4010. Physical Metallurgy Principles. 3 hours. Physical metallurgy principles with a focus on understanding structure-property relationships in metals and alloys. Topics include structure, dislocations, mechanical behavior, grain boundaries, annealing, recrystallization, grain growth, diffusion, phase diagrams, transformations, strengthening mechanisms, fatigue, creep and fracture. Emphasis on the basic structure-property-processing relationships in metals and how they differ from other material classes. Prerequisite(s): MTSE 3010, 3030 and 3040.

4020. Materials in Medicine. 3 hours. The science and engineering of materials having medical applications. Provides students with an understanding of the challenges that materials (metals, polymers and ceramics) face/create during short- and long-term contact with mammalian physiology. Develops the student's understanding of the relationships controlling acceptance or failure of a given material in the body. Exposes students to strategies used in current and future biomaterials. Prerequisite(s): MTSE 3010 and 3050.

4030. Ceramic Science and Engineering. 3 hours. Emphasis on structure-property relationships: chemical bonding, crystal structures, crystal chemistry, electrical properties, thermal behavior, defect chemistry. Processing topics: powder preparation, sol-gel synthesis, densification, toughening mechanisms. Materials topics: glasses, dielectrics, superconductors, aerogels. Prerequisite(s): MTSE 3010, 3020, 3040.

4040. Computational Materials Science. 3 hours. Introduction to the basic principles used to simulate, model and visualize the structure and properties of materials. Topics include the various methods used at different length and time scales ranging from the atomistic to the macroscopic. Prerequisite(s): MTSE 3010 and 3030; MATH 3310.

4050. Polymer Science and Engineering. 3 hours. Chemical structures, polymerization, molar masses, chain conformations. Rubber elasticity, polymer solutions, glassy state and aging. Mechanical properties, fracture mechanics and viscoelasticity. Dielectric properties. Polymer liquid crystals. Semi-crystalline polymers, polymer melts, rheology and processing. Thermal analysis, microscopy, diffractometry and spectroscopy of polymers. Computer simulations of polymer-based materials. Prerequisite(s): MFET 3450.

4060. Materials Selection and Performance. 3 hours. Integration of structure, properties, processing and performance principles to formulate and implement solutions to materials engineering problems. Prerequisite(s): MTSE 3030, 3040 and 3050.

4070. Electronic Materials. 3 hours. Intensive study of electronic, optical and magnetic properties of materials with an emphasis on the fundamental physics and chemistry associated with these material systems. Prerequisite(s): MFET 3450 and MATH 3310.

4090. Senior Research Project I. 2 hours. Provides students with experience in research and development. Students pick a faculty mentor for this class and attend bi-weekly meetings with the other students to discuss progress, strategies, outcomes, etc. Designed primarily for the students to do a literature survey on the selected topic and a research plan to be initiated either late in the semester or in the follow-on course in the subsequent semester. Prerequisite(s): MTSE 3010, 3020, 3030, 3040, 3050, 3070 and 3080.

4100. Senior Research Project II. 2 hours. Follow-on course from MTSE 4090, Senior Research Project I. Students continue to work with the same faculty mentor for this class and will continue to attend bi-weekly meetings with the other students to discuss progress, strategies, outcomes, etc. Designed primarily for the students to perform the proposed research plan established in MTSE 4090. Prerequisite(s): MTSE 4090.

4500. Internship in Materials Science. 3 hours. A supervised industrial internship requiring a minimum of 150 hours of work experience. Prerequisite(s): consent of department.

4900. Special Topics in Materials Science and Engineering. 1–3 hours (maximum of 8 credits). Lectures, laboratory or other experiences covering specially selected topics in materials science and engineering. Prerequisite(s): MATH 1710, CHEM 1410/1430. May be repeated as topics vary.

4910. Materials Science Research. 1–3 hours. Introduction to research; may consist of an experimental, theoretical or review topic.

4920. Cooperative Education in Materials Science. 3 hours. Supervised work in a job directly related to the student's major, professional field of study or career objectives. Prerequisite(s): 12 hours of credit in materials science; student must meet employer's requirements and have consent of department. May be repeated for credit.

4951. Honors College Capstone Thesis. 3 hours. Major research project prepared by the student under the supervision of a faculty member and presented in standard thesis format. An oral defense is required of each student for successful completion of the thesis. Prerequisite(s): completion of at least 6 hours in honors courses; completion of at least 12 hours in the major department in which the thesis is prepared; approval of the department chair and the dean of the school or college in which the thesis is prepared; approval of the dean of the Honors College. May be substituted for HNRS 4000.

Mathematics

Mathematics, MATH

Students taking mathematics courses at the 2000 level or above are expected to be competent in computer programming using such languages as BASIC, C, FORTRAN or PASCAL. This competency can be obtained through completion of CSCE 1020.

For all mathematics courses, a grade of C or better is strongly recommended before progressing to the next course.

1010. Fundamentals of Algebra. 3 hours. Basic algebraic operations, linear equations and inequalities, polynomials, rational expressions, factoring, exponents and radicals, and quadratic equations. Prerequisite(s): consent of department. Students may not enroll in this course if they have credit for any other UNT mathematics course. Credit in this course does not fulfill any degree requirement.

1100 (MATH 1314 or 1414). College Algebra. 3 hours. Quadratic equations; systems involving quadratics; variation, ratio and proportion; progressions; the binomial theorem; inequalities; complex numbers; theory of equations; determinants; partial fractions; exponentials and logarithms. Prerequisite(s): two years of high school algebra and one year of geometry, and consent of department. A grade of C or better in MATH 1100 is required when MATH 1100 is a prerequisite for other mathematics courses. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1190 (MATH 1325 or 1425). Business Calculus. 3 hours. Differential and integral calculus with emphasis on applications to business. Prerequisite(s): MATH 1100 with a grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1350 (MATH 1350). Mathematics for Elementary Education Majors I. 3 hours. Concepts of sets, functions, numeration systems, different number bases, number theory, and properties of the natural numbers, integers, rational, and real number systems with an emphasis on problem solving and critical thinking. Only for students requiring course for teacher certification. Prerequisite(s): MATH 1100 with a grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1351 (MATH 1351). Mathematics for Elementary Education Majors II. 3 hours. Concepts of geometry, probability and statistics, as well as applications of the algebraic properties of real numbers to concepts of measurement with an emphasis on problem solving and critical thinking. Only for students requiring course for teacher certification. Prerequisite(s): MATH 1350. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1400. College Math with Calculus. 3 hours. An applied mathematics course designed for non-science majors. All topics are motivated by real world applications. Equations, graphs, functions; exponentials and logarithms; mathematics of finance; systems of linear equations and inequalities, linear programming; probability; basic differential calculus with applications. Prerequisite(s): two years of high school algebra and consent of department; or MATH 1100 with grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1650 (MATH 2312 or 2412) Pre-Calculus. 5 hours. A preparatory course for calculus. Trigonometric functions, their graphs and applications; the conic sections, exponential and logarithmic functions and their graphs; graphs for polynomial and rational functions; general discussion of functions and their properties. Prerequisite(s): MATH 1100 with a grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1680 (MATH 1342 or 1442). Elementary Probability and Statistics. 3 hours. An introductory course to serve students of any field who want to apply statistical inference. Descriptive statistics, elementary probability, estimation, hypothesis testing and small samples. Prerequisite(s): MATH 1100 with grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1710 (MATH 2313 or 2413 or 2513). Calculus I. 4 hours. Limits and continuity, derivatives and integrals; differentiation and integration of polynomial, rational, trigonometric, and algebraic functions; applications, including slope, velocity, extrema, area, volume and work. Prerequisite(s): MATH 1650. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1720 (MATH 2314 or 2414). Calculus II. 3 hours. Differentiation and integration of exponential, logarithmic and transcendental functions; integration techniques; indeterminate forms; improper integrals; area and arc length in polar coordinates; infinite series; power series; Taylor's theorem. Prerequisite(s): MATH 1710. *Satisfies the Mathematics requirement of the University Core Curriculum.*

1780. Probability Models. 3 hours. Probability theory, discrete and continuous random variables, Markov chains, limit theorems, stochastic processes, models for phenomena with statistical regularity. Prerequisite(s): MATH 1710.

2510. Real Analysis I. 3 hours. Introduction to mathematical proofs through real analysis. Topics include sets, relations, types of proofs, continuity and topology of the real line. Prerequisite(s): MATH 1720.

2700 (MATH 2318 or 2418). Linear Algebra and Vector Geometry. 3 hours. Vector spaces over the real number field; applications to systems of linear equations and analytic geometry in En, linear transformations, matrices, determinants and eigenvalues. Prerequisite(s): MATH 1720.

2730 (MATH 2315 or 2415). Multivariable Calculus. 3 hours. Vectors and analytic geometry in 3-space; partial and directional derivatives; extrema; double and triple integrals and applications; cylindrical and spherical coordinates. Prerequisite(s): MATH 1720.

2770 (MATH 2305 or 2405). Discrete Mathematical Structures. 3 hours. Introductory mathematical logic, mathematical induction, relations and functions, combinatorics, counting techniques, graphs and trees, and finite automata theory. Prerequisite(s): MATH 1710; CSCE 1020 or 1030 (may be taken concurrently).

2900-2910. Special Problems. 1–3 hours each. May be repeated for credit.

3010. Seminar in Problem-Solving Techniques. 1 hour. Problem-solving techniques involving binomial coefficients, elementary number theory, Euclidean geometry, properties of polynomials and calculus. May be repeated for credit.

3310. Differential Equations for Engineering Majors. 3 hours. First order linear equations, separable equations, second order linear equations, method of undetermined coefficients, variation of parameters, regular singular points, Laplace transforms, 2x2 and 3x3 first order linear systems, phase plane analysis, introduction to numerical methods and various applications. Topics include motion problems, electric circuits, growth and decay problems, harmonic oscillators, simple pendulums, mechanical vibrations, Newton's law of gravity and predator-prey problems. Recommended for engineering majors. May not use both 3310 and 3410 to satisfy a requirement of differential equations. Prerequisite(s): MATH 1720.

3350. Introduction to Numerical Analysis. 3 hours. Description and mathematical analysis of methods used for solving problems of a mathematical nature on the computer. Roots of equations, systems of linear equations, polynomial interpolation and approximation, least-squares approximation, numerical solution of ordinary differential equations. Prerequisite(s): MATH 2700 and computer programming ability.

3400. Number Theory. 3 hours. Factorizations, congruencies, quadratic reciprocity, finite fields, quadratic forms, diophantine equations. Prerequisite(s): MATH 2510 or MATH 2770.

3410. Differential Equations I. 3 hours. First-order equations, existence-uniqueness theorem, linear equations, separation of variables, higher-order linear equations, systems of linear equations, series solutions and numerical solutions. Prerequisite(s): MATH 1720 and MATH 2700.

3420. Differential Equations II. 3 hours. Ordinary differential equations arising from partial differential equations by means of separation of variables; method of characteristics for first-order PDEs; boundary value problems for ODEs; comparative study of heat equation, wave equation and Laplace's equation by separation of variables and numerical methods; further topics in numerical solution of ODEs. Prerequisite(s): MATH 2700 and 3410.

3510. Introduction to Abstract Algebra I. 3 hours. Groups, rings, integral domains, polynomial rings and fields. Prerequisite(s): MATH 2510.

3520. Abstract Algebra II. 3 hours. Topics from coding theory, quadratic forms, Galois theory, multilinear algebra, advanced group theory, and advanced ring theory. Prerequisite(s): MATH 3510.

3610. Real Analysis II. 3 hours. Continuation of 2510. Topics include derivatives, integrals, limits of sequences of functions, Fourier series; and an introduction to multivariable analysis. Prerequisite(s): MATH 2510; and 2700 (may be taken concurrently).

3680. Applied Statistics. 3 hours. Descriptive statistics, elements of probability, random variables, confidence intervals, hypothesis testing, regression, contingency tables. Prerequisite(s): MATH 1710; MATH 1720 (may be taken concurrently).

3740. Vector Calculus. 3 hours. Theory of vector-valued functions on Euclidean space. Derivative as best linear-transformation approximation to a function. Divergence, gradient, curl. Vector fields, path integrals, surface integrals. Constrained extrema and Lagrange multipliers. Implicit function theorem. Jacobian matrices. Green's, Stokes', and Gauss' (divergence) theorems in Euclidean space. Differential forms and an introduction to differential geometry. Prerequisite(s): MATH 2700 and 2730.

4050. Advanced Study of the Secondary Mathematics Curriculum. 3 hours. Study of mathematical topics in the secondary curriculum from an advanced viewpoint. Discussion of the relationship between the secondary and collegiate curricula. As each of the mathematical topics is studied, related issues involving cognitive development, pedagogical methods and the philosophy of teaching and learning are considered. Prerequisite(s): MATH 3510 and 4060, EDSE 3830, and acceptance into the secondary teacher education program.

4060. Foundations of Geometry. 3 hours. Selections from synthetic, analytic, projective, Euclidean and non-Euclidean geometry. Prerequisite(s): MATH 2510. Prior or concurrent enrollment in MATH 3510 or MATH 3610 is strongly recommended.

4100. Fourier Analysis. 3 hours. Application-oriented introduction to Fourier analysis, including Fourier series, Fourier transforms, discrete Fourier transforms, wavelets, orthogonal polynomials and the Fast Fourier Transform (FFT) algorithm. The theoretical portions of the course emphasize interconnections and operator algebraic formalism. Applications are chosen from among differential equations, signal processing, probability and high precision arithmetic. Prerequisite(s): MATH 1720 and 2700; MATH 2730 and 3410 are recommended (may be taken concurrently).

4200. Dynamical Systems. 3 hours. One-dimensional dynamics. Sarkovskii's theory, routes to chaos, symbolic dynamics, higher-dimensional dynamics, attractors, bifurcations, quadratic maps, Julia and Mandelbrot sets. Prerequisite(s): MATH 3610.

4430. Introduction to Graph Theory. 3 hours. Introduction to combinatorics through graph theory. Topics introduced include connectedness, factorization, Hamiltonian graphs, network flows, Ramsey numbers, graph coloring, automorphisms of graphs and Polya's Enumeration Theorem. Connections with computer science are emphasized. Prerequisite(s): MATH 2510 or 2770.

4450. Introduction to the Theory of Matrices. 3 hours. Congruence (Hermitian); similarity; orthogonality, matrices with polynomial elements and minimal polynomials; Cayley-Hamilton theorem; bilinear and quadratic forms; eigenvalues. Prerequisite(s): MATH 2700.

4500. Introduction to Topology. 3 hours. Point set topology; connectedness, compactness, continuous functions and metric spaces. Prerequisite(s): MATH 3610.

4520. Introduction to Functions of a Complex Variable. 3 hours. Algebra of complex numbers and geometric representation; analytic functions; elementary functions and mapping; real-line integrals; complex integration; power series; residues, poles, conformal mapping and applications. Prerequisite(s): MATH 2730.

4610. Probability. 3 hours. Combinatorial analysis, probability, conditional probability, independence, random variables, expectation, generating functions and limit theorems. Prerequisite(s): MATH 2730.

4650. Statistics. 3 hours. Sampling distributions, point estimation, interval estimation, hypothesis testing, goodness of fit tests, regression and correlation, analysis of variance, and non-parametric methods. Prerequisite(s): MATH 3680 and 4610.

4900-4910. Special Problems. 1–3 hours each.

4951. Honors College Capstone Thesis. 3 hours. Major research project prepared by the student under the supervision of a faculty member and presented in standard thesis format. An oral defense is required of each student for successful completion of the thesis. Prerequisite(s): completion of at least 6 hours in honors courses; completion of at least 12 hours in the major department in which the thesis is prepared; approval of the department chair and the dean of the school or college in which the thesis is prepared; approval of the dean of the Honors College. May be substituted for HNRS 4000.

Mechanical and Energy Engineering

Mechanical and Energy Engineering, MEEN

1110. Mechanical and Energy Engineering Practice I. 1 hour. Introduction to the practice of Mechanical and Energy Engineering, applications of the subject, presentation of the work of the faculty and practicing engineers, seminars on "real world" projects, ethics and professional orientation.

1210. Mechanical and Energy Engineering Practice II. 1 hour. Continuation of MEEN 1110. Applications of Mechanical and Energy Engineering, presentations by faculty and practicing engineers, professional orientation, professional ethics.

2130. Statics and Dynamics. 4 hours. Statics of particles and rigid bodies. Concepts of force, moments, free body diagrams, equilibrium and friction with engineering applications. Kinematics and kinetics of particles and rigid bodies. Energy and impulse momentum methods applied to particles and rigid bodies. Plane motion of rigid bodies and force analysis of linkages. Prerequisite(s): MATH 1720, PHYS 1710 and 1730.

2210. Thermodynamics. 3 hours. Zeroth, first and second laws of thermodynamics with applications to engineering and energy conversion, open and closed systems, thermodynamic properties of simple substances, equations of state, thermodynamic properties of mixtures, psychrometrics and psychrometric charts. Prerequisite(s): MATH 2730.