Physical Science Department

Physical Sciences Degrees, Minors, and Certificates

Chemistry

- Bachelor of Science in Chemistry (catalog.dixie.edu/programs/physical-sciences/chemistry-bs)
- Bachelor of Science in Molecular Biology - Biochemistry (catalog.dixie.edu/programs/physical-sciences/molecular-biology-biochemistry-bs)
- Bachelor of Arts / Science in Integrated Studies - Chemistry Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-chemistry-ba-bs)
- Minor in Chemistry (catalog.dixie.edu/programs/physical-sciences/chemistry-minor)
- Minor in Chemistry Education (catalog.dixie.edu/programs/physical-sciences/chemistry-education-minor)

Engineering

- Bachelor of Science in Mechanical Engineering (catalog.dixie.edu/programs/physical-sciences/mechanical-engineering-bs)
- Associate of Science in Pre-Engineering (APE) (catalog.dixie.edu/programs/physical-sciences/pre-engineering-ape)
- Maker Certificate (catalog.dixie.edu/programs/physical-sciences/maker-certificate)

Physical Science

- Bachelor of Science in Physical Science Composite Teaching, Secondary Education Licensure (catalog.dixie.edu/programs/physical-sciences/physical-science-composite-teaching-bs)
- Bachelor of Arts / Science in Integrated Studies - Earth Science Emphasis (catalog.dixie.edu/programs/interdisciplinary-arts-and-sciences/integrated-studies-earth-science-ba-bs)
- Minor in Physics (catalog.dixie.edu/programs/physical-sciences/physics-minor)

Click here for Physical Sciences Website (https://science.dixie.edu) **(following this link will take you out of the University Catalog)**

Chemistry Courses

CHEM 1001. FYE: Chemistry. 1 Hour.
Strongly recommended for entering freshmen and transfer students with 0-24 credits interested in the BS degree in chemistry. Designed to help students adapt to college life and become integrated into DSU. Students will refine academic skills, learn about college resources and procedures, and explore different fields of study, degree options, and career opportunities. Multiple listed with all other sections of FYE (all 1001 courses and ENGR 1000). Students may only take one FYE course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know their way around Dixie State University. This includes knowing: where to find buildings and services that you may need on campus, what campus services are available to you, how to do things like add classes, drop classes, change your major, check your account balance, use your Dmail, and so on, how to get involved in college life, what your rights and responsibilities are as a student. 2. Know some strategies for dealing with the challenges of college life. This includes: managing your time, staying safe on campus, recognizing and dealing with stress, staying healthy, managing your money, networking with other students and professors, staying motivated when the going gets tough. 3. Know how to succeed academically. This includes knowing how to: use a course syllabus, read a college textbook, talk to your professors, take good notes, write good papers, study effectively, recognize and deal with test anxiety, take tests effectively, avoid academic dishonesty, take advantage of your learning style. 4. Understand your major or area of study. This includes knowing: what General Education is, and how to fulfill the GE requirements, how to chose a major that is right for you, what the course requirements are in your major, how to construct a graduation plan, what kinds of careers your major will prepare you for. FA.

CHEM 1010. Introduction to Chemistry (PS). 3 Hours.
Fulfills General Education Physical Science requirement for students majoring in Business, Communication, Fine Arts, Humanities, and other non-Science disciplines. Emphasizes basic chemical concepts within daily life. CHEM 1015 lab course recommended but not required. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Correctly use the language of chemistry. 2. Use the Periodic Table of Elements to predict the behavior of atoms. 3. Perform chemical skills (such as balancing an equation or drawing a Lewis dot structure for a covalent compound). 4. Explain how chemical concepts apply to the world around you and your everyday life. FA, SP, SU.

CHEM 1015. Intro to Chemistry Lab (LAB). 1 Hour.
Lab portion of CHEM 1010. Lab fee required. Corequisite: CHEM 1010. FA, SP.

CHEM 1020. Culinary Chemistry. 3 Hours.
Course content will demonstrate how basic scientific principles underlie everyday aspects of food and cooking; learning about fruits, grains, and meats to sauces and candies. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know the fundamental principles of food preparation and meal management. 2. Be able to share recipes with class members by practicing at home, planning, and preparing food for the class. 3. Apply chemical principles to the understanding of the physical and natural world. 4. Distinguish between chemical and physical processes and properties of matter. 5. Understand how heat relates to chemical processes. 6. Describe the intermolecular forces which influence the properties of gases, liquids, and solids. FA.

CHEM 1110. Elementary General/Organic Chemistry (PS). 4 Hours.
Fulfills General Education Physical Science requirement for students majoring in Health Sciences, Family & Consumer Science, Natural Resources, or Agriculture. Not appropriate for students majoring in Life Sciences, Physical Sciences, pre-Medical, pre-Dental or other pre-professional program. First semester in a 2-course sequence covering fundamental laws and reactions of general inorganic and organic chemistry, including the basic organic functional groups. Successful completion satisfies prerequisite for CHEM 1120. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and apply the major principles and vocabulary of general and organic chemistry, including the relationships between chemicals and life. 2. Describe and use the periodic table to predict the behavior of elements, compounds, and atoms. 3. Apply basic skills such as balancing chemical equations, drawing Lewis dot structures, and predicting the results of radioactive decay. 4. Discuss basic chemical reactions, organic functional groups in larger molecules, and predicting products of basic chemical reactions. Prerequisite: MATH 1010 or MATH 1040 (All grade C- or higher) or Math Placement score 23 or higher. Corequisite: CHEM 1115. FA, SP, SU.

CHEM 1115. Elem General/Organic Chemistry Lab (LAB). 1 Hour.
Lab portion of CHEM 1110. Successful completion satisfies pre-requisite for CHEM 1125. Lab fee required. Corequisite: CHEM 1110. FA, SP, SU.

CHEM 1120. Elem Organic / Bio Chemistry. 4 Hours.
Continuation of CHEM 1110. Second semester in a 2-course sequence covering fundamental laws of carbohydrates, lipids, proteins, biochemical energy, enzymes, and molecular biology, as well as the organic functional groups related to these biochemicals. Successful completion prepares students for further study in Chemistry and Life Sciences. Prerequisite: CHEM 1110 (grade C or higher). Corequisite: CHEM 1125. SP.

CHEM 1125. Elem Organic/Bio Chemistry Lab. 1 Hour.
Lab portion of CHEM 1120. Lab fee required. Prerequisite: CHEM 1115 (Grade C or higher). Corequisite: CHEM 1120. SP.

CHEM 1200. Preparation for Gen Chemistry (PS). 3 Hours.
For students with little or no background in Chemistry and is designed to prepare students for General Chemistry. Covers basic topics through lecture and online problems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply chemical principles to the understanding of the physical and natural world. 2. Apply mathematical skills and the mole concept to solve chemical problems, balancing equations and stoichiometry. 3. Build skills and knowledge required to be successful in university courses in science. Prerequisite: MATH 1050 (can be concurrently enrolled).

CHEM 1210. Principles of Chemistry I (PS). 4 Hours.
Fulfills General Education Physical Science requirement for students majoring in Life or Physical Sciences, Engineering, and pre-professional programs (pre-medical, pre-dental, etc.). Provides theoretical and practical framework for further study in the sciences; emphasizes measurement, stoichiometry, the nature of the atom, chemical periodicity, the states of matter, thermodynamics and bonding. Successful completion satisfies pre-requisite for CHEM 1220. Completion of a prior Chemistry course is strongly recommended before enrolling in this course. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. Prerequisite: MATH 1050 (Grade C or higher), or equivalent placement score taken within 2 years prior to enrollment in this course. Corequisite: CHEM 1215. FA, SP.

CHEM 1215. Principles of Chemistry I Lab (LAB). 1 Hour.
Lab portion of CHEM 1210. Successful completion satisfies pre-requisite for CHEM 1225. Lab fee required. Corequisite: CHEM 1210. FA, SP.

CHEM 1220. Principles of Chemistry II. 4 Hours.
Continuation of CHEM 1210. Emphasizes kinetics, equilibrium, descriptive chemistry, nuclear chemistry, and special topics. Successful completion prepares students for and satisfies prerequisite for CHEM 2310 and further study in life and physical sciences. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the nature of molecular interactions by using kinetic data. 2. Apply chemical principles to the understanding of the physical and natural world. 3. Explain chemical processes and discuss their impact on the technological and environmental concerns of our modern industrialized society. 4. Describe the relationship between electrical and chemical energy. 5. Analyze equilibria in aqueous solutions and calculate the concentration of reactants and products at equilibrium. Prerequisite: CHEM 1210 (Grade C- or higher). Corequisite: CHEM 1225. FA, SP.

CHEM 1225. Principles of Chemistry II Lab. 1 Hour.
Lab portion of CHEM 1220. Successful completion satisfies prerequisite for CHEM 2315. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the influence of chemical change in the context of environmental situations and technological applications. 2. Explain the use of basic laboratory equipment and techniques of laboratory measurement and procedure. 3. Apply mathematical models to the analysis of laboratory data. 4. Discuss experimental observations in the laboratory setting and creating scientific reports to communicate the information gained. Course fee required. Prerequisite: CHEM 1215. Corequisite: CHEM 1220. FA, SP.

CHEM 2310. Organic Chemistry I. 4 Hours.
For Chemistry, Biology, pre-Medical, pre-Dental, pre-Optometry, pre-Pharmacy majors, pre-Chiropractic, pre-Medical Technician, and pre-Veterinary majors. Introduction to functional groups and related reactions, including an introduction to spectroscopy. Successful completion satisfies prerequisite for CHEM 2320. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain structures (hybridization, geometry, polarity) and compare physical properties (boiling point, melting point, solubility, conformation, stability) of organic compounds with various functional groups. 2. Name organic molecules using nomenclature, stereochemistry, and spectroscopy to give systematic names for compounds, draw correct structures, identify and label stereoisomers, recognize the possible stereochemical implications of a chemical reaction, and characterize and identify organic compounds. 3. Formulate, identifiy, and/or draw starting materials, reagents, and products for reactions of alkanes, alkenes, alkynes, and aromatics. 4. Apply mechanistic principles to recognize nucleophiles, electrophiles, acids, and bases, and correctly draw the mechanisms of selected reactions; use mechanisms to predict regio- and stereoselectivity of products. 5. Apply fundamental concepts to complex and advanced problems beyond the immediate context, including in making informed decisions in everyday life. Prerequisite: CHEM 1220 (Grade C- or higher). Corequisite: CHEM 2315. FA, SP.

CHEM 2315. Organic Chemistry I Lab. 1 Hour.
Lab portion of CHEM 2310. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate safe handling and appropriate disposal of laboratory chemicals. 2. Apply knowledge and principles from organic chemistry lecture to hands on laboratory experiences. 3. Perform appropriate calculations involving mass, moles, equivalents, volume, density, molecular weight, % composition, theoretical yield, % yield, and % recovery. 4. Demonstrate the ability to perform and the following organic laboratory techniques and explain the principles behind them: filtration, rotary evaporation, recrystallization, liquid/liquid extraction, TLC analysis, column chromatography, melting point, boiling point, distillation, and obtaining IR spectra. 5. Run an organic reaction, then isolate, purify, and characterize the products. 6. Write appropriate lab notebook entries which include an introduction, safety information, the reaction to be performed, a data table, a step by step procedure, and accurate and objective observations. 7. Write typewritten discussions which include a restatement of the purpose of the lab, a summary of the procedure used, a discussion of the observations and results obtained, and a conclusion based on this data. Course fee required. Prerequisite: CHEM 1225 (Grade C- or higher). Corequisite: CHEM 2310. FA, SP.

CHEM 2320. Organic Chemistry II. 4 Hours.
A continuation of CHEM 2310. Further study of functional groups and related reactions, including organic reactions necessary for synthesis of larger molecules. Successful completion prepares students for further study in biochemistry and physical chemistry. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Utilize mechanistic principles to recognize nucleophiles and electrophiles, acids and bases, and correctly draw the mechanisms of selected reactions; use mechanisms to predict the regio- and stereo-selectivity of product, and, in depth, the mechanism and kinetics of substitution and elimination reactions (SN1/SN2/E1/E2). 2. Identify, draw, and construct syntheses and reactions of numerous functional groups including: alkyl halides, alcohols, ethers, epoxides, carbonyl compounds, amines, and carbohydrates. 3. Design multi-step reaction sequences to synthesize increasingly complex organic molecules. 4. Pass a standardized Organic Chemistry exam covering the full year's course. 5. Apply fundamental concepts to complex and advanced problems beyond the immediate context, including in making informed decisions in everyday life. Prerequisite: CHEM 2310 (Grade C- or higher). Corequisite: CHEM 2325. FA, SP.

CHEM 2325. Organic Chemistry II Lab. 1 Hour.
Lab portion of CHEM 2320. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Practice safe handling and appropriate disposal of laboratory chemicals. 2. Apply knowledge and principles from organic chemistry lecture to hands-on laboratory experiences. 3. Perform appropriate calculations involving mass, moles, equivalents, volume, density, molecular weight, % composition, theoretical yield, and % yield. 4. Demonstrate the ability to perform the following organic laboratory techniques and explain the principles behind them: filtration, rotary evaporation, recrystallization, liquid-liquid extraction, TLC analysis, column chromatography, melting point, boiling point, distillation, and obtaining IR spectra. 5. Run a variety of organic reactions, then isolate, purify, and characterize the products. 6. Use data from a mass spectrum, IR spectrum, 1H and 13C NMR spectra, chemical test results, and a boiling or melting point to determine the identity of an unknown organic compound. 7. Write an appropriate lab notebook entry including an introduction, important safety information, the reaction to be performed, a data table, a step-by-step procedure, and accurate and objective observations. 8. Write a typewritten discussion which includes a restatement of the purpose of the lab, a summary of the procedure used, a discussion of the observations and results obtained, and a conclusion based on this data. 9. Perform chemical demonstrations suitable for an audience of elementary school children. Course fee required. Prerequisite: CHEM 2315 (Grade C- or higher). Corequisite: CHEM 2320. FA, SP.

CHEM 2700R. Field Methods in Chemistry Research. 1 Hour.
A preparatory course for undergraduate participation in field research projects in chemistry. Repeatable for a maximum of 3 credits. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Collect and organize scientific data from field investigations. 2. Gain familiarity with the context of the particular data set under consideration and will discover how the concepts and skills they are acquiring in their other coursework can be developed through interdisciplinary research. 3. Be prepared for participation in a research project. Course fee required. Prerequisite: CHEM 1215 (Grade B- or higher).

CHEM 2990. Chemistry Seminar and Professional Development. 1 Hour.
Seminar course aimed to help students who have declared a chemistry major prepare for future careers in their field. Seminar and workshop activities will include potential career paths in chemistry and biochemistry, professional development and research experience opportunities, preparing cover letters and resumes/CVs, and the process of applying to graduate programs and jobs. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify potential opportunities as a chemistry degree graduate. 2. Prepare and evaluate professional materials that will be needed to apply for summer and post-graduate jobs and programs. 3. Interact and collaborate with faculty, peer students, and guest speakers in a professional setting. 4. Develop professional skills for interviews and collaborative settings. Prerequisite: Declared as Chemistry or Molecular Biology-Biochemistry major. FA.

CHEM 3000. Quantitative Chemical Analysis. 4 Hours.
This course is focusing on understanding the principles of analytical chemistry and the application of these principles in various scientific disciplines. This course is addressing aspects of modern chemical analysis with emphasis on chemical equilibrium. Volumetric, gravimetric, and instrumental methods are described. Course will cover basic statistics, chemical equilibrium, gravimetric analysis, volumetric analysis, acid-base chemistry, complexation, spectrophotometry, and separations. There is a lecture and a laboratory component to this course. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply stoichiometry and chemical equilibrium for analysis. 2. Discuss and apply chemical measurement calibration. 3. Apply statistical methods for evaluating and interpreting data. 4. Identify the proper analytical technique for sample analysis. Course fee required. Prerequisite: CHEM 1220 (Grade C or higher). FA (even).

CHEM 3060. Physical Chemistry 1. 4 Hours.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the difference between classical and quantum mechanics, understanding the time, length, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the time, length, and energy scales on which chemical processes occur. 2. Understand the differences between classical and quantum mechanics. 3. Connect operators to observables. 4. Distinguish probabilities, amplitudes, averages, expectation values, and observables. 5. Understand the origin and implications of quantum coherence. 6. Interpret spectra. 7. Connect common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals). 8. Develop molecular-level critical thinking skills. Prerequisites: CHEM 1220 and PHYS 2210 (Grade C or higher). FA (odd).

CHEM 3065. Physical Chemistry I Lab. 1 Hour.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the difference between classical and quantum mechanics, understanding the time, length, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the time, length, and energy scales on which chemical processes occur. 2. Understand the differences between classical and quantum mechanics. 3. Connect operators to observables. 4. Distinguish probabilities, amplitudes, averages, expectation values, and observables. 5. Understand the origin and implications of quantum coherence. 6. Interpret spectra. 7. Connect common approximation methods to standard chemical frameworks (Born-Oppenheimer, molecular orbitals). 8. Develop molecular-level critical thinking skills. Course fee required. Prerequisites: CHEM 2320 and CHEM 2325 (both Grade C or higher), and PHYS 2210 and PHYS 2215 (both Grade C or higher). Corequisite: CHEM 3060. FA (odd).

CHEM 3070. Physical Chemistry II. 4 Hours.
Introduction to microscopic and bulk thermodynamics, partition functions, theory of electrolytes and electrochemistry, and chemical kinetics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Problem solve and critically think about thermodynamic and kinetic problems and extrapolate solutions based on learned theory. 2. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics. 3. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises. 4. Take their learning of thermodynamics and kinetics and be able to communicate current knowledge in the field in written form. 5. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems. Prerequisites: CHEM 3060 (Grade C or higher) and MATH 2210 (Grade C or higher). SP (even).

CHEM 3075. Physical Chemistry II Lab. 1 Hour.
A problem-oriented course in atomic and molecular structure, states of matter, and chemical kinetics. Introduction to efficient retrieval of information from the physical chemical literature and thinking critically about the material. Students will understand the kinetics and thermochemistry. The will gain understanding in statistical distributions, mechanistic pathways, and energy scales on which chemical processes occur, and connect common approximation methods to standard chemical frameworks. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Problem solve and critically think about thermodynamic and kinetic problems and extrapolate solutions based on learned theory. 2. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics. 3. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises. 4. Take their learning of thermodynamics and kinetics and be able to communicate current knowledge in the field in written form. 5. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems. Course fee required. Prerequisite: CHEM 1220 and CHEM 2320 and PHYS 2210 (all Grade C or higher). Corequisite: CHEM 3070. SP (even).

CHEM 3100. Inorganic Chemistry. 4 Hours.
Covers current theory and concepts in inorganic chemistry with an emphasis on general trends and periodic properties of the elements and their compounds. Topics include bonding and structure, acid-base theories, redox properties, molecular symmetry, coordination compounds, and crystal-field theory. Students will expand their knowledge of the role of metals in nature and use gained knowledge and critical thinking skills for problem solving. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply bonding theories to describe the structure and bonding of inorganic compounds. 2. Use symmetry and group theory to describe bonding and other chemical properties. 3. Understand and predict periodic trends in main group and d-block elements. 4. Explain the mechanisms and predict the products of some common inorganic reactions. 5. Demonstrate the ability to solve basic problems in each of the major areas of inorganic chemistry. Prerequisites: CHEM 2320 and CHEM 2325. FA.

CHEM 3300. Instrumental Analysis. 4 Hours.
Focuses on understanding the theory and practice of modern analytical instrumentation. Course emphasis will be placed on chromatography, optical spectroscopy, mass spectrometry, microscopy as well as sample preparation techniques, statistical data treatment, and quality assurance of data. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss the principles of the measurement by various instruments. 2. Generate data analysis, data manipulation and data interpretation. 3. Design analyses for specific problems with various analytes. 4. Produce scientific reports and presentations. Course fee required. Prerequisite: CHEM 3000 (Grade C or higher). SP (odd).

CHEM 3510. Biochemistry I. 3 Hours.
Covers cellular metabolism of biologically-important molecules (carbohydrate, lipids, proteins, and nucleic acids) as well as regulation of these metabolic processes. Principles will be taught using structure/function relationships. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the properties of water and how the aqueous environment influences the behavior of biological macromolecules. 2. Duplicate the structures of amino acids, explain their chemical properties and their organization into polypeptides and proteins. 3. Describe key principles of protein function, structure and characterization. 4. Discuss enzymes and how they catalyze reactions, as well as enzyme kinetics. 5. Describe structure and basic function of carbohydrates and lipids, and describe their roles in biological systems, including through the use of of signal transduction pathways. Prerequisites: BIOL 1610 AND BIOL 1615; AND CHEM 2320 AND CHEM 2325 (all Grade C- or higher). Corequisite: CHEM 3515. FA.

CHEM 3515. Biochemistry I Lab. 1 Hour.
Introduction to current biochemical techniques including spectrophotometry, chromatography, and electrophoresis. Includes analysis and manipulation of nucleic acids. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Confirm proficiency in micropipetting and solution preparation. 2. Investigate protein expression and purification, SDS-PAGE electrophoresis, and Western blotting. 3. Predict enzymatic kinetics and formulate associated calculations. 4. Analyze and process data and draw appropriate conclusions. 5. Generate scientific ideas by writing them in clear, concise, logical, and an accurate manner. Course fee required. Prerequisite: CHEM 2325 (Grade C or higher). Corequisite: CHEM 3510. FA.

CHEM 3520. Biochemistry II. 3 Hours.
Continuation of Biochemistry I. Introduction into catabolic and anabolic processes of animal and plant metabolism. Includes protein and nucleic acid biosynthesis and signal transduction. Discussion of current biochemical methods. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the molecules involved in the major biochemical metabolic pathways such as glycolysis, gluconeogenesis, citrate cycle, respiratory electron transport system, etc. 2. Explain the reactions and recognize rate-regulatory steps involved in the aforementioned pathways. 3. Discuss the origin of mitochondria and their essential role in oxidative phosphorylation. 4. Analyze the energy yield from the catabolism of any compound. 5. Explain how a membrane is synthesized by the incorporation of monoacyglycerols and their modifications and the synthesis and degradation of fatty acids mirror each other in their chemical reactions. Prerequisite: CHEM 3510 (Grade C or higher). Corequisite: CHEM 3525. SP.

CHEM 3525. Biochemistry II Lab. 1 Hour.
A laboratory course to be taken concurrently with CHEM 3520. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compose a comprehensive laboratory report based on multiple experiments. 2. Examine and quantify multiple metabolites found in cells. 3. Produce a Western blot independently. 4. Generate primers to amplify a gene and characterize using agarose gels. Course fee required. Prerequisite: CHEM 3515 (Grade C or higher). Corequisite: CHEM 3520. SP.

CHEM 4100. Advanced Inorganic Chemistry. 3 Hours.
A continuation of CHEM 3100. Topics may include more in-depth emphasis on molecular symmetry, group theory, organometallic reactions, bonding and structure, acid-base theories, redox properties, coordination compounds, and crystal-field theory. Students will expand their knowledge of the role of metals in nature and use gained knowledge and critical thinking skills for problem solving. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply bonding theories to describe the structure and bonding of inorganic compounds. 2. Use symmetry and group theory to describe bonding and other chemical properties. 3. Understand and predict periodic trends in main group and d-block elements. 4. Explain the mechanisms and predict the products of some common inorganic reactions. 5. Demonstrate the ability to solve basic problems in each of the major areas of inorganic chemistry. Prerequisite: CHEM 3100 (Grade C or higher). SP (odd).

CHEM 4200. Environmental Chemistry. 3 Hours.
This course will focus on the fundamental principles of chemistry necessary for understanding of the source, fate, and reactivity of compounds in natural and polluted environments. Emphasis will be placed on the environmental implications of energy utilization and on the chemistry of the atmosphere, hydrosphere, and lithosphere. Environmental issues that will be discussed include air pollution, stratospheric ozone depletion, pollution and treatment of water sources, and the utilization of insecticides and herbicides. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the chemistry of the atmosphere and environmental and health consequences of indoor and outdoor pollution. 2. Describe the nature, reactivity, and environmental fates of toxic organic chemicals. 3. Discuss the chemistry of natural waters and their pollution and purification. 4. Evaluate environmental chemistry issues and generating a comprehensive scientific report. Prerequisite: CHEM 2320 (Grade C or higher). FA (odd).

CHEM 4310. Adv Organic Chemistry I. 3 Hours.
A problem-oriented course that explores organic structure, stereochemistry, and thermodynamics and kinetics in organic reaction mechanisms. Introduction to efficient retrieval of information from the organic chemical literature, and to thinking critically about the material. Introduction to molecular orbital theory and aromaticity and resulting spectroscopic properties. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Predict the conformational preferences of common organic structures accounting for steric and electronic interactions. 2. Assign symmetry elements to molecules and determine symmetry point groups. 3. Describe stereochemical relationships and predict stereochemical outcomes for organic reactions. 4. Make logical predictions about the reactivity patterns to be expected from organic molecules. 5. Predict relative acidity of molecules. 6. Write kinetic rate laws for reactions and use these to evaluate proposed reaction mechanisms. 7. Draw molecular orbital diagrams for simple organic molecules. 8. Use Frontier Molecular Orbitals to understand and predict reactions. 9. Determine whether a pericyclic reaction is thermally or photochemically allowed using Molecular Orbital theory. 10. Learn to predict the products formed in various classes of pericyclic reactions. 11. Propose reasonable explanations for observed products. 12. Propose informative and incisive experimental tests to distinguish between mechanistic proposals. Prerequisite: CHEM 2310 (Grade C or higher); AND CHEM 2320 (Grade C or higher); AND CHEM 2325 (Grade C or higher). FA (even).

CHEM 4510. Chemistry of Materials. 3 Hours.
Provides the molecular understanding of materials structure and properties, including solid-state chemistry, chemical bonding in bulk materials, and properties of materials as function of local and extended structures. Topics include inorganic solids, organic and coordination polymers, organic conductors, hybrid materials, optical and magnetic materials, and biomaterials. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand inter- and intramolecular chemical bonding in bulk systems. 2. Assign symmetry elements to molecules and determine symmetry point groups. 3. Predict local and extended network structures in solids, liquids, and glasses. 4. Use structural information to predict properties of bulk systems. 5. Understand emerging properties from atomic to nano to bulk systems. 6. Predict and determine optical, electronic and magnetic properties of materials. 7. Learn techniques for structural and property determination. 8. Conceptualize relationships between natural, anthropogenic, and biological materials. Prerequisites: CHEM 2310, CHEM 2320, CHEM 2325; and either CHEM 3100 or CHEM 4310, or instructor permission. FA, SP.

CHEM 4610. Nutritional Biochemistry. 3 Hours.
A course in advanced biochemistry using nutrition as a model. The course will focus on human nutrition and metabolism. The functional and regulatory roles of macronutrients and micronutrients will be stressed. Additional components of the course will emphasize how nutrition science relates to nutrition information available to the lay public and drives nutrition policy. Students will be guided through an exploration of recent scientific literature in the areas of biochemistry and nutrition, and ways in which one informs the other. Current challenges in the field of nutrition will be related to the lecture material. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the basic concepts of biochemistry-bonds between molecules, digestion and absorption, actions of enzymes, protein, carbohydrate, and fat metabolism, actions of hormones, and regulation of gene expression. 2. Understand and explain the digestion, absorption, and metabolism of the energy providing nutrients -- carbohydrate, lipid and protein. 3. Understand and explain the interrelationship of the energy providing nutrients (carbohydrate, lipids, and fat) in the various metabolic pathways and their roles in supporting disease prevention. 4. Understand and explain the role of micronutrients (vitamins and minerals) in disease prevention. Prerequisites: CHEM 3520 (Grade C or higher). FA (odd).

CHEM 4800R. Independent Research. 1-3 Hours.
An independent research course that allows the students to explore science through the scientific method, and allows close interaction between the student and faculty member to address scientific problems through experiment design and execution. Projects are at the discretion of the faculty member, in line with the student's interests in the various scientific areas. Repeatable up to 6 credits subject to graduation and program restrictions. Variable credit: 1-3. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, design experiments, and draw conclusions from results. 2. Design and modify experiments during the progress of a research project. 3. Interpret results from experiments, modify the hypothesis. 4. Draw conclusions according to research goals. 5. Perform research independently, and interact with other students and faculty that are engaged in the project. 6. Utilize outside resources (scientific databases, literature, etc) to interpret results and compare to existing and previous work in the field of your research project. Prerequisites: CHEM 2310 AND CHEM 2320 AND CHEM 2325; AND ENGL 2010 or ENGL 2010A; AND instructor permission. FA, SP, SU.

CHEM 4910. Chemistry Senior Seminar. 1 Hour.
A seminar course where students will share their research results or literature searches with fellow students and faculty in written and oral formats. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to develop hypotheses, search literature or utilize results from experimentation, and defend in an oral presentation to faculty and students. 2. Become extremely familiar with using literature to support a topic or idea and discuss pros/cons and scientific validity of prior results. 3. Communicate results and discuss relevant scientific topics in oral presentations in a scientific group setting. 4. Interact with other students and faculty that are engaged in scientific discussion to analyze data, results, and different perspectives, participate in scientific discussion. 5. Utilize outside resources (scientific databases, literature, etc.) to help interpret results and compare to existing and previous work in the field. 6. Prepare written reports that effectively summarize a chosen scientific topic using the vast literature and compiled data. Prerequisites: CHEM 2320 and CHEM 2325 (Grade C or higher); and ENGL 2010 (Grade C or higher); Advanced Standing; and Instructor Permission. FA, SP.

Mechanical Engineering Courses

MECH 1000. Design: Introduction to Mechanical Design & Rapid Prototyping. 3 Hours.
An introduction to mechanical design and rapid prototyping required for Mechanical Engineering majors and open to makers. Students learn about mechanism design through design projects and rapid prototyping. Topics include: computer-aided design, dimensioning, tolerances, standard mechanical components, linkages, cams, gears, and 3D printing. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the Mechanical Engineering Program at DSU. 2. Know: TIE Center & Intellectual Property; CAD, 3D parts to 2D schematics; standard mechanical components and design for cost; the engineering design process; 3D printing technology & materials; 3D printing software; tolerances and probability distributions; Microsoft Word, PowerPoint, and Excel; Friction, joints, and fits; linkage design and CAD motion study; gear and gear train design; Cam and follower design. Course fee required. Corequisite: MECH 1005. FA.

MECH 1005. Design: Introduction to Mechanical Design & Rapid Prototyping Lab. 0 Hours.
Lab portion of MECH 1000. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use 3D printing slicing software. 2. Operate 3D printers. 3. Load and unload 3D prints. Corequisite: MECH 1000. FA.

MECH 1100. Design: Manufacturing Processes. 3 Hours.
An introduction to manufacturing processes required for Mechanical Engineering majors and open to makers. Students learn about various manufacturing processes through lecture and tours of local manufacturing facilities. Topics include: advantages and limitations of common manufacturing methods, component assembly, quality control, and manufacturing economics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe both the technical and business considerations of various manufacturing processes seen in local manufacturing facilities. 2. Compare the advantages and disadvantages of different manufacturing processes when determining how to manufacture a part. 3. Develop and construct a solution to a defined task using manufacturing methods taught in the course. 4. Employ basic experimental techniques to examine the effectiveness of multiple manufacturing processes. 5. Summarize a wide range of manufacturing processes, including reduction, consolidation, and additive techniques. FA.

MECH 1150. Design: Prototyping Techniques. 2.5 Hours.
Prototyping required for Mechanical Engineering majors and open to makers. Students learn the following prototyping techniques through hands-on training: basic machining, manual and CNC milling and turning, laser/plasma/EDM/waterjet cutting, laying composites, injection/blow molding, lost wax/foam casting, welding, vacuum forming, electroplating, post processing of 3D printed parts, and the use of adhesives and fasteners. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compare the advantages and disadvantages of different prototyping techniques when creating a product. 2. Demonstrate competency in various prototyping techniques, including machining, casting, coating, and plastic extrusion. 3. Design, model, and create prototypes that meets specified design criteria using modern and varied prototyping techniques. Course fee required. Prerequisite: MECH 1000 (Grade C- or higher). FA.

MECH 1200. Mechatronics: Coding. 3 Hours.
An introduction to coding required for Mechanical Engineering majors and open to makers. Students learn and apply the fundamentals of procedural and graphical programming to control microcontrollers, create user interfaces, and perform engineering analysis. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the following software products Matlab, Simulink, and Microcontrollers. 2. Produce order of operations, data types, variables, arrays functions. 3. Produce common functions. 4. Write scripts and debug scripts for errors. 4. Produce 2D plotting. 5. Wirte conditional statements and logic, loops, custom functions and scope, strings, complex numbers, matrices. 6. Produce 3D plotting. 7. Format cells arrays and structures, Input and output functions (I/O). 8. Produce graphical programming using Simulink and event-based programming using App Designer. Course fee required. Prerequisite: MECH 1000 (Grade C- or higher). Corequisite: MECH 1205. SP.

MECH 1205. Mechatronics: Coding Lab. 1 Hour.
Lab portion of MECH 1200. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand microcontrollers, interfacing, and flashing; taking data from sensors; moving motors; Matlab control of microcontrollers; Simulink control of microcontrollers; and Dixie Design Day preparation. Corequisite: MECH 1200. SP.

MECH 2010. Solid Mechanics: Statics. 3 Hours.
Fundamentals of static analysis required for Mechanical Engineering majors. Students learn to analyze bodies in equilibrium. Topics include: force vectors, equilibrium of particles and rigid bodies, structural analysis, internal forces, friction, centroids, and moments of inertia. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply principles of statics to analyze and solve engineering problems that relate to forces, rigid bodies, and moments of inertia. 2. Compare the difference between theoretical and experimental values when evaluating physical statics systems and articulate reasons for these differences. 3. Identify and breakdown real-world problems into solvable statics problems using appropriate simplifying assumptions. 4. Describe the basic concepts of statics, including force vectors, equilibrium, structural analysis, internal forces, center of gravity and moments of inertia. Corequisites: MATH 1220 AND PHYS 2210. FA.

MECH 2030. Solid Mechanics: Dynamics. 3 Hours.
Fundamentals of dynamic analysis required for Mechanical Engineering majors. Students learn to analyze bodies not in equilibrium. Topics include: force, acceleration, work, energy, impulse, and momentum of particles and rigid bodies. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Produce free body diagrams of complex engineering systems using appropriate simplifying assumptions. 2. Demonstrate the relationship between acceleration, velocity, position, and forces in multiple coordinate systems. 3. Assess the validity of proposed solutions to specific problems using principles of dynamics. 4. Describe the basic concepts of dynamics, including kinematics, work & energy, and impulse &momentum for particle, rigid body, and planar systems. Prerequisites: MECH 2010 (Grade C- or higher) AND PHYS 2210 (Grade C- or higher). SP.

MECH 2160. Solid Mechanics: Materials Science. 3 Hours.
Fundamentals of materials science required for Mechanical Engineering majors. Students learn about properties and microstructure of metals, ceramics, polymers, and composites. Topics include: atomic bonding and structure, diffusion, modes of material failure, phase diagrams, and material selection. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand materials science; atomic bonding; crystalline structure; crystal defects and noncrystalline structure; diffusion; mechanical behavior; thermal behavior; failure analysis and prevention; phase diagrams; kinetics - heat treatment; metals, ceramics, and glasses; polymers and composites; electronic materials; optical and magnetic materials; and materials in engineering design. Prerequisites: CHEM 1210 (Grade C- or higher) and MATH 1220 (Grade C- or higher; can be enrolled concurrently). SP.

MECH 2210. Mechatronics: Circuits. 2 Hours.
Fundamentals of circuit analysis required for Mechanical Engineering majors and open to makers. Students learn to analyze DC and AC circuits through lecture and laboratory experiments. Topics include: resistive circuits, inductance and capacitance, transients, diodes, transistors, operational amplifiers, and transformers. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of circuits; resistive circuits, inductance and capacitance; transients (1st order); steady-state sinusoidal analysis (AC); diodes; field-effect transistors; bipolar junction transistors; operational amplifiers; and magnetic circuits and transformers. Corequisites: PHYS 2220 AND MECH 2215. Prerequisite: MECH 1200 (Grade C- or higher). FA.

MECH 2215. Mechatronics: Circuits Lab. 1 Hour.
Lab portion of MECH 2210. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand electronic testing equipment, safety, procedures; voltage dividers and wheatstone bridge; 1st order transients, capacitor discharge; resonance; diodes, rectifiers, and LEDs; MOSFETs and BJTs; and op-amps. Corequisite: MECH 2210. FA.

MECH 2250. Mechatronics: Sensors & Actuators. 3 Hours.
Fundamentals of sensors and actuators required for Mechanical Engineering majors and open to makers. Students learn to implement sensors and actuators into an internet of things (IoT) application through lecture and laboratory experiments. Topics include: data acquisition, signal conditioning, uncertainty analysis, sensors and measurements, actuator control, and IoT. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of measurement methods; internet of things (IoT); Static and dynamic characteristics of signals; measurement system behavior; probability and statistics; uncertainty analysis; analog electrical devices and measurements; sampling, digital devices, and data acquisition; temperature measurements; pressure and velocity measurements; flow measurements; and strain measurements. Corequisite: MECH 2255. Prerequisite: MECH 2210 (Grade C- or higher); and MATH 2250 (can be concurrently enrolled) or MATH 2280 (can be concurrently enrolled). SP.

MECH 2255. Mechatronics: Sensors & Actuators Lab. 1 Hour.
Lab portion of MECH 2250. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand data acquisition; sensors and associated circuits; filtering; various motors and control of motors using microcontrollers; integrating sensor data and motor control with ThingSpeak; and Dixie Design Day preparation. Corequisite: MECH 2250. SP.

MECH 3200. Mechatronics: Systems & Controls. 3 Hours.
Fundamentals of systems and controls required for Mechanical Engineering majors. Students learn to model and control multi-domain systems through lecture and laboratory experiments. Topics include: mechanical, electrical, electromechanical, fluidic, and thermal systems, time and frequency domain analysis, feedback control, and control system design. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of systems and controls; dynamic response and Laplace transforms; mechanical systems; block diagrams and state variables; electrical and electromechanical systems; fluid and thermal systems; time domain analysis; frequency domain analysis; feedback control systems; control system design; and compensator design. Corequisite: MECH 3205. Prerequisites: MECH 2030, AND MECH 2250, AND MATH 2270 OR MATH 2280 (All Grade C- or higher). FA.

MECH 3205. Mechatronics: Systems & Controls Lab. 0.5 Hours.
Lab portion of MECH 3200. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Observe, test, and model --mechanical translational system. 2. Observe, test, and model -- mechanical rotational and translational system. 3. Observe, test, and model -- electromechanical system. 4. Observe, test, and model -- fluidic system. 5. Explore P, I and D and PID control. Corequisite: MECH 3200. FA.

MECH 3250. Mechatronics: Machinery. 3 Hours.
Fundamentals of machine design required for Mechanical Engineering majors. Students learn to design mechanical components in power transmission systems. Topics include: failure criteria, fatique, and analytical and finite-element analysis of stress in shafts, fasteners, joints, springs, bearings, and gears. The course culminates in a major design project that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand machine design; load and stress analysis; finite element analysis basics in CAD; failures resulting from static loading; fatigue failure resulting from variable loading; shafts and shaft components; screws, fasteners, and the design of non-permanent joints; welding, bonding, and the design of permanent joints; mechanical springs; rolling-contact bearings; lubrication and journal bearings; gears; spur and helical gears; and bevel and worm gears. Corequisite: MECH 3255. Prerequisites: MECH 3200 AND MECH 3300 AND MECH 2160 (All Grade C- or higher). SP.

MECH 3255. Mechatronics: Machinery Lab. 1 Hour.
Lab portion of MECH 3250. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand structural health monitoring; hydraulics and pneumatics; vibration table test; power transmission; and Dixie Design Day preparation. Corequisite: MECH 3250. SP.

MECH 3300. Solid Mechanics: Strength of Materials. 4 Hours.
Fundamentals of strength of materials required for Mechanical Engineering majors. Students learn to analyze stress, strain, and deflection in deformable bodies through lecture and laboratory experiments. Topics include: stress and strain, mechanical properties of materials, axial loading, torsion, bending, transverse shear, combined loadings, stress and strain transformations, deflection in beams and shafts, column buckling, and energy methods. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of strength of materials; stress; strain; mechanical properties of materials; axial loading; torsion; bending; transverse shear; combined loadings; stress transformations; strain transformations; design of beams and shafts; deflection of beams and shafts; buckling of columns; and Energy Methods. Corequisites: MATH 2210 AND MECH 3305. Prerequisite: MECH 2010 (Grade C- or higher). FA.

MECH 3305. Solid Mechanics: Strength of Materials Lab. 0.5 Hours.
Lab portion of MECH 3300. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know tension/compression; hardness testing; shear; beam bending; column buckling; and failure design competition. Corequisite: MECH 3300. FA.

MECH 3600. Thermofluids: Thermodynamics. 4 Hours.
Fundamentals of thermodynamics required for Mechanical Engineering majors. Students learn to apply the laws of thermodynamics to open and closed systems through lecture and laboratory experiments. Topics include: energy transfer, laws of thermodynamics, power cycles, refrigeration and heat pump cycles, gas mixtures, psychrometrics, combustion, and chemical and phase equilibrium. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze thermodynamic systems, including open and closed systems, using appropriate models and simplifications. 2. Arrange complex thermodynamic cycles into simpler systems to evaluate cycle efficiency, output power, and input power. 3. Design and report on a thermodynamic cycle that satisfies specific customer needs, with suitable consideration of efficiency, economics, and environmental impact. 4. Summarize basic concepts of thermodynamics, including properties of pure substances, thermodynamic laws, entropy, gas mixtures, psychrometrics, and combustion. Prerequisites: PHYS 2210 AND MATH 2210 (Both Grade C- or higher). SP.

MECH 3605. Thermofluids: Thermodynamics Lab. 0.5 Hours.
Lab portion of MECH 3600. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know heat engine experiment; gas laws; flame temperature; humidity and dew point; and air conditioning. Corequisite: MECH 3600. SP.

MECH 3650. Thermofluids: Heat Transfer. 3 Hours.
Fundamentals of heat transfer required for Mechanical Engineering majors. Students learn to analyze conduction, convection, and radiation heat transfer through lecture and laboratory experiments. Topics include: steady state and transient conduction, forced and natural convection, boiling and condensation, heat exchangers, and radiation heat transfer. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of heat transfer; heat conduction equation; steady state heat conduction; transient heat conduction; numerical methods in heat conduction; fundamentals of convection; forced convection; natural convection; boiling and condensation; heat exchangers; radiation heat transfer; and mass transfer. Corequisite: MECH 3655. Prerequisites: MATH 3500 AND MECH 3700 (both Grade C- or higher). SP.

MECH 3655. Thermofluids: Heat Transfer Lab. 0.5 Hours.
Lab portion of MECH 3650. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know thermal conductivity of materials; 1D conduction heat transfer -- rod; 2D conduction heat transfer -- plate; 1D conduction and convection heat transfer -- rod; heat exchangers; convection heat transfer -- stirring; and radiation cube. Corequisite: MECH 3650. SP.

MECH 3700. Thermofluids: Fluid Mechanics. 4 Hours.
Fundamentals of fluid mechanics required for Mechanical Engineering majors. Students learn to analyze fluids through lecture and laboratory experiments. Topics include: fluid statics, conservation of mass, work and energy of moving fluids, fluid momentum, dimensional analysis and similitude, viscous flow within enclosed surfaces, pipe flow, compressible flow, and turbomachines. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic concepts of fluid mechanics; fluid statics; linematics of fluid motion; conservation of mass; work and energy of moving fluids; fluid momentum; dimensional analysis and similitude; viscous flow within enclosed surfaces; analysis and design for pipe flow; viscous flow over external surfaces; compressible flow; and turbomachines. Corequisites: MATH 3500 AND MECH 3705. Prerequisites: MATH 2210 AND MECH 2030 AND MECH 3600 (All Grade C- or higher). FA.

MECH 3705. Thermofluids: Fluid Mechanics Lab. 0.5 Hours.
Lab portion of MECH 3700. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know hydraulic lift; major and minor losses in pipe flow; flow visualization and drag force for various objects; airfoil lift and drag; pressure distribution over a cylinder; slats and flaps; boundary layer growth; and pumps. Corequisite: MECH 3700. FA.

MECH 4000. Design: Product Design I. 3 Hours.
First course in the product design series required for Mechanical Engineering majors. Students work in teams to develop a product through customer needs identification, concept generation and selection, concept testing, benchmarking, design parameter specification, engineering analysis, and critical function prototyping. The course culminates in an alpha prototype and formal design review of the product with faculty and industry leaders. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know product design; product development process; product planning and project management. 2. Identify customer needs. 3. Understand product specifications; concept generation; concept selection; concept testing & robust design; design for manufacturing; prototyping; product architecture; patents and intellectual property; and product development economics. Corequisite: ENGL 3010. Prerequisites: MECH 3650 AND MECH 3250 AND MECH 1100 AND MECH 1150 (All Grade C- or higher). FA.

MECH 4010. Design: Product Design II. 3 Hours.
Second course in the product design series required for Mechanical Engineering majors. Student teams further develop their product through engineering analysis, beta testing, economic analysis, design for manufacturing, design reviews, and documentation. The course culminates in a final product that will be presented to the public at Dixie Design Day. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know product specifications; project logistics; design reviews; product documentation; and Dixie Design Day preparation. Prerequisite: MECH 4000 (Grade C- or higher). SP.