B.Sc. MATHEMATICS

YEAR ONE	SEMESTER ONE		T	PT	C
MTH 171	Algebra and Trigonometry	3	1	3	
MTH 173	Introduction to Logic and Set Theory	3	1	3	
MTH 175	Vectors and Coordinate Geometry	3	1	3	
MTH 177	Introduction to Probability and Statistics		3	1	3
ICT 151	Information Technology I		2	2	3
ENG 155	Communication Skills 1		2	0	2
ACT201	Principles of Accounting		2	2	3
			18	**8**	**20**

YEAR ONE	SEMESTER TWO		T	PT	C
MTH 172	Calculus I		3	1	3
MTH 174	Vectors and Mechanics		3	1	3
MTH 176	Introduction to Discrete Mathematics		3	1	3
MTH 178	Introduction to Probability Distributions	3	1	3	
ICT 152	Information Technology II		2	2	3
ENG156	Communication Skills II		2	0	2
			16	**6**	**17**

YEAR TWO	SEMESTER ONE		T	PT	C
MTH 271	Complex Numbers and Matrices		3	1	3
MTH 273	Calculus II		3	1	3
MTH 275	Introduction to Analysis		3	1	3
MTH 277	Statistical Methods I		3	1	3
MTH279	Introduction to Algebraic Structures	3	1	3	
ECO 201	Elements of Microeconomics	3	0	3	
			18	**6**	**18**

YEAR TWO	SEMESTER TWO		T	PT	C
MTH 272	Ordinary Differential Equations I	3	1	3	
MTH 274	Mechanics I		3	1	3
MTH 276	Multivariate Calculus I	3	1	3	
MTH 278	Introduction to Programming		3	1	3
MTH 280	Statistical Methods II	3	1	3	
ECN 202	Elements of Macroeconomics		3	0	3
			18	**6**	**18**

YEAR THREE	SEMESTER ONE		T	PT	C
	CORE COURSES				
MTH 371	Linear Algebra		3	1	3
MTH 373	Analysis		3	1	3
MTH 375	Ordinary Differential Equations II		3	1	3
MTH 377	Multivariate Calculus II	3	1	3	

ELECTIVE COURSES: CHOOSE ANY TWO

MTH 379	Linear Models (Statistical Analysis)	3	1	3	
MTH 381	Mechanics I	3	1	3	
MTH 383	Introduction to Numerical Methods	3	1	3	
MTH 385	Probability Distributions		3	1	3
			18	**6**	**18**

YEAR THREE SEMESTER TWO			**T**	**PT**	**C**
	CORE COURSES				
MTH 372	Abstract Algebra I		3	1	3
MTH 374	Complex Analysis		3	1	3
MTH 376	Partial Differential Equations	3	1	3	
MTH 378	Euclidean and Non-Euclidean Geometry		3	1	3
	ELECTIVE COURSES: CHOOSE ANY TWO				
MTH 380	Time Series Analysis	3	1	3	
MTH 382	Convex Optimization	3	1	3	
MTH 384	Stability Theory of Dynamical Systems	3	1	3	
MTH 384	Topology I		3	1	3
MTH 388	Numerical Methods and Computational Mathematics		3	1	3
MTH 390	Non-parametric Statistics	3	1	3	
			18	**6**	**18**

YEAR FOUR	SEMESTER ONE		T	PT	C
	CORE COURSES				
MTH 471	Measure Theory		3	1	3
MTH 473	Integral Equations		3	1	3
MTH 475	Abstract Algebra II		3	1	3
MTH 469	Project		1	6	3
	ELECTIVE COURSES: CHOOSE ANY TWO				
MTH 477	Multivariate Data Analysis		3	1	3
MTH 479	Calculus of Variation	3	1	3	
MTH 481	Differential Geometry		3	1	3
MTH 483	Mathematical Economics I		3	1	3
MTH 485	Topology II		3	1	3
MTH 487	Nonlinear Optimization		3	1	3
			16	**7**	**18**

YEAR FOUR	SEMESTER TWO		T	PT	C
	CORE COURSES				
MTH 470	Project		1	6	3
MTH 472	Integration Theory		3	1	3
MTH 474	Introduction to Functional Analysis	3	1	3	
MTH 476	Galois Theory	3	1	3	
	ELECTIVE COURSES: CHOOSE ANY TWO				
MTH 478	Sample Survey Theory		3	1	3
MTH 480	Stochastic Processes	3	1	3	
MTH 482	Mathematical Economics II		3	1	3
MTH 484	Special Functions		3	1	3
MTH 486	Optimal Control theory		3	1	3

ICT 357	Application Development (with VB.Net)	3	1	3
		16	**11**	**18**

Minimum number of credits required for graduation 145

YEAR ONE SEMESTER ONE

MTH 171: Algebra and Trigonometry (3, 1, 3)

Course Objective

This course is designed for students to extend their understanding of algebra and introduce the study of trigonometry. A thorough understanding of functions and their graphs will be stressed.

Course Content

Concepts of algebra: Natural, integers, rational and real numbers. Algebra of indices, logarithms and rational expressions

Analysis and graphs of functions: polynomials, rational, exponential, logarithmic and trigonometric functions. Solution of their equations and inequalities. Factoring, long division and remainder. Solution of system of equations. Partial fractions.

arithmetic and geometric sequences and series and solve related problems. Binomial Theorem
Angle measure. Right triangle trigonometry. Graphs of trigonometric functions and their inverses. Trigonometric identities including sums and differences of angles, double angle, half angle, power reduction, sum to product,
and product to sum; trigonometric equations and solutions

MTH 173: Introduction to Logic and Set Theory. (3, 1, 3)

Course Objective

This course provides an introduction to the basic concepts and results of mathematical logic and set theory. The course introduces some basic notions that will be needed as background for most of the mathematics courses. Also, the course will familiarize students with abstract mathematical thinking.

Course Content

The Symbols~, $\wedge$, $\vee$, $\Rightarrow$, $\Leftarrow$, $\Leftrightarrow$, $\equiv$, as applied to Statements, Equivalence of Statements. Truth Tables. Arguments. Some important tautologies like, Law of Excluded Middle, Law of Non-contradiction, Law of Transposition and Rule of Detachment, etc. Relationship between logic and Set Theory. Necessary and sufficient conditions. Universal and Existential Quantifies. Union, Intersection Complement. Mapping: Images and Inverse images. Injective, Surjective, and Bijective mappings. Cardinality of sets. Proof techniques.

MTH 175: Vectors and Coordinate Geometry (3, 1, 3)

Course Objective

This course introduces students to vector spaces including algebra and products of vectors and their use to determine the equations of straight lines, curves, planes and conic sections.

Course Content

Vectors in Euclidean Spaces. Notation of a vector and algebra of vectors. Positive vector in a plane and in space. Dot (Scalar) Product, Cross (Vector) Product of Vectors. Vector equations of a lines. Parallel and perpendicular lines. Mid point of line segments. Algebraic and parametric representation of a curve.Equation of a circle, loci. Algebric and geometric definition of conic section: Parabola, ellipse and hyperbola. Eccentricity, focus.

MTH 177: Introduction to Probability and Statistics (3, 1, 3)

Course Objective

This course provides an elementary introduction to probability and statistics with applications.

Course Content

General introduction, including the Uses and Applications of Statistics, Types of Data and their Collection Methods, Stages of Statistical Investigation; Descriptive Analysis of Data including Exploratory Data Analysis; Introductory Study of Probability Theory: Sets and sample space, Random Experiments and Outcomes, Measure of Probability of Events, Mutually exclusive and Independent Events, Conditional Probability and Bayes‘ theorem, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions; Moments and Moment Generating Functions.

ICT 151: Information Technology 1 (2, 2, 3)

Course Objective

The course helps students to develop an appreciation and understanding of the important components of computer-based information systems and how they are employed in achieving the aims of organizations.

Course Content

The history of computing technology, the basics components of computers and how they interrelate, and the role of IT in modern society. Classification of computers, characteristics and functional parts of the computer: processing, storage, input/output, and telecommunication hardware, types and applications of computer software. Data: hierarchy, logical versus physical representation. Types of file organization and processing methods.Introduction to searching and sorting methods. The practical components will focus on developing competency in the use of the Windows Operating System and Office applications with particular reference to Word Processing.

ENG 155: Communication Skills I (2 0 2)

Course Objective

This course deals with the review of English Grammar and is a required course for al first year students of the college.

Course Content

Students will be assisted to review some of thecommon problem areas of their writing such as the verb/tense system, concord, sentence construction and organization of the paragraph. There will also be a study of basic grammatical structures that shall involve teaching students to write formally correct sentences, avoiding sentence errors and using punctuations effectively.

ACT 201: Principles of Accounting (2, 2, 3)

Course Objective

The aim of this course is to equip students with the fundamental principles, concepts and convention of financial accounting.

Course Content

It deals with the meaning and importance of financial accounting, the accounting cycle, recording of business transactions under the double entry system, and the preparation of accounts for sole proprietorship and not for profit making organization and interpretation of accounts.

YEAR ONESEMESTER TWO

MTH 172: Calculus I (3, 1, 3)

Course Objective

This foundational pure mathematics course teaches the student to appreciate this branch of mathematics primarily involved in the development of mathematical principles that may not necessarily lead to any immediate practical applications.

Course Content

SETS:Definition and representation of sets. Classification of sets.

RELATION: Cartesian and product of two sets. Domain and range of a relation

FUNCTIONS: Definition of function: domain, codomain, image set

Classification of functions: one-to-one functions, many-to-one functions, into functions, onto functions, bijection

Special functions: monotonic functions, even/odd functions, step functions, monomial functions, binomial functions, Sequence and series (Arithmetic Progression, Geometric Progression)

Algebraic functions: Polynomial and Rational functions

Transcendental functions and power series representation

Exponential, Logarithm,Trigonometry functions including angle argument type, addition and factor theorems. Function Composition

Limits and Continuity: One-sided limits, limit at a point, limit at infinity

Continuity (at a point and on the domain)

Derivative of monomials from 1^{st} principles

Rules of differentiation, Derivatives of polynomials, rational functions, Exponential, logarithm, trigonometry functions. Derivatives of composite functions – chain rule

Higher order derivatives. Differentiation of implicit functions. Maxima and minima

MTH 174: Vectors and Mechanics (3, 1, 3)

Course Objective

This course is aimed at equipping students with the understanding of concepts and application of Newton's laws and the equations of motion of single particle, analysis of simple harmonic motion and undamped vibration.

Course Content

Topics to be covered include; Position vector of a particle. Vector function of a single variable; differentiation and integration of a vector function of a single variable (time). Concept of force, line of action of a force, force acting on a particle. Static motion of a particle. Kinematics: displacement, velocity and acceleration of a particle in Cartesian coordinate. Concept of relative motion. Newton's laws of motion; work, energy and power. Impulse and momentum, conservation of energy and momentum. Rectilinear motion. Motion under gravity.Simple pendulum.

MTH 176: Introduction to Discrete Mathematics (3, 1, 3)

Course Objective

This course aims at introducing students to basic concepts of Discreteobjects in Mathematics, counting techniques, difference equations and Boolean algebra with applications.

Course Content

Topics to be covered are; sets, functions, relations, graphs, digraphs, trees, recursion, mathematical induction. Counting techniques. Multinomial coefficients. Finite Difference Equations. The Z-transform approach to solution. Duality, Consistency. Difference Equations with Characteristics Polynomials, which have complex roots. Boolean algebra. Basic Boolean Functions. Digital Logic Gates Minterm and Maxterm Expansions.

MTH 178: Introduction to Probability Distributions (3, 1, 3)

Course Objective

This course will introduce students to the fundamentals of probability theory and random processes.

Course Content

Review of Probability Spaces and Measure, Properties and Concept of Random Variables and Probability Distributions; Some useful Discrete and Continuous Probability Distribution Functions, Moment-generating Functions, Characteristics Functions and Limit Theorems; Joint Probability Distributions; Random Walks and Poisson Processes;

ICT 152: Information Technology II (2, 2, 3)

Prerequisite : ICT 151 Information Technology 1

Course Objective

This course is a follow-up to ICT 151 and aims to providefurtherunderstanding of the information system developmentprocess

The development of competencies in Office applications of PowerPoint, Spreadsheet and Database Applications in lab sessions will continue.

Course Content

Students will be introduced to the Internet, World Wide Web, and its applications to email, internet searches. The topics under the treatment of the Internet include the following: The history and the impact of the Internet on the world, hands on experience on websites and pages, web browsers, technologies associated with Internet technologies (on-line domain, sub domain, ISP, TCP, IP addresses, etc), introduction to LAN, WAN, MAN, WWW – topologies, Global Internet and Global Information structure, features and tools for navigating the Internet, Services available on the Internet: electronic mail, network news, bulletin board services, World Wide Web (introduction to html, FrontPage, SQL), Telephone related communication services, etc.

ENG 156: Communication Skills II (2 0 2)

Prerequisite ENG 155 Communication Skills 1

Course Objective

This course is dedicated to introducing students to know the various aspects of English as a language that can be studied.

Course Content

Topics will include morphology, syntax, phonology and semantics. Other related aspects of language like pragmatics and sociolinguistics will have space under this course. The key concern here is mainly for students to be aware of the different parts

into which the English language can be put and what each of these parts is all about, not necessarily delving deep into these aspects. A bit of attention will also be paid to the interrelationships that exist between these parts of language.

YEAR TWO SEMESTER ONE

MTH 271: Complex Numbers and Matrices (3, 1, 3)

Course Objective

The course will emphasize the theoretical and conceptual aspects ofthe subject, and students will be expected to write proofs.

Course Content

Complex numbers and algebra of complex numbers. Argand diagram, modulus-argument form of a complex number. De Moivres theorem, root of unity, roots of general complex number, complex conjugate roots of a polynomial equation with real coefficients. Geometrical applications, loci in the complex plane. Transformation from one complex plane (the z-plane) to another (the w-plane) using $w = f(z)$. Matrices and algebra of matrices and determinants, inverse of a matrix and applications to system of linear equations. Linear transformation and matrix representations of linear transformations. Eigenvalue problem.

MTH 273: Calculus II (3, 1, 3)

Prerequisite: MTH 172

Course Objective

MTH 273 builds on the earlier course MTH 172 and details some of the possible applications of pure mathematics to business management and social service problems

Course Content

Integration as inverse of differentiation. Antiderivatives, Indefinite integrals, Definite integrals. Fundamental theorem of calculus

Methods of integration: integration by algebraic and trigonometry substitution, integration by parts. Use of partial fractions in integration

Improper integrals. Laplace transform. Fourrier series. Fourrier transform

MTH 275: Introduction to Analysis (3, 1, 3)

Course Objective

In this course we will study the foundations of real analysis, and convergence and limits of sequences.

Course Content

Basic properties of real numbers, bounded sets, infimum and supremum. Convergence of sequences, Cauchy convergence.Limits, continuity and differentiability, Rolle's Theorem, mean value-theorem and their applications. Integration, definition of the integral of a continuous function in terms of supremum and infinumof the Riemann integral.

MTH 277: Statistical Methods I (3, 1, 3)

Prerequisite: MTH 177 Introduction to Probability and Statistics

Course Objective

This aims at introducing students to statistical inference, estimation and sampling techniques as well as sampling distribution.

Course Content

Estimation: Point and Interval Estimation of Parameters (Mean, Proportion and Variance), Properties of Point Estimators, Methods of Point and Interval Estimation; Hypothesis Testing: Concepts of Statistical Inference, Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Proportions and Variances**.** Basic Concepts, Significance Tests for Parameters including Analysis of Variance.

MTH 279: Introduction to Algebraic Structures (3, 1, 3)

Prerequisite: MTH 171 Algebra and Trigonometry

Course Objective

This course aims to equip students with systematic procedure to think and reason logically and be able to apply the basic principles` and enhanced deductive skills underying the method of reasoning. It also introduces the algebraic structures of rings and fields; describe the quotient structure and its connection with homomorphisms of rings; present important examples rings and develop some of their properties with particular emphasis on polynomial rings and factorisation in rings.

Course Content

Topics to be covered include, Logic and concept of proof. Elements of theory of sets, Cartesian product of sets, binary relation on a set, equivalence relation. The number system and number theory. Factorisation of Polynomials and Roots of Polynomials. Vector Spaces and Subspaces, Basis Dimension and Co-ordinates. Axiomatically defined systems; concept of a group, ring, integral domains and field. Isomorphisms.

ECO 201: Elements of Microeconomics (3, 0, 3

Course Objective

This course introduces students with no previous knowledge of economics to fundamental concepts and the use of analytical techniques

Course Content

Price determination, theories of household decision at higher level and theories of consumer behaviour. It also deals with production and cost decisions of firms, market structures and the analyses of the impact of government policies in the decision of various economic agents

YEAR TWO SEMESTER TWO

MTH 272: Ordinary Differential Equations I (3, 1, 3)

Course Objective

Upon completion, students should be able to understand the concepts and techniques of construction and solving differential equations to analyze the phenomena.

Course Content

Topics to be covered are; Ordinary differential equations of first order; separable type; homogeneous type, linear equations, exact equations, use of integrating factors. Second order differential equations; linear homogeneous equations with constant coefficients, inhomogeneous equations and the method of undermined coefficients. Systems of first order equations, reduction of n^{th} order equations to a system of first order equations. Methods of variation of parameters. Laplace transform solution to initial value problems.

MTH 274: Mechanics I (3, 1, 3)

Prerequisite MTH 174: Vectors and Mechanics

Course Objective

This course is aimed at equipping students with concepts and applications of kinematics of motion in cartesian and curvilinear cordinates. Dynamics of motion of single particle Analysis of harmonic motion, conservation theorems, central force and application.

Course Content

Mechanics of single particles: derivation of unit vectors s in Cartesian and curvilinear coordinates. Time rate of change of unit vectors. Kinematics: displacement, velocity,

acceleration in Cartesian and curvilinear coordinates. Review on Newton's Law of mechanics. Review of solutions of Newton's equations for time, velocity, position dependent forces. Harmonic oscillator: simple, damped and forced oscillators. Concept of force and potential fields. Conservative force fields. Work and energy. Theorems on energy, momentum and angular momentum conservation. Central forces problem. Effective potential. Stable and unstable equilibrium.Solution by energy integral. Solution by equation of motion. Conic section and planetary motion. Kepler'slaws .

MTH 276: Multivariate CalculusI (3, 1, 3)

Prerequisite: MTH 273 Calculus II (3, 1, 3)

Course Objective

This course aims at deepening students understanding in calculus of several variables including partial differentiation, and tangents to surfaces..

Course Content

Domain and functions of several variables. Limits and continuity. Partial Differentiation of Function of Several Variables. Total Differential. Implicit Function Theorem. The Hessian, maxima and minima. Lagrange multipliers. Differentiation of a Vector Function of Several Variables. Jacobian. Tangent Plane to Surface. The Tangent Vector.

MTH 278: Introduction to Programming (3, 1, 3)

Course Objective

This course is intended to assist undergraduates with learning the basics of programming in general and programming, MATLAB® in particular.

Course Content

MATLAB programming interface. Variable declaration. Arrays and subarrays. Operators and hierarchy: arithmetic relational and logic operators. Built-in functions. Plotting: basic plot, subplot, multiple plots and plot properties. Control structures. M-files: script and functions. Error handling and debugging. Cell array. Structure array. Symbolic Computations.

MTH 280: Statistical Methods II (3, 1, 3)

Prerequisite MTH 277 Statistical Methods I

Course Objective

This course introduces students to statistical test procedures.

Course Content

Non-Parametric Tests (Chi-Square Tests, Tests for Independent and Paired Samples); Type I and II Errors and Power Function, Neyman-Pearson Lemma and Likelihood Ratio Test for Most Powerful Critical Region.

ECO202: Elements of Macroeconomics (3, 0, 3)
Prerequisite ECO 201 Elements of Microeconomics
Course Objective

Introduces students to the study of national income and economy including GNP, GDP, etc.

Course Content

The course deals with the circular flow of income, measures of aggregate income, aggregate equilibrium and a simple Keynesian model, the multiplier, accelerator, and a Keynesian view of the business cycle. It will also cover money and its relation to the main economics aggregates, the balance of payments and the exchange rate and introduction to government policy instruments.

YEAR THREE SEMESTER ONE

MTH 371: Linear Algebra (3, 1, 3)
Course Objective

Students will further study vector and dual spaces, multilinear forms, Eigen values and Eigen vectors, operators and transformations.

Course Content

Review of vector space. Orthogonalization process. Mapping in vector space. Adjoints, Unitary, and Hermitian Transformations.Solution of system of equations: Nullity, rank. Solution of system of equations by Gaussian elimination. Consistent and inconsistent systems of equations. Inner product space. Cartesian product space. Linear functional and dual space. Bilinear and quadratic forms. Eigenvalues and eigenvectors. Reduction of quadratic form to canonical form.

MTH 373: Analysis (3, 1, 3)

Course Objective

Upon completion students are expected to be well informed about the number system.

Course Content

Construction of Real Numbers. Dedekind cuts. Least Upper Bound, Greatest Lower Bound of a Set. Convergence of Sequences. Upper and Lower Limits. The Bolzano-Weierstrass Theorem and the Cauchy Principles of Convergence. The Notion of a Function. Inverse and Composite Functions, Limit and Continuity. Differentiability and integrability.

MTH 375: Ordinary Differential Equations II (3, 1, 3)

Course Objective

This course aims at solution of differential equations with variable coefficients.

Course Content

Ordinary points, regular singular points, interval of convergence of convergence of solutions. Summation limits. Recurrence relation Taylor's solution. Frebonius solution. Application to hypergeometric, Bessel and Legendre equations.

MTH 377: Multivariate Calculus II (3, 1, 3)

Course Objective

Students to understand the concepts and techniques of iterated integrals for area and volume in Cartesian and Curvilinear Co-ordinates.

Course Content

Differential domain in cartesian, plane polar, cylindrical and spherical coordinates. Multiple Integrals. Line Integrals, Surface and Volume Integral. Gradient, Divergence and Curl. The Theorems of Green, Gauss, and Stokes.

ELECTIVE COURSES: CHOOSE ANY TWO

MTH 379: Statistical Linear Models (3, 1, 3)

Course Objective

Students get an appreciation of bivariate and multivariate analysis, including regression and correlation.

Course Content

Basic Concepts of Regression and Correlation Analysis; Correlation Coefficient and Scatter Diagram; Estimation of Parameters of Regression Models by the Least Squares Method, Inferential Analyses on Regression Parameters; Concept of Multicolinearity and the Use of Qualitative Variables in Regression Models; Residual Analysis for Testing Model Assumptions; Correlation Analysis of Response and Predictor Variables; Use of Statistical Computer Packages (e.g. R) for Regression and Correlation Analyses, Interpretation of Results from Statistical Packages.

MTH 381: Mechanics II (3, 1, 3)

Prerequisite MTH 274: Mechanics I

Course Objective

This course is aimed at equipping students with the concepts of mechanics of system of several particles.

Course Content

Motion of systems of discrete particles: centre of mass motion, relative motion of particles with respect to centre of mass, constraint motion, translational and rotational motion. Motion of systems of particles as solid. Volume mass density. Forces on systems of particles: internal and external forces. Motion under forces: linear momentum angular momentum energy. Conservation laws. Rotational motion and moments of inertia. Generalized coordinates: Lagrangean motion. Hamilton's equations.

MTH 383: Introduction to Numerical Methods (3, 1, 3)

Course Objective

This course offers an advanced introduction to problems in numerical linear and non-linear algebra.

Course Content

Function Evaluations. Fixed point representation of numbers and error analysis in Numerical Computations. Methods for solving Systems of Equations: Direct methods (Gaussian, LU and Cholesky decomposition) and Iterative Methods (Jacobi, Gauss-Seidel and QR methods). Interpolation and Approximations. Numerical Integration: Trapezoidal Method, Simpson's Method and Gaussian Quadrature.Methods for solving Transcendental Equations. Newton-Raphson solution of non-linear equations.

MTH 385: Probability Distributions (3, 1, 3)

Course Objective

This course investigates the probability distributions and simulation of these distributions.

Course Content

Students are expected to estimate probability density functions and probability models. Some useful Discrete and Continuous Probability Distribution Functions, Moment-generating Functions, Characteristics Functions and Limit Theorems; Joint Probability Distributions; will be discussed.

YEAR THREE SEMESTER TWO

MTH 372: Abstract Algebra 1 (3, 1, 3)
Course Objective

This course will provide the student with an introduction to the topics of abstract algebra so as to better understand its role in modern mathematics and its applications to other fields.

Course Content

Groups. Examples of Groups such as Cyclic Groups, Groups of Permutations, and Dihedral Groups. Subgroups, Cosets and Lagrange's Theorem. Normal Subgroups and Factor Groups. The Homomorphism Theorems for Groups. Rings and Fields; Definitions, Examples and Properties. Polynomial Rings. Euclidean Algorithms. Ideals and Quotient Rings. The Homomorphism Theorems. The field of Quotients of an Integral Domain. Principal Ideal Domains. Factorisation in Principal Ideal Domain.

MTH 374: Complex Analysis (3, 1, 3)
Prerequisite MTH 373: Analysis
Course Objective

Students are introduced to the analysis of complex numbers, including convergence, differentiability and integration

Course Content

Convergence of Series. Uniform Convergence of Sequences and Functions. Power Series. Functions defined by Laurent and Power Series. Analytic functions. Differentiation. Cauchy-Riemann Equations. Cauchy's Theorem. Cauchy's Integral Formulae. Harmonic Functions. Calculus of Residues. Maximum Modulus Principle, and Fundamental Theorem of Algebra.

MTH 376: Partial Differential Equations (3, 1, 3)
Course Objective

This course aims at understanding the concept and methods of solving a Partial Differential Equation (PDE).

Course Content

Equation of the First Order, Cauchy Problem, Methods of Characteristics and Lagrange. Classification of Second Order Equations. Laplace and Poisson Equations. Boundary Value Problems, the Sturm-Liouville Problem, Separation of Variables, Properties of Harmonic Functions, Fundamental Solution of Potentials and their Properties, Gauss' mean value theorem, Green's Function, Uniqueness Theorems. The Wave and Heat Equations, Method of Eigen functions, Expansions. Fourier series solutions.

MTH 378: Euclidean and Non-Euclidean Geometry (3, 1, 3)

Course Objective

The main purpose is to provide a rigorous treatment of the foundations of Euclidean geometry and an introduction to hyperbolic geometry (with emphasis on its Euclidean models).

Course Content

Axiomatic systems and incidence geometry. Axioms for plane geometry. Neutral geometry. Euclidean geometry. Hilbert's axioms for Euclidean Geometry. Non-Euclidean geometry. Hypebolic geometry. Tranformational geometry.

ELECTIVE COURSES: CHOOSE ANY TWO

MTH 380: Time Series Analysis and Forecasting (3, 1, 3)
Course Objective

This course provides students with skill of modelling a time series data.
Course Content

Basic Concepts of Time Series Analysis; Components of Time Series; Trend Analysis: Moving Averages, Exponential Smoothing, Autoregressive and Partial Autoregressive Functions; Forecasting Models: Moving/Autoregressive Integrated Moving Averages (MA, AR, ARMA and ARIMA); Prediction Limits, Forecast Updating and Holt-Winter's Methods; Box-Jenkins Method of Modelling; Index Numbers: Price Indexes; Use of Statistical Packages (eg. R) for Graphical and Numerical Analysis of Time Series Data.

MTH 382: Convex Optimization (3, 1, 3)
Course Objective

This course deals with linear programming applied to transportation and assignment problems; interior point methods are also studied.

Course Content

Description of the Problem of Optimisation and the Geometry of R^n, $n > 1$. Convex sets and convex functions. Linear Programming: Basic Concepts, Solution Methods and Application problems in Transportation, Assignment problems, etc. Duality Theorem and Complementary Slackness Principle. Integer programming. Interior point methods.

MTH 384: Stability Theory of Dynamical Systems (3, 1, 3)
Course Objective

This course provides an introduction to applied dynamical systems and the qualitative study of differential equations.

Course Content

Topics to be covered include Phase Space and Solution of Linear Dynamical Systems. Characteristics of Critical Points. Solutions of Non-Linear Systems and their Stability. Autonomous Systems. Almost Linear Systems. Liapunov Methods (Simple and Damped pendulum, Competing Species and Predator-prey equations). Periodic Solutions. Limit Cycles. Bifurcation Theory. Chaos and Attractions. Solution of Lorentz Equations.

MTH 386: Topology I (3, 1, 3)
Course Objective

This course introduces topology, covering topics fundamental to modern analysis and geometry.

Course Content

These deals with the concept of a Topology: Open Sets. Closed Sets Interior, Closure, Derived Set, and Boundary of a Subset. Continuous Mapping. Metric Spaces. Uniformly Continuous Mapping. Homeomorphism. Dense Sets. Complete Metric Spaces. Separable Spaces. Connectedness. Compactness.

MTH 388: Numerical Methods and Computational Mathematics (3, 1, 3)
Course Objective

This course deals with methods of solving linear/non-linear systems of equation, Eigen values problems and differential equations.

Course Content

This aims at Eigen values Problems: Direct methods (power methods), Iterative methods (QR methods). Non-linear Algebraic Equations: Iterative methods Newton's Methods, Acceleration techniques, e.g. Aitken's), Generalized Newton's Method, Polynomial, Iterative methods (Bernoulli, Bairstow, Sturm Sequences) and Continuation Methods. Numerical Solution of Ordinary Differential Equations: Single Step Methods, Multi-Step Methods and Predictor-Corrector Methods. Partial Differential Equations (PDE): Discrimination methods: Basis Function Expansion, Finite Difference, Finite Element and Finite Volume Methods.

YEAR FOUR SEMESTER ONE

MTH 469: Project 1 (1, 6, 3)

Course Objective

Projects are a necessary part of the BSc. Mathematics programme and all final year students are required to carry out independent research projects selected with reference to their research interests and capabilities of staff. Main objectives- use of literature, learning of research techniques, an appreciation of the nature of the problems and their solutions, devising appropriate experiments and/or planning sets of observations. Projects should preferably be professionally relevant to enhance individual employment prospects. Students will normally plan and begin their research in the first semester

MTH 471: Measure Theory I (3, 1, 3)

Course Objective

The course covers essentially the development of the theory of measure and integration.

Course Content

Algebra of sets, Borel sets, Measures, Outer Measure and Caratheodory's Theorem. Completion of Measure. Lebesgue Measure in R^n. Existence of a Non-Measurable Set. Measurable Functions. Convergence almost everywhere. Egoroff's Theorem, Lusin's Theorem on the structure of Measureable functions. Theorems on integration of sequences of functions: Monotone convergence theorem, Fatou's Lemma and Dominated convergence theorem.

MTH 473: Integral Equations (3, 1, 3)

Course Objective

This course emphasizes concepts and techniques for solving integral equations from an applied mathematics perspective.

Course Content

Concept of Integral Equations: Classification. Method of Successive Approximations, Fredholm Theorem and its Corollaries. Application to the solution to Cauchy and Boundary value problems for Ordinary Differential Equations. Green's Function**.**

MTH 475: Abstract Algebra II (3, 1, 3)
Prerequisite MTH 372: Abstract Algebra 1

Course Objective

This course aims at strengthening students' appreciation for the power of abstract mathematics, and Building upon the logic and proof writing skills.

Course Content

Topics to be covered include, Gaussian Integers. Euclidean Domains. Direct Products. Finitely Generated Abelian groups. Automorphisms of a Group. The Normalizer of a Subgroup. Derived Subgroups. Conjugate classes, Centralizers of Elements, and Class Equation. Cauchy's Theorem. Sylow Theorems.

ELECTIVE COURSES: CHOOSE ANY TWO

MTH 477: Multivariate Data Analysis (3, 1, 3)

Course Objective

Students are expected to understanding of underlying theory for the analysis of multivariate data.

Course Content

Multivariate normal distribution; maximum likelihood estimation, Wishart's distribution, Hotelling's T2 and hypothesis testing for multivariate normal data. Principal Components Analysis and derivation of principal components; PCA structural model; PCA on normal populations; biplots; Factor Analysis orthogonal factor model; estimation and factor rotation. Linear discriminant analysis; Fisher's method, discrimination with two groups; discrimination with several groups. Hierarchical clustering methods, measures of distance, non-hierarchical methods, model-based clustering. Concepts of correspondence analysis, chi-square distance and inertia, multiple correspondence analysis.

MTH 479: Calculus of Variations (3, 1, 3)

Course Objective

The course provides foundations of calculus of variations and its applications in mathematics, physics and engineering and shows how engineering problems can be described by energy methods and the calculus of variations. Student should be able to:

- derive the Euler-Lagrange equations for variational problems, including the case of general variations
- derive conserved quantities from symmetries, and use them to solve the Euler-Lagrange equations
- solve variational problems with constraints: both algebraic and isoperimetric

Content

Classical Variational Problem, Extremum of a Functional. Fixed End Points. Fundamental Lemma of the Calculus of Variations. Euler-Lagrange Equation and Extensions. Applications.

MTH 481: Differential Geometry (3, 1, 3)

Course Objective

Student gain an understanding of the study of the properties of curves and surfaces including curvature.

Course Content

Curves in Euclidean Space, Serret-Frenet Formulae. Theorems on Plane curves and closed curves. Surfaces in Euclidean Space. First and Second Fundamental Forms. Tangent Surface, Developable and Ruled Surfaces. Principal Mean and Gaussian Curvature, Line of Curvature, Rodrigue's Formula. Geodesic Curvature, Geodesics, Geodesic Triangles, the Gauss-Bonnet formula, Geodesic Polar; Coordinates. Surface of Constant Curve.

MTH 483: Mathematical Economics I (3, 1, 3)

Course Objective

Students will learn how to apply mathematical tools to economic problems.

Course Content

Students will be taken through, Treatment of Microeconomic Theory with a mathematical approach: Theory of Consumer Behaviour, Constrained OptimisingBehaviour. The Slutsky Equation, Construction of Utility Number. Theory of the Firm. Constant Elasticity of Substitution (CES) production function. Market

Equilibrium with Lagged Adjustment and Continuous Adjustment. Multi Market Equilibrium. Pareto Optimality. General Economic OptimisationOver Time. Linear Models. Input-Output (I-O) models, Concepts of Linear Programming and Applications

MTH 485 Topology II (3, 1, 3)

Prerequisite MTH 386: Topology I

Course Objective

Upon completion of this course, students will be able to argue in general and apply the ideas to specific examples, knowledge about topology and its role in mathematics, Familiarity with results that need topological ideas in their proofs.

Course Content

Topics to be covered are; Topological spaces, functors, homotopy, the fundamental group, covering spaces, higher homotopy groups, simplicial complexes, homology theories.

MTH 487: Nonlinear Optimization (3, 1, 3)

Course Objective

This course aims at understanding the concepts and learning of methods of solving unconstrained and constrained problems in R^n. Pointwise

Course Content

Differentiable and non-differentiable objective functions. Algorithm of Davies, Swann and Campey (DSC), Powell and Goggin (DSC-Powell). Simultaneous Search and Sequential Algorithms. Elements of Project scheduling and Network Analysis, Inventory Control, Queuing Theory. Introduction to heuristics and location problems

YEAR FOUR SEMESTER TWO

MTH 470: Project II (1 6, 3)

Course Objective

Students finish their research projects and write a thesis that will be duly graded and marks awarded.

MTH 472: Integration Theory (3, 1, 3)

Course Objective

The purpose of the course is to understand the concepts of Lebesgue's integration theory with applications to analysis.

Course Content

Topics include relationship between the Lebesgue and Riemann Integrals, Differentiation of the Lebesgue Integral. Product Measure and Fubini's Theorem. Functions of Bounded Variation. Riemann-Stieltjes Integral. Absolutely Continuous Functions. Differentiation and relationship with Integration. The Space L_2, and L_2 Space with weight (L_2 W). Riesz-Fisher Theorem.

MTH 474: Introduction to Functional Analysis (3, 1, 3)
Course Objective

Study of vector spaces, Banach spaces, Hilbert spaces and boundedness and operators

Course Content

Topological Vector Spaces. Factor Spaces. Frechet Spaces. Banach Spaces. Hilbert Spaces. Bounded Linear Mappings. Decomposition Theorem. Projections. Dual Space. Baire Category, Banach-Steinhans Theorem. Open Mapping Theorem. Riesz Representation Theorem. Bounded Linear Operators. Adjoint Operators. Closed Graph Theorem.

MTH 476: Galois Theory (3, 1, 3)
Course Objective

Upon completion students are expected to explain the fundamental concepts of field extensions and Galois Theory and their role in modern mathematics and applied contexts and demonstrate accurate and efficient use of field extensions and Galois theory.

Course Content

Topics include, Extension of Fields, especially Finite Extension and Algebraic Extension. Gauss' Theorem on Primitive Polynomials. Construction by a Straight Edge and a Compass. Simple Extensions, Separable Extensions. Automorphisms of a Field. Normal Extensions. Galois Extensions. The fundamental Theorem of Galois Theory.Solvability by Radicals.

ELECTIVE COURSES: CHOOSE ANY TWO

MTH 478: Sample Survey Theory (3, 1, 3)
Course Objective

The course is designed to introduce students to various methods of data collection.

Course Content

Basic Concepts of Sampling; Sampling Techniques: Types of Sampling. Mathematical Properties of Estimates and some other Concepts; Ratio and Regression

Estimations; Collection of Data: Design of Questionnaire and Data Collection Methods; Errors in Surveys. Mini project.

MTH 482: Mathematical Economics II (3, 1, 3)
Prerequisite MTH 483: Mathematical Economics I

Course Objective

This course aims at Mathematical Treatment of Macro-Economic Theory. **Course Content**

Topics include, Simple model of Income Determination, Consumption and Investment, the Investment Savings (IS) Curve. Monetary Equilibrium, the Liquidity Preference/ Money Profit (LM) Curve. Labour Wages and Price (Inflation) models. Full employment equilibrium models of Income Determination. Aggregate demand and Supply analysis. Balance of Trade (Payments), Model of Income Determination. Dynamic Models of Income Determination. Stabilisation Policy, Comparative Statistics Analysis of Monetary Fiscal Policy, the Harold Domar Growth model, the Neo-classical growth model. Interest Theory.

MTH 480: Stochastic Processes (3, 1, 3)
Course Objective

The objective of this course is to teach the students the most important knowledge in probability theory and stochastic processes.
Course Content

The course will also introduce the students to a broad range of stochastic processes that underlie models in operations research, finance, economics and information science. The focus will be a basic probabilistic review, discrete time Markov chains, and Poisson processes, continuous Markov processes, Brownian motion, queuing models and other applications.

MTH 484: Special Functions (3, 1, 3)
Course Objective

This examines the existence and uniqueness of Solution of Differential Equations.

Course Content

Solution of Linear Differential Equations in Series: Legendre's Equation and Bessel's Equation. Special Functions: Legendre Polynomials, Bessel Functions, Hermite and Chebychev Polynomials, Laguerre and Hypergeometric functions. Orthogonality. Asymptotic Expansions. The method of Steepest Descent. The method of Stationary Phase. Recurrence Relations. Watson's Lemma. The Error Function. The Exponential Integral.Gamma and Beta functions.

MATH 486: OPTIMAL CONTROL THEORY (3, 1, 3)

Course Objective

The course enable students:

- Understand different forms of performance measures as applied to variety of optimal control problems and Pontryagin's minimum principle.
- Apply dynamic programming.
- Apply optimal control law.
- Apply computational procedure to solve optimal control problems.
- Understand and apply Hamilton-Jacobi-Bellman equations.

Content

State variable representation of systems. Performance measure. Optimal control law. The principle of optimality. Dynamic programming. Hamilton-Jacobi-Bellman equation. Review of calculus of variations. Pontryagin minimum principle. Minimum time problem. Minimum control effort problem. Optimal trajectories: method of steepest descent, variation of extremals. Quasilinearization

ICT 357 APPLICATION DEVELOPMENT (WITH VB.NET) (2, 2, 3)

Course Objective

This course intends to impart expertise to the student in developing programmes and programming in Visual Basic.

Course Content

The introduction to VB controls; Variables, constants and calculations; Decisions and Conditions; Menus, Sub-Procedures and Sub-functions; Multiple Forms; Lists, Loops and Printing; Arrays; OOP in VB; Data Files; Accessing Data Files. Concepts and methods of object-oriented programming and design, creating applications using a development cycle approach, and discipline coding style are included.