STANDARD	COURSE	LEARNING OPPORTUNITIES	ASSESSMENTS
A. A teacher of mathematics understands patterns, relations, functions, algebra, and basic concepts underlying calculus from both concrete and abstract perspectives and is able to apply this understanding to represent and solve real world problems. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) recognize, describe, and generalize patterns and build mathematical models to describe situations, solve problems, and make predictions;	MCS-122 MCS-221 MCS-313	6.1-6.5,8.1-8.5,9.1-9.4 1.10, 2.6, 2.7, 4.8 4.9, 5.6 Whole class	Homework, exams Projects Homework, exams
(2) analyze the interaction between quantities and variables to model patterns of change and use appropriate representations including tables, graphs, matrices, words, ordered pairs, algebraic expressions, algebraic equations, and verbal descriptions;	MCS-122 MCS-221	9.1-9.4 5.6	Homework, exams Homework, exams
(3) represent and solve problem situations that involve variable quantities and use appropriate technology;	MCS-122 MCS-220 MCS-221 MCS-313	Whole class Chap. 1 Whole class Chap. 0,5,6,10	Homework, exams Homework, exams Homework, exams Homework, exams
(4) understand patterns present in number systems and apply these patterns to further investigations;	MCS-313	Whole Class	Homework, exams
(5) apply properties of boundedness and limits to investigate problems involving sequences and series;	MCS-122 MCS-220	11.1-1.10 Chapter 14	Homework, exams Homework, exams
(6) apply concepts of derivatives to investigate problems involving rates of change;	MCS-122	9.1-9.4	Homework, exams
(7) apply concepts and standard mathematical representations from differential, integral, and multivariate calculus; linear algebra, including vectors and vector spaces; and transformational operations to solve problems; and	MCS-122 MCS-221 MCS-222	Whole class (integral calculus) Whole class (vectors and vector spaces) Whole class	Homework, exams Homework, exams Homework, exams
(8) apply properties of group and field structures to mathematical investigations.	MCS-220 MCS-313	Chapt. 1 Whole class	Homework, exams Homework, exams
B. A teacher of mathematics understands the discrete processes from both concrete and abstract perspectives and is able to identify real world applications; the differences between the mathematics of continuous and discrete phenomena; and the relationships involved when discrete models or processes are used to investigate continuous phenomena. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) the application of discrete models to problem situations using appropriate representations such as sequences, vertex-edge graphs and	MCS-220	Chapter 11	Homework, exams

trees, matrices, and arrays;			
(2) application of systematic counting techniques to problem situations including determination of the existence of a solution, the determination of the number of possible solutions, or the optimal solution;	MCS-220	Chap. 5, 10	Homework, exams
(3) application of discrete mathematics strategies, for example, pattern searching, organization of information, sorting, case-by-case analysis, iteration and recursion, and mathematical induction, to investigate, solve, and extend problems;	MCS-177 MCS-220	Whole class Chap. 1-5, 10,11,13-15	Homework, exams, labs Homework, exams
(4) exploration, development, analysis, and comparison of algorithms designed to accomplish a task or solve a problem;	MCS-177	Whole class	Homework, exams, labs
(5) application of additional discrete strategies including symbolic logic and linear programming;			
(6) matrices as a mathematical system and matrices and matrix operations as tools to record information and find solutions of systems of equations; and	MCS-221	1.1-3.2	Homework, exams, projects
(7) analysis of iterative and recursive algorithms to estimate the time needed in order to execute the algorithms for data likely to be encountered in problem situations.	MCS-177	Whole class	Homework, exams, labs
C. A teacher of mathematics understands that number sense is the underlying structure that ties mathematics into a coherent field of study, rather than an isolated set of rules, facts, and formulae. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) an intuitive sense of numbers including a sense of magnitude, mental mathematics, place value, and a sense of reasonableness of results;			
(2) an understanding of number systems, their properties and relations including whole numbers, integers, rational numbers, real numbers, and complex numbers;	MCS-220 MCS-313	Chap. 1, 13-15 Chap. 12-14	Homework, exams Homework, exams
(3) translation among equivalent forms of numbers to facilitate problem solving;	MCS-122	Calculator use + geometric series	Homework, exams
(4) application of appropriate methods of estimation of quantities and evaluation of the reasonableness of estimates;	MCS-142	Whole class	Homework, exams
(5) a knowledge of elementary operations, application of properties of operations, and the estimation of results;	MCS-221 MCS-313	Matrix/vector operations Groups & rings	Homework, exams Homework, exams
(6) geometric and polar representation of complex numbers and the interpretation of complex solutions to equations;	MCS-222	Unit on complex numbers	Homework, exams
(7) algebraic and transcendental numbers;	MCS-220	Chap. 1	Homework, exams
(8) numerical approximation techniques as a basis for numerical integration, numerical-based proofs, and investigation of fractals; and	MCS-122 MCS-303	7.7 Chapter of fractal geometry	Homework, exams Homework, exams

(9) number theory divisibility, properties of prime and composite numbers, and the Euclidean algorithm.	MCS-220 MCS-313	Chap. 1 Chap. 0-4, 13	Homework, exams Homework, exams
D. A teacher of mathematics understands geometry and measurement from both abstract and concrete perspectives and is able to identify real world applications and to use geometric learning tools and models, including geoboards, compass and straight edge, rules and protractor, patty paper, reflection tools, spheres, and platonic solids. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) shapes and the ways shapes can be derived and described in terms of dimension, direction, orientation, perspective, and relationships among these properties;	MCS-122 MCS-222 MCS-303	Chap. 6, 8 Whole class Whole class	Homework, exams Homework, exams Homework, exams
(2) spatial sense and the ways shapes can be visualized, combined, subdivided, and changed to illustrate concepts, properties, and relationships;	MCS-303	Chap. On transformations and symmetry	Homework, exams
(3) spatial reasoning and the use of geometric models to represent, visualize, and solve problems;	MCS-303	Whole course	Homework, exams
(4) motion and the ways in which rotation, reflection, and translation of shapes can illustrate concepts, properties, and relationships;	MCS-122 MCS-221 MCS-303	6.2, 6.3, 8.2, 9.1-9.4 2.7, 4.4, 5.6, 6.1-6.7 Chap. On transformations and symmetry	Homework, exams Homework, exams, projects Homework, exams
(5) formal and informal argument, including the processes of making assumptions; formulating, testing, and reformulating conjectures; justifying arguments based on geometric figures; and evaluating the arguments of others;	MCS-303	Whole class	Homework, exams
(6) plane, solid, and coordinate geometry systems including relations between coordinate and synthetic geometry, and generalizing geometric principles from a two-dimensional system to a three-dimensional system;	MCS-221 MCS-222 MCS-303	4.4-4.8 Chap. On coord systems Chap. On coord systems	Homework, exams Homework, exams Homework, exams
(7) attributes of shapes and objects that can be measured, including length, area, volume, capacity, size of angles, weight, and mass;	MCS-122	6.1-6.3, 8.1, 8.2	Homework, exams
(8) the structure of systems of measurement, including the development and use of measurement systems and the relationships among different systems;	MCS-303	Intro to course	Homework
(9) measuring, estimating, and using measurements to describe and compare geometric phenomena;	MCS-303	Section on golden ratio	Labs on math in art and surveying
(10) systems of geometry, including Euclidean, non-Euclidean, coordinate, transformational, and projective geometry;	MCS-303	Whole course	Homework, exams, projects.
(11) transformations, coordinates, and vectors, including polar and parametric equations, and the use of these in problem solving;	MCS-221	2.1-2.9, 4.1-5.7	Homework, exams
(12) three-dimensional geometry and its generalization to other	MCS-222	Whole course	Homework, exams

dimensions;			
(13) topology, including topological properties and transformations;			
(14) extend informal argument to include more rigorous proofs; and	MCS-220 MCS-303 MCS-313	Whole course Whole course Whole course	Homework, exams Homework, exams, projects. Homework, exams
(15) extend work with two-dimensional right triangles including unit circle trigonometry.	MCS-303	Unit on circle geometry	Homework, exams
E. A teacher of mathematics uses a variety of conceptual and procedural tools for collecting, organizing, and reasoning about data; applies numerical and graphical techniques for representing and summarizing data; and interprets and draws inferences from these data and makes decisions in a wide range of applied problem situations. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) data and its power as a way to explore questions and issues in our world;	MCS-142	Chap. 1-3	Homework, quizzes, exams, articles, and presentations
(2) investigation through data including formulating a problem; devising a plan to collect data; and systematically collecting, recording, and organizing data;	MCS-142	Chap. 3	Homework, quizzes, exams, articles, and presentations
(3) data representation to describe data distributions, central tendency, and variance through appropriate use of graphs, tables, and summary statistics;	MCS-142	Chap. 1,2	Homework, quizzes, exams, articles, and presentations
(4) analysis and interpretation of data, including summarizing data, and making or evaluating arguments, predictions, recommendations, or decisions based on an analysis of the data; and	MCS-142	Chap. 1,2	Homework, quizzes, exams, articles, and presentations
(5) descriptive and inferential statistics, including validity and reliability.	MCS-142	Chap. 1,2, 6-12	Homework, quizzes, exams, articles, and presentations
F. A teacher of mathematics understands how to reduce the uncertainties through predictions based on empirical or theoretical probabilities. The teacher of mathematics must demonstrate knowledge of the following mathematical concepts and procedures and the connections among them:			
(1) inference, and the role of randomness and sampling in statistical claims about populations;	MCS-142	Chap. 4,5	Homework, quizzes, exams, articles, and presentations
(2) probability as a way to describe chance or risk in simple and compound events;	MCS-142	Chap. 4	Homework, quizzes, exams, articles, and presentations
(3) predicting outcomes based on exploration of probability through data collection, experiments, and simulations;	MCS-142	Chap. 4	Homework, quizzes, exams, articles, and presentations
(4) predicting outcomes based on theoretical probabilities, and comparing mathematical expectations with experimental results;	MCS-142	Chap. 4	Homework, quizzes, exams, articles, and presentations
(5) random variable and the application of random variable to generate and	MCS-142	Chap. 4	Homework, quizzes, exams,

interpret probability distributions;			articles, and presentations
(6) probability theory and the link of probability theory to inferential statistics; and	MCS-142	Chap. 4-8	Homework, quizzes, exams, articles, and presentations
(7) discrete and continuous probability distributions as a basis for making inferences about population.	MCS-142	Chap. 4-8	Homework, quizzes, exams, articles, and presentations
G. A teacher of mathematics is able to reason mathematically, solve problems mathematically, and communicate in mathematics effectively at different levels of formality and knows the connections among mathematical concepts and procedures as well as their application to the real world. The teacher of mathematics must be able to:			
(1) solve problems in mathematics by:			
(a) formulating and posing problems;	MCS-122 MCS-220 MCS-221 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(b) solving problems using different strategies, verifying and interpreting results, and generalizing the solution;	MCS-122 MCS-220 MCS-221 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(c) using problem solving approaches to investigate and understand mathematics; and	MCS-122 MCS-220 MCS-221 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(d) applying mathematical modeling to real world situations;	MCS-122 MCS-220 MCS-221 MCS-313	6.1-6.5, 8.1-8.5, 9.1-9.4 1.10, 2.6, 2.7, 4.8 4.9, 5.6	Homework, exams Homework, exams, projects
(2) reason in mathematics by:			
(a) examining patterns, abstracting and generalizing based on the examination, and making convincing mathematical arguments;	MCS-122 MCS-220 MCS-221 MCS-303 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(b) framing mathematical questions and conjectures, formulating counter-examples, and constructing and evaluating arguments; and	MCS-220 MCS-221 MCS-303 MCS-313	Whole course	Homework, exams
(c) using intuitive, informal exploration, and formal proof.	MCS-220 MCS-221 MCS-303	Whole course	Homework, exams Homework, exams

	MCS-313		
(3) communicate in mathematics by:			
(a) expressing mathematical ideas orally, visually, and in writing;	MCS-220 MCS-221 MCS-303 MCS-313	Whole course	Homework, exams, projects
(b) using the power of mathematical language, notation, and symbolism; and	MCS-122 MCS-220 MCS-221 MCS-303 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(c) translating mathematical ideas into mathematical language, notations, and symbols; and	MCS-122 MCS-220 MCS-221 MCS-313	Whole course Whole course	Homework, exams Homework, exams, projects
(4) make mathematical connections by:			
(a) demonstrating the interconnectedness of the concepts and procedures of mathematics;	CAPSTONES		Homework, exams, projects
(b) making connections between mathematics and other disciplines;	MCS-122 MCS-221	6.1-6.5, 8.1-8.5, 9.1-9.4 1.10, 2.6, 2.7, 4.8 4.9, 5.6	Homework, exams Homework, exams, projects
(c) making connections between mathematics and daily living; and	MCS-142	Whole class	Homework, quizzes, exams, articles, and presentations
(d) making connections between equivalent representations of the same concept.	MCS-221	Multiple interpretations of matrices	
H.A teacher of mathematics must:			
(1) understand the historical bases of mathematics, including the contributions made by individuals and cultures, and the problems societies faced that gave rise to mathematical systems;	MCS-303	Unit on history of math	homework
(2) recognize that there are multiple mathematical world views and how the teacher's own view is similar to or different from that of the students;			
(3) understand the overall framework of mathematics including the:			
(a) processes and consequences of expanding mathematical systems;			
(b) examination of the effects of broad ideas, including operations or properties, as these ideas are applied to various systems;			
(c) examination of the same object from different perspectives; and	MCS-303	Chapters on Euclidean and non-Euclidean geometries	Homework, exams
(d) investigation of the logical reasoning that takes place within a system; and	MCS-220 MCS-303 MCS-313	Whole course	Homework, exams

(4) understand the role of technology, manipulatives, and models in mathematics.			

References:

All chapter and section numbers refer to texts currently being used for the listed courses

MCS-122: Stewart, James, Calculus, *Single Variable Early Transcendentals* 7th ed. (2012) Brooks-Cole.
MCS-142: Moore, D., McCabe, G., and Craig, B. *Introduction to the Practice of Statistics* 7th ed. (2012) Freeman.
MCS-177: Miller, B. and Ranum, D., *Python: Programming in Context* 2nd ed. (2012) Jones & Bartlett.
MCS-220: D'Angelo, J. and West, D., *Mathematical Thinking: Problem-Solving and Proofs* 2nd ed. (2000) Prentice-Hall.
MCS-221: Lay, David C., *Linear Algebra and its applications* 4th ed. (2012) Pearson.
MCS-222: Marsden, J. and Tromba, A., *Vector Calculus* 6th ed. (2012) Freeman.
MCS-303: Hvidsten, M. *Geometry with Geometry Explorer* (2005) McGraw-Hill.
MCS-313: Gallian, J., *Contemporary Abstract Algebra*, 7th ed. (2010) Brooks-Cole. or
       Pinter, C. *A Book of Abstract Algebra* 2nd ed. (1990) Dover.

Notes:

1) All majors are required to take a capstone course (MCS-314, MCS-332, MCS-342, MCS-344, MCS-357, MCS-358) that are designed to bring together many of the ideas that students learn in the mathematics major.