods and Planning	Engineering and construction fundamentals of earthwork operations, moving of materials, concrete construction, formwork, false work, and other temporary structures. Relationship to a construction project's constructability, cost, and schedule.
CE 480	Environmental Measurements Laboratory	Basic chemical and microbiological methods used in the analysis of environmental media. Laboratory safety, quality assurance, quality control, and statistics used in laboratory analysis. Related technical communication, laboratory report writing.
CE 481	Environmental Chemistry: Equilibrium Concepts	Chemistry of natural environmental systems and pollutants. Equilibrium concepts and calculations for acid-base, solubility, complexation, redox and phase partitioning reactions and processes. Applications to ecosystem analysis, pollutant fate and transport, and environmental protection.
CE 483	Water and Wastewater Engineering	Engineering and scientific basis and design of physical, chemical and biological methods for the treatment of drinking water and wastewater. Operation process selection and design.
CE 485	Landfill Design	Geotechnical and environmental design of solid waste landfills.
CE 487	Microbiology for Environmental Science and Engineering	Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.
CE 489	Air Pollution: Science and Engineering	Basic physical and chemical principles governing indoor and atmospheric air pollution. Elements of air pollution meteorology, climate change, atmospheric transformations and transport. Air pollution sources and methods for their control. The role of local, state and federal government in air pollution control.
CE 495	Senior Design in Civil and Environmental Engineering	Preliminary design. Application of design concepts in civil engineering. Integrated design solutions using geotechnical, hydrological, pavement, structural, environmental, and transportation considerations. Planning the design process. Design Specifications. Cost. Written and oral presentations. Issues of professional practice.

Chemistry - CEM

CEM 121	Explorations in Chemistry	Introduction to core ideas in chemistry (structure and properties of matter, energy, and electrical forces) blended with science practices (use of models, argumentation, construction of scientific explanations, mathematical thinking) to understand and explain chemical phenomena.
CEM 141	General Chemistry	Elements and compounds; reactions; stoichiometry; thermochemistry; atomic structure; chemical bonding; states of matter; solutions; acids and bases; aqueous equilibria.
CEM 142	General and Inorganic Chemistry	Kinetics; gaseous equilibria; acids and bases; pH; buffers; hydrolysis; titrations; heterogeneous equilibria; thermodynamics; redox and electrochemistry; transition metal chemistry; nuclear chemistry; main group chemistry.
CEM 143	Survey of Organic Chemistry	Chemistry of carbon compounds. Chemistry of the main organic functional groups with applications to everyday life, industry, and biology.

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CEM 151	General and Descriptive Chemistry	Stoichiometry; solutions; reactions and thermochemistry; quantum mechanics and atomic structure; periodic properties; chemical bonding; molecular structure; coordination chemistry; organic molecules and functional groups.
CEM 152	Principles of Chemistry	Gases, liquids, and solids; thermodynamics; changes of state; solutions and colligative properties; chemical equilibria; acids, bases, and aqueous equilibria; kinetics; redox reactions and electrochemistry; nuclear chemistry.
CEM 161	Chemistry Laboratory I	Introduction to basic chemistry laboratory techniques, including measurements, chemical reactions and basic spectroscopy.
CEM 162	Chemistry Laboratory II	Continuation of CEM 161 with additional emphasis on kinetics, thermochemistry, titration, and synthesis.
CEM 181H	Honors Chemistry I	Atomic structure and quantum mechanics; chemical bonding and molecular structure; spectroscopy; coordination chemistry; materials or biological macromolecules.
CEM 182H	Honors Chemistry II	Gases, solids, liquids, solutions, and phase transitions; thermodynamics; spontaneity and the second law of thermodynamics; chemical equilibrium; acid-base equilibria; redox reactions and electrochemistry; kinetics.
CEM 185H	Honors Chemistry Laboratory I	Spectroscopic methods used to determine the structure of molecules and materials. Experiments applying principles of physical, organic, inorganic, analytical, biological, and materials chemistry, while introducing analytical (qualitative and quantitative) and synthetic techniques.
CEM 251	Organic Chemistry I	Common classes of organic compounds including their nomenclature, structure, bonding, reactivity, and spectroscopic characterization.
CEM 252	Organic Chemistry II	Continuation of CEM 251 with emphasis on polyfunctional compounds, particularly those of biological interest.
CEM 255	Organic Chemistry Laboratory	Preparation and qualitative analysis of organic compounds.
CEM 262	Quantitative Analysis	Introduction to analytical chemistry and quantitative methods; aqueous solution equilibria and statistics related to quantitative chemical analysis; titrimetric, gravimetric, and spectrophotometric measurements.
CEM 311	Inorganic Chemistry	Basic symmetry, molecular orbital theory, and valence bond theory applications to inorganic systems. Physical properties and reactivity of transition metal systems.
CEM 333	Instrumental Methods and Applications	Principles and applications of instrumental analysis of separation techniques.
CEM 351	Organic Chemistry I	Structure, bonding, and reactivity of organic molecules.
CEM 352	Organic Chemistry II	Carboxylate derivatives. Conjugation. Aromaticity. Amino acids. Proteins. Carbohydrates. Nucleic acids.
CEM 355	Organic Laboratory I	Organic laboratory techniques. Distillation. Spectroscopy. Melting points. Recrystallization. Chromatography. Measuring physical properties.
CEM 356	Organic Laboratory II	Multi-step organic synthesis. Qualitative organic analysis. Separation, identification, and characterization of unknowns.
CEM 383	Introductory Physical Chemistry I	Physical chemistry of macroscopic systems: thermodynamics, kinetics, electrochemistry.
CEM 384	Introductory Physical Chemistry II	Physical chemistry of microscopic systems: quantum mechanics, spectroscopy.
CEM 395	Analytical/Physical Laboratory	Chemical kinetics, thermodynamics, and computer-based data analysis methods.
CEM 400H	Honors Work	Readings and investigations in chemistry.
CEM 411	Advanced Inorganic Chemistry	Principles of structure and bonding. Symmetry. Solid state chemistry. Acid-base and redox reactions. Main group chemistry: transition metal bonding, spectra, and reaction mechanisms.
CEM 415	Advanced Synthesis Laboratory	Methods of synthesizing inorganic and organometallic compounds.
CEM 417	Instrumental Methods of Analysis in Neuroscience	Design, operational principles and practical application of modern instrumental methods used for the separation, identification and quantification of neurochemical species in neuroscience. Application of methods of chemical analysis to study neurosignaling, chemical composition in single secretory cells, chemical structure of cells and tissues.
CEM 425	Chemistry Communication and Professional Development (W)	Written and oral communication skills for entering and participating in the chemistry profession and post-undergraduate programs. Includes discussion of academic honesty and research integrity.

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CEM 434	Advanced Analytical Chemistry	Instrumental methods of analysis, including spectroscopy, chromatography, and electrochemistry.
CEM 435	Analytical Chemistry Laboratory	Application of instrumental spectroscopic, electrochemical, and chromatographic methods to solve quantitative chemical problems in the laboratory.
CEM 444	Chemical Safety	Prudent laboratory practices. Regulatory agencies' expectations of chemical industries and academia.
CEM 481	Seminar in Computational Chemistry	Potential energy surfaces; matrix representation of quantum mechanics; linear combination of atomic orbitals; Hartree-Fock approximation; electron correlation; configuration interaction; coupled cluster theory; Moller Plesset perturbation theory; density functional theory
CEM 482	Science and Technology of Wine Production	Origin and history of wine and wine production. Determination and timing of harvest, methods of postharvest handling, storage, and processing of grapes into juice and wine. Physical and chemical changes in wine and processes. Analysis of must and its adjustment, fermentation, fining, and aging. Physiology of yeasts and bacteria involved in winemaking and spoilage. Cellar practices, problems, and operations.
CEM 483	Quantum Chemistry	Postulates of quantum mechanics and the application to model systems, atoms and molecules. Introduction to molecular spectroscopy.
CEM 484	Molecular Thermodynamics	Microscopic properties of atoms and molecules revealed by spectroscopic measurements; connection between thermodynamic properties of macroscopic chemical systems and microscopic properties established using statistical thermodynamics.
CEM 485	Modern Nuclear Chemistry	Elementary nuclear processes and properties; radioactivity, its measurement and its interaction with matter.
CEM 495	Molecular Spectroscopy	Experiments in magnetic resonance, optical, and vibrational spectroscopies.
CEM 499	Chemical Physics Seminar	Written and oral reports on selected journal articles in chemical physics.

Chemical Engineering - CHE		
CHE 201	Material and Energy Balances	Chemical engineering calculations. Synthesis of chemical process systems. Analysis of chemical processes using material and energy balances. Enthalpy calculations for changes in temperature, phase transitions, and chemical reactions.
CHE 210	Modeling and Analysis of Transport Phenomena	Steady and unsteady state material and energy balances. Fluxes and rate processes. Shell balances. Balance equations for mass, heat, and momentum transport. Analogies among mass, heat, and momentum transport. Analytical and numerical solutions. Application of computational methods to problem solutions.
CHE 311	Fluid Flow and Heat Transfer	Thermodynamics of fluid flow. Laminar and turbulent flow. Design of flow systems. Heat transfer in solids and flowing fluids. Interphase heat transfer. Radiant heat transfer. Multiple effect evaporation. Design of heat exchange equipment.
CHE 312	Mass Transfer and Separations	Diffusion. Mass transfer coefficients. Design of countercurrent separation systems, both stagewise and continuous. Distillation, absorption, extraction. Multicomponent separations. Batch processes. Computer-aided design methods.
CHE 316	Laboratory Practice and Statistical Analysis	Practical experience with unit operations equipment, including separations processes, reactor systems, and chemical processes requiring analysis of heat, mass and momentum transport. Laboratory assignments requiring teamwork. Engineering statistics with focus on model building, experimental design, and statistical quality control.
CHE 321	Thermodynamics for Chemical Engineering	First and second laws. Thermodynamics of flow and energy conversion processes. Properties of single and multi-component systems. Phase equilibria. Chemical equilibria in reacting systems.
CHE 431	Chemical Reaction Engineering	Design and analysis of homogeneous flow and batch reactors. Chemical kinetics and equilibria. Reaction rate expressions from mechanisms and experimental data. Mass and heat transfer in heterogeneous reactors. Heterogeneous reactor design. Catalysis.
CHE 432	Process Analysis and Control	Modeling of process dynamics. Basics of control theory. Design of control systems and specification of control strategies. Integration of control theory with modern practice.
CHE 433	Process Design and Optimization I	Applications of chemical engineering principles in design calculations. Selection of optimum design. Influence of design on capital investment, operating cost, product loss and quality. Mathematical programming methods for optimization.
CHE 434	Process Design and Optimization II	Design project requiring an integrated design of chemical engineering processes. Process and project engineering. Instrumentation and control systems. Flowsheet layout and optimization. Process simulation.

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CHE 468	Biomass Conversion Engineering	Physicochemical and biological pretreatment. Biomass conversion to alcohols, biodiesel, bio-oil, syngas, and other value-added products using advanced biological, chemical, and thermochemical treatments.
CHE 469	Sustainable Bioenergy Systems	Biorefinery analysis and system design. Life cycle assessment to evaluate sustainability of bioenergy systems. Current policy regulating the bioeconomy and system economics. Product commercialization.
CHE 472	Composite Materials Processing	Manufacturing processes for thermoset and thermoplastic matrix composites. Mechanical and thermal evaluation of composites. Rheology and molding of fiber-filled materials.
CHE 473	Chemical Engineering Principles in Polymers and Materials Systems	Application of chemical engineering principles to polymer and materials systems. Structures and properties of metals, ceramics and polymers. Thermodynamics, synthesis, rubber elasticity, viscoelasticity, kinetics, rheology, and processing of polymers systems. Application of statistics and problem-solving skills to materials systems.
CHE 481	Biochemical Engineering	Applications of microbiology and biochemistry to biochemical engineering. Kinetics and thermodynamics of biochemical reactors. Transport phenomena in biological systems. Bioreactor design and scale-up.
CHE 482	Science and Technology of Wine Production	Origin and history of wine and wine production. Determination and timing of harvest, methods of postharvest handling, storage, and processing of grapes into juice and wine. Physical and chemical changes in wine and processes. Analysis of must and its adjustment, fermentation, fining, and aging. Physiology of yeasts and bacteria involved in winemaking and spoilage. Cellar practices, problems, and operations.
CHE 483	Brewing and Distilled Beverage Technology	Raw materials for fermentation and basics of alcohol fermentation, beer and cider production; basics of distillation; brandy and eau de vie production; whiskey production; vodka, gin and flavored spirits production; flavor chemistry

Computational Mathematics, Science and Engineering - CMSE

CMSE 201	Introduction to Computational Modeling	Computational modeling using a wide variety of applications examples. Algorithmic thinking, dataset manipulation, model building, data visualization, and numerical methods all implemented as programs.
CMSE 202	Computational Modeling Tools and Techniques	Continuation of introduction to computational modeling focusing on standard methods and tools used for modeling and data analysis. Topics may include statistical analysis, symbolic math, linear algebra, simulation techniques, data mining.
CMSE 401	Methods for Parallel Computing	Core principles, techniques, and use of parallel computation using modern supercomputers. Parallel architectures and programming models. Message-passing and threaded programming. Principles of parallel algorithm design. Performance analysis and optimization.
CMSE 402	Visualization of Scientific Datasets	Core principles, methods, and techniques of effective data visualization. Visualization toolkits. Vector and scalar data. Multivariate visualization. Relationship between data analysis and visualization.

Communicative Sciences and Disorders - CSD

CSD 213	Anatomy and Physiology of the Speech and Hearing Mechanisms	Structural and functional analyses of the central and peripheral auditory mechanisms, and of the respiratory, phonatory, and articulatory mechanisms for speech.
CSD 313	Speech Science	Processes underlying the production and perception of speech.

Computer Science and Engineering - CSE

CSE 101	Computing Concepts and Competencies	Core concepts in computing including information storage, retrieval, management, and representation. Applications from specific disciplines. Applying core concepts to design and implement solutions to various focal problems, using hardware, multimedia software, communication and networks.
CSE 131	Technical Computing and Problem Solving	Use of computing systems for technical problem solving in engineering and science.

Courses used to meet University requirements cannot be used to meet this requirement.

CSE 201	Fundamentals of Information Technology	Digital representation of objects such as numbers, signals, and 3-dimensional shapes. Algorithms that operate on digital objects. Computer communications and the Internet. Computer security and web services.
CSE 220	Programming in C	Basics of programming in C. Data types, operators, control, functions, arrays, pointers, file processing, testing and debugging.
CSE 231	Introduction to Programming I	Introduction to programming using Python. Design, implementation and testing of programs to solve problems such as those in engineering, mathematics and science. Programming fundamentals, functions, objects, and use of libraries of functions.
CSE 232	Introduction to Programming II	Continuation of object-centered design and implementation in C++. Building programs from modules. Data abstraction and classes to implement abstract data types. Static and dynamic memory allocation. Data structure implementation and algorithm efficiency. Lists, tables, stacks, and queues. Templates and generic programming.
CSE 251	Programming in C	Programming in the C language. Data and control. Compiling and linking.
CSE 260	Discrete Structures in Computer Science	Propositional and first order logic. Equivalence and methods of proof. Basics of counting. Set operations, relations, functions. Grammars and finite state automata. Discrete probability. Applications to computer science and engineering.
CSE 320	Computer Organization and Architecture	Boolean algebra and digital logic. Combinational and sequential circuits. Representations of data and instructions. Architecture and major components of computer systems. Assembly language programming and interfacing to high level languages. Assembler and linker processing.
CSE 331	Algorithms and Data Structures	Linear data structures, trees, graphs and algorithms which operate on them. Fundamental algorithms for searching, sorting, string matching, graph problems. Design and analysis of algorithms.
CSE 335	Object-oriented Software Design	Development of large software products, libraries, and product families. Object-oriented programming using inheritance and polymorphism. Design methods. Specification and the use of contracts to design reliable software. Configuration management and life-cycle issues.
CSE 402	Biometrics and Pattern Recognition	Automated techniques used for feature extraction and pattern matching focusing on face, fingerprint and iris recognition.
CSE 410	Operating Systems	Principles and evolution of operating systems. Process and processor management. Concurrent processes and threads. Primary and secondary storage management. Case studies of modern operating systems.
CSE 415	Introduction to Parallel Computing	Core principles and techniques of parallel computing. Parallel architectures. Parallel programming models. Principles of parallel algorithm design. Performance analysis and optimization. Use of parallel computers.
CSE 420	Computer Architecture	Organization and architecture of computer systems. Arithmetic Logic Unit and control unit implementations. Hardwired and microprogrammed control. Pipelined processors; data and branch hazards. Memory hierarchy and storage devices. Input-output and peripheral devices. Advanced architectures.
CSE 422	Computer Networks	Computer network architectures and models. Physical media and signaling. Data link protocols. Medium access control. Routing and IP. Transport services including TCP/UDP. Network applications. Local-area and wide-area networks.
CSE 425	Introduction to Computer Security	Theory and practice of security engineering. Security protocols. Cryptography and cryptanalysis. Smartcards. Network security and intrusion detection. Common system attacks.
CSE 431	Algorithm Engineering	Algorithm analysis, design, implementation, and optimization for a broad range of problem categories including techniques to recognize and cope with intractable problems.
CSE 435	Software Engineering	Software lifecycle including specification, design, coding, testing, and verification of a software product. Stepwise refinement and traceability. Software maintenance and documentation.
CSE 440	Introduction to Artificial Intelligence	Fundamental issues in intelligent systems. Knowledge representation and mechanisms of reasoning. Search and constraint satisfaction. Agents. Application areas of AI and current topics.
CSE 444	Information Technology Project Management	Practical training and experiences in design, testing, and launch of new information technologies and systems.
CSE 450	Translation of Programming Languages	Theory and practice of programming language translation. Languages, grammars and parsing. Lexical, syntactic and semantic analysis. Compile-time error handling. Code optimization and code generation.
CSE 460	Computability and Formal Language Theory	Formal models of computation such as finite state automata, pushdown automata and Turing machines. Formal definitions of languages, problems, and language classes including recursive, recursively enumerable, regular, and context free languages. The relationships among various models of computation, language classes, and problems. Church's thesis and the limits of computability. Proofs of program properties including correctness.

Courses used to meet University requirements cannot be used to meet this requirement.

CSE 471	Media Processing and Multimedia Computing	Basic operations for processing images, video, and audio. Devices for input and output. Data formats and compression. Tools for processing images and sound. Multimedia authoring tools. Applications.
CSE 472	Computer Graphics	Graphics systems. Two- and three-dimensional imaging geometry and transformations. Curve and surface design. Rendering, shading, color, and animation. Graphics programming.
CSE 473	Fundamentals of 3D Game Development	Fundamental algorithms and techniques for 3D computer game development including geometric transformations, procedural and keyframe animation, models and scene graphs, skeletal animation and skinned characters, illuminations and shading, collision detection, and level of detail.
CSE 476	Mobile Application Development	Software development techniques for mobile devices such as smart phones and tablet computers.
CSE 477	Web Application Architecture and Development	Fundamentals of World Wide Web (WWW) programming, including protocols, client-server interaction, markup languages, client- and server-side programming, databases, and remote procedure calls. Development of a WWW server and WWW sites with browser-based interfaces to remote databases. Students will incorporate scaling, throughput, and latency considerations in the development of widely-distributed systems.
CSE 480	Database Systems	Storage of and access to physical databases including indexing, hashing, and range accesses. Relational data models, database design principles, query languages, query optimization, transaction processing and recovery techniques. Object-oriented and distributed databases.
CSE 482	Big Data Analysis	Data collection, storage, and preprocessing, and analysis techniques. Programming for large-scale data analysis. Case studies and applications.
CSE 484	Information Retrieval	Retrieval models including Boolean, vector space, and probabilistic models. Architecture of information retrieval systems. Text clustering, categorization and filtering. Recommendation systems. Natural language processing for text retrieval. Information extraction, question answering. Multimedia retrieval. Digital libraries.
CSE 498	Collaborative Design (W)	Development of a comprehensive software and/or hardware solution to a problem in a team setting with emphasis on working with a client. Participation in a design cycle including specification, design, implementation, testing, maintenance, and documentation. Issues of professionalism, ethics, and communication.

Crop and Soil Sciences - CSS

CSS 101	Introduction to Crop Science	Principles of crop production including integrated crop management. Sustainable agriculture. International agriculture. Environmental challenges to crop production.
CSS 210	Fundamentals of Soil Science	Agricultural and natural resource ecosystems: soil, vegetation, and ground water components. Energy, water, and nutrient cycles. Soil classification and mapping. Land management and use issues.

Community Sustainability – CSUS

CSUS 200	Introduction to Sustainability	Introduction to sustainability and personal role in sustainability initiatives. Implications of individual actions for key sustainability challenges. Application of sustainability principles and leadership skills in community.
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Electrical and Computer Engineering - ECE

ECE 101	Introduction to Electrical and Computer Engineering	Basic stamp microcontroller. Passive circuit elements. Sensors. Boe-bot and Sumo-bot. Survey of electrical and computer engineering careers. Resume preparation. Design day competition.
ECE 201	Circuits and Systems I	Resistive circuits. Loop and modal analysis. Network theorems, dependent sources. Capacitor and inductor circuits. Transient analysis. Introduction to computer-aided design.
ECE 202	Circuits and Systems II	Sinusoidal steady-state response. Laplace transforms. S-Domain circuit analysis. Frequency response. Fourier series. Mutual inductance. Power in sinusoidal steady state.
ECE 203	Electric Circuits and Systems Laboratory	Electrical test equipment and measurement fundamentals. Circuit and filter design using integrated circuit amplifiers.

Courses used to meet University requirements cannot be used to meet this requirement.

ECE 230	Digital Logic Fundamentals	Binary information. Switching algebra, combinational logic, minimization. Programmable logic devices. Sequential system fundamentals and state machines. Arithmetic operations and circuits. Memory elements and systems. Design tools. Design problems.
ECE 280	Electrical Engineering Analysis	Application of linear algebra, vectors, probability, and random processes to elementary problems in electrical and computer engineering. Application to signals, systems, noise, electromagnetics, and reliability. Modeling using standard software packages.
ECE 302	Electronic Circuits	Volt-ampere characteristics of diodes and transistors. Modeling using SPICE software. Differential, multistage, and integrated circuit amplifiers. High frequency effects.
ECE 303	Electronics Laboratory	Electronic test equipment and measurement fundamentals. Circuit design using diodes, transistors, integrated circuits, and sensors.
ECE 305	Electromagnetic Fields and Waves I	Transient and time-harmonic transmission lines. Smith charts. Two-port networks. Maxwell's equations. Force, energy, and power. Plane electromagnetic waves. Guided waves.
ECE 313	Control Systems	Analysis and design of control systems using transfer functions and state variable methods.
ECE 320	Energy Conversion and Power Electronics	Power and energy. Magnetics and transformers. Elementary and induction machines. Power semiconductors. Controlled rectifiers and inverters. Power supplies and motor drives.
ECE 331	Microprocessors and Digital Systems	Microcomputers. Microprocessor architecture. Addressing modes. Assembly language programming. Parallel and serial input and output. Interfacing. Interrupts. Peripheral device controllers. Applications and design.
ECE 345	Electronic Instrumentation and Systems	Electrical and electronic components, circuits and instruments. Circuit laws and applications, frequency response, operational amplifiers, semi-conductor devices, digital logic, counting circuits.
ECE 366	Introduction to Signal Processing	Continuous- and discrete-time signal analysis fundamental to modern signal processing and communications technologies. Fourier and spectral analysis of signals. Elementary modulation techniques. Filtering and channel models. The z-transform. Introduction to random processes and noise in discrete time. Application examples.
ECE 402	Applications of Analog Integrated Circuits	Circuit design using analog integrated circuits. SPICE macromodeling. Operational amplifiers, comparators, timers, regulators, multipliers and converters. Design project with hardware and software verification.
ECE 404	Radio Frequency Electronic Circuits	Radio frequency active and passive circuit design. Impedance matching for specific bandwidths. Tuned amplifier, filter, mixer, and oscillator analysis. High frequency measurements and equipment.
ECE 405	Electromagnetic Fields and Waves II	Microwave networks. Scattering parameters. Solutions to Coulomb's law, Gauss' Law and the wave equation. Planar transmission lines. Antennas. Waveguides and cavities. Measurement of the properties of antennas and microwave networks.
ECE 407	Electromagnetic Compatibility	Electromagnetics for electrical systems. Signals and spectra. Regulations. Radiated and conducted emissions. Conducted and radiated immunity. Mitigation techniques.
ECE 410	VLSI Design	Digital integrated circuit design fundamentals. Design specifications: functionality, performance, reliability, manufacturability, testability, cost. Standards, silicon compilers, foundries. Design layout rules, rule checking. Circuit extraction, simulation, verification. Team-based design.
ECE 411	Electronic Design Automation	Electronic circuit design hierarchy and the role of methodology. Application specific integrated circuits. Hardware description languages. Behavioral and structural circuit modeling. Design algorithms and design tools. Design projects.
ECE 412	Introduction to Mixed-Signal Circuit Design	Mixed-signal circuit design. Analog and digital very large scale integration (VLSI). Design and analysis of switched capacitor circuits. Design and analysis of digital-to-analog converters of analog-to-digital converters. Performance analysis and testing of data converters.
ECE 415	Computer Aided Manufacturing	CAD/CAM fundamentals, programmable controllers, numerical control, NC part programming, sensors, data acquisition systems.
ECE 416	Digital Control	State-space models. Analysis and design of control systems using state models. Digital control. Discrete-models of sampled-data systems. Quantization effects and sample-rate selection. System identification. Simulation of nonlinear control systems. Examples of nonlinear phenomena. State of the art of control engineering. Control laboratory.
ECE 420	Machines and Power Laboratory	Experimental investigation of machines, power electronics and power systems. Experimental verification of material found in introductory courses on energy conversion with extension to power electronics and power systems.
ECE 423	Power System Analysis	Synchronous machines. Models and measurements of power components. Symmetrical components. Short-circuit analysis and equipment protection. Load flow. Voltage and frequency control. Operation and planning of power systems.

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ECE 425	Solid State Power Conversion	Power converter topologies:DC/DC converters, DC/AC inverters, AC/DC rectifiers, AC/AC converters. Semiconductor switching devices. Modeling and control of power converters: steady-state analysis, state space averaging, small-signal model, closed-loop control, simulation. Application of power converters in motor drives and renewable power generation.
ECE 442	Introduction to Communication Networks	Fundamental theories of communication networks with emphasis on statistical performance modeling of Medium Access Control, Data Link Control, Routing and Transport Layer protocols. Network design and analysis using basic probabilistic and statistical tools, including Little's formula, Markov Chain, and introductory queuing theory. Discrete event simulation projects.
ECE 445	Biomedical Instrumentation	Fundamentals of biomedical measurements. Sensors. Instrumentation electronics. Biomedical devices, applications and case studies. Commercialization of biomedical technology. Hands-on experience with sensors, instrumentation electronics, and biomedical devices.
ECE 446	Biomedical Signal Processing	Deterministic and random digital signal processing theory in the context of biomedical applications with computer projects on the analysis of real physiologic signals.
ECE 447	Introduction to Biomedical Imaging	Fundamental mathematics, physics, engineering principles, and applications of biomedical imaging techniques including ultrasound, x-ray imaging, computed tomography, nuclear medicine, including PET and SPECT, and magnetic resonance imaging.
ECE 448	Modeling and Analysis of Bioelectrical Systems	Principles of biophysics and electrophysiology, ionic basis of neuronal excitability, introduction to computational models of signal generation and propagation in the nervous system, applications to neural systems and neuroprosthetics.
ECE 449	Fundamentals of Acoustics	Development of the fundamental theoretical concepts of acoustical systems,including plane and spherical waves, radiation, diffraction, and absorption.
ECE 456	Introduction to Communication and Network Security	Security primitives, major network security protocols and applications, system security practices, wireless security physical-layer built-in security, secure multiple-party computing, privacy-preserving computation.
ECE 457	Communication Systems	Representation and processing of signals in the presence of noise. System performance. Modulation, detection, and coding of information. System design applications in radar, sonar, radio, television, satellite communications, digital telephony, and wireless systems.
ECE 458	Communication Systems Laboratory	A projects laboratory in communication systems.
ECE 466	Digital Signal Processing and Filter Design	Discrete Fourier transforms, sampling theorem, circular convolution, Z-transforms. Design of infinite impulse resistance filters using prototypes and algorithmic methods. Design of finite impulse resistance filters by windowing, frequency sampling.
ECE 474	Principles of Electronic Devices	Energy levels in atoms. Crystal properties, energy bands and charge carriers, semiconductors, transport properties of bulk materials. P-n junction diodes, bipolar transistors, field effect transistors.
ECE 476	Electro-Optics	Operational theory, characteristics and applications of optical components, light emitting diodes, lasers, laser diodes, photodetectors, photovoltaics, fiber optics, optical modulators and non-linear optical devices.
ECE 477	Microelectronic Fabrication	Microelectronic processing fundamentals and simulations. Comparison of current microfabrication technologies and their limitations.
ECE 480	Senior Design	Electrical engineering and computer engineering senior design experience involving contemporary design tools and practices, engineering standards, cross-functional teaming, oral and written technical communication, and lifelong learning.

Engineering - EGR		
EGR 100	Introduction to Engineering Design	Engineering design process as modeled by team-based, interdisciplinary design projects. Roles of engineers and the contributions of engineering in society. Project management, creativity and design of products and processes to specified outcomes under specified constraints. Introduction to computing tools and physical equipment in support of engineering design. Engineering ethics. Oral and written technical communications.
EGR 102	Introduction to Engineering Modeling	Application of systematic approaches to engineering problems. Problem decomposition and identification of a solution approach. Solution using tools such as advanced spreadsheet features and MATLAB. Data representation, curve fitting and analysis. Mathematical modeling of engineering systems. Application of principles through team-based engineering projects.
EGR 192	Environmental Issues Seminar	Environmental issues and problems explored from a variety of perspectives, including legal, scientific, historical, political, socio-economic, and technical points of view.

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EGR 292	Applications in Environmental Studies	Community engagement project. Projects vary depending on student's major and area of environmental interest.
EGR 393	Engineering Cooperative Education	Pre-professional educational employment experiences in industry and government related to student's major. Educational employment assignment approved by College of Engineering.
EGR 480	Information and Communication Technologies and Development	Role of information and communications technologies (ICT) in low income countries and in disadvantaged areas in middle and high income countries. Theories and case studies that link ICT and social, political, economic and environmental change.
EGR 488	Information and Communication Technology Development Project (W)	Challenges and opportunities of implementing an information and communication technology in a developing country or underprivileged region of the United States. Hands-on experience conducting field work on location.

Environmental Engineering - ENE

ENE 280	Principles of Environmental Engineering and Science	Physical, chemical and biological processes related to environmental science and engineering. Environmental systems analysis with application to air, water and soil. Analysis of environmental problems and development of engineering solutions.
ENE 421	Engineering Hydrology	Hydrologic design of storm water systems. Equilibrium hydrograph analysis, unit hydrographs, infiltration, hydrograph synthesis, and reservoir routing. Groundwater: Darcy's law, flow nets, well hydraulics, design of capture wells.
ENE 422	Applied Hydraulics	Fundamentals of open-channel flow. Rapidly and gradually varied nonuniform flow analysis. Confined flows past submerged bodies, in pipe networks, and in turbo machinery. Design applications.
ENE 480	Environmental Measurements Laboratory	Basic chemical and microbiological methods used in the analysis of environmental media. Laboratory safety, quality assurance, quality control, and statistics used in laboratory analysis. Related technical communication, laboratory report writing.
ENE 481	Environmental Chemistry: Equilibrium Concepts	Chemistry of natural environmental systems and pollutants. Equilibrium concepts and calculations for acid-base, solubility, complexation, redox and phase partitioning reactions and processes. Applications to ecosystem analysis, pollutant fate and transport, and environmental protection.
ENE 483	Water and Wastewater Engineering	Engineering and scientific basis and design of physical, chemical and biological methods for the treatment of drinking water and wastewater. Operation process selection and design.
ENE 485	Landfill Design	Geotechnical and environmental design of solid waste landfills.
ENE 487	Microbiology for Environmental Science and Engineering	Fundamentals of microbiology. Application of these concepts to environmental processes such as wastewater treatment, human health and bioremediation.
ENE 489	Air Pollution: Science and Engineering	Basic physical and chemical principles governing indoor and atmospheric air pollution. Elements of air pollution meteorology, climate change, atmospheric transformations and transport. Air pollution sources and methods for their control. The role of local, state and federal government in air pollution control.

Entomology - ENT

ENT 110	Applied Entomology of Economic Plants	Arthropod pests of horticultural plants and turf grasses. Groups and species of economic importance to Michigan.
ENT 111	Basics of Applied Entomology	Basic insect biology, principles of integrated pest management, and the major pests of field crops, woody ornamentals, other perennials, turf, and commercial greenhouses.
ENT 205	Pests, Society and Environment	Nature of pests and their impact on society. Principles of integrated pest management in relation to environmental quality and sustainable development.
ENT 319	Introduction to Earth System Science	Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.
ENT 364	Turfgrass Entomology	Life history, identification, and collection of turfgrass insects. Cultural biological and insecticide control. Principles of pest management.

Courses used to meet University requirements cannot be used to meet this requirement.

ENT 404	Fundamentals of Entomology	Insect classification, identification, diversity, physiology and ecology. Importance of insects to humans and the environment. Insect collection required.
ENT 407	Diseases and Insects of Forest and Shade Trees	Diseases, insects, and environmental problems affecting trees in forests, parks, suburbs, and nurseries. Methods of control.
ENT 410	Apiculture and Pollination	Biology of bees and their relationship to flowers, pollination and crop production. Offered first ten weeks of semester. Laboratory sessions at MSU apiary.
ENT 422	Aquatic Entomology	Biology, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.
ENT 460	Medical Entomology	Transmission and management of infectious diseases involving insects and acarines.
ENT 461	Field Ecology of Disease Vectors	Collection and identification of arthropod vectors of human and animal diseases in Michigan. Assays for associated pathogens. Integration of disease ecology and public health responses to vector-borne disease
ENT 469	Biomonitoring of Streams and Rivers	Practical field and lab rapid bioassessment methodologies used to sample and assess the biota of streams and rivers. Sampling and identification of fish, macroinvertebrates and other biota.
ENT 477	Pesticides in Pest Management	Chemistry, modes of action, product development and regulation of pesticides. Environmental and social aspects of pesticide use.
ENT 479	Organic Pest Management (W)	Theory, philosophy and application of organic pest management systems.

Epidemiology - EPI

EPI 280	Applied Analytic Methods in Health Studies I	Introduction to conceptual and analytical methods used in Public Health and Epidemiology. Programming, statistical techniques, and interpretation of health data.
EPI 380	Applied Analytic Methods in Health Studies II	Topics in conceptual and analytical methods used in Public Health and Epidemiology. Continuation of EPI 280.
EPI 390	Disease in Society: Introduction to Epidemiology and Public Health	Human epidemiology and population health issues facing contemporary society. Developed and less-developed settings. Health-related information in the mass media and scholarly publications.
EPI 465	Bayesian Statistical Methods	Probability, belief, and exchangeability. Objective, subjective, and empirical Bayes approaches. Applications to one-parameter models, linear regression models, and multivariate normal models. Hierarchical modeling. Computational methods.
EIPI 490	Advanced Topics/Methods in Global Public Health and Epidemiology	Conceptual and analytical methods used in public health and epidemiology.

Geography, Environment, and Spatial Science - GEO

GEO 201	Introduction to Plant Geography	Geographic distribution and characteristics of plants throughout the world; relationships between biomes and aspects of the physical environment (climate, soils, landforms, disturbance); plant ecology; human impacts on vegetation; optional field trip on campus.
GEO 203	Introduction to Meteorology	Fundamentals of meteorology. Energy balance, adiabatic processes, horizontal motion, cyclogenesis, and severe weather.
GEO 206	Physical Geography	Geographic and functional interrelationships within the physical environment: Earth-sun relationships, weather, climate, soils, vegetation and landforms (terrain characteristics).
GEO 206L	Physical Geography Laboratory	Geographic aspects of weather, climate, soil, vegetation, and terrain. Interpretation and application of maps and remotely sensed imagery.
GEO 221	Introduction to Geographic Information	Principles and methods of spatial data collection, handling, analysis, and display. Introduction to remote sensing, geographic information systems, and cartography.

Courses used to meet University requirements cannot be used to meet this requirement.

GEO 221L	Introduction to Geographic Information Laboratory	Basic skills for working with Geographic Information Systems, remotely sensed imagery, design of maps, geospatial tools and technologies for data analysis and problem-solving.
GEO 302	Climates of the World	Regional climates and underlying atmospheric circulation patterns. Climate classification, physical climatic processes, spatial and temporal aspects of climate, climate changes. Sources and use of climate data.
GEO 303	Severe and Hazardous Weather	Extratropical cyclones, freezing precipitation and ice storms, lake effect snowstorms, cold waves, blizzards, thunderstorms, tornadoes, downbursts, tropical cyclones, floods, drought, and heat waves.
GEO 306	Environmental Geomorphology	Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.
GEO 324	Remote Sensing of the Environment	Features and interpretation methods of remotely-sensed imagery, especially black-and-white and color infrared airphotos. Basic features of radar, thermal, and multispectral imagery. Interpretation for agriculture, archaeology, fisheries, forestry, geography, landscape architecture, planning, and wildlife management.
GEO 325	Geographic Information Systems	Technical and theoretical issues in the design, implementation, and use of geographic information systems for research and applications.
GEO 401	Global Plant Geography	Patterns of global plant distributions. Plant-atmosphere interactions, ecological processes, biogeographic patterns and predictive models of plant distributions.
GEO 402	Agricultural Climatology	Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.
GEO 403	Dynamic Meteorology (W)	Principles of fluid dynamics and their application to the atmosphere.
GEO 405	Weather Analysis and Forecasting	Dynamic and thermodynamic principles of atmospheric science applied to the development and evolution of extratropical cyclones. Laboratory sessions include analysis of current observations and satellite imagery.
GEO 411	Stream Systems and Landforms	Themes associated with stream systems. Evolution of drainage basins and channel hydrology. The nature of flowing water, stream discharge, and flooding. Controls of stream behavior. Channel patterns and landform development. Character of Michigan stream systems. Field project.
GEO 424	Advanced Remote Sensing	Interaction of solar radiation with the atmosphere, lithosphere, hydrosphere, and biosphere. Introductory digital image processing. Earth-resources satellite sensors, data products, and applications. Radar and thermal remote sensing.
GEO 425	Problems in Geographic Information Science (W)	Advanced theoretical and technical issues in geographic information science utilizing a problems oriented approach. Development and implementation of geographic information science solutions and formal documentation of work.

Geological Sciences - GLG		
GLG 201	The Dynamic Earth	Physical and chemical processes related to the past, present and future behavior of the earth system, and the energy systems that drive these processes. A study of the earth's materials, the earth's surface and the earth's interior.
GLG 202	Geology of Michigan	Integration of the geological evolution of Michigan with its social and economic development. Field trips are required.
GLG 301	Geology of the Great Lakes Region	Geological, physical and chemical processes related to the origin and evolution of the Earth, North American continent, and the Great Lakes environment. Soils, hydrology, Earth structure and materials, geologic hazards.
GLG 303	Oceanography	Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.
GLG 304	Physical and Biological History of the Earth	Origin of the Earth. Differentiation of the Earth's core, mantle, and crust. Lithospheric tectonics over geologic time. Origin and evolution of the Earth's hydrosphere, atmosphere and climate. Origin and evolutionary history of biological life. Interactions of life with the Earth's endogenic and exogenic systems.
GLG 306	Environmental Geomorphology	Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

Courses used to meet University requirements cannot be used to meet this requirement.

GLG 319	Introduction to Earth System Science	Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.
GLG 321	Mineralogy and Geochemistry	Earth materials and their origin, modification, structure, dynamics and history. Crystallography and crystal chemistry, and geochemical properties and processes in mineral crystallization and recrystallization. Analytical identification and characterization of minerals in their lithologic context.
GLG 361	Igneous and Metamorphic Geochemistry and Petrology	Evolution, origin, occurrence and tectonic setting of igneous and metamorphic rocks. Phase relations of igneous and metamorphic systems. Studies of rocks in thin sections.
GLG 401	Global Tectonics and Earth Structure (W)	Structural geology, geological and geophysical methods of studying the structure and dynamics of the earth and planets. Plate kinematics and global geodynamic processes, plate margin processes and evolution, marine geology.
GLG 411	Hydrogeology	Source, occurrence, and movement of groundwater emphasizing geologic factors and controls.
GLG 412	Glacial Geology and the Record of Climate Change	In-depth analysis of glacial geology and the record of climate change, with emphasis on North America and Europe.
GLG 421	Environmental Geochemistry	Natural and anthropogenic processes affecting the chemistry of the environment with an emphasis on the water cycle. Equilibria and kinetic balances, biogeochemical cycling, contaminant chemicals, chemical origins, environmental health.
GLG 431	Sedimentology and Stratigraphy	Sediments, sedimentary rocks, sedimentary processes, and depositional environments through geologic time. Facies event correlation. Fossils as tools in stratigraphy and environmental analysis. Biostratigraphy, paleoecology and taphonomy.
GLG 433	Vertebrate Paleontology	Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.
GLG 434	Evolutionary Paleobiology	Patterns and processes of evolution known from the fossil record
GLG 435	Geomicrobiology	Geological and microbiological perspectives on microbial activities in diverse environmental settings, including geological change mediated by microorganisms, microbial evolution driven by geologically diverse habitats, including the evolution of life on Earth, the search for life on other planets, the study of life in extreme environments, and industrial applications of geomicrobiology.
GLG 440	Planetary Geology	Surficial and internal properties and processes of planets and their natural satellites, asteroids, comets, and meteorites. Origin, composition, structure, tectonics, volcanism, impact phenomena, atmospheric evolution, atmosphere-surface interactions, and history of solar system bodies. Results of recent space exploration programs, projects and missions.
GLG 446	Ecosystems Modeling, Water and Food Security	Impacts of climate variability and change on water availability, food security and global environmental change. Integrated models to identify adaption and mitigation strategies to such changes and to enhance the efficiency of natural resources use.
GLG 470	Solid Earth Geophysics and Geodynamics	Theory and applications of solid-earth geophysics including geochronology, geothermics, geomagnetism and paleomagnetism, geodesy and gravity, rheology, and seismology.
GLG 471	Applied Geophysics	Application of seismic, gravity, magnetic, resistivity, and electromagnetic methods to problems related to engineering studies, mineral and oil exploration, groundwater, subsurface mapping, pollution, and hazardous waste.
GLG 481	Reservoirs and Aquifers	Principles of the origin and evolution of porous media. Porosity and permeability of sediments and sedimentary rocks. Computing techniques for evaluating reservoirs and aquifers.
GLG 491	Field Geology - Summer Camp (W)	Field analysis of rock types: igneous, metamorphic, sedimentary. Structural analysis. Preparation of stratigraphic sections, geologic maps and cross sections. Air photo analysis.
GLG 493	Field Studies in Geological Sciences	Field experiences in solid earth and environmental geosciences within the US and abroad.
GLG 498	Topics in Geological Sciences	Selected topics in geological and geoenvironmental sciences supplementing or expanding specific topics, or examining topics not covered in regular courses.

Courses used to meet University requirements cannot be used to meet this requirement.

Human Nutrition and Foods - HNF		
HNF 150	Introduction to Human Nutrition	Nutrient function and metabolism. Food and nutrients in health and disease. Socioeconomic and environmental influences on food and health. Incorporation of healthy food choices into daily living.
HNF 375	Community Nutrition	Guidelines for dietary and anthropometric components of nutritional status, including health surveys. Agencies and programs that address food and nutritional needs of target populations throughout the life cycle.
HNF 385	Public Health Nutrition	Nutrition from a public health perspective. Overview of public health research, evidence-based recommendations and epidemiology. Diet and nutrition assessment. Ethical issues surrounding public health nutrition recommendations.
HNF 456	Eating Disorders	Treatment and prevention of anorexia nervosa, bulimia nervosa, and other eating disorders.
HNF 457	Sports and Cardiovascular Nutrition	Nutrition for optimizing sport training, recovery, and performance; power, intermittent, and endurance sports. Role of nutrition, physical activity and exercise on cardiovascular and overall health.

History - HST		
HST 250	History and Technology of the Digital Age	Historical foundations of modern computing technology. Technological and functional underpinnings of computers and computer systems. Social dimensions of computing and computing technology, information technology, and communication technology.

Integrative Biology - IBIO		
IBIO 101	Exploring Biology	Biology as a discipline. Investigation of diverse career options and of skills and background knowledge required to be a modern biologist. Integration of human and technical skills in scientific scholarship and inquiry.
IBIO 150	Integrating Biology: From DNA to Populations	Examine biological systems across multiple levels of organization - spatial, temporal, taxonomic - using evolutionary biology as the common thread.
IBIO 162	Organismal and Population Biology	Biological diversity and organismal biology. Principles of evolution, transmission genetics, population biology, community structure, ecology.
IBIO 172	Organismal and Population Biology Laboratory	Nature and process of organismal biology including experimental design, statistical methods, hypothesis testing in genetics, ecology, and evolution.
IBIO 182H	Honors Organismal and Population Biology	Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.
IBIO 192H	Honors Organismal and Population Biology Laboratory	Nature and process of organismal biology, including experimental design and statistical methods, hypothesis testing, genetics, ecology, and evolution.
IBIO 300	Neurobiology	Structure and function of nerve cells and nervous systems.
IBIO 303	Oceanography	Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.
IBIO 306	Invertebrate Biology	Systematics, morphology, and natural history of invertebrate animals. Identification of live and preserved specimens. Recognition of selected groups.
IBIO 310	Psychology and Biology of Human Sexuality	Sexual behavior from biological, psychological and neuroscience perspectives. Sexual differentiation of the body. Role of hormones in development and reproduction in humans and other animals. Human sexual orientation. Fertility and contraception. Sexual disorders. Sexually transmitted diseases.
IBIO 313	Animal Behavior	Development, physiological mediation, adaptive significance and evolution of behavior.
IBIO 316	General Parasitology	Identification, life history, host-parasite relationships, and epidemiology of protozoan, helminth, acanthocephalan, copepod, and arthropod parasites of animals and humans.

Courses used to meet University requirements cannot be used to meet this requirement.

IBIO 319	Introduction to Earth System Science	Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.
IBIO 320	Developmental Biology	Principles of development, emphasizing vertebrates. Illustrations from morphological and experimental investigations.
IBIO 328	Comparative Anatomy and Biology of Vertebrates	Comparative morphology, evolution and biodiversity of vertebrates. Dissection of representatives of most vertebrate classes.
IBIO 341	Fundamental Genetics	Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.
IBIO 343	Genetics Laboratory	Experiments involving genetics of <i>Drosophila</i> and other eucaryotic organisms.
IBIO 353	Marine Biology (W)	Analysis of marine and estuarine systems. Integration of biology, chemistry, and physics. Life histories of marine organisms. Biology of special marine habitats including rocky intertidal zones, upwellings, coral reefs and deep sea.
IBIO 355	Ecology	Interrelationships of plants and animals with each other and the environment. Principles of individual, population, community, and ecosystem ecology. Application of ecological principles to global change and other anthropogenic stressors.
IBIO 355L	Ecology Laboratory (W)	Population, community, and ecosystem ecology, utilizing plant and animal examples to demonstrate general field principles.
IBIO 357	Global Change Biology (W)	Causes and consequences of modes of contemporary global change that are caused by biological systems or impact biological systems. Theories, evidence, and predictions in global warming, ocean acidification, desertification, eutrophication, food security, and mass extinction.
IBIO 360	Biology of Birds	Behavior, ecology, evolution, and systematics of birds; biodiversity. Laboratories emphasize diversity of form and function, life history patterns, and identification.
IBIO 365	Biology of Mammals	Analysis of the behavior, ecology, evolution, and systematics of mammals. Laboratories emphasize diversity of form and function, life history patterns, and identification.
IBIO 368	Zoo Animal Biology and Conservation	Captive animal biology including illustrated examples of care, behavioral welfare and conservation work.
IBIO 369	Introduction to Zoo and Aquarium Science	Fundamentals of zoo and aquarium operations including research, interpretation, design, nutrition, captive breeding, conservation, ethics and management.
IBIO 370	Introduction to Zoogeography	Patterns of geographical distribution of animals and the ecological and historical processes leading to these patterns.
IBIO 384	Biology of Amphibians and Reptiles (W)	The evolution, systematics, ecology, and behavior of amphibians and reptiles. Laboratory emphasizes diversity and identification of families and Great Lakes species. Field trips may be required.
IBIO 390	Practicum in Zoo/Aquarium Careers	Practical application of science, business and education methods through typical workdays with zoo professionals.
IBIO 403	Integrative Neurobiology	How the nervous system has evolved mechanisms to determine the location and significance of physical and social sensory information. Epigenetic factors that guide nervous system development.
IBIO 405	Neural Basis of Animal Behavior	Structure and function of neurons and neural circuits underlying naturally-occurring animal behaviors.
IBIO 408	Histology	Structure of cells and their interactions to form tissues.
IBIO 413	Laboratory in Behavioral Neuroscience (W)	Theory and laboratory experience in the study of behavioral neuroscience. Relationship among hormones, brain, and behavior.
IBIO 415	Ecological Aspects of Animal Behavior (W)	Advanced topics in the ecology and evolution of animal behavior.
IBIO 416	Development of the Nervous System Through the Lifespan	Development of neurons and their connections, roles of both genetics and behavioral experience in shaping the mammalian nervous system.
IBIO 420	Stream Ecology	Biological and environmental factors determining structure and function of stream ecosystems.
IBIO 422	Aquatic Entomology	Biology, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.
IBIO 424	Algal Biology	Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats.
IBIO 425	Cells and Development (W)	The role of cells in growth, differentiation and development of animals from protozoa to mammals.

Courses used to meet University requirements cannot be used to meet this requirement.

IBIO 433	Vertebrate Paleontology	Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.
IBIO 434	Evolutionary Paleobiology	Patterns and processes of evolution known from the fossil record
IBIO 435	Ion Channels of Excitable Membranes	Introduction to ion channels and their critical role in normal physiological functioning, sensory and neuromuscular diseases and disorders, as well as targets of toxins and poisons.
IBIO 440	Field Ecology and Evolution	Solving conceptual and practical research problems in ecology and evolution under field conditions.
IBIO 443	Restoration Ecology	Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans.
IBIO 444	Conservation Biology	Ecological theories and methodologies to manage species, communities and genetic diversity on a local and global scale.
IBIO 445	Evolution (W)	Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.
IBIO 446	Environmental Issues and Public Policy	Interrelationship of science and public policy in resolving environmental issues. Technical, social, economic, and legal influences. Case study approach.
IBIO 450	Cancer Biology (W)	Cancer biology: cellular and molecular aspects. Applications of modern biotechnology to cancer research. Causes, treatment, and prevention of cancer. World distribution and risk factors of cancer.
IBIO 471	Ichthyology	Fish morphology and physiology. Development, behavior, evolution, and ecology. World fishes with emphasis on freshwater fishes.
IBIO 472	Limnology	Ecology of lakes with emphasis on interacting physical, chemical, and biological factors affecting their structure and function.
IBIO 474	Field and Laboratory Techniques for Aquatic Studies	Field and laboratory techniques for the investigation and analysis of lake and stream ecosystems and their biota.
IBIO 483	Environmental Physiology (W)	Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.
IBIO 485	Tropical Biology (W)	Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.
IBIO 489	Seminar in Zoo and Aquarium Science	Scientific writing and oral presentations related to zoo and aquarium studies.
IBIO 492	Interdisciplinary Studies in Conservation Medicine	Interdisciplinary studies focused on "health" as defined by the interactions of animal health, ecosystem health, and human health, viewed through the lens of human culture in an off-campus, multicultural setting.
IBIO 492L	Advanced Research Applications in Conservation Medicine	Field and laboratory techniques for assessing and monitoring biodiversity and health of humans, animals, and ecosystems in an off-campus, multicultural setting. Tools and techniques will be drawn from ecology, microbiology, molecular biology, genetics, histopathology, bioinformatics and statistics.
IBIO 493	International Communications in Conservation Medicine (W)	Development of communication skills (written and oral) to convey scientific information to scientists, health professionals, general public, and indigenous communities.
IBIO 495	Undergraduate Seminar	Economic, social and environmental impact of current developments in Zoology.

Kinesiology - KIN		
KIN 216	Applied Human Anatomy	Structural anatomy of the human body. Interrelationships of structure, function, and human movement.
KIN 217	Applied Human Anatomy Laboratory	Major bones, muscles, nerves, vessels, and organs of the human body. Articulations, muscle origins, muscle insertions, and prime moving actions.
KIN 330	Biomechanics of Physical Activity	Biomechanical analysis of human movement based upon musculoskeletal structure and function. Mechanical principles.

Courses used to meet University requirements cannot be used to meet this requirement.

Lyman Briggs - LB		
LB 117	Functions and Trigonometry	Rational and real numbers; functions and inverses. Equations and systems of equations. Inequalities; graphing; trigonometry; and coordinate geometry. Exponential and logarithmic functions.
LB 118	Calculus I	Limits, continuity, differentiation, integration, and elementary applications.
LB 119	Calculus II	Continuation of LB 118. Integration techniques, elementary differential equations, parametric curves, polar coordinates, sequences and series, vectors, and vector operations.
LB 144	Biology I: Organismal Biology	Modern biology at the organismal level of integration. Principles of genetics, evolution, ecology, and organismal diversity as interactive units.
LB 145	Biology II: Cellular and Molecular Biology	Modern biology, mainly at the cellular level of integration. Principles of cell structure and function used to explain processes of bioenergetics, protein synthesis, and development.
LB 155	Introduction to Quantitative Science and Research	Exploration of fundamental chemistry, biology, physics, mathematics and statistics. Quantitative analysis and research.
LB 171	Principles of Chemistry I	Stoichiometry, quantum mechanics and interactions of light with matter, periodic trends, Lewis dot structures, molecular structure, polarity and intermolecular forces, valence bond theory, introduction to organic chemistry, enthalpy and heat transfer.
LB 171L	Introductory Chemistry Laboratory I	Determination of density and molecular weight. Stoichiometry. Acid-base titration, redox titration. Reaction kinetics, thermochemistry, Beer's law, freezing point depression, and equilibrium constants.
LB 172	Principles of Chemistry II	Gases, properties of solutions, introduction to solid state chemistry, molecular orbital theory, chemical equilibria, chemical kinetics, acid/base equilibria, solubility equilibria, entropy, free energy, electrochemistry, redox reactions, nuclear chemistry.
LB 172L	Principles of Chemistry II - Reactivity Laboratory	Synthesis and characterization of chemical systems.
LB 181H	Honors Cell and Molecular Biology	Physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.
LB 182H	Honors Organismal and Population Biology	Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.
LB 191H	Honors Cell and Molecular Biology Laboratory	Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation; biochemistry, molecular biology and genetics.
LB 192H	Honors Organismal and Population Biology Laboratory	Nature and process of organismal biology, including experimental design and statistical methods, hypothesis testing, genetics, ecology, and evolution.
LB 220	Calculus III	Continuation of LB 119. Differential calculus of functions of two or three variables. Double and triple integrals. Line and surface integrals.
LB 270	Medical Terminology	Medical terminology, focusing on human systems, anatomy and physiology, fundamental word building principles, and phonetic pronunciations.
LB 273	Physics I	Basic physics principles and problem solving techniques. Mechanical systems (Newton's laws, momentum and energy conservation, rotational motion, gravity), elementary thermodynamics, oscillations and waves, and atomic nuclei. Laboratory techniques, instrumentation, and selected experiments in classical and modern physics.
LB 274	Physics II	Basic physics principles and problem solving techniques. Principles of electromagnetic theory, circuits, special relativity, quantum physics, optics, atomic and subatomic physics. Laboratory error analysis and selected experiments in classical and modern physics.

Mechanical Engineering - ME		
ME 201	Thermodynamics	Basic concepts of thermodynamics. Property evaluation of ideal gases and compressible substances. Theory and application of the first and second laws of thermodynamics. Entropy and Carnot efficiency.
ME 221	Statics	Vector description of forces and moments. Two- and three- dimensional equilibrium of particles and rigid bodies. Analysis of trusses, frames, and machines. Coulomb friction.

Courses used to meet University requirements cannot be used to meet this requirement.

ME 222	Mechanics of Deformable Solids	Tension compression and shear stresses. Axially loaded bars. Torsion of circular shafts. Beam theory. Combined stresses. Mohr's circles. Columns.
ME 280	Graphic Communications	Computer-aided three-dimensional design. Freehand sketching. Two-and-three-dimensional visualization. Blueprint reading.
ME 285	Computer Aided Design Tools	Advanced 3-D solid modeling
ME 332	Fluid Mechanics	Statics, control volume equations, similitude, and exact fluid solutions. Turbulence, pipe flow, boundary layer flow, compressible flow, and Navier-Stokes equations.
ME 361	Dynamics	Kinematics of particles, rigid bodies, and mass moments of inertia. Kinetics of particles and rigid bodies. Energy and momentum principles.
ME 371	Mechanical Design I	Analysis of displacement, velocity and acceleration in mechanical linkages. Kinematics and dynamics of machines.
ME 372	Machine Tool Laboratory	Principles and practice of machine tools. Safety, terminology, measurement, and working procedures for hand and machine tools.
ME 385	Computer Aided Design Tools	Advanced 3-D solid modeling
ME 391	Mechanical Engineering Analysis	Analytical and numerical methods for the modeling and analysis of mechanical engineering systems. Applications to vibrating elements, heat transfer, linear springs, and coupled spring-mass systems.
ME 410	Heat Transfer	Steady state and transient heat conduction. Natural and forced convection based on boundary layer theory. Application of Nusselt number correlations. Radiant heat transfer principles and applications including radiation networks.
ME 412	Heat Transfer Laboratory	Practices and measurement techniques for heat transfer and thermal systems. Experimental problem solving applied to heat transfer.
ME 416	Computer Assisted Design of Thermal Systems	Classifying, cataloging and processing design information. Modeling of thermal equipment. Simulation and optimization of thermal systems. Computer based design projects.
ME 417	Design of Alternative Energy Systems	Analysis of alternative energy systems, including ocean, wind, fuel cells, solar, and nuclear. Predictive models for the systems. Design studies.
ME 422	Introduction to Combustion	Thermodynamics, chemistry, fluid mechanics, and heat transfer principles applied to combustion.
ME 423	Intermediate Mechanics of Deformable Solids	Stress, strain and linearly elastic behavior. Plane stress and plane strain. Torsion. Yield criteria. Elastoplastic behavior of beams, shafts and cylinders. Unsymmetrical bending. Curved beams.
ME 425	Experimental Mechanics	Measurement of stress, strain, vibration, and motion using strain gauges, accelerometers, photoelasticity, holography, Moire patterns, laser speckle and electronic imaging. Transducer design.
ME 426	Introduction to Composite Materials	Constituents and interfacial bonding. Manufacturing techniques. Microstructure and micromechanics. Theory of anisotropy. Classical laminate theory. Material characterization. Failure and damage. Composite structure design.
ME 433	Introduction to Computational Fluid Dynamics	Theory and application of finite difference and finite volume methods to selected fluid mechanics and heat transfer problems developed based on Euler and Navier-Stokes equations. Application of commercial software to computational fluid dynamics problems.
ME 440	Aerospace Propulsion	Fundamentals of thrust and propulsion systems, including gas turbines, ramjets, rockets and electric devices. Compressible flow through nozzles and shocks. Cycle analysis of airbreathing jet propulsion and chemical rocket propulsion. Performance and design of propulsion components.
ME 442	Turbomachinery	Applying energy, momentum, and continuity equations of thermo-fluids to turbomachinery. Blade geometry and aerodynamics. Performance and design parameters. Turbomachine design.
ME 444	Automotive Engines	Design and development of internal and external combustion engines for vehicular propulsion.
ME 445	Automotive Powertrain Design	Design of powertrain systems including piston ring assembly, combustion and induction systems, and transmissions. Performance emission tradeoffs with emphasis on emission control. Detailed design study required.
ME 451	Control Systems	Mathematical modeling of dynamic systems. Standard feedback control formulation. Transient and sinusoidal steady state analysis. Time and frequency domain controller synthesis.
ME 461	Mechanical Vibrations	Modeling and analysis of oscillatory phenomena found in linear discrete and continuous mechanical systems.

Courses used to meet University requirements cannot be used to meet this requirement.

ME 464	Intermediate Dynamics	Kinematics and kinetics of particle and rigid body systems. Virtual work, Lagrangian method, and Euler equations. Basic vibrations of discrete and continuous systems. Elementary wave propagation.
ME 465	Computer Aided Optimal Design	Modeling for mechanical design optimization. Algorithms for constrained and unconstrained optimization. Optimality criteria. Optimization using finite element models. Design projects.
ME 471	Mechanical Design II	Engineering design of machine elements and mechanical systems. Computer-based analysis in support of design. Design for static and fatigue strength, deflection, and reliability.
ME 475	Computer Aided Design of Structures	Computational methods for analysis, design, and optimization of structural components. Basic concepts in geometric modeling, finite element analysis, and structural optimization.
ME 477	Manufacturing Processes	Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining, and surface processing. Selection of manufacturing processes based on design and materials.
ME 478	Product Development	Simulation of industrial environment for product development. Product concept, design, and manufacturing.
ME 481	Mechanical Engineering Design Projects	Application of design concepts in mechanical engineering. Problem definition, design specifications. Modeling and analysis methods. Design optimization, economics, reliability. Manufacturing considerations in design. Capstone design projects.
ME 489	Technical Communication for Engineers	Investigation of technical communication in the engineering workplace. Drafting, revising, and editing communications directed at a variety of audiences. Includes team writing activities, presentations, style, and flow.
ME 494	Biofluid Mechanics and Heat Transfer	Applications of fluid mechanics, heat transfer, and thermodynamics to biological processes, including blood flow in the circulatory system, heart function, effects of heating and cooling on cells, tissues, and proteins. Pharmacokinetics.
ME 495	Tissue Mechanics	Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.
ME 497	Biomechanical Design in Product Development	Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.

Microbiology and Molecular Genetics - MMG		
MMG 141	Introductory Human Genetics	Inheritance of human traits. Impact of genetic technology on society. Ethical and legal issues. Risks and benefits of genetic technology.
MMG 161	Cell and Molecular Biology	Macromolecular synthesis. Energy metabolism. Molecular aspects of development. Molecular genetics.
MMG 171	Cell and Molecular Biology Laboratory	Principles and applications of common techniques used in cell and molecular biology.
MMG 181H	Honors Cell and Molecular Biology	Physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.
MMG 191H	Honors Cell and Molecular Biology Laboratory	Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation; biochemistry, molecular biology and genetics.
MMG 201	Fundamentals of Microbiology	Microbial structure, function, growth, control, and diversity. Role of microbes in health, industry, and the environment.
MMG 301	Introductory Microbiology	Fundamentals of microbiology, including microbial structure and function, nutrition and growth, death and control. Importance and applications of major microbial groups.
MMG 302	Introductory Laboratory for General and Allied Health Microbiology	Methodology of microbiology. Microscopy, staining, aseptic technique, media, quantification, diagnostics, and laboratory safety.
MMG 365	Medical Microbiology	Laboratory diagnosis, disease and epidemiology of the most common bacterial, viral, fungal and parasitic pathogens and concepts in infectious disease control, prevention and treatment.
MMG 365L	Medical Microbiology Laboratory	Practical experience in safely and accurately performing standard clinical microbiology tests to diagnose disease-causing microbes.

Courses used to meet University requirements cannot be used to meet this requirement.

MMG 400	Introduction to Bioinformatics	Managing and analyzing biological data with bioinformatic tools, basic programming, and statistics.
MMG 404	Human Genetics	Inheritance of human traits. Medical, molecular, physiological and forensic applications. Biochemical, clinical, and molecular genetics of human disease. Prenatal, pre-symptomatic, and clinical diagnosis. Ethical, legal and social considerations.
MMG 408	Advanced Microbiology Laboratory (W)	Microbiological techniques and procedures to study physiology and genetics of bacteria and bacteriophages. Collection and critical assessment of quantitative data and written communication of results.
MMG 409	Eukaryotic Cell Biology	Structure and function of nucleated cells. Emphasis on the molecular mechanisms that underlie cell processes.
MMG 413	Virology	Viruses and modern molecular biology. Viral replication and gene expression of the major classes of viruses. Virus-cell interactions and viral diseases.
MMG 421	Prokaryotic Cell Physiology	Prokaryotic cell structure and function. Growth and replication. Macromolecular synthesis and control.
MMG 425	Microbial Ecology	Microbial population and community interactions. Microbial activities in natural systems, including associations with plants or animals.
MMG 431	Microbial Genetics	Genetics of bacteria, their viruses, plasmids, and transposons. Emphasis on genetic principles.
MMG 433	Microbial Genomics	Structure of microbial genomes and implications for growth and evolution of bacteria and fungi. Computer analysis of genome sequence databases. Applications to gene expression and phylogenetic analysis.
MMG 434	Laboratory in Genomics and Molecular Genetics (W)	Genomics and molecular genetic techniques using microbes. Collection and critical assessment of quantitative data and written communication of results.
MMG 435	Geomicrobiology	Geological and microbiological perspectives on microbial activities in diverse environmental settings, including geological change mediated by microorganisms, microbial evolution driven by geologically diverse habitats, including the evolution of life on Earth, the search for life on other planets, the study of life in extreme environments, and industrial applications of geomicrobiology.
MMG 440	Food Microbiology	Major groups of microorganisms of importance to the food industry. Ecological, physiological, and public health aspects.
MMG 441	Food Microbiology Laboratory	Methods for studying major groups of microorganisms important to the food industry. Isolation, enumeration, characterization, identification, and use of microorganisms.
MMG 445	Microbial Biotechnology (W)	Applications of microbial products and processes in areas such as biopharmaceuticals, bioremediation, biocatalysis and other green chemistries.
MMG 451	Immunology	Structure and function of molecules involved in immune responses. Quantification of immune responses and cellular participants. Immunologic abnormalities. Immunotherapy. Experimental approaches to dissection of immune functions.
MMG 461	Molecular Pathogenesis	Molecular basis of microbial virulence. Nature of determinants and their role in overcoming host defense mechanisms.
MMG 465	Advanced Medical Microbiology	Advanced laboratory diagnosis, epidemiology, and prevention of infectious diseases using an anatomical system specimen approach to study a comprehensive set of human pathogens and microbiota.
MMG 465L	Advanced Medical Microbiology Laboratory	Practical experience in safely and accurately performing standard clinical microbiology tests to process clinical specimens, identify pathogens and perform and interpret susceptibility testing.

Materials Science and Engineering - MSE		
MSE 200	Materials and Society	Material capabilities, limitations, and their utilization in the service and advancement of society. Role of materials in our day-to-day lives. Resource and environmental concerns including current material-related issues.
MSE 250	Materials Science and Engineering	Structure of metals, ceramics and polymers. Phase diagrams, thermomechanical treatments, physical and mechanical properties, diffusion, microstructure studies, environmental effects.
MSE 260	Electronic, Magnetic, Thermal, and Optical Properties of Materials	Processing, structures, and properties of ceramics, polymers, and composites. Electrical, thermal, magnetic and optical properties of materials. Materials selection and design.

Courses used to meet University requirements cannot be used to meet this requirement.

MSE 310	Phase Equilibria in Materials	Enthalpy. Entropy. Free energy. Phase changes in metal, ceramic, and polymer materials systems. Application to alloying, phase diagram determination, and electrochemistry.
MSE 320	Mechanical Properties of Materials	Mechanical behavior of metals, ceramics, and polymers. Three-dimensional stress-states. Stress, strain, and compliance tensors. Test methods. Elastic, viscoelastic, and plastic deformation. Fracture, fatigue, and creep.
MSE 331	Materials Characterization Methods I	Thermal analysis, microindentation techniques, quantitative optical microscopy, effects of alloying on creep deformation, slip systems in ionic crystals, viscoelastic of solids, and polymer rheology.
MSE 360	Fundamentals of Microstructural Design	Fick's laws of diffusion. Models of solid state diffusion. Arrhenius plots. Use of non-equilibrium energy storage from solidification, phase changes, and deformation to predict and control microstructural changes and stability during processing in metal, ceramic, and polymer systems.
MSE 370	Synthesis and Processing of Materials	Chemical and physical processing of materials. Powder synthesis and processing, consolidation, casting, microdevice fabrication and surface treatments, corrosion mitigation
MSE 381	Materials Characterization Methods II	Characterization of materials by electron microscopy, X-ray diffraction and fluorescence spectroscopy. Fractography, surface analysis, dynamic mechanical analysis, electrical and thermal property measurements.
MSE 410	Materials Foundations for Energy Applications	Survey of materials that enable new energy generation, storage, and distribution technologies; thermoelectric materials, electrochemistry of batteries, semiconductors for solar cells, radiation tolerant materials, processing of biobased fuels, greenhouse gas mitigation approaches
MSE 425	Biomaterials and Biocompatibility	Materials science of human implants. Design requirements imposed by the human body, and need for bodily protection.
MSE 426	Introduction to Composite Materials	Constituents and interfacial bonding. Manufacturing techniques. Microstructure and micromechanics. Theory of anisotropy. Classical laminate theory. Material characterization. Failure and damage. Composite structure design.
MSE 460	Electronic Structure and Bonding in Materials and Devices	Relationship between quantum mechanics and material properties. Free electron theory. Energy bands, semiconductors. Dielectrics and ferroelectrics. Dia-, para-, ferro-, and antiferro-magnetism. Superconductivity. Thermal properties.
MSE 465	Design and Application of Engineering Materials	Fundamental principles of strengthening: toughening, specific strength, and stiffness. Material development based on environmental, temperature, wear, damping, fatigue, and economic considerations.
MSE 466	Design and Failure Analysis (W)	Modes and causes of failure in mechanical components and role of design. Non-destructive evaluation. Legal and economic aspects of materials failure. Student projects.
MSE 474	Ceramic and Refractory Materials	Ceramic and glassy materials. High temperature processes. Mechanical and physical properties of technical ceramics.
MSE 476	Physical Metallurgy of Ferrous and Aluminum Alloys	Heat treatment and properties of ferrous and aluminum alloys. Casting and solidification. Effects of alloying elements, high strength low alloy steels, hardenability, and case hardening. Joining of materials, such as welding.
MSE 477	Manufacturing Processes	Fundamentals of manufacturing processes such as casting, heat treating, particulate processing, forming, machining, joining, and surface processing. Selection of manufacturing processes based on design and materials.
MSE 481	Spectroscopic and Diffraction Analysis of Materials	General properties, generation, and detection of x-rays interaction with solids. Crystallography, reciprocal space, diffraction analysis, and techniques. Single crystal methods. Stereographic projection. X-ray microanalysis.
MSE 499	Senior Research and Design Project (W)	Design and analysis to solve materials and/or mechanics related problem. Preparation of written report, oral presentation, and defense of the project.

Mathematics - MTH

MTH 101	Quantitative Literacy I	Quantitative literacy including applications to health and risk, science, and the environment.
MTH 102	Quantitative Literacy II	Quantitative literacy including applications to finance, economics, and politics.
MTH 103	College Algebra	Number systems; functions and relations; exponents and logarithms; elementary theory of equations; inequalities; and systems of equations.

Courses used to meet University requirements cannot be used to meet this requirement.

MTH 110	Finite Mathematics and Elements of College Algebra	Functions and graphs. Equations and inequalities. Systems of equations. Matrices. Linear programming. Simplex algorithm. Probability and statistics.
MTH 112	Finite Mathematics: Applications of College Algebra	Combinatorics, probability and statistics, mathematics of finance, geometry, transition matrices, and linear programming. The course emphasizes applications and includes work using spreadsheets.
MTH 114	Trigonometry	Radian and degree measure of angles. Definitions and graphs of trigonometric functions and their inverses. Solving trigonometric equations. Applications including identities, indirect measurement and trigonometric modeling.
MTH 116	College Algebra and Trigonometry	Functions and graphs. Equations and inequalities. Exponential and logarithmic functions. Trigonometric functions. Systems of equations. Binomial theorem.
MTH 124	Survey of Calculus I	Study of limits, continuous functions, derivatives, integrals and their applications.
MTH 126	Survey of Calculus II	Application of partial derivatives, integrals, optimization of functions of several variables and differential equations.
MTH 132	Calculus I	Limits, continuous functions, derivatives and their applications. Integrals and the fundamental theorem of calculus.
MTH 133	Calculus II	Applications of the integral and methods of integration. Improper integrals. Polar coordinates and parametric curves. Sequences and series. Power series.
MTH 152H	Honors Calculus I	Limits, continuous functions, derivatives, integrals, fundamental theorem of calculus. Special emphasis on concepts and theory.
MTH 153H	Honors Calculus II	The integral. Improper integrals. Polar coordinates and parametric curves. Sequences and series. Power and Taylor series. Special emphasis on concepts and theory.
MTH 201	Elementary Mathematics for Teachers I	Mathematics needed for K-8 teaching. Place value and models for arithmetic, mental math, word problems, and algorithms. Factors, primes, proofs, and prealgebra. Fractions, ratios, rates, and percentages. Negative, rational, and real numbers. Special emphasis on the appropriate sequential order for teaching.
MTH 202	Elementary Mathematics for Teachers II	A continuation of MTH 201. Geometry, measurement, and elementary data analysis.
MTH 234	Multivariable Calculus	Vectors in space. Functions of several variables and partial differentiation. Multiple integrals. Line and surface integrals. Green's and Stokes's theorems.
MTH 235	Differential Equations	Separable and exact equations. Linear equations and variation of parameters. Higher order linear equations. Laplace transforms. Systems of first-order linear equations. Introduction to partial differential equations and Fourier series.
MTH 254H	Honors Multivariable Calculus	Vectors in space. Functions of several variables and partial differentiation. Multiple integrals. Line and surface integrals. Green's and Stokes's Theorems.
MTH 299	Transitions	Introduction to mathematical reasoning, basic logic, set theory, integers, natural numbers and induction, basic number theory, real numbers, limits, sequences, series.
MTH 301	Foundations of Higher Mathematics	Elementary set theory including permutations, combinations, cardinality theorems, relations, functions and quotient sets. Basic principles of logic and proof techniques. Elementary number theory and abstract algebra.
MTH 304	Algebra for Elementary and Middle School Teachers	Algebra needed for understanding connections between topics of algebra and the mathematics taught in elementary and middle school.
MTH 305	Functions and Calculus for Elementary and Middle School Teachers (W)	Functions and calculus needed for understanding connections between topics of calculus and the mathematics taught in middle school.
MTH 309	Linear Algebra I	Matrices, systems of linear equations, vector spaces, linear transformations, inner products and orthogonal spaces, eigenvalues and eigenvectors, and applications to geometry. A writing course with emphasis on proofs.
MTH 310	Abstract Algebra I and Number Theory	Structure of the integers, congruences, rings, ring homomorphisms, ideals, quotient rings. A writing course with an emphasis on proofs.
MTH 314	Matrix Algebra with Applications	Problem-solving and applications in matrix algebra for scientists and engineers. Vectors, matrices, linear transformations, inner products, dimension, eigenvalues and eigenvectors. Applications to systems of equations and to geometry.

Courses used to meet University requirements cannot be used to meet this requirement.

MTH 317H	Honors Linear Algebra	Systems of equations, matrix algebra, vector spaces, linear transformations, geometry of \mathbb{R}^n , eigenvalues, eigenvectors, diagonalization, inner products. Emphasis on mathematical reasoning, proofs, and concepts.
MTH 320	Analysis I	Convergence of sequences and series. Upper and lower limits, completeness, limits and continuity. Derivatives. Uniform convergence.
MTH 327H	Honors Introduction to Analysis	Emphasis on foundations and metric topology. Convergence of sequence and series, continuity of functions. Differentiation and integration in one dimension.
MTH 330	Higher Geometry	Topics in transformations: isometries, similarities, inversion. Advanced Euclidean geometry: theorems of Menelaus, Ceva, and Desargues. Cross ratio, harmonic points, analytic, metric, and vector methods, and convexity.
MTH 340	Ordinary Differential Equations I	Techniques for solving differential equations, existence and uniqueness theorems, qualitative theory, Fourier series and applications.
MTH 347H	Honors Ordinary Differential Equations	Separable and exact equations, linear equations and variation of parameters, higher order linear equations, Laplace Transforms, first-order linear systems, classification of singularities, nonlinear systems, partial differential equations and Fourier Series, existence and uniqueness theorems. Emphasis on theory.
MTH 360	Theory of Mathematical Interest	Measurement of interest rates, basic problems in interest theory, basic annuities, continuous and varying annuities, yield rates, amortization, bonds and other securities, practical applications, and stochastic approaches to interest.
MTH 361	Financial Mathematics for Actuaries I	Introduction to the mathematics of financial derivatives. Options, forwards, futures, swaps, investment and hedging strategies.
MTH 396	Capstone in Mathematics for Secondary Education (W)	A capstone course for secondary education math majors. High school mathematics from an advanced viewpoint.
MTH 411	Abstract Algebra II	Continuation of MTH 310. Permutation groups, groups of transformations, normal subgroups, homomorphism theorems, modules. Principal ideal rings, unique factorization domains, noncommutative rings, rings of fractions, ideals.
MTH 414	Linear Algebra II	Linear transformations on finite dimensional vector spaces. Invariant subspaces, rank, eigenvalues and eigenvectors. Canonical forms. Bilinear and multilinear forms.
MTH 415	Applied Linear Algebra	Matrices and linear algebra. General linear systems of equations. Least squares minimization techniques. Eigenvalues and eigenvectors, spectral decompositions, and exponentials.
MTH 416	Introduction to Algebraic Coding	Concepts and techniques of abstract algebra applied to the design of communication systems for use in imperfect circumstances. Theory of codes designed by algebraic means.
MTH 417	Topics in Number Theory	Congruences of higher degree, primitive roots and quadratic reciprocity. Number-theoretic functions, algebraic numbers. Dirichlet Series, p-order expansion, continued fractions.
MTH 418H	Honors Algebra I	Theory of groups, Sylow theory, the structure of finite Abelian groups, ring theory, ideals, homomorphisms, and polynomial rings.
MTH 419H	Honors Algebra II	Algebraic field extensions, Galois theory. Classification of finite fields. Fundamental Theorem of Algebra.
MTH 421	Analysis II	Continuation of MTH 320. Riemann integral. Metric spaces. Differentiation in higher dimensions. Inverse and implicit function theorems.
MTH 425	Complex Analysis	Analytic functions of a complex variable, Cauchy integral theorem, conformal maps, bilinear transformation, harmonic functions. Classification of singularities, residues, conformal mappings.
MTH 428H	Honors Complex Analysis	Analytic functions of a complex variable, line integrals and harmonic functions, Cauchy's theorem and integral formula, power series, Laurent series, isolated singularities, residue calculus, Rouché's theorem, automorphisms of the disk, the Riemann mapping theorem.
MTH 429H	Honors Real Analysis	Continuation of MTH 327H. Convergence of sequences and series of functions, differentiation and integration in higher dimensional settings. Inverse and implicit function theorems.
MTH 432	Axiomatic Geometry	Axiomatic systems and finite geometries: axioms of Euclidean and hyperbolic geometry, the Poincaré model, independence of the parallel postulate. Classical constructions and the impossibility of angle trisection.
MTH 441	Ordinary Differential Equations II	Existence and uniqueness theorems; Linearization; Local and global stability; Saddle-node, Hopf and heteroclinic bifurcations; Hamiltonian and gradient system; The Poincaré map; The Poincaré-Bendixson theorem and limit cycles; Selected applications.
MTH 442	Partial Differential Equations	Classification of second order partial differential equations. Boundary and initial value problems for heat, Laplace, and wave equations in dimensions 1, 2 and 3. Variational methods and maximum principles. Separation of variables, Fourier series, Sturm-Liouville theory. Green's functions.

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MTH 451	Numerical Analysis I	Numerical solution of linear and nonlinear algebraic equations and eigenvalue problems. Curve fitting. Interpolation theory. Numerical integration, differentiation, and solution of differential equations. Algorithms implementation with a programming language like Fortran, C/C++ or MATLAB.
MTH 452	Numerical Analysis II	Iterative methods for solving linear systems, approximation theory, approximating eigenvalues, solutions of systems of nonlinear equations, boundary-value problems for ordinary differential equations, numerical methods for partial differential equations.
MTH 455	Actuarial Models I	Stochastic models used in insurance. Survival distributions, life insurance, life annuities, benefit premiums, benefit reserves, and analysis of benefit reserves.
MTH 456	Actuarial Models II	Continuation of STT 455. Benefit reserves. Multiple life functions. Multiple decrement models and their applications. Elements of stochastic processes for actuaries including Markov chains and Poisson processes
MTH 457	Introduction to Financial Mathematics	Mathematical overview of basic financial instruments. A unified partial differential equation approach to model derivative securities. Partial differential equations in financial mathematics, Black-Scholes equation. Numerical methods for valuing derivatives.
MTH 458	Financial Mathematics for Actuaries II	Evaluate and construct interest rate models. Rational valuation of derivative securities using put-call parity and calculation of European and American options. Risk management techniques using the method of delta-hedging.
MTH 459	Construction and Evaluation of Actuarial Models	Severity, frequency, and aggregate models. Construction of empirical models. Parametric statistical methods. Credibility analysis. Simulation methods.
MTH 461	Metric and Topological Spaces	Set theory, metric spaces, topological spaces, maps, product and quotient topologies. Connected and compact spaces, separation axioms, pointwise and uniform convergence.
MTH 467	Insurance Operations	Regulation, marketing and distribution, underwriting, risk control, premium auditing, the claim function, actuarial operations, and reinsurance.
MTH 468	Predictive Analytics	Predictive analytics for insurance business and risk management with an emphasis on the use of machine learning tools.
MTH 481	Discrete Mathematics I	Binomial and multinomial theorems. Graphs and digraphs, graph coloring. Generating functions, asymptotic analysis, trees. Representing graphs in computers.
MTH 482	Discrete Mathematics II	Recurrence and generating functions, Ramsey theory. Block designs, Latin squares, Eulerian and Hamiltonian paths. Minimum spanning trees, network flows.
MTH 492H	Undergraduate Thesis (W)	Undergraduate thesis on an advanced-level topic in mathematics.
MTH 496	Capstone in Mathematics (W)	A capstone course integrating several areas of mathematics.

Neuroscience - NEU		
NEU 215	Neuroscience and Society	Critical examination of important societal issues related to neuroscience, including stress, addiction, and sex differences. Comparison of peer-reviewed neuroscientific research and popular press publications.
NEU 230	Basic Concepts in Neuroscience	Introduction to fundamental neuroscience concepts including neuroanatomy, neuronal signaling, and molecular mechanisms of learning and memory.
NEU 300	Neurobiology	Structure and function of nerve cells and nervous systems.
NEU 301	Introduction to Neuroscience I	Survey of the field of neuroscience, including molecular, cellular, and autonomic, sensory and motor systems.
NEU 302	Introduction to Neuroscience II	Survey of brain-based behavioral and cognitive systems and related human diseases.
NEU 310	Psychology and Biology of Human Sexuality	Sexual behavior from biological, psychological and neuroscience perspectives. Sexual differentiation of the body. Role of hormones in development and reproduction in humans and other animals. Human sexual orientation. Fertility and contraception. Sexual disorders. Sexually transmitted diseases.
NEU 311L	Neuroscience Laboratory (W)	Overview of neuroscience research methodology, including experimental design, data analysis, and presentation of results.
NEU 333	The Neurobiology of Food Intake and Overeating	Physiological and neurological mechanisms that drive food intake and overeating. Vulnerabilities to obesity.

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NEU 415	Neuroinformatics and Quantitative Reasoning	Quantitative reasoning and statistical methods for querying internet databases and understanding basic neuroscience models
NEU 416	Development of the Nervous System Through the Lifespan	Development of neurons and their connections, roles of both genetics and behavioral experience in shaping the mammalian nervous system.
NEU 417	Instrumental Methods of Analysis in Neuroscience	Design, operational principles and practical application of modern instrumental methods used for the separation, identification and quantification of neurochemical species in neuroscience. Application of methods of chemical analysis to study neurosignaling, chemical composition in single secretory cells, chemical structure of cells and tissues.
NEU 420	Neurobiology of Disease	Genetic, molecular, cellular, systems, and behavioral abnormalities that contribute to the manifestation of neurologic and psychiatric diseases and disorders that affect the nervous system.
NEU 422	Fundamentals of Neuropharmacology	Mechanisms and uses of action of drugs on neurons and neuron-controlled activities
NEU 425	Computational Modeling in Neuroscience	Introduction to theory and network modeling techniques in neuroscience, using brain activity data to validate theoretical models. Review of successful network models.
NEU 430	Genomics of Brain Development, Learning, and Behavior	Role of genes in brain development and function. Issues in behavioral and psychiatric genetics.
NEU 431	Pharmacology of Drug Addiction	Introduction to pharmacology and neuropharmacology. Understanding of the biological basis for drug abuse and addiction.
NEU 435	Ion Channels of Excitable Membranes	Introduction to ion channels and their critical role in normal physiological functioning, sensory and neuromuscular diseases and disorders, as well as targets of toxins and poisons.
NEU 440	Synaptic Transmission	Chemical and electrical aspects of nerve impulse transmission at synaptic and neuroeffector junctions. Influence of drugs.
NEU 445	Analysis of Neural Activity Data (W)	Conceptual and practical approaches to analyzing large functional datasets. Emphasis on statistical issues, including preprocessing, estimation methods, hypothesis testing, dimension reduction, and correlation with behavior. Data types include electrophysiological recording, electroencephalography (EEG), magnetoencephalography (MEG), functional Magnetic Resonance Imaging (fMRI) and optical imaging.

Natural Science – NSC

NSC 476	Natural Science Field Studies in Selected U.S.A. Locations	Contemporary issues in environmental, geological, biological or human health-related sciences of a selected domestic study away location.
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Nursing - NUR

NUR 300	Pathophysiology	How disrupting normal structures and functions of the human body leads to disease processes from the cellular to the multi-system level. Critical examination of the mechanisms underlying signs and symptoms.
NUR 301	Clinical Pathophysiology	How disrupting normal structures and functions of the human body leads to disease processes from the cellular to the multisystem level. Critical examination of the mechanisms underlying signs and symptoms of diseases.

Pharmacology and Toxicology - PHM

PHM 211	Pharmacology and Toxicology in Society	Introduction for non-science or science students to the field of pharmacology and toxicology. History of pharmacology and toxicology. Present issues and future possibilities. Society and systems of drug development and delivery. Drug abuse and policies.
PHM 321	Common Drugs	Introduction to commonly used drugs. Emphasis on over-the-counter medications and frequently prescribed prescription drugs. Selected natural products also will be covered. How commonly used drugs

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		affect the body to treat or cure various conditions and how the body handles drugs. Principles of appropriate drug use and consequences of misuse.
PHM 350	Introductory Human Pharmacology	General principles of pharmacology. Central nervous system, autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.
PHM 351	Fundamentals of Drug Safety	How and why drugs are tested and monitored for safety. The roles of the FDA, USDA, and EPA to ensure drug safety.
PHM 421	Clinical Toxicology	Basic methods and procedures commonly employed in clinical toxicology will be introduced and explained. Mechanisms of toxicity, symptoms, diagnostics, and treatment of the most commonly encountered toxins in clinical exposure will be reviewed in detail.
PHM 422	Fundamentals of Neuropharmacology	Mechanisms and uses of action of drugs on neurons and neuron-controlled activities
PHM 430	Human Pharmacology	General principles of pharmacology. Central nervous system and autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.
PHM 431	Pharmacology of Drug Addiction	Introduction to pharmacology and neuropharmacology. Understanding of the biological basis for drug abuse and addiction.
PHM 440	Principles of Drug Action	Factors influencing drug action. Absorption, distribution, and elimination. Factors controlling intensity, selectivity and nature of drug action. Mismatches of drug presence and drug action including receptor-effector coupling mechanisms and mechanisms of drug tolerance.
PHM 450	Introduction to Chemical Toxicology	Mammalian toxicology. Disposition of chemicals in the body, detoxication, elimination, and mechanisms of toxicity in major organ systems. Selected toxic agents.

Physics - PHY

PHY 101	Concepts in Physics	Conceptual foundations of physics emphasizing key experiments.
PHY 102	Physics Computations I	Use of Mathematica to solve, analyze and graph equations and data from mechanics.
PHY 170	Investigations in Physics	Experiments in optics, electronics, sound and mechanics; analysis of data using computers, library research and oral presentations.
PHY 183	Physics for Scientists and Engineers I	Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, and waves.
PHY 183B	Physics for Scientists and Engineers I	Mechanics, Newton's laws, momentum, energy conservation laws, rotational motion, oscillation, gravity, waves. This course is given in the competency based instruction format.
PHY 184	Physics for Scientists and Engineers II	Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction.
PHY 184B	Physics for Scientists and Engineers II	Electricity and magnetism, electromagnetic waves, light and optics, interference and diffraction. This course is given in the competency based instruction format.
PHY 191	Physics Laboratory for Scientists, I	Error analysis, exercises in motion, forces, conservation laws and some electricity and magnetism studies.
PHY 192	Physics Laboratory for Scientists, II	Electric and magnetic fields, circuits, wave optics, modern physics.
PHY 193H	Honors Physics I-Mechanics	Mechanics and waves.
PHY 215	Thermodynamics and Modern Physics	Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles.
PHY 215B	Thermodynamics and Modern Physics	Thermodynamics, atomic physics, quantized systems, nuclear physics, solids, elementary particles. This course is given in the competency based instruction format.
PHY 231	Introductory Physics I	Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound.
PHY 231C	Introductory Physics I	Mechanics, Newton's Laws, momentum, energy, conservation laws, thermodynamics, waves, sound. This course is an internet based course.
PHY 232	Introductory Physics II	Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics.
PHY 232C	Introductory Physics II	Electricity and magnetism; optics; atomic, nuclear, and subnuclear physics. This course is an internet based course.
PHY 233B	Calculus Concepts in Physics I	Kinematics, dynamics, applications of Newton's laws. This course is given in the competency based instruction format.

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PHY 234B	Calculus Concepts in Physics II	Electricity and magnetism. This course is given in the competency based instruction format.
PHY 241	Physics for Cellular and Molecular Biologists I	Physics of cellular and molecular biology. Examples will be drawn from systems such as bacterial flagella, myosin and protein folding.
PHY 242	Physics for Cellular and Molecular Biologists II	Physics of cellular and molecular biology. Examples will be drawn from systems such as ATPase and photosynthesis.
PHY 251	Introductory Physics Laboratory I	Laboratory exercises involving simple mechanical systems.
PHY 252	Introductory Physics Laboratory II	Laboratory exercises involving simple electromagnetic and optical systems.
PHY 294H	Honors Physics II- Electromagnetism	Electricity and magnetism, electromagnetic waves and optics.
PHY 321	Classical Mechanics I	Newtonian point particles. Oscillations. One-particle chaos. Central-force motion. Systems of particles.
PHY 410	Thermal and Statistical Physics	Equilibrium statistical mechanics and thermodynamics, kinetic theory, phase transformations.
PHY 415	Methods of Theoretical Physics	Mathematical methods applied to physical problems in mechanics, electromagnetism, and thermodynamics. Multiple integration, vector calculus, Fourier series, ordinary and partial differential equations, eigenvector problems, coordinate transformations, and complex analysis. Newtonian mechanics, rigid body dynamics, heat flow, electrostatics, harmonic motion, and waves.
PHY 422	Classical Mechanics II	Hamiltonian and Lagrangian mechanics. Non-inertial frames. Coupled oscillations. Continuous systems.
PHY 431	Optics I	Lenses, aberrations, apertures, and stops. Diffraction, interferometry, spectroscopy, fiber optics.
PHY 440	Electronics	Concepts of electronics used in investigating physical phenomena. Circuits, amplifiers, diodes, LEDs, transistors.
PHY 451	Advanced Laboratory	General research techniques, design of experiments, and the analysis of results based on some historical experiments in modern physics.
PHY 471	Quantum Physics I	Schrodinger equation, hydrogen atom, harmonic oscillator, and other one-dimensional systems.
PHY 472	Quantum Physics II	Matrix formulation of quantum mechanics, perturbation theory, scattering.
PHY 480	Computational Physics	Applications of scientific computational techniques to solutions of differential equations, matrix methods, and Monte Carlo methods used in physics.
PHY 481	Electricity and Magnetism I	Electrostatics, dielectrics, magnetic fields of steady state currents, Faraday law of induction.
PHY 482	Electricity and Magnetism II	Maxwell's equations, scalar and vector potentials, electromagnetic plane waves.
PHY 490	Physics Senior Thesis	Design, carry out, and analyze an original experiment or computation. A written and oral report is required.
PHY 491	Introduction to Condensed Matter Physics	Many-electron atoms. Molecules, crystal structure, lattice dynamics. Band models of metals and semiconductors, transport properties.
PHY 492	Introduction to Nuclear Physics	Survey of phenomena and conceptual foundations of nuclear physics.
PHY 493	Introduction to Elementary Particle Physics	Introduction to concepts and theory for elementary particle physics.

Plant Biology - PLB		
PLB 105	Plant Biology	Plant structure, function, development, genetics, diversity and ecology.
PLB 106	Plant Biology Laboratory	Cell structure, anatomy, physiology, growth and development, and diversity of plants.
PLB 162	Organismal and Population Biology	Biological diversity and organismal biology. Principles of evolution, transmission genetics, population biology, community structure, ecology.
PLB 172	Organismal and Population Biology Laboratory	Nature and process of organismal biology including experimental design, statistical methods, hypothesis testing in genetics, ecology, and evolution.

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PLB 182H	Honors Organismal and Population Biology	Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.
PLB 192H	Honors Organismal and Population Biology Laboratory	Nature and process of organismal biology, including experimental design and statistical methods, hypothesis testing, genetics, ecology, and evolution.
PLB 203	Biology of Plants	Evolution and diversification of plants. Structural innovations and physiological attributes of vascular land plants. Career opportunities, developing professional practices and Responsible Conduct of Research (RCR).
PLB 218	Plants of Michigan	Plant taxa of Michigan and the Great Lakes region and the major habitats in which they occur. Principles and rationale of classification. Relationships between life histories, morphology and environment.
PLB 301	Introductory Plant Physiology	General principles of plant physiology relating plant structure to function. Cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.
PLB 319	Introduction to Earth System Science	Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.
PLB 341	Fundamental Genetics	Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.
PLB 355	Ecology	Interrelationships of plants and animals with each other and the environment. Principles of individual, population, community, and ecosystem ecology. Application of ecological principles to global change and other anthropogenic stressors.
PLB 355L	Ecology Laboratory (W)	Population, community, and ecosystem ecology, utilizing plant and animal examples to demonstrate general field principles.
PLB 400	Introduction to Bioinformatics	Managing and analyzing biological data with bioinformatic tools, basic programming, and statistics.
PLB 402	Biology of Fungi	Characteristics, habitats, and diversity of major groups of fungi. Ecologic and economic importance of fungi.
PLB 407	Diseases and Insects of Forest and Shade Trees	Diseases, insects, and environmental problems affecting trees in forests, parks, suburbs, and nurseries. Methods of control.
PLB 415	Plant Physiology	Principles of plant metabolism, growth, and development. Photosynthesis, water relations, nitrogen metabolism, and cell wall biosynthesis. Environmental and hormonal factors that control plant growth and development. Gene regulation and genetic engineering of plants.
PLB 416L	Plant Physiology Laboratory	Experimental methods and experiment design in plant physiology and molecular biology, with emphasis in photosynthesis, water relations, plant growth, plant development, genetics and gene regulation. Communication of scientific information in written and graphical format.
PLB 418	Plant Systematics	Classification and evolution of higher plants, with emphasis on identification, characteristics of plant families, and systematic theory and practice.
PLB 424	Algal Biology	Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats.
PLB 434	Plant Structure and Function	Plant morphology and anatomy from a structural and functional perspective. Ecological and evolutionary significance of variation in the physiology and development of plant cells, tissues, meristems and organs.
PLB 440	Field Ecology and Evolution	Solving conceptual and practical research problems in ecology and evolution under field conditions.
PLB 441	Plant Ecology	Ecology of plants and their communities. Effects of biotic and climatological factors influencing global distribution of plant communities. Community structure and function, microclimatology, ecophysiology, and adaptation.
PLB 443	Restoration Ecology	Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans.
PLB 445	Evolution (W)	Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.
PLB 485	Tropical Biology (W)	Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.
PLB 490	Directed Studies	Directed study of published literature in an area of plant biology.
PLB 490H	Honors Directed Studies	Directed study of published literature in an area of plant biology.
PLB 499	Senior Seminar (W)	A capstone experience that focuses on current developments and issues in plant biology. Scientific writing and oral presentation.

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Plant Pathology - PLP		
PLP 104	Applied Plant Pathology for Ornamentals and Turf	Diseases of woody ornamentals and turf grasses.
PLP 105	Fundamentals of Applied Plant Pathology	Diseases of major agronomic and horticultural plants. Disease management. Offered first ten weeks of the semester.
PLP 200	Plant Diseases and Their Pathogens	Plant diseases. Biology of pathogens that cause disease. Disease management, with focus on Northern Michigan.
PLP 266	Turf Pathology	Turf pathogens and turf diseases. Cultural, biological and chemical methods for turf disease management.
PLP 402	Biology of Fungi	Characteristics, habitats, and diversity of major groups of fungi. Ecologic and economic importance of fungi.
PLP 405	Plant Pathology	Plant diseases and the organisms that cause them. Principles of disease management including application of chemicals, plant breeding, biological control, and genetic engineering.
PLP 407	Diseases and Insects of Forest and Shade Trees	Diseases, insects, and environmental problems affecting trees in forests, parks, suburbs, and nurseries. Methods of control.
PLP 492	Seminar	Capstone course. Experience in scientific writing, oral presentations, professional preparation, and current developments in plant pathology.

Physiology - PSL		
PSL 250	Introductory Physiology	Function, regulation and integration of organs and organ systems of higher animals emphasizing human physiology.
PSL 310	Physiology for Pre-Health Professionals	Human organ system physiology with clinical applications for students entering health care fields.
PSL 311L	Physiology Laboratory for Pre-Health Professionals	Laboratory exercises in human and animal physiology, including neural, sensory, muscle, cardiovascular, and urinary function, with an emphasis on the integration of physiological systems. Laboratory exercises relevant for pre-health students and the development of data analysis and problem solving skills.
PSL 331	Concepts and Critical Thinking in Physiology	Knowledge, skills, and approaches necessary to create deep understanding of biological concepts for success in advanced physiology courses
PSL 425	Physiological Biophysics	The quantitative physical phenomena underlying kinetics and equilibria of physiological processes.
PSL 429	Biomedical Imaging Methods	Overview of biomedical imaging techniques from theory to application, with emphasis on health care and research.
PSL 431	Human Physiology I	Molecular basis of physiological control systems, physiology of excitable cells, autonomic nervous system, function and regulation of cardiovascular and respiratory systems.
PSL 432	Human Physiology II	Continuation of PSL 431. Function and regulation of the digestive, endocrine, renal, and reproductive systems. Integration of physiological responses.
PSL 450	Physiology in Health and Disease	Advanced topics in normal and abnormal physiology. Chronic diseases, disease progression, and animal models of disease.
PSL 475L	Capstone Laboratory in Physiology	Laboratory exercises in human and animal physiology, including cardiovascular, respiratory, neural, muscle, sensory, and hormonal function, as well as systems physiology studies in exercise and systemic reflexes.
PSL 499	Physiology Senior Research Thesis	Independent research with faculty supervision culminating in a thesis.

Psychology - PSY		
PSY 333	The Neurobiology of Food Intake and Overeating	Physiological and neurological mechanisms that drive food intake and overeating. Vulnerabilities to obesity.

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PSY 413	Laboratory in Behavioral Neuroscience (W)	Theory and laboratory experience in the study of behavioral neuroscience. Relationship among hormones, brain, and behavior.
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Statistics and Probability - STT		
STT 200	Statistical Methods	Data analysis, probability models, random variables, estimation, tests of hypotheses, confidence intervals, and simple linear regression.
STT 201	Statistical Methods	Probability and statistics with computer applications. Data analysis, probability models, random variables, tests of hypotheses, confidence intervals, simple linear regression. Weekly lab using statistical software.
STT 224	Introduction to Probability and Statistics for Ecologists	Probability and statistics with computer applications for the analysis, interpretation and presentation of ecological data. Data analysis, probability models, random variables, estimation, confidence intervals, test of hypotheses, and simple linear regression with applications to ecology.
STT 231	Statistics for Scientists	Calculus-based course in probability and statistics. Probability models, and random variables. Estimation, confidence intervals, tests of hypotheses, and simple linear regression with applications in sciences.
STT 250	Statistics and Probability for K-8 Teachers	Data collection and analysis. Statistics, probability models. Decision-making in the presence of variability. Computer software relevant for teaching practice.
STT 301	Computational Methods for Data Science	Obtaining and managing data using statistical software. Data visualization and graphics. Special challenges in working with high-dimensional data.
STT 315	Introduction to Probability and Statistics for Business	A first course in probability and statistics primarily for business majors. Data analysis, probability models, random variables, confidence intervals, and tests of hypotheses with business applications.
STT 317	Quantitative Business Research Methods	Application of statistical techniques, including forecasting, to business decision making. Includes applications of linear regression and correlation, analysis of variance, selected non-parametric tests, time series, and index numbers.
STT 351	Probability and Statistics for Engineering	Probability models and random variables. Estimation, confidence intervals, tests of hypotheses, simple linear regression. Applications to engineering.
STT 421	Statistics I	Basic probability, random variables, and common distributions. Estimation and tests for one-, two-, and paired sample problems. Introduction to simple linear regression and correlation, one-way ANOVA.
STT 422	Statistics II	Goodness of fit and other non-parametric methods. Linear models including multiple regression and ANOVA for simple experimental designs.
STT 430	Introduction to Probability and Statistics	Calculus-based probability and statistics with applications. Discrete and continuous random variables and their expectations. Point and interval estimation, tests of hypotheses, and simple linear regression.
STT 441	Probability and Statistics I: Probability	Probability, conditional probability and independence. Random variables. Discrete, continuous, univariate, and multivariate distributions. Expectation and its properties, moment generating functions. Law of large numbers, central limit theorem.
STT 442	Probability and Statistics II: Statistics	Parameter estimation, sampling distributions, confidence intervals, hypothesis testing, simple and multiple regression, analysis of variance. Time series models, data analysis and forecasting
STT 455	Actuarial Models I	Stochastic models used in insurance. Survival distributions, life insurance, life annuities, benefit premiums, benefit reserves, and analysis of benefit reserves.
STT 456	Actuarial Models II	Continuation of STT 455. Benefit reserves. Multiple life functions. Multiple decrement models and their applications. Elements of stochastic processes for actuaries including Markov chains and Poisson processes
STT 458	Financial Mathematics for Actuaries II	Evaluate and construct interest rate models. Rational valuation of derivative securities using put-call parity and calculation of European and American options. Risk management techniques using the method of delta-hedging.
STT 459	Construction and Evaluation of Actuarial Models	Severity, frequency, and aggregate models. Construction of empirical models. Parametric statistical methods. Credibility analysis. Simulation methods.

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STT 461	Computations in Probability and Statistics	Computer algorithms for evaluation, simulation and visualization. Sampling and prescribed distributions. Robustness and error analysis of procedures used by statistical packages. Graphics for data display, computation of probabilities and percentiles.
STT 464	Statistics for Biologists	Biological random variables. Estimation of population parameters. Testing hypotheses. Linear correlation and regression. Analyses of counted and measured data to compare several biological groups including contingency tables and analysis of variance.
STT 465	Bayesian Statistical Methods	Probability, belief, and exchangeability. Objective, subjective, and empirical Bayes approaches. Applications to one-parameter models, linear regression models, and multivariate normal models. Hierarchical modeling. Computational methods.
STT 467	Insurance Operations	Regulation, marketing and distribution, underwriting, risk control, premium auditing, the claim function, actuarial operations, and reinsurance.
STT 468	Predictive Analytics	Predictive analytics for insurance business and risk management with an emphasis on the use of machine learning tools.
STT 481	Capstone in Statistics (W)	Selected readings and projects illustrating special problems encountered by statisticians in their roles as consultants, educators, researchers and analysts.



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