MTSE 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 MTSE 3050.

MTSE 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, MTSE 3020, MTSE 3040.

MTSE 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 MTSE 3030; MATH 3310.

MTSE 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): ENGR 3450.

MTSE 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, MTSE 3040 and MTSE 3050.

MTSE 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): ENGR 3450 and MATH 3310.

MTSE 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, MTSE 3020, MTSE 3030, MTSE 3040, MTSE 3050, MTSE 3070 and MTSE 3080.

MTSE 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.

MTSE 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.

MTSE 4580. Materials for a Sustainable Environment. 3 hours. Properties of renewable and nonrenewable, sustainable and non-sustainable materials, effects of product application and needs on material choices for a sustainable environment; degradation mechanisms; and influence of the environment on mechanisms. Prerequisite(s): CHEM 1415 or equivalent or CHEM 1410/CHEM 1430; PHYS 1710/PHYS 1730; MATH 1710.

MTSE 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/CHEM 1430. May be repeated as topics vary.

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

MTSE 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.

MTSE 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 languages such 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.

MATH 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.

MATH 1100 (MATH 1314 or MATH 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.*

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

MATH 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.*

MATH 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.*

MATH 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.*

MATH 1580 (MATH 1332). Survey of Mathematics with Applications. 3 hours. Topics include probability, statistics, algebra, logic and the mathematics of finance. Additional topics are selected from geometry, sets, cryptography, fair division, voting theory and graph theory. Emphasis is on applications. Recreational and historical aspects of selected topics are also included. Technology is used extensively. MATH 1580 is not intended to prepare students for calculus, science, engineering or business courses. Prerequisite(s): two years of high school algebra and one year of high school geometry and consent of department, or MATH 1010 with a grade of C or better. Students may not receive credit for both MATH 1580 and MATH 1581. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1581 (MATH 1432). Survey of Mathematics with Applications and Algebra Review. 4 hours. (3;1) An alternate version of MATH 1580 for students identified in the mathematics placement process as requiring supplemental instruction to strengthen their algebra skills. Students may not enroll in this course if they have received credit for any other UNT mathematics course with a grade of C or better. Students may not receive credit for both MATH 1580 and MATH 1581. Prerequisite(s): consent of department. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1600 (MATH 1316). Trigonometry. 3 hours. Trigonometry based on both right triangles and the unit circle: graphs of trigonometric functions; inverse trigonometric functions; trigonometric identities and equations; laws of sines and cosines; polar coordinates; DeMoivre's theorem; vectors. MATH 1600 and MATH 1610 together cover approximately the same material as MATH 1650. Students who already have credit for MATH 1650 may not receive credit for MATH 1600. Prerequisite(s): MATH 1100 with a grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1610. Functions, Graphs and Applications. 3 hours. Preparatory course for calculus: algebra and graphs of functions; properties and graphs of polynomials and rational functions; graphs and applications of exponential and logarithmic functions; applications of trigonometric functions and graphs; sequences, series and their applications. MATH 1600 and MATH 1610 together cover approximately the same material as MATH 1650. Students who already have credit for MATH 1650 may not receive credit for MATH 1610. Prerequisite(s): MATH 1600. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1650 (MATH 2312 or MATH 2412). Pre-Calculus. 5 hours. Preparatory course for calculus: trigonometric functions, their graphs and applications; sequences and series; exponential and logarithmic functions and their graphs; graphs of polynomial and rational functions; general discussion of functions and their properties. MATH 1650 covers approximately the same material as MATH 1600 and MATH 1610 together. Students who already have credit for both MATH 1600 and MATH 1610 may not receive credit for MATH 1650. Prerequisite(s): MATH 1100 with a grade of C or better. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1680 (MATH 1342 or MATH 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): two years of high school algebra and one year of high school geometry and consent of department, or MATH 1010 with grade of C or better. Students may not receive credit for both MATH 1680 and MATH 1681. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1681 (MATH 1442). Elementary Probability and Statistics with Algebra Review. 4 hours. (3;1) An alternate version of MATH 1680 for students identified in the mathematics placement process as requiring supplemental instruction to strengthen their algebra skills. Students may not enroll in this course if they have received credit for any other UNT mathematics course with a grade of C or better. Students may not receive credit for both MATH 1680 and MATH 1681. Prerequisite(s): consent of department. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1710 (MATH 2313 or MATH 2413 or MATH 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; or both MATH 1600 and MATH 1610. *Satisfies the Mathematics requirement of the University Core Curriculum.*

MATH 1720 (MATH 2314 or MATH 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.*

MATH 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.

MATH 2100. Functions and Modeling for Secondary Mathematics Instruction. 3 hours. In-depth study of topics in secondary school mathematics. Emphasis is on modeling with linear, exponential and trigonometric functions; curve fitting; discrete and continuous models. Exploratory work with presentations of findings is an integral part of the course. Pedagogical uses of appropriate technology are explored. Prerequisite(s): MATH 1710, MATH 1720 (may be taken concurrently) and TNTX 1100 (may be taken concurrently), or consent of the Teach North Texas advisor.

MATH 2700 (MATH 2318 or MATH 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.

MATH 2730 (MATH 2315 or MATH 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.

MATH 2770 (MATH 2305 or MATH 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 CSCE 1030 (may be taken concurrently).

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

MATH 3000. 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.

MATH 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.

MATH 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. Only one of MATH 3310 and MATH 3410 may be used to satisfy requirements for a mathematics major or minor. Prerequisite(s): MATH 1720.

MATH 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.

MATH 3400. Number Theory. 3 hours. Factorizations, congruencies, quadratic reciprocity, finite fields, quadratic forms, diophantine equations. Prerequisite(s): MATH 3000 or MATH 2770.

MATH 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. Only one of MATH 3310 and MATH 3410 may be used to satisfy requirements for a mathematics major or minor. Prerequisite(s): MATH 1720 and MATH 2700.

MATH 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 MATH 3410.

MATH 3510. Introduction to Abstract Algebra I. 3 hours. Groups, rings, integral domains, polynomial rings and fields. Prerequisite(s): MATH 3000.

MATH 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.

MATH 3610. Real Analysis II. 3 hours. Continuation of 3000. Topics include derivatives, integrals, limits of sequences of functions, Fourier series; and an introduction to multivariable analysis. Prerequisite(s): MATH 3000; and MATH 2700 (may be taken concurrently).

MATH 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).

MATH 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 MATH 2730.

MATH 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 secondary and collegiate curricula. Combinatorics. The Euclidean algorithm, congruence classes, and prime factorization. Modeling with differential equations. Conic sections. Pedagogical techniques. Prerequisite(s): MATH 2100 and either MATH 3510 or MATH 3610.

MATH 4060. Foundations of Geometry. 3 hours. Selections from synthetic, analytic, projective, Euclidean and non-Euclidean geometry. Prerequisite(s): MATH 3000. Prior or concurrent enrollment in MATH 3510 or MATH 3610 is strongly recommended.

MATH 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 MATH 2700; MATH 2730 and MATH 3410 are recommended (may be taken concurrently).

MATH 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.

MATH 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 3000 or MATH 2770.

MATH 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.

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

MATH 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.

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

MATH 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 or at least a 4 on the AP Statistics test; and MATH 4610.

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

MATH 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

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. Prerequisite(s): MATH 1650 or the equivalent (with a grade of C or better) or concurrent enrollment in MATH 1710.

MEEN 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. Prerequisite(s): MATH 1650 (with a grade of C or better).

MEEN 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 PHYS 1730.

MEEN 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.

MEEN 2250. Computer Aided Engineering. 3 hours. (2;3) Computational techniques applied to engineering analysis, design and technical visual communication for engineering practice. Contains two interrelated modules: computer aided design (CAD) and numerical methods (NM). The CAD module surveys engineering drawing techniques with emphasis on modern computer-driven solid object parametric modeling. The NM module includes constrained and unconstrained optimization, simulation and solution of simple differential equations, symbolic manipulation, and application of finite element analysis. Prerequisite(s): MATH 2700 (with a grade of C or better) and CSCE 1020 (with a grade of C or better).

MEEN 2900-MEEN 2910. Special Problems in Mechanical and Energy Engineering. 1–3 hours each. Individual instruction in theoretical, experimental or research problems. Prerequisite(s): consent of instructor. Each course may be repeated for 6 credit hours. For elective credit only; may not be substituted for required MEEN courses.