CS & Applied Mathematics Dual Degree Curriculum Content

General Education (41 credits)
- COMM 101: Written and Oral Communication I
- COMM 301: Written and Oral Communication II
- ECON 201: Economic Principles
- HUMN 201: Introduction to Humanities
- LS 489: Senior Seminar
- ORTH 101: Learning, Success, and Teamwork
- SSCI 201: Introduction to Social Science
- Advanced Humanities Elective
- Advanced Social Science Elective
- Liberal Studies Elective
- Liberal Studies Elective

Basic Science (20 credits)
- CHEM 135/136: Principles of Chemistry (w/Lab)
- PHYS 114/115: Newtonian Mechanics (w/Lab)
- PHYS 224-225: Electricity & Magnetism (w/Lab)
- Basic Science Elective
- Basic Science Elective

Computer Science (56 credits)
- CS 101: Computing and Algorithms I
- CS 102: Computing and Algorithms II
- CS 202: Systems Programming Concepts
- CS 203: Computing and Algorithms III
- CS 211: Discrete Mathematics
- CS 300: The Computing Professional
- CS 312: Theory of Computation
- CS 435: Functional Languages and Parsing
- CS 451: Operating Systems
- CS 471: Software Engineering
- Computer Science Elective
- Computer Science Elective
- Computer Science Elective
- Computer Science Elective

Computer Engineering (8 credits)
- CE 210: Digital Systems I
- CE 320: Microcomputers I

Mathematics (60 credits)
- MATH 101: Calculus I
- MATH 102: Calculus II
- MATH 203: Multivariate Calculus
- MATH 204: Differential Equations/Laplace Transforms
- MATH 305: Numerical Methods & Matrices
- MATH 307: Matrix Algebra
- MATH 308: Abstract Algebra
• MATH 313: Boundary Value Problems
• MATH 321: Real Analysis I
• MATH 327: Mathematical Statistics I
• MATH 328: Methods of Applied Mathematics
• MATH 412: Complex Variables
• MATH 416: Vector Analysis
• MATH 418: Intermediate Diff. Equations
• MATH 423: Partial Differential Equations

Thesis (4 credits)
• Senior Thesis

Total CS/AM Dual Degree (189 credits minimum)

CS/AM Dual Degree Course Descriptions

COMM 101: Written & Oral Communication I
This course is designed to help students write and speak effectively in academic settings and in their work organizations. Basic principles underlying practical communication techniques are taught, with an emphasis on skills for conveying technical and business information. Students engage in writing and speaking assignments that familiarize them with appropriate formats for those kinds of communication. Student performance is analyzed as a means of promoting individual improvement.

Terms Offered: All
Prerequisites: None
Corequisites: None
Minimum Class Standing: None
Credits: 4

COMM 301: Written & Oral Communication II
The course prepares students to launch their thesis project and to perform other advanced writing and speaking tasks. Thus students will employ the concepts and skills gained in the foundational course Written & Oral Communication I (COMM101). Emphasis is placed on helping students to communicate effectively in regard to the technologies and business purposes of their own workplace and profession. Student's development of the required skills is demonstrated in writing assignments and oral presentations. Credit must be received for the course before a student's Senior Thesis Assignment Proposal will be processed for its approval.

Terms Offered: All
Prerequisites: COMM 101
Corequisites: None
Minimum Class Standing: JR
Credits: 4

ECON 201: Economic Principles
This course introduces the student to the economic way of thinking. Students learn how individuals, firms, and societies make choices among alternative uses of scarce resources. A survey course, it covers both introductory microeconomics and introductory macroeconomics. The course combines applied theory and policy, and equips the student with the necessary tools to analyze and interpret the market economy.

Terms Offered: All
**HUMN 201: Introduction to the Humanities**
The humanities are disciplines focused on the study of literature, philosophy, and the arts. This course is designed to introduce students to the humanities by the examination of selected works in drama, fiction, poetry, philosophy, and the fine arts. Formal graded writing assignments will be integrated into the course.

Terms Offered: All  
Prerequisites: COMM 101  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**LS 489: Senior Seminar: Leadership, Ethics and Contemporary Issues**
This course examines the interrelated subjects of leadership, ethics and contemporary issues. Because it is a culmination of their general education, students in this course use the methods and perspectives learned in the preceding general education courses. After examining general theoretical approaches through a common text, the course will involve three —case studies— with suitable assigned readings. One case study will focus on a corporation in order to illustrate leadership, ethics and contemporary issues; a second will focus on a person in order to illustrate leadership, ethics, and contemporary issues; the third will focus on an important modern episode, event or condition that exemplifies issues of ethics and leadership.

Terms Offered: All  
Prerequisites: COMM 101, COMM 301, ECON 201, HUMN 201, SSCI 201, a 300 level course in either Humanities or Social Science  
Corequisites: None  
Minimum Class Standing: SR  
Credits: 4

**ORTN 101: Learning, Success, and Teamwork**
This course will provide critical information on professionalism, teamwork, and personal development for first-year students. Students will learn to interact in the academic and cooperative work environments successfully. Mentoring and interaction with the instructors will provide support and guidance for students to be fully integrated into Kettering University. Team-based assignments and projects will enhance student transition and acclimation to policies and procedures at Kettering University. Topics to be covered include: self-assessment, decision-making, resource management, and goal-setting.

Terms Offered: All  
Prerequisites: None  
Corequisites: None  
Minimum Class Standing: None  
Credits: 1

**SSCI 201: Introduction to the Social Sciences**
This course will offer a broad comparative study of the nature of human experience, how social scientists study that experience, and some of their findings. It will consider moral and ethical issues (in society and in studying society). It will examine selected topics for what they teach us about society in general, our present society, or social science. The topics selected will vary from term to
term but will include contemporary issues within such areas as science and technology, religion, politics, the environment, and human conflict.

Terms Offered: All
Prerequisites: COMM 101
Corequisites: None
Minimum Class Standing: None
Credits: 4

**CHEM 135: Principles of Chemistry**

An introduction to fundamental concepts and applications of chemistry, including the Periodic Table and chemical nomenclature, reactions and reaction stoichiometry, atomic structure, chemical bonding and chemical equilibrium. Applied topics include batteries, fuel cells and corrosion, and a description of the chemistry and uses of metals and nonmetals.

Terms Offered: Summer, Fall
Prerequisites: None
Corequisites: CHEM 136
Minimum Class Standing: None
Credits: 3

**CHEM 136: Principles of Chemistry Laboratory**

The laboratory introduces and/or illustrates chemical concepts and principles, and teaches the skills of data collection and evaluation. The SI system is emphasized.

Terms Offered: Summer, Fall
Prerequisites: None
Corequisites: CHEM 135
Minimum Class Standing: None
Credits: 1

**PHYS 114: Newtonian Mechanics**

A calculus-based introduction to classical Newtonian mechanics including; vectors, translational and rotational kinematics and dynamics, work, energy, impulse, and linear and angular momentum.

Terms Offered: All
Prerequisites: MATH 101 or MATH 101X
Corequisites: MATH 102 or MATH 102X or MATH 102H, and PHYS 115
Minimum Class Standing: None
Credits: 3

**PHYS 115: Newtonian Mechanics Laboratory**

Laboratory activities will explore position, velocity, and acceleration, force, momentum and energy, all as function of time. Applications to vehicle crash safety are incorporated. Laboratory skills, including: uncertainty, simple data acquisition and sensor instrumentation, and analysis techniques are essential.

Terms Offered: All
Prerequisites: MATH 101 or MATH 101X
Corequisites: MATH 102 or MATH 102X or MATH 102H, and PHYS 114
Minimum Class Standing: None
Credits: 1
**PHYS 224: Electricity and Magnetism**
An investigation of the physics of electricity and magnetism with a focus on the physics of electric and magnetic fields and their effects on electric charges. Topics will include the relationships between charges, forces, fields, potentials, and currents, as well as the physics of capacitors, resistors, and inductors.

Terms Offered: All  
Prerequisites: MATH 102 or MATH 102X or MATH 102H, and PHYS 114 and PHYS 115  
Corequisites: MATH 203 or MATH 203H, PHYS 225  
Minimum Class Standing: None  
Credits: 3

**PHYS 225: Electricity and Magnetism Laboratory**
This laboratory investigates the physics of electricity and magnetism. It includes a practical study of electric potential and electric current, as well as the fundamental circuit elements: capacitors, resistors, and inductors.

Terms Offered: All  
Prerequisites: MATH 102 or MATH 102X or MATH 102H, and PHYS 114, and PHYS 115  
Corequisites: MATH 203 or MATH 203H, PHYS 224  
Minimum Class Standing: None  
Credits: 1

**CS 101: Computing and Algorithms I**
An introduction to algorithmic problem solving, with emphasis on elementary program and software engineering techniques. Syntax and semantics of a modern programming language; programming and debugging at the file level; true object-orientation; Strings, arrays, sorting, inheritance, and exception handling.

Terms Offered: All  
Prerequisites: None  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**CS 102: Computing and Algorithms II**
A second course in algorithmic problem solving. Recursion, abstract data types, dynamic data structures, comparison-based sorting, elementary algorithm analysis, design of software projects of moderate size, and continuing development of programming skills.

Terms Offered: All  
Prerequisites: CS 101  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**CS 202: Systems Programming Concepts**
Fundamental system programming concepts are examined using the C programming language. Topics include: machine organization, data representation, interrupt handling, I/O, file management, dynamic structures, parameter passing, memory management, system calls, process creation, process control, interprocess communication, and language interfaces.

Terms Offered: Winter, Spring  
Prerequisites: CS 102
**CS 203: Computing & Algorithms III**
The design and analysis of advanced data structures and algorithms. Algorithm design techniques, algorithm analysis techniques, advanced data structures, advanced sorting, applications to various problem domains.

Terms Offered: Summer, Fall  
Prerequisites: CS 102, CS 211  
Corequisites: None  
Minimum Class Standing: SO  
Credits: 4

**CS 211: Discrete Mathematics**
Propositional and first-order logic; logical equivalence and inference. Proof techniques, mathematical induction and principle of diagonalization. Set operations, relations, functions. Introduction to graphs and trees and their applications to computer science. Lattice structures and Boolean algebras. Truth tables and minimization of Boolean expressions.

Terms Offered: All  
Prerequisites: None  
Corequisites: MATH 101 or MATH 101X  
Minimum Class Standing: None  
Credits: 4

**CS 300: The Computing Professional**
An examination of the profession of computing from historical and ethical perspectives. Overview of the history of computing, from the earliest computational devices and theoretical foundations to modern developments. Discussion of the social impact of computing on society and the ethical implications for computing professionals, including analysis of case studies.

Terms Offered: Summer, Fall, alternate years  
Prerequisites: CE 210 or CS 102, COMM 101  
Corequisites: None  
Minimum Class Standing: SO  
Credits: 4

**CS 312: Theory of Computation**
Regular languages and grammars; finite-state machines and transducers; relationships between finite-state automata and regular languages. Context-free languages and grammars; language recognition with stack machines and parsers. Properties of formal languages. Computability and undecidability. Introduction to computational complexity.

Terms Offered: Summer, Fall, alternate years  
Prerequisites: CS 102, CS 211  
Corequisites: None  
Minimum Class Standing: SO  
Credits: 4

**CS 435: Functional Languages and Parsing**
Introduction to contemporary functional programming languages and techniques: lists, first class and higher order functions, lazy evaluation, and infinite data structures. Introduction to context free languages and parsing techniques: LL(k), LR(k). Construction of hand written parsers and use
of automated tools for parser construction.

Terms Offered: Winter, Spring, alternate years
Prerequisites: CS 102
Corequisites: None
Minimum Class Standing: None
Credits: 4

**CS 451: Operating Systems**

Operating system function and implementation; process and thread management, scheduling and synchronization; deadlock; real and virtual memory management, file-system structure and implementation. Case studies of historical and modern operating systems.

Terms Offered: Summer, Fall
Prerequisites: CS 102
Corequisites: None
Minimum Class Standing: None
Credits: 4

**CS 471: Software Engineering**

Software life cycle including specification, design, coding, testing, and verification of a software project. Stepwise refinement and rapid prototyping. Software portability, reusability and maintenance in the team construction of a large software product. Software quality assurance.

Terms Offered: Winter, Spring, alternate years
Prerequisites: CS 102
Corequisites: None
Minimum Class Standing: JR
Credits: 4

**CE 210: Digital Systems I**

Design and analysis techniques for combinational and sequential logic circuits are studied. Topics include binary number systems and binary addition/subtraction, combination logic minimization, frequently used combinational logic circuits, finite state machines, shift registers and counters. VHDL will be used for description, simulation and FPGA synthesis of digital circuits.

Terms Offered: All
Prerequisites: ECE 101 or CS 101 or IME 211
Corequisites: None
Minimum Class Standing: None
Credits: 4

**CE 320: Microcomputers I**

Principles of microcomputer hardware and software are presented. Topics include instruction sets and addressing modes, structured assembly language programming, toplevel design, introductory machine architecture and its relationship to programming, introduction to hardware in typical microcontrollers, and an introduction to programming microcontrollers in C.

Terms Offered: All
Prerequisites: CE 210
Corequisites: None
Minimum Class Standing: None
Credits: 1
**MATH 101: Calculus I**
An introduction to the theory and techniques of differentiation of polynomial, trigonometric, exponential, logarithmic, hyperbolic, and inverse functions of one variable. Also included are limits, continuity, derivative applications and interpretations. Computer software will be used to aid in understanding these topics.

Terms Offered: All  
Prerequisites: Sufficient score on the placement exam, or permission of Department Head  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**MATH 102: Calculus II**
Riemann integration and the Fundamental Theorem of Calculus, including applications to area, volume, etc., and basic methods for conversion of integrals including change of variable, substitutions, partial fractions, integration by parts, improper integrals and numerical integration. Also introduced are sequences and series in one variable with emphasis on Taylor Series. Computer software will be used to aid in understanding these topics.

Terms Offered: All  
Prerequisites: MATH 101 with a minimum grade of C  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**MATH 203: Multivariate Calculus**
A study of polar coordinates, parametric equations, and the calculus of functions of several variables with an introduction to vector calculus. Topics include surface sketching, partial derivatives, gradients, differentials, multiple integrals, cylindrical and spherical coordinates and applications. Computer software will be used to aid in understanding these concepts.

Terms Offered: All  
Prerequisites: MATH 102 or MATH 102X or MATH 102H  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**MATH 204: Differential Equations and Laplace Transforms**
An introduction to the principles and methods for solving first order, first degree differential equations, and higher order linear differential equations. Includes a study of the Laplace transform and its application to the solution of differential equations. Existence and uniqueness theorems for O.D.E.’s are also discussed.

Terms Offered: All  
Prerequisites: MATH 203 or MATH 203H  
Corequisites: None  
Minimum Class Standing: None  
Credits: 4

**MATH 305: Numerical Methods and Matrices**
An introduction to numerical methods including the study of iterative solutions of equations, interpolation, curve fitting, numerical differentiation and integration, and the solution of ordinary differential equations. An introduction to matrices and determinants; application to the solution of linear systems.
MATH 307: Matrix Algebra
A study of matrix concepts including such topics as basic algebraic operations, determinants, inversion, solution of systems of linear equations, vector spaces, basis and dimension, eigenvalues, and eigenvectors.

MATH 308: Abstract Algebra
Students will learn topics in modern algebra and will practice proof techniques. Topics will include: congruence classes, modular arithmetic, groups, subgroups, normal subgroups, Lagrange's theorem, rings, subrings, ideals, quotient rings, isomorphisms and homomorphisms, polynomial arithmetic, fields, divisors, factorization, and proofs of the main theorems. The course is required for mathematics majors and is also useful in cryptography and quantum physics.

MATH 313: Boundary Value Problems
An introduction to linear partial differential equations (PDE's) and basic techniques of applied mathematics used to solve initial, boundary value problems associated with these equations. Topics include: derivation of some of the fundamental PDE's and boundary conditions that arise in science and engineering; Fourier Series; Sturm-Liouville Systems including eigenvalues, eigenfunctions and eigenfunction expansions; the separation of variables techniques; Fourier Transforms. Applications to problems of science and engineering will be given throughout the course.

MATH 321: Real Analysis I
A more advanced study of functions in one real variable including limits, uniform continuity, differentiation, integration, and sequences and series of functions; topology of R.
MATH 327: Mathematical Statistics I
A study of random variables and their distribution functions including expectations, transformations, moment generating functions, stochastic independence, and sampling distribution. Also, a study of order statistics and limiting distributions of sample mean.

Terms Offered: Winter, Spring
Prerequisites: MATH 203 or MATH 203H
Corequisites: None
Minimum Class Standing: JR
Credits: 4

MATH 328: Methods of Applied Mathematics
Topics from advanced calculus, dimensional analysis and scaling, perturbation and asymptotic methods, calculus of variations and integral equations. Applications of these tools to problems in engineering will be included.

Terms Offered: Winter, Spring
Prerequisites: MATH 204 or MATH 204H
Corequisites: None
Minimum Class Standing: JR
Credits: 4

MATH 412: Complex Variables
An introduction to the theory of complex variables. Includes basic algebra of complex numbers, analytic functions and the Cauchy-Riemann equations, elementary transformations, complex integration, the Cauchy integral formulas, Taylor and Laurent series, and the theory of residues.

Terms Offered: As Needed
Prerequisites: MATH 203 or MATH 203H
Corequisites: None
Minimum Class Standing: SO
Credits: 4

MATH 416: Vector Analysis
An introduction to vector algebra and calculus including vector products, vector functions, and their differentiation and integration, gradients, line and surface integrals, conservative fields and potentials functions, Green's theorem, parametric equations, curvature, and curvilinear coordinates.

Terms Offered: Winter, Spring
Prerequisites: MATH 203 or MATH 203H
Corequisites: None
Minimum Class Standing: SOII
Credits: 4

MATH 418: Intermediate Differential Equations
A study of systems of linear and nonlinear ordinary differential equations (ODE's). Systems of linear ODE's, matrix methods, variation of parameters, and perturbation methods and boundary layers, phase portraits and stability of nonlinear ODE's. Numerical methods for solving systems of ODE's will be presented and used to solve physical problems of applied mathematics and engineering.

Terms Offered: Summer, Fall
Prerequisites: MATH 204 or MATH 204H, MATH 305
Corequisites: None
**MATH 423: Partial Differential Equations**

This course is a continuation of MATH-313. Topics include Bessel's equation and Legendre's equation, boundary value problems in curvilinear coordinate systems, Green's functions for ordinary and partial differential equations. Applications to problems of science and engineering will be given throughout the course.

Terms Offered: Winter, Spring
Prerequisites: MATH 305, MATH 313
Corequisites: None
Minimum Class Standing: JR
Credits: 4