Engineering (ENGR)

Course information contained within the Bulletin is accurate at the time of publication in August 2023 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

ENGR 1001. College of Engineering First Year Seminar. 1 Credit Hour.
This course will focus on helping first-year engineering students develop the skills needed to effectively transition to college life in their engineering program at Temple University. The course is designed to provide students with an introduction to valuable and functional time management skills, goal setting, study and test-taking strategies and career and professional development skills necessary for success in engineering. The course will also focus on student engagement by introducing students to experiential education, student professional organizations, research opportunities, and other social activities within the College of Engineering and Temple community. NOTE: Registration for this course is restricted to first year students enrolled in the College of Engineering.

Class Restrictions: Must be enrolled in one of the following Classes: Freshman 0 to 29 Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

ENGR 1101. Introduction to Engineering & Engineering Technology. 3 Credit Hours.
Provides an understanding of the study and practice associated with bioengineering, civil, electrical, mechanical engineering and technology disciplines. Understand the importance of good communications and teamwork skills in a successful engineering and technology career. Understand the basics of problem solving and design. Discipline-specific labs.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

ENGR 1102. Introduction to Engineering Problem Solving. 3 Credit Hours.
This course is designed to introduce students to important computational skills and tools that will provide the basis for future work and study in engineering. The overall theme of the course will focus on the role of the computer in engineering problem solving and analysis. Students will learn the fundamentals of algorithmic thinking, program design, program development, debugging, and critical analysis of the suitability of different techniques for different problems. Applications to problems in engineering analysis with topics selected from the engineering degree programs offered.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 1101 or ENGR 1901)

ENGR 1103. Introduction to Mathematical Modeling for Engineers. 4 Credit Hours.
This course will provide an overview of the salient math topics most heavily used in the core sophomore-level engineering courses. These include algebraic manipulation of engineering equations, trigonometry, vectors and complex numbers, sinusoids and harmonic signals, systems of equations and matrices, differentiation, integration and differential equations. All math topics will be presented within the context of an engineering application, and reinforced through extensive examples of their use in the core engineering courses.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C in (MATH 1021, 'Y' in MC5, 'Y' in MC6, 'Y' in MC6A, 'Y' in CRMA04, or 'Y' in MC6T)

ENGR 1117. Engineering Graphics. 2 Credit Hours.
Computer-aided geometrical construction, solids modeling, charts, orthographic and isometric drawings, dimensioning, auxiliary views, sectioning, geometric tolerancing, and elementary drafting problems.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

ENGR 1185. Internship Experience I. 1 to 4 Credit Hour.
Work experience in industry, governmental agencies, or educational institutions is arranged through the Director of Career Services in the College of Engineering. The course is for one semester of work experience. Letter from supervisor and report by student are required.

Class Restrictions: May not be enrolled in one of the following Classes: Freshman 0 to 29 Credits.

Repeatability: This course may be repeated for additional credit.

ENGR 1901. Honors Introduction to Engineering. 3 Credit Hours.
Provides a high level understanding of the study and practice associated with bioengineering, civil, electrical, mechanical engineering and technology disciplines. Understand the importance of good communication and teamwork skills in a very successful engineering and technology career. Understand the fundamentals of problem solving and design. Discipline-specific labs.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may not be repeated for additional credits.

ENGR 2011. Engineering Analysis & Applications. 3 Credit Hours.
This course introduces applications of linear algebra for solving engineering problems from theoretical, analytical, and computer-based perspectives. Topics include linear matrix equations with engineering applications, vector and matrix operations, rank and determinant, matrix inversion, linear independence, eigenvalues and eigenvectors, rectangular and polar representations of complex numbers, and complex number algebra. Engineering applications of various concepts are emphasized. Modern appropriate software tools will be utilized to aid in solving these mathematical problems.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042, MATH 1942, 'Y' in MATW, 'Y' in CRMA09, or 'Y' in METW), ENGR 1102, and ENGR 2013 (may be taken concurrently)

ENGR 2013. Engineering Analysis and Applications Lab. 1 Credit Hour.
This is a supplementary computer laboratory course for ENGR 2011 Engineering Analysis and Applications. Modern appropriate software tools will be utilized to aid in solving mathematical problems studied in ENGR 2011.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042, MATH 1942, 'Y' in MATW, or 'Y' in METW), ENGR 1102, and ENGR 2011 (may be taken concurrently)

ENGR 2101. Professional Development Seminar for Engineers. 1 Credit Hour.
The purpose of this course is to help prepare students for engineering internship, research, Co-Op, and job search processes and experiences. Guided by the National Association of Colleges and Employers (NACE) career readiness and competencies framework the course will help students gain, refine, and demonstrate requisite skills necessary for a successful transition into the professional work environment.

Repeatability: This course may not be repeated for additional credits.

ENGR 2181. Co-Op Work Experience I. 3 Credit Hours.
Each is a prerequisite to the course that follows. Full time work experience in industry, governmental agencies, or educational institutions is arranged through the co-op coordinator of the College of Engineering (15 weeks, 40 hours/week). Students are considered as academically full-time during work periods.

Class Restrictions: May not be enrolled in one of the following Classes: Freshman 0 to 29 Credits.

Repeatability: This course may be repeated for additional credit.

ENGR 2185. Internship Experience II. 1 to 4 Credit Hour.
Work experience in industry, governmental agencies, or educational institutions is arranged through the Director of Career Services in the College of Engineering. The course is for one semester of work experience. Letter from supervisor and report by student are required.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 1185.

ENGR 2196. Technical Communication. 3 Credit Hours.
Technical Communication prepares students for their capstone Senior Design project and professional communication as engineers. This course emphasizes technical research and source evaluation, audience-specific writing, accuracy, and clarity. Responsible engineering is a core component, particularly current events, the impact of engineering, and ethical decision-making. Students are encouraged to explore areas of personal interest for the term paper, which can be used as a writing sample or draft for later publication.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1031 (may be taken concurrently), 'Y' in MATW, or 'Y' in METW) and (PHYS 1061 (may be taken concurrently), PHYS 2021 (may be taken concurrently), PHYS 2921 (may be taken concurrently), or PHYS 1021 (may be taken concurrently))

ENGR 2331. Engineering Statics. 3 Credit Hours.
You will learn fundamental concepts that are used in every engineering discipline: vector mechanics of concentrated and distributed forces, moments, Free Body Diagrams, static analyses of trusses, frames and machines, internal forces and moments, frictional systems, centroids, and moments of inertia.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1031, 'Y' in MATW, or 'Y' in METW) and (PHYS 1061, PHYS 2021, PHYS 2921, or PHYS 1021)

ENGR 2332. Engineering Dynamics. 3 Credit Hours.
A vector approach to the study of the rectilinear and curvilinear motion of particles and rigid bodies as described by rectangular, polar, and path coordinates and the study of the forces that produce such motion as described through the application of Newton's second law of motion, work-energy relationships, and impulse and momentum principles, including rigid body rotation and relative motion.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 2331 or ENGR 2931)

ENGR 2333. Mechanics of Solids. 3 Credit Hours.
Classical approach to axial stress and strain, torsion, bending, combined stress, biaxial stress, deflection of beams and frames, elastic strain energy, pressure vessels, column stability, and buckling.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 2331 or ENGR 2931)

ENGR 2334. Engineering Statics/Dynamics. 3 Credit Hours.
Vector mechanics of force and moment systems in two and three dimensions, free body diagrams and the static equilibrium of structures, centroids, area and mass of the rectilinear and curvilinear motion of particles as described by rectangular, polar and path coordinates and the study of the forces that produce such motion using Newton's second law of motion, work-energy relationships, and impulse-momentum techniques. An overview of rigid body rotation is presented.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1041, MATH 1941, MATH 1038, 'Y' in MATW, or 'Y' in METW) and (PHYS 1021 or PHYS 1061)

ENGR 2335. Mechanics I. 3 Credit Hours.
A vector mechanics study of STATICS: free body diagrams, equilibrium, resultant force/couple systems, reaction forces and couples on 2-D and 3-D systems, member forces in trusses; and DYNAMICS: kinematics and kinetics of particles.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (MATH 1042 (may be taken concurrently), MATH 1942 (C or higher; may be taken concurrently), MATH 1951 (C or higher; may be taken concurrently), any MATH course numbered 2043 to 3080 (may be taken concurrently), 'Y' in MA07, 'Y' in MATW, 'Y' in CRMA11, or 'Y' in METW) and (PHYS 1061 (may be taken concurrently), PHYS 2021 (may be taken concurrently), PHYS 2921 (may be taken concurrently), PHYS 1062 (may be taken concurrently), PHYS 2022 (may be taken concurrently), PHYS 2922 (may be taken concurrently), any PHYS course numbered 2101 to 2701 (may be taken concurrently), any PHYS course numbered 3101 to 3701 (may be taken concurrently), or any PHYS course numbered 4101 to 4796 (may be taken concurrently))

ENGR 2336. Mechanics II. 3 Credit Hours.
A vector mechanics study of STATICS: centroids, moments of inertia, shearing force and bending moment diagrams, frictional systems; and DYNAMICS: the rectilinear and curvilinear motion, rigid bodies as described by rectangular, polar and path coordinates and the study of the forces that produce such motion as described through the application of Newton's second law of motion, work-energy relationships, and impulse and momentum principles, including rigid body rotation and relative motion.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- in ENGR 2335.

ENGR 2900. Honors Special Topics. 3 Credit Hours.
Variable Honors offerings on special topics that are not part of the standard roster of courses. Check with the College of Engineering office for details on Special Topics courses.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may be repeated for additional credit.

ENGR 2931. Honors Engineering Statics. 3 Credit Hours.
Vector mechanics of force and moment systems in two and three dimensions, freebody diagrams and the static equilibrium of structures, centroids, moments of inertia, frictional systems, shearing force, and bending moment diagrams. This honors class will be held to high standards.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1041, MATH 1941, MATH 1038, 'Y' in MATW, or 'Y' in METW) and (PHYS 1061, PHYS 2021, or PHYS 2921)

ENGR 2933. Honors Mechanics of Solids. 3 Credit Hours.
Classical approach to axial stress and strain, torsion, bending, combined stress, biaxial stress, deflections of beams and frames, elastic strain energy, pressure vessels, column stability, and buckling. Very challenging honors course.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in ENGR 2931.

ENGR 2996. Honors Technical Communication. 3 Credit Hours.
This course prepares engineering and other STEM honors students for the technical writing and related communications they will generate in subsequent courses and professionally. (The growing interdisciplinarity of engineering projects has prompted this invitation to other STEM majors. But note that this course teaches communication topics generically - not specialized terminologies, document types, or writing styles.) Writing skills emphasized in the course include finding and properly using technical research sources, responding to the needs of diverse audiences, ensuring accuracy and clarity, and automating documents for efficient maintainability. Students are encouraged to put extra effort into their self-designed main paper to increase its value as a professional writing sample and perhaps even for publication. The course also readies students for responsible professional practice by having them analyze relevant news developments, project impacts, and ethical challenges.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), MATH 1031 (may be taken concurrently), 'Y' in MATW, or 'Y' in METW) and (PHYS 1021 (may be taken concurrently), PHYS 1061 (may be taken concurrently), PHYS 1961 (may be taken concurrently), PHYS 2021 (may be taken concurrently), PHYS 2921 (may be taken concurrently), CHEM 1031 (may be taken concurrently), CHEM 1035 (may be taken concurrently), or CHEM 1951 (may be taken concurrently))

ENGR 3001. Engineering Economics. 3 Credit Hours.
The objectives of the course are to apply economic theory to design, planning and execution of engineering problems and projects. This course focuses on modern economic theories such as behavioral economics and random theory to provide engineering students with the decision-making skills necessary to evaluate the economic feasibility of investment projects. As the capital outlays may be significant and affect the productive potential of a firm over the long term, it is important to understand the time value of money and how it may be impacted by parameters such as climate change. The course emphasizes on measurements of economic worth, after tax cash flow analysis, replacement analysis, and supplemental analysis; including break even, sensitivity, and risk analysis. A final project consisting of evaluating a real-world investment project is performed and submitted as a report and presented at the end of the course.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

ENGR 3033. Entrepreneurial Engineering. 3 Credit Hours.
The course is specifically designed to introduce students to the ideas and concepts of entrepreneurship; to help students recognize the entrepreneurial potential within themselves and others in their environment; link the entrepreneur's spirit with the engineer's mind and discipline; give the students the understanding of the opportunities and challenges facing any entrepreneur from the start up through running and growing a business; and create an understanding of the role of technology in developing the students' understanding of all the different opportunity paths that are available in today's economic and global environment. Students will develop an awareness of how to detect, understand, and develop product and/or service opportunities; understand and master the different business, legal, regulatory and human challenges that confront any business every day; understand the basic accounting, marketing, sales, negotiating, communication, intellectual property and analytical tools of business and how to apply them; understand how to decipher and learn from case studies; and learn the importance of and the creation of a business plan and how to use it to raise money and/or support for their business venture.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

ENGR 3077. Simulation of Linear and Nonlinear Engineering Systems. 3 Credit Hours.
A first course on the theory and engineering applications of mathematical modeling of linear and nonlinear systems. Building mathematical models from essential laws, the role of assumptions, development of governing equations, dimensional analysis, solutions of fundamental equations, computer programming using Maple, simulation, effect of parameter estimation, forecasting, graphical systems analysis, model verification, and validation.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 2043 (may be taken concurrently) or 'Y' in METW)

ENGR 3117. Computer-Aided Design (CAD). 3 Credit Hours.
Introduction to Computer-Aided Design (CAD) using the state of the art ANSYS finite element program. The focus is to train students to perform advanced two- and three- dimensional solid modeling/stress analysis using ANSYS finite element software for solving and designing complex mechanical structures. It is expected that before taking this course, students have fundamental understanding of statics, dynamics, and solid mechanics concepts. Design projects will be given where students will have to design, analyze, and manufacture structural designs.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in (ENGR 1117 (D- or higher) or MEE 1117 (D- or higher)), (ENGR 2333, ENGR 2933, or BIOE 3312), and (MEE 3011 (D- or higher) or Complete the following: (ENGR 2332 or BIOE 2312), (MATH 2101, ENGR 2011, or MEE 2011), and (MATH 2041, MATH 2941, MATH 3041, MATH 3941, or 'Y' in METW))

ENGR 3181. Co-Op Work Experience II. 3 Credit Hours.
Each is a prerequisite to the course that follows. Full time work experience in industry, governmental agencies, or educational institutions is arranged through the co-op coordinator of the College of Engineering (15 weeks, 40 hours/week). Students are considered as academically full-time during work periods.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 2181.

ENGR 3185. Internship Experience III. 1 to 4 Credit Hour.
Work experience in industry, governmental agencies, or educational institutions is arranged through the Director of Career Services in the College of Engineering. The course is for one semester of work experience. Letter from supervisor and report by student are required.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 2185.

ENGR 3201. Material Science for Engineers. 3 Credit Hours.
Atomic and molecular structures, bonding and interatomic forces, thermodynamics and kinetics of solid reactions, mechanical, electronic, and magnetic properties of solids.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (PHYS 1062, PHYS 2022, or PHYS 2922), (CHEM 1031, CHEM 1035, or CHEM 1951), and (ENGR 2333 (may be taken concurrently) or ENGR 2933 (may be taken concurrently))

ENGR 3281. Co-op Experience I. 3 Credit Hours.
Students will research Co-op opportunities, receive the Director's approval for the specific Co-op, set up interviews, and obtain a position and work a minimum thirty-five hours a week during the 14-week term for the three credit hours in a professional environment related to the careers they might have an interest. Students are responsible for preparing themselves for the professional experience in consultation with the Director of the Co-op program. There will be a number of sources to choose from, including approved opportunities maintained on file in the Director's office, student generated or discovered opportunities for which student must receive prior approval and opportunities with established commercial, engineering and professional organizations approved by the Director. Students may take Co-op experiences with different entities but are encouraged to repeat professional experiences with the same organization.

Class Restrictions: May not be enrolled in one of the following Classes: Freshman 0 to 29 Credits.

Repeatability: This course may be repeated for additional credit.

ENGR 3334. Mechanical Systems. 3 Credit Hours.
This course considers the fundamentals of mechanics including statics, dynamics, materials, thermodynamics and fluid mechanics and their application to systems of beams, pulleys, gear trains, levers exhibiting vibration, heat conduction, convection and expansion and fluid flow.

Department Restrictions: Must be enrolled in one of the following Departments: Engineering:Elec Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in PHYS 1062 and (MATH 2043 or 'Y' in METW)

ENGR 3381. Co-op Experience II. 3 Credit Hours.
Students will research Co-op opportunities, receive the Director's approval for the specific Co-op, set up interviews, and obtain a position and work a minimum thirty-five hours a week during the 14-week term for the three credit hours in a professional environment related to the careers they might have an interest. Students are responsible for preparing themselves for the professional experience in consultation with the Director of the Co-op program. There will be a number of sources to choose from, including approved opportunities maintained on file in the Director's office, student generated or discovered opportunities for which student must receive prior approval and opportunities with established commercial, engineering and professional organizations approved by the Director. Students may take Co-op experiences with different entities but are encouraged to repeat professional experiences with the same organization.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in minimum GPA of 2.5 in: ENGR 3281.

ENGR 3553. Mechanics of Fluids. 3 Credit Hours.
General physical properties of fluids. Fluid statics and pressure measurements. Kinematics of fluid motion. Conservation laws in control volume and differential forms with applications. Bernoulli's equation and irrotation flow. Viscous flow in pipes and flow measurements. Boundary layer concepts. Numerical methods. Design project.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 2332 or BIOE 3312), (MATH 3041 (may be taken concurrently), MATH 3941 (may be taken concurrently), MATH 2041 (may be taken concurrently), MATH 2941 (may be taken concurrently), or 'Y' in METW), and (MATH 2043, MATH 2943, or 'Y' in METW)

ENGR 3571. Classical and Statistical Thermodynamics. 3 Credit Hours.
The study of the concepts, theory, and application of energy and entropy from a classical and statistical viewpoint. NOTE: Special Authorization for Non-Majors. Open to all engineering majors.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (PHYS 1062, PHYS 1962, PHYS 2022, or PHYS 2922), (MATH 1042, MATH 1942, 'Y' in MATW, or 'Y' in METW), and (CHEM 1031, CHEM 1035, CHEM 1041, or CHEM 1951)

ENGR 3953. Honors Mechanics of Fluids. 3 Credit Hours.
General physical properties of fluids. Fluid statics and pressure measurements. Kinematics of fluid motion. Conservation laws in control volume and differential forms with applications. Bernoulli's equation and irrotation flow. Viscous flow in pipes and flow measurements. Boundary layer concepts. Numerical methods. Design project. This honors course will be held to high standards.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 2332 or BIOE 3312), (MATH 3041 (may be taken concurrently), MATH 3941 (may be taken concurrently), MATH 2041 (may be taken concurrently), MATH 2941 (may be taken concurrently), or 'Y' in METW), and (MATH 2043, MATH 2943, or 'Y' in METW)

ENGR 3982. Honors Independent Study. 1 to 4 Credit Hour.
A challenging opportunity to either 1) study an honors course which is not offered during the semester, or 2) study specialized topics not covered in currently available honors courses. High standards are expected of the student by an honors faculty who will supervise.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO

Repeatability: This course may be repeated for additional credit.

ENGR 4040. Special Topics. 1 to 4 Credit Hour.
A course designed to present new and emerging areas of engineering. The course may also be used to present areas not normally taught in the College. Course requirements vary with the topic and instructor. Offered as needed or as appropriate.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may be repeated for additional credit.

ENGR 4101. Fundamentals of Engineering (FE) Examination Review. 1 Credit Hour.
This course will give students the practical and theoretical knowledge to help pass the FE examination. The course provides a comprehensive review of basic science and engineering, theories and applications, advanced topics in civil and mechanical engineering. Problem solving and test taking strategies will be an integral part of the course. The course will provide additional assessment for ABET.

Repeatability: This course may not be repeated for additional credits.

ENGR 4116. Spacecraft Systems Engineering. 3 Credit Hours.
This course will introduce the systems engineering concept through satellite applications. The goals of this course are to introduce: a) systems engineering concepts, b) satellite subsystems, c) astrodynamics, and d) intellectual property. Topics covered will include space environment, dynamics of spacecraft, celestial mechanics, mission analysis, attitude control, systems engineering, and patents.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- in (MATH 3041, MATH 3941, MATH 2041, MATH 2941, or 'Y' in METW)

ENGR 4121. Design of Experiments. 3 Credit Hours.
The practice of modern science and engineering is synonymous with the ability to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions in applications ranging from new product design and development to phenomenological/basic science studies. In this course we will focus primarily on methodological and design issues in planning experiments rather than on statistical analysis of the data. Nevertheless, we will briefly review various statistical analysis approaches required for fully designed experiment. Case studies involving single factor experiments, factorial designs, manipulation checks, etc. will be used to develop hands on skills for designing your own experiments. The course will have a focus on engineering approach to design of experiments with a particular emphasis on problem definition, system identification, data collection, statistical analysis, and hypothesis testing. For the final project, you will prepare a fellowship or grant (e.g. NSF GRFP or AHA Predoctoral) application ready for submission to a funding agency.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.

Repeatability: This course may not be repeated for additional credits.

ENGR 4169. Engineering Seminar. 1 Credit Hour.
Preparation for entering the professional world of engineering. Includes job placement, professional registration, ethics, professional societies, case studies, and guest speakers.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (ENGR 2196 (may be taken concurrently) or ENGR 2996 (may be taken concurrently))

ENGR 4171. Senior Design Project I for Industrial and Systems Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for industrial and systems engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Industrial + Sys Engineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in ISE 3102, ISE 3103, ISE 4104, CEE 3048 (D- or higher), and ENGR 4169 (D- or higher)

ENGR 4172. Senior Design Project I for Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Engineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- (except where noted) in (ECE 2332 (C- or higher) or ECE 2112 (C- or higher)), (ECE 3732, ECE 3722, ECE 3622, or ENGR 3553), and ENGR 4169.

ENGR 4173. Senior Design Project I for Environmental Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for environmental engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Environmental Enginrng.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in CEE 3712, CEE 3715, CEE 3717, (CEE 3727 or CEE 4631), CEE 4721, and ENGR 4169 (D- or higher)

ENGR 4174. Senior Design Project I for Bioengineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for bioengineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Bioengineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in BIOE 3001 (may be taken concurrently), BIOE 3101, BIOE 3102 (may be taken concurrently), BIOE 3201, and ENGR 4169 (D- or higher)

ENGR 4175. Senior Design Project I for Civil Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for civil engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Civil Engineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- (except where noted) in CEE 3331, CEE 3332, ((CEE 3411 (D- or higher) and CEE 3412 (D- or higher)) or CEE 3711), ENGR 3553, ENGR 3571, and ENGR 4169 (D- or higher)

ENGR 4176. Senior Design Project I for Electrical Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for electrical engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Electrical Engineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- (except where noted) in (ECE 3412 or CIS 1068), ECE 3512 (C- or higher), ECE 3522, ECE 3612, (ECE 3712 or ECE 3622), and ENGR 4169 (C- or higher)

ENGR 4177. Senior Design Project I for Mechanical Engineering. 2 Credit Hours.
This is the first course of a two-semester senior design sequence intended for mechanical engineering majors. Students will develop and practice skills and techniques for managing and executing engineering design projects. This includes problem identification, planning of the project, formulation of design specifications, the development and evaluation of alternative conceptual designs, the development of detailed designs and specification of manufacturing processes, prototyping of manufacturing processes, and analysis and documentation of results. At completion, students will present their design process and final design in several formats: oral presentations, poster presentations, web pages, and reports.

Field of Study Restrictions: Must be enrolled in one of the following Majors: Mechanical Engineering.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- (except where noted) in ECE 2112, (ENGR 3553 (C- or higher) or ENGR 3953 (C- or higher)), ENGR 3571 (C- or higher), ENGR 4169, MEE 3301, and (ENGR 3117 (may be taken concurrently) or MEE 3117 (may be taken concurrently))

ENGR 4181. Co-Op Work Experience III. 1 Credit Hour.
Each is a prerequisite to the course that follows. Full time work experience in industry, governmental agencies, or educational institutions is arranged through the co-op coordinator of the College of Engineering (15 weeks, 40 hours/week). Students are considered as academically full-time during work periods.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 3181.

ENGR 4182. Independent Study in Engineering. 1 to 5 Credit Hour.
Arranged each semester, please consult with the instructor.

Repeatability: This course may be repeated for additional credit.

ENGR 4185. Internship Experience IV. 1 to 4 Credit Hour.
Work experience in industry, governmental agencies, or educational institutions is arranged through the Director of Career Services in the College of Engineering. The course is for one semester of work experience. Letter from supervisor and report by student are required.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 3185.

ENGR 4201. Micro- to Nano-sized Machines. 3 Credit Hours.
This course begins with a vision of the present and futuristic nano-machines and micro-factories, as well as a brief review of the crystal structure and types of materials most commonly used to make them. The advantages of shrinking bulk machines to microscopic-to-nanoscopic sizes are discussed. The course quantifies 'scaling laws' for various physical properties, and their impact on design and microfabrication considerations. Microfabrication methods are discussed in detail, ranging from hard and soft lithography, to 3d printing. The course classifies various types of actuators and sensors based on thermal, electric, electronic, magnetic, optical, and chemical energy conversion principles; this is followed by their design and microfabrication. The course is supplemented by physical and video demonstrations.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- in (ENGR 3201 or ENGT 3201)

ENGR 4281. Co-Op Work Experience IV. 1 Credit Hour.
Full time work experience in industry, governmental agencies, or educational institutions is arranged through the co-op coordinator of the College of Engineering (15 weeks, 40 hours/week). Students are considered as academically full-time during work periods.

Repeatability: This course may be repeated for additional credit.

Pre-requisites: Minimum grade of D- in ENGR 4181.

ENGR 4296. Capstone Senior Design Project. 3 Credit Hours.
In this college-wide capstone design project, College of Engineering seniors, either individually or in (possibly cross-disciplinary) teams, will devise an engineered solution to a well-defined, approved, problem statement selected by the team in the prior semester. The wide variety of projects which may be undertaken include, for example: industry-sponsored case studies, or a student's entrepreneurial-invention idea, or the development of new instrumentation for a faculty's lab; furthermore, the team may choose to continue, refine, or extend a prior-semester's project. The student (or student team) will identify the relevant stakeholders for their engineered solution, create a prototype and/or a comprehensive analysis of their solution, and document their design in a report which meets the needs of the project's stakeholders. The semester will culminate in the college-wide Capstone Design Poster event, with industry sponsors and industrial advisory boards in attendance.

Course Attributes: WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- in (BIOE 3402, CEE 4446, CEE 4447, ECE 4176, ISE 4176, or MEE 4177)

ENGR 4314. Continuum Mechanics. 3 Credit Hours.
Tensors, Kinematics of Continuum, Stress, Integral Formulations, the Elastic Solid, and the Newtonian Fluid.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in (MATH 2041, MATH 2941, MATH 3041, MATH 3941, or 'Y' in METW), (MATH 2043, MATH 2943, or 'Y' in METW), and (ENGR 2333 or ENGR 2933)

ENGR 4334. Advanced Dynamical Systems. 3 Credit Hours.
This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of 3D bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of C- in MEE 3011.

ENGR 4576. Computational Fluid Dynamics. 3 Credit Hours.
Computational Fluid Dynamics (CFD) simulations are an essential element of thermal and fluid engineering design. In this course, students will be introduced to various numerical methods for computing heat transfer and fluid flows. Fundamental topics include discretization, explicit and implicit schemes, finite differencing, and finite volume formulations. Important aspects of industry applications of CFD will also be covered, including grid generation, flow visualization, and turbulence modeling. MATLAB programming and the use of commercially available software will be emphasized.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- (except where noted) in (ENGR 3553 (C- or higher) or ENGR 3953 (C- or higher)), (ENGR 3117 (may be taken concurrently) or MEE 3117 (may be taken concurrently)), and MEE 4572 (may be taken concurrently)

ENGR 4577. Nanotechnology Solutions for a Sustainable Urban Environment. 3 Credit Hours.
The course will introduce students to the revolutionary field of nanotechnology, where emphasis will be placed on using nanomaterials to the betterment of a sustainable urban environment. Students will be introduced to the remarkable transformation that the mechanical, optical, electrical, and thermal material properties undergo as their dimensions are reduced to the nanoscale. They will also understand the major nanomaterial fabrication techniques such as nanoscale lithography and self-assembly, In addition, students will be introduced to techniques which characterize materials on the nanoscale. The second half of the course will be devoted to applications and potential applications of nanotechnology which will advance urban sustainability. Applications in water purification, transportation, energy and biomedicine will be presented to the students through series of expert lectureships offered by Temple University faculty utilizing nanomaterials in their research laboratories. Students will also carry out laboratory modules devoted to the use of nanomaterials for these applications.

Class Restrictions: Must be enrolled in one of the following Classes: Junior 60 to 89 Credits, Senior 90 to 119 Credits, Senior/Fifth Year 120+ Credits.
College Restrictions: Must be enrolled in one of the following Colleges: Engineering.

Course Attributes: SE, SF

Repeatability: This course may not be repeated for additional credits.

ENGR 4996. Honors Capstone Senior Design Project. 3 Credit Hours.
In this college-wide capstone design project, College of Engineering seniors, either individually or in (possibly cross-disciplinary) teams, will devise an engineered solution to a well-defined, approved, problem statement selected by the team in the prior semester. The wide variety of projects which may be undertaken include, for example: industry-sponsored case studies, or a student's entrepreneurial-invention idea, or the development of new instrumentation for a faculty's lab; furthermore, the team may choose to continue, refine, or extend a prior-semester's project. The student (or student team) will identify the relevant stakeholders for their engineered solution, create a prototype and/or a comprehensive analysis of their solution, and document their design in a report which meets the needs of the project's stakeholders. The semester will culminate in the college-wide Capstone Design Poster event, with industry sponsors and industrial advisory boards in attendance. For those on the Honors Scholar track, the final report produced in this course may also be submitted as the Honors Scholar Project so long as it meets the Honors Scholar project requirements.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR.

Course Attributes: HO, WI

Repeatability: This course may not be repeated for additional credits.

Pre-requisites: Minimum grade of D- in (BIOE 3402, CEE 4446, CEE 4447, ECE 4176, ISE 4176, or MEE 4177)

ENGR 5011. Engineering Mathematics I. 3 Credit Hours.
This is a survey course in essential mathematics for first-year graduate students in engineering and physical sciences. Topics include analytic methods in ordinary differential equations, complex-variable theory, the laplace transform and its inversion, and initial-value problems and boundary-value problems. Matlab, numerical methods, and introductory numerical algorithm design are introduced.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5012. Engineering Mathematics II. 3 Credit Hours.
This is a survey course in classical numerical and analytical methods for partial differential equations, for first-year masters and doctoral students in engineering and physical sciences. Topics include analytic methods and numerical methods for partial differential equations in cartesian and non-cartesian coordinate systems, and an introduction to perturbation theory. The course will emphasize quantitative analysis, and assignments will entail computational algorithm design.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5022. Engineering Analysis and Applications. 3 Credit Hours.
Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5031. Engr Prob Stats Stoc Met. 3 Credit Hours.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5032. Probability, Statistics, and Stochastic Methods. 3 Credit Hours.
A balanced approach to probability, statistics, stochastic models, and stochastic differential equations with special emphasis on engineering applications. Random variables, probability distributions, Monte Carlo simulations models, statistical inference theory, design of engineering experiments, reliability and risk assessment, fitting data to probability distributions, ANOVA, stochastic processes, Brownian motion, white noise, random walk, colored noise processes. Differential equations subject to random initial conditions, random forcing functions, and random parameters. Partial differential equations subject to stochastic boundary conditions. New techniques for non-linear differential equations. Computer simulation with MAPLE and other symbolic algebra software.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5033. Probability and Random Processes. 3 Credit Hours.
Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5110. Special Topics. 3 Credit Hours.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 5116. Spacecraft Systems Engineering. 3 Credit Hours.
The concept of systems engineering is introduced using a satellite application. Systems engineering is a top-down approach to the design, implementation, testing, and deployment of large-scale systems to meet the needs of users. The topics will include systems engineering methodology, dynamics of spacecraft, and celestial mechanics. This course will also introduce the notion of invention and innovation, and how they are related to the intellectual property issues.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5117. Experimental Methods. 3 Credit Hours.
Application and design of experimental techniques and measurement systems used in engineering laboratories. Introduction to the DMM, digital scope, and computer-based data acquisition systems for measurements of force, motion, pressure, temperature, and flow in steady and unsteady systems. Data transmission, data analysis and presentation, and computer interfacing techniques. Statistical methods and uncertainty analysis. Hands-on experience with state-of-the-art instrumentation systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5121. Design of Experiments. 3 Credit Hours.
The practice of modern science and engineering is synonymous with the ability to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions in applications ranging from new product design and development to phenomenological/basic science studies. In this course we will focus primarily on methodological and design issues in planning experiments rather than on statistical analysis of the data. Nevertheless, we will briefly review various statistical analysis approaches required for fully designed experiment. Case studies involving single factor experiments, factorial designs, manipulation checks, etc. will be used to develop hands on skills for designing your own experiments. The course will have a focus on engineering approach to design of experiments with a particular emphasis on problem definition, system identification, data collection, statistical analysis, and hypothesis testing. For the final project, you will prepare a fellowship or grant (e.g. NSF GRFP or AHA Predoctoral) application ready for submission to a funding agency.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5201. Multiscale Design of Materials and Structures. 3 Credit Hours.
All materials and structures have a multiscale nature spanning from atoms to molecules, microstructures, and finally to structures with real-world functionality and applications. This course is important for a comprehensive and project-based understanding of computational techniques that enable high-fidelity, simulation-driven design across multiple length scales. Students will learn the theory and practice of several computational techniques including molecular dynamics, micromechanics, and structural optimization. Students will apply computational tools to extract material properties based on atomic structures or microstructures, design atomic structures or microstructures of materials to achieve desired properties, and optimize engineering structures based on material properties fed from lower-scale calculations. Students will become independently competent in atomistic modeling and simulation of fluids and solids, microstructural analysis and design of hybrid composites and structured materials, and the optimal design of engineering structures for maximum performance and weight savings.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5314. Continuum Mechanics. 3 Credit Hours.
This course covers tensors, kinematics of a continuum, stress, integral formulations, linear isotropic elastic solid, and an introduction to Newtonian Fluid (CLO 3).

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5334. Dynamical Systems. 3 Credit Hours.
This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of 3D bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5511. Fluid Dynamics. 3 Credit Hours.
Navier-Stoke's equation, Laminar and turbulent flow, boundary layer phenomena, compressible fluid flow including isotropic flow, shock waves, friction flow, and flow with heat transfer.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5576. Computational Fluid Dynamics. 3 Credit Hours.
This course introduces the fundamentals of numerical solution methods for thermal and fluid dynamics applications. Focus is placed on the development of explicit and implicit methods for solving linear and nonlinear partial differential equations for heat conduction, wave propagation, and potential flow. Important topics pertaining to the use of commercial and research grade CFD software are included. As a final course objective, students will develop a solution method for 2D incompressible flow using MATLAB or a similar programming environment.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 8110. Special Topics. 3 Credit Hours.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9182. Independent Study I. 3 Credit Hours.
Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by MS/MSE students and once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9185. Experience in Engineering Profession I. 1 to 3 Credit Hour.
This course involves work experience in industry on current industrial practices of advanced engineering concepts under the supervision of a faculty advisor and an industrial mentor. At the end of the internship period, the student submits a technical report that is suitable for general public release. The report is graded by the faculty advisor in consultation with the industrial mentor. Students already employed in the industry are not eligible to register for this course.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9282. Independent Study II. 3 Credit Hours.
Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9285. Exper Engineer Prof II. 1 to 3 Credit Hour.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9990. Engineering Seminar. 1 to 3 Credit Hour.
Students present their research results at an open seminar. The seminars may be arranged on a biweekly basis over the semester. Active participation of all graduate students is expected.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9991. Directed Research. 1 to 6 Credit Hour.
Under the guidance of a faculty member, the student will conduct independent research on a selected topic in engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.
This course is intended for Ph.D. students who have completed their coursework but who have not yet passed both the Ph.D. Preliminary Examination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9995. Project. 1 to 3 Credit Hour.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9996. Thesis. 3 Credit Hours.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.
This course is intended for Ph.D. students who have passed both the Preliminary and Qualifying Examinations but who have not been elevated to candidacy.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9999. Dissertation Research. 1 to 6 Credit Hour.
This course is intended only for those students who have achieved Ph.D. Candidacy status. A minimum of 6 semester hours is required for graduation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.
Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.