

## MATHEMATICS

### **MA 049. ARITHMETIC SKILLS IMPROVEMENT 2 HRS.**

(Prerequisite, for students whose APT, a departmental examination for MA 199 scores indicate a need for arithmetic skills prior to re-enrolling in MA 199.) Review of arithmetic skills including addition, subtraction, multiplication, and division of fractions and decimals; percentages and their applications; and geometric concepts such as area and perimeter.

### **MA 095. BEGINNING ALGEBRA 3 HRS.**

(Prerequisite, for students whose ACT scores and/or departmental screening examination indicate basic need for computational and algebraic skills prior to enrollment in the proper general education course.) Review of computational skills in the arithmetic of whole numbers, fractions, and decimals. Review of proportion and percent concepts. Review of basic algebra skills including signed numbers, algebraic expressions and simplification, laws of algebra, factoring, equation solving, graphing, and formula usage. Computer aided instruction will enhance skills development.

### **MA 096. GEOMETRY CONCEPTS AND SKILLS DEVELOPMENT 2 HRS.**

(Successful completion of the course MA 095 or successful completion of a departmental screening exam designed to exempt a student from the necessity of taking MA 095.) (Prerequisite for students whose results in the departmental screening exam indicate a need for basic geometric skills and knowledge.) Basic concepts in geometry including names and properties of geometric figures, concepts of parallelism and perpendicularity, congruence and similitude. Measurements associated with geometric figures. Use of basic geometry concepts as they relate to applications of a geometric nature. Coordinate Geometry. Computer aided instruction used to enhance concepts.

### **MA 098. INTERMEDIATE ALGEBRA 3 HRS.**

(Prerequisite, MA 095 or appropriate ACT score or appropriate score on the math placement exam.) A thorough review of the fundamentals of elementary algebra, linear and quadratic equations, exponents and radicals.

### **MA 103. ALGEBRA ENHANCEMENT 3 HRS.**

(Corequisite, concurrent enrollment in MA 098 and consent of instructor.) This course is designed to enrich the mathematical experiences of students who are enrolled in MA 098, Intermediate Algebra. Students work in collaborative groups to solve open-ended and non-routine problems. The use of current technology, which includes computers and graphing calculators, is used in solving application problems involving linear and quadratic models.

### **MA 107. TECHNICAL MATHEMATICS 3 HRS.**

(For Flint Hills Technical College students only.) Technical Mathematics is designed to provide many of the math skills needed in the general and technical courses that follow as students progress through the Power Plant Technology Program.

### **MA 110. COLLEGE ALGEBRA 3 HRS.**

(Prerequisite, MA 095 and MA 098, or appropriate ACT score or appropriate score on the math placement exam.) Basic

operations, products and factoring, linear and quadratic equations, graphs, ratio and proportion, inequalities, logarithms, mathematical induction, permutations, combinations, determinants.

**MA 112. TRIGONOMETRY** 2 HRS.  
(Prerequisite, MA 110 or equivalent.) Trigonometric functions, identities, graphs, trigonometric equations, radian measure, complex numbers, polar coordinates, solving triangles, applications.

**MA 120. ELEMENTARY STATISTICS** 3 HRS.  
(Prerequisite, High school Algebra or MA 095 is highly recommended.) This course is designed to introduce students to basic statistics, summarizing univariate data, correlation and regression for bivariate data, concepts of probability, probability distributions, simulation, sampling distributions, estimation, and hypothesis testing. Some uses of statistical software will be incorporated into this course.

**MA 125. INTRODUCTION TO MATHEMATICS** 1 HR.  
(Prerequisite, course will be required for all students with Math or Math Ed. Majors, who are new to the program, whether freshman or transfer students.) This course introduces incoming majors to the math department, the world of mathematics and the college environment. It addresses goals, expectations, responsibilities, math classes, decision making, study skills, problem solving and the joy of doing mathematics, as well as career choices in mathematics.

**MA 156. PRINCIPLES OF MATHEMATICS** 3 HRS.  
(Prerequisite, MA 098 or appropriate ACT score or appropriate score on the Mathematics Placement examination.) A course in mathematics for the nontechnically oriented student. Problem solving skills and critical thinking skills are developed through a selection of interesting and unique mathematical content and topics. Previously learned skills in algebra and geometry are enhanced and improved as students develop a greater awareness of and appreciation for mathematics.

**MA 160. FUNCTIONS OF CALCULUS** 3 HRS.  
(Prerequisites, high school trigonometry and two years high school algebra or equivalent. Credit can be obtained in this course by passing the qualification test.) Functions as mappings, associations and ordered pairs; graphs of algebraic, absolute value, greatest integer, logarithmic, trigonometric, exponential functions; sequences; operations on and inverses of function; conics.

**MA 161. CALCULUS I** 5 HRS.  
(Prerequisite, MA 110 and MA 112 or equivalent, or appropriate ACT score.) Calculus of algebraic functions of one variable: limits differentiation, implicit differentiation, definite and indefinite integrals. Mean value theorem, maxima and minima, area, and volume. Applications to other fields.

**MA 165. BASIC CALCULUS** 5 HRS.  
(Prerequisite, MA 110 or equivalent.) A course designed for non-math majors which emphasizes the application of calculus procedures to Economics, Business, Social Sciences, Life Sciences, and other areas. Topics include limits, derivatives, and integrals.

**MA 180. PROBABILITY** 2 HRS.  
(Prerequisite, two years of high school algebra or equivalent.)  
An introduction to the theory of probability, probability models, random sampling, frequency distributions, binomial, normal and uniform distributions.

**MA 210. HONORS SEMINAR** 1 HR.  
(Prerequisite, Honors Program.) An in-depth study of problem solving techniques dealing with material from the student's previous and/or current mathematics courses.

**MA 225. MATHEMATICS AS A DECISION MAKING TOOL** 3 HRS.  
(Prerequisite, MA 110.) This course is designed for non-mathematics majors. The focus of this course is to develop quantitative skills, and reasoning ability necessary to help students read critically and make decisions in our technical information society. A project tying this course to the student's own interests is a course requirement. Major topics include: collecting and describing data, inferential statistics and probability; geometric similarity, geometric growth, symmetry and patterns.

**MA 240. DISCRETE MATHEMATICS** 3 HRS.  
(Prerequisites, MA 161, MA 165, or permission of the instructor.) Includes sets, logic, proof, Boolean Algebra, functions and relations, mathematical induction, recursion, graphs.

**MA 262. CALCULUS II** 5 HRS.  
(Prerequisite, MA 161 or equivalent.) Theory of limits, continuity, differentiation, integration. Inverses of transcendental functions, chain rule, techniques of integration, improper integral. Sequences and series.

**MA 263. CALCULUS III** 3 HRS.  
(Prerequisite, MA 262 or equivalent.) Multivariable calculus, double integral, triple integral and partial derivatives. Vectors, polar coordinates, parametric equations, and vector valued functions.

**MA 291. MATHEMATICAL MODELING** 3 HRS.  
(Prerequisite, MA 161 or MA 165.) A study of mathematical modeling, including the modeling process, model fitting, optimization, experimental modeling, dimensional analysis and similitude, simulation, and modeling using the derivative.

**MA 307. MATHEMATICS FOR ELEMENTARY/MIDDLE SCHOOL TEACHERS I** 3 HRS.  
(Prerequisite, must have a grade of "C" or higher in MA 110.) This course will prepare prospective elementary and middle school teachers to know, understand, and use the basic principles and concepts of mathematics involving sets, whole numbers, integers, rational numbers, and real numbers. Each student enrolled in this course must complete an arithmetic proficiency test (APT) at a level of 80% or above at the beginning of the semester. For further details, contact the Department of Mathematics, Computer Science and Economics.

**MA 308. MATHEMATICS FOR ELEMENTARY/MIDDLE SCHOOL TEACHER II** 3HRS.  
(Prerequisite, must have a "C" or higher in MA 307.) This

course will prepare prospective elementary and middle school teachers to know, understand, and use the basic principles and concepts of mathematics involving probability, statistics, measurement, and geometric concepts, such as properties of two and three-dimensional shapes, congruency, similarity, and transformations.

**MA 312. ALGEBRA FOR THE ELEMENTARY/  
MIDDLE SCHOOL TEACHER 3 HRS.**  
(Prerequisite, MA 225 or equivalent.) Algebraic concepts needed for today's elementary/middle schools including properties of the field of real numbers, algebraic and graphic solutions of equations and of inequalities. Concrete models, such as algebra tiles, will be examined in the teaching and learning of algebra.

**MA 313. GEOMETRY FOR THE ELEMENTARY/  
MIDDLE SCHOOL TEACHER 3 HRS.**  
(Prerequisite, MA 308.) Geometric concepts needed for today's elementary/middle schools including geometric constructions, experimental geometry, and a study of congruences, similarity, and measurement.

**MA 315. TECHNICAL CALCULUS I 3 HRS.**  
(Prerequisite, K.G.E. employees only.) A new course in differential calculus designed solely for the Kansas Gas & Electric (KGE) education program at the Wolf Creek Nuclear Power Plant offered by the continuing education program at ESU.

**MA 316. TECHNICAL CALCULUS II 3 HRS.**  
(Prerequisite, KGE employees only.) A new course in calculus designed solely for the Kansas Gas & Electric (KGE) education program at the Wolf Creek Nuclear Power Plant offered by the continuing education program at ESU. This is the sequence to Technical Calculus I.

**MA 317. APPLIED DIFFERENTIAL EQUATIONS 3 HRS.**  
(Prerequisite, KGE employees only.) A new course in differential equations covering methods of solution of elementary and linear differential equations, including Laplace transforms, with applications to geometry and the physical sciences; designed to meet the needs of KGE and offered by the continuing education program at ESU.

**MA 322. INTRODUCTION TO LINEAR ALGEBRA 3 HRS.**  
(Prerequisites, MA 240 or permission of instructor.) Elementary vector arithmetic and matrix arithmetic. Gaussian Elimination and the Reduced Echelon Form. Solutions of linear systems of equations. Vector geometry in  $R^3$ . The concepts linear independence, basis, dimension, range, null space, rank, determinants, orthogonality, Triangle and Schwarz's inequalities, Gram-Schmidt process, and eigenspaces.

**MA 331. THE MATHEMATICS OF FINANCE 3 HRS.**  
(Prerequisite, two years high school algebra or equivalent.) Simple and compound interest and discount, present value and accumulated value of annuities, bonds, amortizations, sinking funds, depreciation, life annuities and life insurance. Introduction to linear programming for solution of problems of business and industry.

**MA 335. DIFFERENTIAL EQUATIONS 3 HRS.**

(Prerequisite, MA 262.) Methods of solution of elementary and linear differential equations with applications to geometry and the physical science.

**MA 341. INTRODUCTION TO PROBABILITY AND STATISTICS 3 HRS.**

(Prerequisites, MA 110 or equivalent.) An introductory study of probability and statistics for students who wish to apply statistics to their field of study. The course includes methods of presenting and interpreting data. Topics include frequency distributions, measures of central tendency, measures of dispersion, probability, probability distributions, normal distributions, sampling distributions, confidence intervals for large and small samples, and hypothesis testing of means for large and small samples.

**MA 380. PROBABILITY AND STATISTICS 3 HRS.**

(Prerequisite, MA 262 or consent of department.) An introduction to statistical methods with basic probability, distribution theory, confidence intervals, significance tests, and sampling.

**MA 386. INTERNSHIP: MATHEMATICS 1-3 HRS.**

(Prerequisite, 20 hours in mathematics courses.) An academic course to provide students with an opportunity to gain field experience in mathematics through professional experience. The academic experience is developed jointly by the student and the faculty advisor. No more than 3 hours in MA 386 may be counted toward the mathematics major.

**MA 410. SEMINAR IN MATHEMATICS 0-4 HRS.**

(Prerequisite, permission of mathematics department.) A seminar involving various topics in mathematics.

**MA 421. COLLEGE GEOMETRY 5 HRS.**

(Prerequisites, MA 161 and MA 240.) Axiomatic Structure of Geometry, Finite Geometries, Geometric Transformations, Euclidean Geometry and Constructions, Hyperbolic and Elliptic Geometry, Projective Geometry, Inversion Theory and Geometric Topology.

**MA 425. ABSTRACT ALGEBRA 3 HRS.**

(Prerequisite, MA 322 or permission of instructor.) Foundations of deductive mathematical reasoning and proof. Basic concepts of abstract algebra including symbolic logic, proof strategies, sets, relations mapping and binary operations. A study of some algebraic structures including groups, rings, integral domains and fields.

**MA 450. INTERDISCIPLINARY SCIENCES: MATHEMATICS 3 HRS.**

(Prerequisite, permission of instructor.) In this interdisciplinary course students and faculty will collaborate to conduct quantitative research on biological systems. Weekly meetings will entail group discussions in which we will identify potential questions, design experiments to investigate those questions, and interpret the results of the experiments. With the use of sophisticated computer technologies we will analyze phenomena that were previously too fast, slow, small or large to be investigated with quantitative precision. Digital video and image processing techniques will be used to measure properties of biological systems. A variety of mathematical and statistical software will be used to analyze and model the observation. Students will develop written reports of their investigations; students

will make public presentations of their findings at university seminars and possibly at professional meetings.

**MA 460. HISTORY OF MATHEMATICS** 1 HR.  
(Prerequisites, MA 161, MA 165, or permission of instructor.)  
A survey of ancient and modern mathematics. Problems of historical interest. Appreciation of the contributions of mathematics to present civilization.

**MA 470. TEACHING MATHEMATICS IN THE MIDDLE/HIGH SCHOOL** 2-3 HRS.  
(Prerequisite, Phase I or consent of department.) Methods of teaching contemporary content in high school algebra, geometry and general mathematics. Practical experiences in teaching college trigonometry. Studies in research in mathematics education, recommendations of national committees, setting goals, and writing objectives, selecting materials, diagnosis and remediation, techniques of evaluations.

**MA 480. INDEPENDENT STUDY (MATHEMATICS)** 1-4 HRS.  
(Open only to qualified juniors and seniors.) Topics of special interest in some area of mathematical study not included in regularly listed courses.

**MA 532. MATHEMATICAL STATISTICS I** 3 HRS.  
(Prerequisite, MA 262 and MA 380.) Fundamental principles of a random variable and its distribution; the binomial, normal, the F, the Student-t, and Chi-Square; testing hypotheses, estimation, and applications.

**MA 591. TOPICS IN MATHEMATICS** 1-3 HRS.  
(Prerequisites will vary with topic.) An in-depth study of selected topics in mathematics not currently found in other mathematics courses. May be repeated with different topics for a maximum of six credits. See Schedule of Classes for specific topic and prerequisites when offered.

**MA 592. TOPICS IN ELEMENTARY/MIDDLE SCHOOL MATHEMATICS** 1-3 HRS.  
(Prerequisites will vary with topic, possibly including but not limited to MA 312 or MA 313.) A course designed to enrich and supplement the teaching of elementary/middle school mathematics. May be repeated with different topics for credit. See Schedule of Classes for specific topic (and prerequisites) when offered.

**MA 715. TOPOLOGY** 3 HRS.  
(Prerequisite, consent of mathematics department.) Theory of point sets with applications to analysis. Topological, metric, and function spaces, sequences, continuity, connectedness, compactness, separation, completions.

**MA 721. PROJECTIVE GEOMETRY** 3 HRS.  
(Prerequisite, MA 421 or consent of department.) Projective geometry of one and two dimensions, its axiomatic foundation, and the fundamental ideas of the projective plane. Duality, harmonic forms, coordinates, conics, polarities, and a brief introduction to geometry of higher dimensions.

**MA 722. NON-EUCLIDEAN GEOMETRY** 3 HRS.  
(Prerequisite, MA 421 or consent of department.) A

comparison of non-Euclidean geometries with Euclidean geometry. Hilbert's axioms, history of the parallel postulate, elementary theorems of hyperbolic plane geometry and a brief introduction to elliptic geometry.

**MA 727. GROUPS, RINGS, AND FIELDS** 3 HRS.  
(Prerequisites, MA 322 and MA 425 or consent of the mathematics department.) The properties of groups, rings and fields with emphasis on the algebraic structure and morphisms. Algebraic and transcendental field extensions.

**MA 728. VECTOR SPACES** 3 HRS.  
(Prerequisite, MA 322 and MA 425 or consent of department.) The structure of vector spaces, algebras and fields. Transformations, linear independence, bases and other topics are studied.

**MA 733. MATHEMATICAL STATISTICS II** 3 HRS.  
(Prerequisite, MA 532.) Probability, distributions, expected values, moments, sampling distribution and point estimation. Multivariate normal distribution, maximum likelihood estimation, interval estimation, test of hypotheses, linear regression, experimental design and analysis of variance.

**MA 734. COMPLEX VARIABLES** 3 HRS.  
(Prerequisite, MA 263.) A study of the complex plane, holomorphic functions, the elementary functions, complex integration. Taylor's series and the Laurent expansion, the calculus of residues and conformal mapping.

**MA 735. ADVANCED CALCULUS I** 3 HRS.  
(Prerequisite, MA 263.) A rigorous treatment of limits, continuity and differentiation, Riemann integrals, improper integrals, indeterminate forms and special functions.

**MA 736. ADVANCED CALCULUS II** 3 HRS.  
(Prerequisite, MA 735.) Infinite series, power series, Riemann- Stieltjes integrals, partial differentiation, sequences and series of functions, multiple integration, line integrals, differentials.

**MA 740. NUMBER THEORY** 3 HRS.  
(Prerequisite, MA 425 or consent of department.) Properties of numbers, prime and composite, Euclid's algorithm, indeterminate problems. Diophantine problems, congruences and residues, Buler's Theorem, Fermat's Theorem, classical problems.

**MA 744. INTRODUCTION TO MATHEMATICAL LOGIC** 3 HRS.  
(Prerequisites, MA 240, MA 161.) Deductive logic as applied in secondary school mathematics. Symbolic Aristotelian logic, truth tables, rules of inference, methods of deductive proof, and the restricted predicate calculus.

**MA 745. VECTOR ANALYSIS** 3 HRS.  
(Prerequisite, MA 263.) Fundamental principles of vector analysis, algebra and calculus of vectors, applications of vectors to geometry and physics.

**MA 764. REGRESSION ANALYSIS** 3 HRS.  
(Prerequisite, MA 380 or equivalent.) Computer oriented statistics methods course. Topics include estimating parameters, testing hypotheses, analysis of variance, and

multiple linear and nonlinear regression methods.

**MA 791. TOPICS IN MATHEMATICS** 1-3 HRS.  
(Prerequisites will vary with topic.) An in-depth study of selected topics in mathematics not currently found in other mathematics courses. May be repeated with different topics for a maximum of six credits. See Schedule of Classes for specific topic and prerequisites when offered.

**MA 792. TOPICS IN ELEMENTARY/MIDDLE SCHOOL MATHEMATICS** 1-3 HRS.  
(Prerequisite, in-service teacher or consent of department.) A course designed to enrich and supplement the teaching of elementary/middle school mathematics. May be repeated with different topics for credit. See Schedule of Classes for specific topic (and prerequisites) when offered.

**MA 793. TOPICS IN SECONDARY SCHOOL MATHEMATICS** 1-3 HRS.  
(Prerequisite, in-service teacher or consent of department.) A course designed to enrich and supplement the teaching of secondary school mathematics. May be repeated with different topics for credit. See Schedule of Classes for specific topic (and prerequisites) when offered.

**MA 810. SEMINAR IN MATHEMATICS** 0-4 HRS.  
Directed reading and research in a selected field.

**MA 820. DIFFERENTIAL GEOMETRY** 3 HRS.  
(Prerequisite, MA 263.) A study of curves and surfaces in Euclidean space. Frenet formulas, curvature, geodesics, and fundamental forms.

**MA 825. GROUP THEORY** 3 HRS.  
(Prerequisite, MA 727.) An introduction to the theory of groups. Topics included are classifications of groups, such as cyclic, Abelian, solvable, nilpotent, etc., homomorphisms and isomorphisms, types of subgroups and factor groups, and the Sylow theorems.

**MA 832. DIFFERENTIAL EQUATIONS II** 3 HRS.  
(Prerequisite, MA 335.) Extension of MA 335 and an introduction to systems of differential equations and partial differential equations; applications.

**MA 835. FUNCTIONS OF A REAL VARIABLE** 3 HRS.  
(Prerequisite, MA 736.) The study of linear sets of points, sequences of functions, upper and lower semi-continuity, equi-continuity, Lebesgue measure, Lebesgue integration, Borel sets, Baire functions and measurable functions.

**MA 847. RESEARCH PROJECTS IN MATHEMATICS** 1-5 HRS.  
Independent study and research in mathematics. Allowed on master's degree program with consent of mathematics department.

**MA 850. THESIS, MA, or MS** 1-6 HRS.  
Required for the Master of Arts degree with a major in Mathematics. Independent study and research in an approved field. Frequent conferences with the instructor.

**MA 955. CURRENT LITERATURE IN**

**MATHEMATICS**

**0-3 HRS.**

(Prerequisite, Master's degree.) Directed reading of current literature and research in mathematics with individual reports and group discussions.

**MA 957. THESIS, ED.S.**

**1-5 HRS.**

Required for the Specialist in Education with a major in mathematics. Independent study and research in mathematics.