MATH 3591 Mathematical Science Project I (3,0,9) (E)
Prerequisite: Year III standing
This is a half-year individual project which usually relates to an interdisciplinary or applied topic, and requires knowledge and skill acquired in various courses. A thesis and an oral presentation are required upon completion of the project.

MATH 3592 Mathematical Science Project II (3,0,9) (E)
Prerequisite: MATH 3591 Mathematical Science Project I and Recommendation by the supervisor
This is an extension of MATH 3591 for outstanding students, who are now supposed to conduct more innovative further developments for their results obtained in MATH 3591. A thesis and an oral presentation for Project I are waived but will be required upon completion of Project II.

MATH 3605 Numerical Methods II (3,3,0) (E)
Prerequisite: MATH 3206 Numerical Methods I, MATH 3405 Ordinary Differential Equations
This is the continuation of the Numerical Methods I. The course covers the concepts of Discrete/Fast Fourier Transform (DFT/FFT), the concepts of optimization, numerical methods for solution of systems of nonlinear equations, numerical methods for optimization and algorithms for solutions of initial value problems and boundary value problems for ordinary differential equation. The constructions of the algorithms and their advantages and limitations will be discussed so that the results of the computations can be properly interpreted.

MATH 3606 Partial Differential Equations (3,3,0) (E)
Prerequisite: MATH 2205 Multivariate Calculus, MATH 3405 Ordinary Differential Equations
This course introduces the theory of multi-dimensional scalar and system of parabolic, elliptic and hyperbolic partial differential equations (PDEs) that model physical processes in areas such as physics, biology, chemistry and social science. Solution techniques such as the separation of variables, eigenfunction expansions, Green functions, Fourier and Laplace transforms for solving the equations in a bounded and unbounded domain, with homogeneous and inhomogeneous source term will be studied in detail. Some classical numerical methods such as finite difference schemes and finite elements schemes for solving partial differential equations will also be introduced.

MATH 3607 Boundary Value Problems (3,3,0) (E)
Prerequisite: MATH 2205 Multivariate Calculus, MATH 3606 Partial Differential Equations
The principle objective of this course is to tie together the mathematics developed and the student's physical intuition by solving boundary value problems involving partial differential equation. This is accomplished by deriving the mathematical model, by using physical reasoning in the mathematical development, by interpreting mathematical results in physical terms, and by studying the heat, wave, and potential equations separately. Student is assumed to have enough background in physics to follow the derivations of the heat and wave equations.

MATH 3615 Digital Image Analysis (3,2,2) (E)
Prerequisite: MATH 1005 Calculus
This course aims to introduce students to the foundation of digital image analysis. Students will learn elementary point operation techniques for image enhancement, and advanced techniques (including the theory of Fourier transform) for image restoration and image analysis. Students will come to understand all the major issues involved in the design and implementation of a digital imaging system.

MATH 3616 Numerical Methods for Differential Equations (3,3,0) (E)
Prerequisite: MATH 3606 Partial Differential Equations and MATH 3206 Numerical Methods I
This course introduces the major numerical techniques for solving partial differential equations. Emphasis is placed on finite difference methods and finite element methods. Some typical engineering problems, such as shock waves, are analysed.

MATH 3617 Systems and Control Theory (3,3,0) (E)
Prerequisite: MATH 1005 Calculus, MATH 2207 Linear Algebra
Many problems in social science, economics, and engineering, can be modeled as linear systems. This course studies the properties of linear systems and how they can be controlled. Emphasis will be placed in understanding the important issues involved in the design and implementation of linear systems, in particular the stability analysis of feedback systems. Examples will be drawn from a wide range of fields.

MATH 3620 Numerical Methods II (3,3,0) (E)
Prerequisite: MATH 2140 Numerical Methods I
As a continuation of MATH 2140 Numerical Methods I, this course covers techniques for numerical solution of mathematical problems. Students are introduced to widely-used computer software packages. At the same time the underlying ideas of algorithms are taught.

MATH 3625 Theoretical Numerical Analysis (3,3,0) (E)
Prerequisite: MATH 3206 Numerical Methods I
This course provides a theoretical understanding of the major ideas of numerical analysis. Emphasis is placed on the study of underlying principles, error bounds, convergence theorems, etc. in the area of numerical analysis.

MATH 3640 Theoretical Numerical Analysis (3,3,0) (E)
Prerequisite: MATH 2140 Numerical Methods I
This course provides a theoretical understanding of the major ideas of numerical analysis. Emphasis is placed on the study of underlying principles, error bounds, convergence theorems, etc. in the area of numerical analysis.

MATH 3650 Topology (3,3,0) (E)
Prerequisite: MATH 1111-2 Mathematical Analysis I & II
This course covers the essential concepts of topological spaces. Important topological properties are also taught to lay the ground work for further studies.

MATH 3660 Operations Research II (3,3,0) (E)
Prerequisite: MATH 1120 Linear Algebra
This course aims to introduce students to some fundamental and advanced topics in operations research. Students will learn theory, techniques, and applications of integer programming, queuing theory, Markov decision process, and nonlinear programming.

MATH 3670 Differential Geometry (3,3,0) (E)
Prerequisite: MATH 1120 Linear Algebra and MATH 2110 Differential Equations
This course teaches students the mathematical tools of classical differential geometry. Applications to curve and surface designs are also given.

MATH 3680 Applied Functional Analysis (3,3,0) (E)
Prerequisite: MATH 1111-2 Mathematical Analysis I & II, MATH 1120 Linear Algebra, and MATH 2130 Real Analysis or consent of instructor
This course aims at familiarizing the student with the basic concepts, principles and methods of functional analysis and its applications. Functional analysis plays an important role in the applied sciences as well as in mathematics itself. Roughly speaking, functional analysis develops the tools from calculus and linear algebra further to the more general setting where one has vector spaces comprising functions or general abstract infinite-dimensional vector spaces. Problems from various application areas can then be conveniently posed in this common general set up, and solved using the techniques of functional analysis. The basic objects studied in functional analysis are vector spaces with a notion of distance between vectors, and continuous maps between such vector spaces. This interplay between the algebraic and analytic setting gives rise to many interesting and useful results, which have a wide range of applicability to diverse mathematical problems, such as from numerical analysis, differential and integral equations, optimization and approximation theory.