School	School of Arts & Science
Major	Master of Science in Applied Mathematics

Core Requirements			
Code	**Title**	**Credits**	**Description**
MATH502	Algebra	3	This is a rigorous course in graduate level algebra. Two courses at the undergraduate level in abstract algebra covering some group and ring theory, as well as a good knowledge of linear algebra, are prerequisites. This subject presents the foundational material for the basic algebraic structures, fields and modules. The basic definitions and elementary results are given, followed classification of finitely generated abelian groups. In particular, we study, Sylow's theorems, applications of Sylow's theorems, simple groups, field extensions, algebraic and transcendental elements, splitting field, finite fields, structure of finite fields, field extensions: algebraic and transcendental extensions of field. The fundamental theorem of Galois theory, solution of polynomial equations by radicals. Elementary properties of modules, quotient modules, module homomorphisms, isomorphism theorems, generation of modules, direct sum of modules, finitely generated modules, and free modules.
MATH505	Numerical linear algebra	3	The course is divided into two parts. The ï¬rst part introduces general numerical techniques based on finite difference method to solve elliptical and parabolic partial diï¬€erential equations. The second part of the course introduces the ï¬nite volume method. Students will be given the chance to implement the introduced numerical techniques and solve some practical problems in heat transfer and ï¬,uid ï¬,ow using ï¬nite volume method or ï¬nite diï¬€erence method on MATLAB.
MATH510	Real Analysis	3	We introduce some basic concepts in modern analysis. The first goal is to provide a comprehensive description of measure theory on general spaces. The foundation of the theory dates back to the classical Greek period. Its modern notion (due to Henri Lebesgue) is a generalization of the "natural measures" of geometrical objects such as length, area, and volume. Recall that a measurable function that is discontinuous almost everywhere is not Riemann integrable. However, given a measure, we can define a more extensible kind of integral called the Lebesgue integral. Lebesgue integrable functions are important for functional analysts and probabilists. The second aim is to go deeply through analysis, covering the Fourier transform and the basics of the distribution theorem.

MATH520	Functional Analysis	3	The aim of this course is to give a comprehensive introduction to functional analysis and operator theory. Functional analysis is a sufficient large area of mathematics covering a lot of topics. It is now the language of analysis and theoretical physics. For example, it is a core part of the problem of finding the solution of ordinary, partial differential and integral These equations are of great interest because they lead to the understanding of the physical phenomena. A moment of reflection shows that this topic will cover a large part of modern analysis. Because of the broad scope of this branch we take a special care to be brief and not to overload the students with enormous amount of information available on this subject. The central concepts are normed spaces which emphasis on Banach and Hilbert spaces. Linear operators acting on these spaces will be covered in details. We investigate the importance of well known theorems in functional analysis such as Banach-Steinhaus theorem, Banach-Alaoglu theorem, Riesz representation theorem. Duality of linear spaces and application to measure theory will be a part of this course. Basic concepts of the abstract theory of functional spaces will be introduced.
MATH522	Topology	3	The word ‘’topology" is derived from the Greek phrase: the study of positions or locations. However, this etymology is not accurate for the spirit of the subject as it stands today. We could describe it as qualitative geometry or the mathematical study of shapes (topological spaces). It is a mathematical sub-discipline that studies the geometric properties which are invariant upon stretching or bending the space. For example, spatial objects like spheres are studied in their own right and not in the way for which they are embedded in space. Topological properties are based on separation, closure and convergence. Therefore, topology is regarded as generalization of analysis with specified open sets. It is possible, for example, to handle the concept of continuity without the notion of the distance. We introduce the bare essentials every student should know about general topology and constitute an awareness of its need in mathematics. In particular, we discuss properties for which a space may enjoy such as compactness and connectedness. We cover topics fundamental to modern analysis, differential geometry and partial differential equations. This is a must course for every mathematician to understand modern mathematics.

MATH560	Modern Differential Geometry	3	Many ancient civilizations had the basic knowledge of geometric shapes, such as pyramids, sphinx, and temples. The interplay between algebra, geometry, and calculus was evident in Euclidean geometry. It should be noted that more than Euclidean geometry is needed for modern mathematics. For example, the shortest path between two points on the earth, idealized as a sphere, is a geodesic (an arc) and not a straight line. This shows that a single coordinate system cannot cover the earth in non-Euclidean and compact space. However, from a local point of view, the earth looks at making it a locally Euclidean space. Differential geometry makes precise the concept of an object which looks locally like Euclidean space. It avails for introducing the numerical coordinate system into geometric objects. These objects, known as smooth manifolds, are the basics of modern differential geometry. Manifolds are topological spaces and are the higher analog of curves and surfaces. The plan is to extend extrinsic geometry (curves and surfaces) to manifolds' intrinsic geometry. Differential geometry uses the tools of calculus to study problems in geometry. We do calculus on manifolds and investigate the interplay of analysis and topology to generalize vector calculus theorems. There are many applications of differential geometry in modern physics. For example, a four-dimensional differential manifold is the mathematical representation of space-time. Riemann's geometry is the language of Einstein's general theory of relativity. Symplectic manifolds best describe Hamiltonian and Lagrangian approaches. Contact manifolds play an essential role in the study of thermodynamics.

Major Requirements			
Code	**Title**	**Credits**	**Description**
MATH649	Master Thesis(Part I)	3	
MATH699	Master Thesis(Part II)	3	