MATH 2230   Operations Research I   (3,3,0) (E)
Prerequisite: MATH 1120 Linear Algebra
This course aims to introduce students some fundamental topics in operations research. Students will learn theory, techniques and applications of linear programming, network programmes, dynamic programming and inventory control problems.

MATH 2610   Graph Theory   (3,3,0) (E)
Prerequisite: Year II standing
This course covers some fundamental concepts and principles of graph theory. Some algorithms of graphs are also discussed. Students will learn some techniques to solve some graph problems.

MATH 2630   Number Theory   (3,3,0) (E)
Prerequisite: Year II standing
This course will provide an introduction to the theory of numbers. Basic concept such as divisibility, congruence, diophantine equations will be covered. Some applications such as cryptography will be introduced.

MATH 2770   Internship I   (1,0,0)
Prerequisite: Students must apply to and receive permission from the co-op coordinator preferably one semester in advance
This is a work experience programme available to students in MATH. Interested students should contact departmental advisors as early in their careers as possible, for proper counselling.

MATH 2780   Internship II   (1,0,0)
Prerequisite: MATH 2770 Internship I, and students must apply to and receive permission from the co-op coordinator preferably one semester in advance
This is a work experience programme available to students in MATH. Interested students should contact departmental advisors as early in thier careers as possible, for proper counselling.

MATH 3205   Linear and Integer Programming   (3,3,0)
Prerequisite: MATH 2207 Linear Algebra
This course aims to introduce students to the fundamental topics in Linear and Integer programming. Students will learn theory, techniques and applications of linear programming and integer programming. Some modeling techniques will be also introduced for linear and integer programming. However, the interior point theory will not be covered.

MATH 3206   Numerical Methods I   (3,3,0)
Prerequisite: MATH 1005 Calculus and MATH 2207 Linear Algebra
This introductory course presents students some classical and commonly used numerical methods in various disciplines involving computing and numerical approximation and solution of equations. The course teaches students how to choose an appropriate numerical method for a particular problem and to understand the advantages and limitations of the chosen numerical scheme for a given mathematical problem so that results from the computation can be properly interpreted. The course also highlights important theoretical considerations on convergence and stability for numerical algorithm design.

MATH 3215   Advanced Calculus I   (3,3,0) (E)
Prerequisite: MATH 1005 Calculus or MATH 1205 Discrete Mathematics (*recommended*)
This course deals with the basic theory of analysis in real-valued functions in single variable. It provides students with a good foundation for more advanced courses in the mathematical science major. Topics include real numbers, sequences, limit and continuity, and differentiation.

MATH 3216   Advanced Calculus II   (3,3,0) (E)
Prerequisite: MATH 3215 Advanced Calculus I
This course deals with the basic theory of analysis in real-valued functions in single variable. It provides students with a good foundation for more advanced courses in the mathematical science major. Topics include integration and series.

MATH 3285   Job Practicum I   (1,0,0)
Prerequisite: Year 2 or above and students must apply to and receive permission from the co-op coordinator preferably one semester in advance
This is the first time of work experience available to students in the department of Mathematics. Interested students should contact departmental advisors as early in their careers as possible, for proper counseling.

MATH 3286   Job Practicum II   (1,0,0)
Prerequisite: MATH 3285 Job Practicum I and students must apply to and receive permission from the co-op coordinator preferably one semester in advance
This is the second time of work experience available to students in the department of Mathematics.

MATH 3287   Job Practicum III   (1,0,0)
Prerequisite: MATH 3286 Job Practicum II and students must apply to and receive permission from the co-op coordinator preferably one semester in advance
This is the third time of work experience available to students in the department of Mathematics.

MATH 3405   Ordinary Differential Equations   (3,3,0)
Prerequisite: MATH 2215 Mathematical Analysis, MATH 2207 Linear Algebra
This course aims to introduce students to the basic theory of linear ordinary differential equations (ODE) with constant and variable coefficients and the modeling of diverse practical phenomena by ODE. Students will learn both quantitative and qualitative methods for solving these equations. Topics include first and second order scalar ODE, systems of first order ODE, autonomous systems of ODE, existence and uniqueness theorem, Laplac transform for initial value problems, regular and singular Sturm-Liouville boundary value problems and nonlinear differential equations.

MATH 3406   Abstract Algebra   (3,3,0)
Prerequisite: MATH 1205 Discrete Mathematics
This course covers some properties of groups, rings and fields. Permutation groups and polynomial rings are included. Application of permutation group on counting and application of finite field on error correcting code are included.

MATH 3407   Advanced Linear Algebra   (3,3,0)
Prerequisite: MATH 2207 Linear Algebra
This course is designed for mathematical science major students. General vector space, linear transformations, inner products, diagonal form, Jordan form, dual space and quadratic forms will be introduced. The course emphasizes on general theory of linear algebra.

MATH 3415   Vector Calculus   (3,3,0)
Prerequisite: MATH 2205 Multivariate Calculus and MATH 2207 Linear Algebra
This course is designed to develop the intuitive understanding, theory, and computational skills necessary for the concepts of vector functions by tying together multivariate calculus with concepts of vector. Topics covered include Vector Fields, Stokes theorem, Green's theorem, Gauss' theorem, and their applications.

MATH 3416   Complex Analysis   (3,3,0)
Prerequisite: MATH 2215 Mathematical Analysis
This course provides an up-to-date introduction to the basic theory of analytic functions of one complex variable. Residue Theorem and its applications to the evaluation of integrals and sums will be one of the main objectives. Also conformal mappings and their applications will be discussed.

MATH 3417   Game Theory   (3,3,0)
Prerequisite: MATH 1205 Discrete Mathematics
The purpose of this class is to provide an introduction to game modeling and theory. In studying of strategic behavior among parties having apposed, mixed or similar interests, students will

be able to think strategically, understand and explain a wide range of problems. Students will learn how to recognize and model strategic situations, to predict when and how your actions will influence the decisions of others and to exploit strategic situations for your own benefit. It is also important to emphases that game theory is a deductive, mathematical enterprise; therefore, it requires abstract, symbolic reasoning. The major topics covered are strategic games, extensive games with perfect and imperfect information, and coalitional games.

MATH 3425   Graph Theory   (3,3,0)
Prerequisite: MATH 1205 Discrete Mathematics
This course covers some fundamental concepts and principles of graph theory. Some algorithms of graphs are also discussed. Students will learn some techniques to solve some graph problems.

MATH 3426   Number Theory   (3,3,0)
Prerequisite: MATH 1205 Discrete Mathematics
This course provides an introduction to the theory of numbers. Basic concept such as divisibility, congruence, diophantine equations will be covered. Some applications such as cryptography will be introduced.

MATH 3427   Real Analysis   (3,3,0)
Prerequisite: MATH 2215 Mathematical Analysis
This course provides an introduction to measure theory, Lebesgue integration, L^P spaces, and Fourier analysis. Equipped with this knowledge, students are prepared for further studies in numerical analysis, functional analysis and advanced probability theory.

MATH 3591   Mathematical Science Project I   (3,0,9)
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)
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)
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)
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)
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)
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   (3,3,0)
**   Differential Equations**
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)
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   Advanced Numerical Analysis   (3,3,0)
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.