

## Course Outcomes Crosswalk

Math Programs Crosswalk					
Course	Student Learning Outcome: Students will be able to:	Knowledge	Justification	Reasoning	Technology
MA 2231	Calculus I				
	Demonstrate knowledge of limit	x			
	Discuss the concept of derivative and take derivatives using standard rules.	x	x		
	Solve realistic application problems.	x		x	
	Use Maple to reconcile a function's behavior with characteristics in first and second derivatives.	x			x
	Take integrals using standard rules.	x			
MA 2232	Calculus II				
	Cite basic definitions.	x			
	Solve definite and indefinite integrals using substitution, integration by parts, and tables.	x	x	x	
	Use Maple to approximate definite integrals using techniques mentioned above.	x			x
	Solve application problems.	x		x	
	Determine convergence of sequences and series.	x	x		
	Determine the limit of a sequence or series for standard special types (such as geometric series).	x	x		
MA 2233	Calculus III				
	Cite basic definitions.	x			
	Evaluate vector operations.	x	x		
	Use Maple to visualize higher dimensional graphs.	x			x
	Compute standard quantities (e.g. arclength, curvature, unit tangent vector, etc.)	x	x		
	Change coordinates (e.g., polar, cylindrical, etc.)	x		x	
	Compute differential and integral operations (partial derivatives, gradients, double integrals, etc.)	x			
	Find critical points, relative and absolute extrema, etc.	x		x	
	Compute standard types of integrals (curve integrals, area integrals, surface integrals, etc.)	x		x	
	Compute integrals using standard theorems (e.g. with potential functions, Green's theorem, etc.)	x		x	

MA 3260	Discrete Structures				
	Demonstrate a proficient understanding and ability to use basic concepts and notation of sets.	x			
	Establish properties and identities of mathematical structures.	x	x	x	
	Determine the truth value of compound statements	x	x	x	
	Demonstrate simple proofs using standard rules of inference: direct, indirect, contradiction, and induction	x	x	x	
	Demonstrate correct application of algorithms for counting permutation and combination for given contexts.	x	x	x	
	Solve recurrence relations	x	x	x	
	Determine properties of an abstract relation (reflexive, irreflexive, symmetric, etc) and establish equivalence relations.	x	x	x	
MA 3280	Linear Algebra				
	Demonstrate comprehension of matrices and matrix algebra.	x			
	Demonstrate understanding of and the ability to solve systems of linear equations.	x			
	Demonstrate comprehension of vector spaces.	x	x		
	Demonstrate comprehension of linear transformations.	x	x	x	
	Demonstrate comprehension of determinants.	x		x	
	Demonstrate comprehension of and ability to compute eigenvalues and eigenvectors.	x			
MA 3305/06	History of Math				
	Demonstrate understanding of the significance of the history of mathematics, particularly in the context of the secondary classroom.	x			
	Demonstrate understanding of the concepts of numbers, number systems, and representations of numbers.	x			
	Demonstrate understanding of the deeply interconnected nature of mathematics.	x			
	Demonstrate excellent communications skills in mathematics.	x			
	Demonstrate understanding of the significance of mathematical models over the course of mathematics history.	x			
	Demonstrate understanding of the significance and nature of axiomatic reasoning.	x	x	x	
	Demonstrate ability to read and discuss mathematical proofs.	x	x	x	

MA 3308	Operations Research				
	convert standard business problems into linear programs	x			
	convert problems from other appropriate applications into linear programs	x		x	
	solve linear programs using the simplex algorithm	x			
	code the simplex algorithm	x			x
	solve integer programs using integer program algorithms	x			x
	solve linear programs using duality theory	x		x	
	construct a project network and apply program evaluation review technique and critical path management	x			
	code the simulation of observations from certain probability distributions	x			x
	code the simulation of the movement of a Markov chain	x		x	x
	classify a Markov Chain according to standard properties	x		x	
	calculate a steady state solution and mean first passage matrix of a Markov chain	x			
	interpret a steady state solution and mean first passage matrix of a Markov chain	x		x	
	solve standard business problems using Markov chains	x		x	
	solve problems with inter-arrival and service times exponentially distributed using queuing theory	x		x	
MA 3310	Numerical Analysis				
	solve an algebraic or transcendental equation using an appropriate numerical method	x			x
	approximate a function using an appropriate numerical method	x			x
	solve a differential equation using an appropriate numerical method	x			x
	evaluate a derivative at a value using an appropriate numerical method	x			x
	solve a linear system of equations using an appropriate numerical method	x			x
	perform an error analysis for a given numerical method	x		x	x
	prove results for numerical root finding methods	x			
	calculate a definite integral using an appropriate numerical method	x			x
	code a numerical method in a modern computer language	x			x

MA 3311	Differential Equations I				
	Classify ordinary differential equations according to order and linearity, as well as distinguish between initial value problems and boundary value problems.	X		X	
	Solve standard constant coefficient nonhomogeneous ordinary differential equations by the methods of undetermined coefficients.	X			
	Use the methods of Euler, Runge-Kutta, and others to solve differential equations numerically.	X			X
	Formulate and solve application problems.	X		X	
	Find series solutions about ordinary and regular-singular points.	X			
	Determine the solution of difference equation problems by z-transform methods and differential equation problems by Laplace Transform methods.	X		X	
MA 3312	Differential Equations II				
	Obtain solutions for ordinary differential equations whose nonhomogeneous terms include discontinuous functions or distributions.	X		X	
	Solve classical partial differential equations such as the heat equation, wave equation, Laplace's equation, and Poisson's equation by various methods.	X			
	Investigate the solutions of boundary value problems by analytical methods, as well as numerical ones such as the Rayleigh-Ritz procedure.	X		X	
	Obtain solutions for systems of ordinary differential equations using various tools of linear algebra.	X		X	
MA 3329/30	Modern Geometries				
	Cite basic definitions.	X			
	Prove typical geometry proofs. (Pythagorean theorem, alternate interior angles, propositions in the Elements, etc.)	X	X		
	Compute geometric quantities in Euclidean and non-Euclidean spaces.	X			
	Prove geometric theorems in non-Euclidean spaces (e.g. angle sum theorem on the sphere.)	X	X	X	
	Prove basic manifold theorems (e.g. Euler characteristic of a torus is zero.)	X	X	X	

MA 3345	Real Analysis				
	prove a basic set theoretic statement	x	x		
	prove an appropriate statement by induction	x	x		
	define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion	x			
	prove a theorem about limits of sequences and functions	x	x		
	define continuity of a function and uniform continuity of a function	x			
	prove a theorem about continuous functions	x	x		
	define the derivative of a function	x	x		
	prove a theorem about the derivatives of functions	x	x		
	define a cluster point and an accumulation point	x	x	x	
	state the Bolzano-Weierstrass theorem, Rolle's theorem, extreme value theorem, and the Mean Value theorem	x			
	define Riemann integrable and Riemann sums	x			
	prove a theorem about Riemann sums and Riemann integrals	x	x		
MA 3361/62	Modern Algebra				
	Demonstrate understanding of the relationships between abstract algebraic structures with familiar numbers systems such as the integers and real numbers.	x	x	x	
	Demonstrate understanding of and the ability to verify relationships between operations satisfying various properties (e.g. commutative property).	x	x	x	
	Demonstrate understanding of and the ability to work within various algebraic structures.	x	x	x	
	Demonstrate understanding of the importance of algebraic properties with regard to working within various number systems.	x	x	x	
	Demonstrate ability to form and evaluate conjectures.	x	x	x	