BSc. Mathematics

- B.SC. Actuarial Science
- BSc. Mathematics
- How to Apply
- Student Associations
- Downloads

COURSE STRUCTURE

YEAR ONE	SEMESTER ONE	T	P	C
MATH 161	Introductory Pure Mathematics I	3	1	3
MATH 163	Introduction to Logic and Set Theory	3	1	3
MATH 165	Introduction to Vector Analysis	3	1	3
PHY 153	Electricity and Magnetism	2	0	2
*CHEM 155	Physical Chemistry I /	2	1	2
*BIOL	(A Basic Course in Biology)	2	1	2
CSM 151	Information Technology I	2	2	3
ENGL 157	Communication Skills I	2	0	2
		17	6	18

* Students to offer one of these two options

YEAR ONE	SEMESTER TWO	T	P	C
MATH 162	Introductory Pure Mathematics II	3	1	3
MATH 164	Introductory Algebra	3	1	3
MATH 166	Introduction to Probability and Statistics	3	1	3
MATH 168	Differential Equations I	3	1	3
MATH 170	Introduction to Discrete Mathematics	2	1	2
CSM 152	Information Technology II	2	2	3
ENGL 158	Communication Skills II	2	0	2
		18	7	19

YEAR TWO	SEMESTER ONE	T	P	C
MATH 261	Linear Algebra	3	1	3
MATH 263	Introduction to Analysis I	3	1	3
MATH 265	Mathematical Methods I	3	1	3
MATH 269	Introductory Programming for Mathematics	3	1	3
MATH 271	Probability and Statistics I	3	1	3
**ENGL 263	Literature in English I	1	0	1
**FC 181	French for Communication I /	2	1	2
ECON 151	Elements of Economics I	2	1	2
		18	6	18

** Students to offer one of these two options

YEAR TWO	SEMESTER TWO	T	P	C
MATH 262	Abstract Algebra	3	1	3
MATH 264	Introduction to Analysis II	3	1	3
MATH 266	Mathematical Methods II	3	1	3
MATH 270	Numerical Methods and Computations I	3	1	3
MATH 272	Probability and Statistics II	3	1	3
**FC 182	French for Communication II/			
**ECON 152	Elements of Economics II	2	1	2
ENGL 264	Literature in English II	1	1	1
		18	7	18

** Students to offer one of these two options

YEAR THREE SEMESTER ONE T P C

MATH 361 Complex Analysis 3 1 3
MATH 363 Theoretical Mechanics I 3 1 3
MATH 365 Differential Equations II 3 1 3
MATH 369 Regression Analysis 3 1 3
MATH 371 Classical Fields I 3 1 3
MATH 375 Numeral Methods and Computations II 3 1 3
18 6 18

YEAR THREE SEMESTER TWO T P C

MATH 362 Topology 3 1 3
MATH 364 Theoretical Mechanics II 3 1 3
MATH 366 Partial Differential Equations 3 1 3
MATH 370 Time Series Analysis and Forecasting 3 1 3
MATH 372 Classical Fields II 3 1 3
MATH 376 Application Development for Mathematics 3 1 3
18 6 18

YEAR FOUR SEMESTER ONE L P C

MATH 461 Real Functions 1 4 1 4
MATH 463 Integral Equations 4 1 4
*MATH 465 Optimization I 3 1 3
*MATH 467 Introduction to Special Relativity 3 1 3
*MATH 469 Advanced Topics in General Topology. 3 1 3
*MATH 471 Tensor Calculus and Differential Geometry I 3 1 3
*MATH 473 Mathematical Economics I 3 1 3
*MATH 475 Sample Survey Theory 3 1 3
MATH 481 Project I 0 4 2
*MATH 483 Stability Theory of Dynamical Systems 3 1 3
*MATH 485 Further Topics in Abstract Algebra 3 1 3
*MATH 487 Application Development 3 1 3
*CSM 487 PC Computing I 3 1 3
*MGT 471 Principles of Management I 3 0 3
16-17 10-11 16-17

* Elective Course:

Students to opt for at least three elective courses

YEAR FOUR SEMESTER TWO T P C

MATH 462 Real Functions II 4 1 4
MATH 464 Introduction to Functional Analysis 4 1 4
*MATH 466 Optimization II 3 1 3
*MATH 468 Stochastic Processes 3 1 3
*MATH 470 Calculus of Variations and Optimal
Control Theory 3 1 3
*MATH 472 Tensor Calculus and Differential Geometry II 3 1 3
*MATH 474 Mathematical Economics II 3 1 3
*MATH 476 Introductory Quantum Mechanics 3 1 3
*MATH 480 Differential Manifolds 3 1 3
MATH 482 Project II 0 4 2
*MATH 484 Design of Experiments 3 1 3
*MATH 486 Galois Theory 3 1 3
*MATH 488 PC Computing II 3 1 3
*MGT 472 Principles of Management II 3 0 3
16-17 8-9 18-19

* Elective Course:

Students to opt for at least three elective courses.

Minimum number of credits required for graduation 140

YEAR ONE

SEMESTER ONE

MATH 161: Introductory Pure Mathematics I (3, 1, 3)

Principles of Induction, Indices, Logarithms, Surds, Polynomials, Rational Functions, Partial Fractions, Permutation and Combinations. Idea of Sequence and Finite Series. The Binomial Theorem for a positive integral index. Trigonometric Functions: Addition and Factor Theorems, Circular Measure. Limits. Differentiation of a composite function. Implicit Differentiation. Maxima and Minima Integration as inverse of differentiation: Application to Trigonometry, Polynimials, Exponential Functions, etc.

MATH 163: Introduction to Logic and Set Theory. (3, 1, 3)

The Symbols ■, ■, ■, ■, ■, ■, ■, as applied to Statements, Equivalence of Statements. Truth Tables. Some important tautologies like, Law of Excluded Middle, Law of Non-contradiction, Law of Transposition and Rule of Detachment, Duality, Consistency etc. Sets Relationship between logic and Set Theory. Universal and Existential Quantifies. Union, Intersection Complement. Mapping: Images and Inverse images. Injective, Surjective, and Bijective mappings. Cardinality. Cardinal Numbers. Addition and Multiplication of Cardinal Numbers. Exponential of cardinal numbers. Inequalities. Cantor's theorem. Countable Sets.

MATH 165: Introduction to Vector Analysis: (2, 1, 2)

Vectors in Euclidean Spaces, especially in dimensions 1,2 and 3. Position Vector. Dot (Scalar) Product, Cross (Vector) Product of Vectors. Composition and Resolution of Vectors. Application of Vectors to Geometry and Mechanics: Static and Dynamics, Velocity, Momentum and Moments, Equilibrium and Conservation Laws; Introduction to vector-valued functions; Differentiation of vector-valued functions.

PHY 153: Electricity and Magnetism (2, 2, 3)

Introduction; Electric fields and Potential; Magnetic field and Introduction; Magnetic materials: A.C. and D.C circuits; Devices

CHEM 155: Physical Chemistry (2, 2, 3)

States of Matter; Thermodynamics, Chemical Kinetics.

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

Data versus Information; Information as a resource for society and organizations; Sources of Data, Data Processing Cycle; Data information needs through an organization and characteristics of information. Evolution of Computers and Development of Data Processing; Classification of Computers; Characteristics and functional parts of the Digital Computers; Processing, Storage, Input/Output and Telecommunication Hardware; Computer Systems; Types and Applications of Computer Software; Data hierarchy, Logical versus Physical Representation; Types of file organization and processing methods; Introduction to searching and sorting. Laboratory Work.

ENGL 157: English Language and Communication Skills (2, 1, 2)

Oral and written Communication skills ability to express ideas in good English. Correction of common deficiencies in English grammar. Comprehension and critical reading skills.

SEMESTER TWO

MATH 162: Introduction to Pure Mathematics II (3, 1, 3)

Co-ordinate Geometry: Equations of Lines and Circles, Conic Sections, Parabola, Ellipse and Hyperbola. Parametric Representation of Curves. Integration: Indefinite Integral and Definite Integral. Application of Integration to Areas and Volumes. Integration by Substitution, Integration by Parts, Integration by Resolution to Partial Fractions. Approximate Integration.

MATH 164: Introductory Algebra (3, 1, 3)

Introduction to Number Theory: Integral Domain. Polynomials: Factorisation of Polynomials and Roots of Polynomials. Matrices and Determinants. Systems of Linear Equations. Vector Spaces and Subspaces, Basis Dimension and Co-ordinates. Algebra of Linear Transformations and Representation by Matrices. Eigenvalues and Eigen-vectors; Similar Matrices, Change of Basis.

MATH 166: Introduction to Probability and Statistics (3, 1, 3)

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: Set Theory, Random Experiments and Outcomes, Measure of Probability of Events, Independence Events, Conditional Probability, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions; Moments and Moment Generating Functions.

MATH 168: Differential Equations I (3, 1, 3)

Introduction: Methods of forming Differential Equations. Ordinary Differential Equations of first order. Separable, Homogeneous, Linear, Exact, Integrating factors. Linear differential equations of the second order with constant coefficients. Systems of first order equations. Solution of ordinary equations of first order Using methods of variation of parameters. Reduction of nth order equation to a system of first order equations.

MATH 170: Introductory Discrete Mathematics (2, 1, 2)

Multinomial coefficients. Complex Numbers. Demoivre's Theorem. Finite Difference Equations. The Z-transform approach to solution. Difference Equations with Characteristics Polynomials, which have complex roots. Boolean Algebra. Basic Boolean Functions. Digital Logic Gates Minterm and Maxterm Expansions. Elements of proof Theory. Relations in a Set. Partial Ordering. Zorn's Lemma.

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

Internet- history and the changing world. Hand on experience on website and pages. Web browsers and browsing examples of websites and services. Lab work. Terminologies associated with Internet technologies (on-line domain, sub domain, ISP, TCP, IP address, etc). Introduction to LAN, WAN, MAN, WWW- topologies; global Internet and global information structure. Features and tools for navigating the Internet. Shared resources-workgroup computing; EDI and Intranet. Services available on the Internet: electronic mail, network news, bulleting board services (BBS), worldwide document (introduction to html, FrontPage, SQL). Telephone related communication services; video/voice communication and picture phone, automated web search, faxes and files (FTP); remote login and remote desktops (Telnet); facilities of secure communication (communication security); electronic commerce and business; global digital library, etc.

ENGL 158: Communication Skills II (2, 1, 2)

Communication Skills Oral presentation, formal speech making, conducting
Interviews and meetings. Communication process, skill in communication, channels in communication in an organisation, preparation of official documents such as letters memos, reports minutes and proposals.

YEAR TWO

SEMESTER ONE

MATH 261: Linear Algebra (3, 1, 3)

Annihilating Polynomials. Cayley-Hamilton Theorem. Linear Functionals, Dual Spaces, Multilinear Forms. Determinant by Multilinear Form,

Uniqueness Properties. Inner Product Spaces. Orthogonalization Process. Best Approximation. Adjoints, and Hermitian Unitary and Normal Transformations. Hermitian, Bilinear and Quadratic Forms, Reduction to a Canonical Form.

MATH 263: Introduction to Analysis (3, 1, 3)

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

MATH 265: Mathematical Methods I (3, 1, 3)

Partial Differentiation of Function of Several Variables. Differentiation of Implicit Functions, Theorem and Applications. Jacobians. Differentiation of a Vector Function of Several Variables. The Tangent Vector. Curvilinear Co-ordinates. Plane Polar, Cylindrical and Spherical Co-ordinates. Multiple Integrals. Line Integrals, Multiple Surface and Volume Integral Gradient, Divergence and Curl. The Theorems of Green, Gauss, and Stokes. Applications to Physical and Geometrical Problems.

MATH 269: Introductory Programming for Mathematics (3, 1, 3)

The aim of this course is to introduce students to the concept and implementation of computer programming in a High Level Language. The course covers:

Quick review of Computer Organization; Arithmetic of the Computer: Floating – Point Format, Representation and Operations in the Computer; Algorithmic Design and Development; Introduction to Computer Programming Techniques: Coding in a High Level Language using MATLAB and if possible one symbolic mathematical application like MATHEMATICA, MAPLE, DERIVE or any other package designed for scientific computing.

MATH 271: Probability and Statistics I (3, 1, 3)

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; Basic Concepts of Statistical Inference, Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Proportions and Variances.

ENGL 263: Literature in English (1, 1, 1)

Literature as Poetry: What is a poem, and its characteristics? Difference between a poem and song. The figure of speech and the literary device. Practical Appreciation. Texts to be studied: selected African and English poems. Literature as Drama: What is a play, and its characteristics: Drama and theatre. Shakespeare. The Modern Play. Texts to be studied: One Shakespeare play and one modern African Play.

FC 181: French for Communication I (2, 1, 2)

This course is aimed at equipping students with basic French Communication Skills. The course is specially tailored for students from various departments who have little or no knowledge in French. French techniques of expression, drawn from short dialogues, are exploited to help students have the ability to communicate freely in French. Attention will be paid to the correct intonation and pronunciation.

ECON 151: Elements of Economics 1 (2, 1, 2)

The purpose of this course is to introduce those without prior knowledge of Economics to the fundamental concepts and the use of analytical techniques which will be helpful in the study of economic problems. It is also to provide those not intending to specialize in the subject with a knowledge of principles which can be in related disciplines. The course covers the Nature and Scope of Economics, Consumer Choice, Determination of Prices in different market conditions, Production Theory, and Theory of Distribution.

SEMESTER TWO

MATH 262: Abstract Algebra (3, 1, 3)

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. Groups. Examples of Groups such as Cyclic Groups, Groups of Permutations, and Dihedral Groups. Subgroups, Cosets and Lagrange's Theorem. groups. Normal Subgroups and Factor Groups. The Homomorphism Theorems for Groups.

MATH 264: Introduction to Analysis II (3, 1, 3)

Differentiation Real-Valued Function of One Variable. Differentiation of Vector-Valued Functions. Riemann Integration. Simple applications of L'Hospital's Rule, Rolle's Theorem, Cauchy Mean Value Theorem. Numerical Series and Convergence Test. Functional Series, Uniform Convergence. Functions of many Variables, Continuity, Partial Differentiation. Total Differential, Tangent Plane to Surface. Taylor's Theorem. Extrema.

MATH 266: Mathematical Methods II (3, 1, 3)

Improper Integrals. Integrals depending on a Parameter. Differentiation and Integration under the Integral Sign. Gamma and Beta Functions; Stirling's Formula. Basic Properties and use of the Laplace Transform. Fourier Series. Fourier Transforms.

MATH 270: Numerical Methods and Computations I (3, 1, 3)

Function Evaluations. Error Analysis in Numerical Computations. Methods for solving Transcendental Equations. Methods for solving Systems of Equations: Linear Systems by Direct and Iterative Methods; Nonlinear Systems. Interpolation and Approximations. Numerical Integration: Trapezoidal Method, Simpson's Method and Gaussian Quadrature.

MATH 272: Probability and Statistics I (3, 1, 3)

Estimation: Point and Interval Estimation of Parameters (Mean, Proportion and Variance), Properties of Point Estimators, Methods of Point and Interval Estimation; Hypothesis Testing: Basic Concepts, Significance Tests for Parameters including Analysis of Variance; 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.

FC 182 : French for Communication II (2, 1, 2)

This course aims at helping students grasp basic French vocabulary to be able to function in everyday situation. Spoken French and Oral comprehension are emphasised. This will be supplemented with exercises aimed at giving students ample opportunity to maximise their use of the language. The communicative approach is used to enable students express themselves in different situations.

ECON 152 : Elements of Economics II (2, 1, 2)

A survey of National Income - its measurement and determinants, Fluctuations in Economics activity and Trends in Ghana's National Income, Index Number, International Trade and National Economy, Role of Government.

ENGL 264 : Literature in English II (1, 0, 1)

Continuation of ENGL 263. Literature as Narrative. Traditional (19th Century) Narrative. Contemporary Narrative. The African Novel texts to be studied: One African Novel and One English Novel.

YEAR THREE

SEMESTER ONE

MATH 361: Complex Analysis (3, 1, 3)

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

MATH 363: Theoretical Mechanics I (3, 1, 3)

Principles of Newtonian mechanics, Single particle under the action of variable forces (F (x), F (t), F (v). Motion in 1-dimension. Potential Energy. Stable Unstable and Neutral Equilibrium. Free, Damped and Forced harmonic Oscillator, Resonance Motion in 2, 3 dimensions. Force. Fields. Conservation Theorem of Energy, Momentum and Angular Momentum. Central Forces; Effective Potential. Kepler's Laws and Planetary motion., 2-3 dimensional Harmonic Oscillator.

MATH 365: Differential Equations II (3, 1, 3)

Existence and Uniqueness of Solution of Differential Equations. Solution of certain Linear Differential Equations of Second Order in Series (for example, Legendre's Equation and Bessel's Equation). Special Functions: Legendre Polynomials, Bessel Functions, Hermite and Chebychev Polynomials, Laguerre and Hypergeometric functions. Gamma and Beta Functions; Sterling's formula, Asymptotic Expansions. The method of Steepest Descent. The method of Stationary Phase. Recurrence Relations. Watson's Lemma. The Error Function. The Exponential Integral.

MATH 369: Regression Analysis (3, 1, 3)

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 Multi-colinearity 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 for Regression and Correlation Analyses, Interpretation of Results from Statistical Packages.

MATH 371: Classical Fields I (3, 1, 3)

Review of Geometrical Vectors in R3: Change of Orthogonal Bases and Co-ordinates. Diagonalization of Symmetric Positive Definite Matrices; Cartesian Tensors: Introductory Algebra and Calculus of Cartesian Tensors. Change of Bases. Isotropy; Continuum Mechanics: Lagrangian and Eulerian Description of Motion, Equation of Continuity; Deformation: Deformation Gradient Tensors, Strain Tensors, Stress Tensors, Cauchy's Equations of Motion or Conservation of Momentum. Hooke's Law for Elastic Media, Strain-rate Tensor, Newtonian Viscosity, Viscous Flow, Navier-Strokes Equations, Simple Examples, Bernoulli's Steady Flow in 2 dimensions. Complex Potential, Blasius Theorem, Milne-Thomson Theorem. Waves. Complex Potential.

MATH 375: Numerical Methods and Computations II (3, 1, 3)

Linear Algebraic Equations: Equilibrium Problems: Elimination methods (Gaussian, LU Decomposition), Iterative methods (Gauss-Seidel). Eigenvalues Problems: Direct methods (e.g. Rayleigh's Quotient), Iterative methods (e.g. Power 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.

SEMESTER TWO

MATH 362: Topology (3, 1, 3)

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 Homoeomorphism. Dense Sets. Complete Matrix Spaces. Separable Spaces. Connectedness. Compactness.

MATH 364: Theoretical Mechanics II (3, 1, 3)

General theorems on the motion of a system of particles with applications. To motion of a Rigid Body. Conservation of Energy, Linear and Angular Momentum. Variational Principles. Lagrange and Hamilton's Equations. Normal co-ordinates.

MATH 366: Partial Differentiation Equations (3, 1, 3)

Definition of a Partial Differential Equations (PDE). Equation of the First Order, Cauchy Problem, Characteristics, Method of 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, Harmonic Functions, Green's Function, Uniqueness Theorems. The Wave and Heat Equations, Method of Eigen functions, Expansions.

MATH 370: Time Series Analysis and Forecasting (3, 1, 3)

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 Moving Averages (MA, AR, ARMA and ARIMA); Prediction Limits, Forecast Updating and Holt-Winter's Methods; Box-Jenkins Method of Modeling; Index Numbers: Price Indexes; Use of Statistical Packages for Graphical and Numerical Analysis of Time Series Data.

MATH 372: Classical Fields II (3, 1, 3)

Review of Vector Analysis: Co-ordinate Free Definitions of Gradient, Curl and Divergence, Scalar and Victor Potential, Notion of Orthogonal Curvilinear Co-ordinates and Bases, Scale Factor; Electrostatics: Law of Force. Electric Potential. Electric Field Equations (Including Point and Dipole Source), Boundary Conditions and Gauss Law in Vacuo and in Dielectric media; Electric Current: Notion of Electric current Flow, Current Density, Equation of Continuity, Steady Current, Electromotive Force. Ohm's Law, Kirchoff's Law and Linear Networks; Magnestostatics: Law of Force, Magnetic Potential, Magnestostatic field Equations (Including Point and Dipole Source), Boundary conditions in Vacuo and in magnetic media; Electromagnetic Induction: Faraday-Lenz Law. Maxwell's Modification of Ampere's Law., Maxwell's Equations. Wave Equation; Poisson's Equations: Existence and Uniqueness of solutions for Neumann and Dirichlet Boundary conditions., Examples from Electrostatics and Magnetostatics with cylindrical and Spherical Symmetry using special function Expansions. Method of Images., Complex Variables.

MATH 376: Application Development for Mathematics (3, 1, 3)

The purpose of this course is to introduce students to the development of basic mathematical applications (in Numerical Methods, Linear Algebra, Differential Equations, Probability and Statistics and other computationally related courses) using a spreadsheet (e.g. Microsoft Excel). The course covers the following: Familiarization and working with mathematical built-in functions in Spreadsheet. Data Analysis in Spreadsheet. Automating tasks in Spreadsheet, using Macros. Programming in Visual Basic for Applications (VBA). Report Development in Spreadsheet. Mini Project.

YEAR FOUR

SEMESTER ONE

MATH 461: Real Functions I (4, 1, 4)

Algebra of sets, Borel sets, Measures Outer Measure and Caratheodory's Theorem Completion of Measure. Lebesgue Measure in Rn. 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, Fatous's Lemma.

MATH 463: Integral Equations (4, 1, 4)

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.

*MATH 465: Optimisation I (3, 1, 3)

Description of the Problem of Optimisation and the Geometry of Rn, n > 1. Convex sets abd convex functions. Solution of systems of algebraic and transcendental equations. Matrices. Farkas Lemma, Gradient and Hessian of function on Rn'. Unconstrained and constrained problems in Rn'. Derivative of objective function available or unavailable., Algorithm of Davies, Swann and Campey (DSC), Powell and Goggin (DSC-Powell). Simultaneous Search and Sequential Algorithms. Constrained Linear Problems in Rn, n > 1.

*MATH 467: Introduction to Special Relativity (3, 1, 3)

Foundation of the Special Theory of Relativity, Space-like and Time-like distances, The Light Cone. Lorentz Transformation. Four Vectors; Four Velocity, Four Acceleration, Four Momentum, Four-Wave Vector, Four Current Density. Principles of Least Action, Application of the Relativistic Mechanics to the decay of the Fundamental particles. Relativistic Optics. Formulation of Maxwell's Theory.

*MATH 469: Advanced Topics in General Topology (3, 1, 3)

Normal Spaces. Compactification of Locally Compact Spaces. Baire's Category. Convergence of a Sequence in a Topological Space. Complete Metric Spaces. Banach's Method of Successive Approximations. Cantor's Ternary Set and its Properties. Identification Topology.

*MATH 471: Tensor Calculus and Differential Geometry I (3, 1, 3)

The Elements of Tensor Calculus, Christoffel Symbols, Covariant Differentiation, Levi-Civita Parallelism, Riemann-Christoffel Tensor. Reimann's Curvature. Curves in Euclidean Space, Frenet Formulae. 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.

*MATH 473: Mathematical Economics I (3, 1, 3)

This is about Microeconomic Theory which is to be treated with a mathematical approach. The topics include the following: Theory of Consumer Behaviour, Constrained Optimising Behaviour. The Slutsky Equation, Construction of Utility Number. Theory of the Firm. Constrained Optimising Behaviour, Constant Elasticity of Substitution (CES) production function. Market Equilibrium with Lagged Adjustment and Continuous Adjustment. Multi Market Equilibrium. Pareto Optimality. General Economic Optimisation Over Time. Linear Models. Input-Output (I-O) models, Concepts of Linear Programming and Applications.

*MATH 475: Sample Survey Theory (3, 1, 3)

Basic Concepts of Sampling; Sampling Techniques: Types of Sampling, Description of Techniques, 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; Students would be required to conduct Sample Surveys on some Socio-economic issues by making use of the Sampling Techniques discussed and submit reports for assessment.

MATH 481: Project (0, 4, 2)
Students are guided to select topics on various areas in Mathematics for their project works.

*MATH 483: Stability Theory of Dynamical Systems (3, 1, 3)
Phase Space and Solution of Linear 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.

*MATH 485: Further Topics in Abstract Algebra (3, 1, 3)
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.

*MATH 487: Application Development (3, 1, 3)
This course aims at introducing students to the art of developing, packaging and distributing Windows - Based Applications. The course covers the following:
Introduction to the general concept of Graphical User Interface (GUI). Introduction to the concept of Objects, Object Oriented Design (OOD) and Object Oriented Programming (OOP). Unified Modeling Language (UML) Diagrams. Coding of Windows – Based Applications using a language of choice of the instructor. Mini Project. The instructor may use Visual Basic 2005, Visual C#, Visual C++, Java, Python or Delph.

*CSM 487: PC COMPUTING I (3, 1, 3)
Concepts of Database Management. Relational Calculus.

*MGT 471: Principles of Management I (3, 0, 3)
The objective of this course is to equip students, without basic knowledge in Management, with the tools of decision making, organization and management of firms and organizations. It covers nature and scope of management, managerial functions, organizational theories, goals of business organizations – economic and social responsibilities of management, decision making techniques and influence, the nature and types of organization and their implications for organizational administration.

SEMESTER TWO

MATH 462: Real Function II (4, 1, 4)
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 L2, and L2 Space with weight (L2 W). Riesz-Fisher Theorem.

MATH 464: Introduction to Functional Analysis (4, 1, 4)
Topological Vector Spaces. Factor Sspaces. Frechet Spaces. Banach Spaces. Hilbert Spaces. Continuous 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.

*MATH 466: Optimisation II (3, 1, 3)
Linear Programming: Basic Concepts, Solution Methods and Application problems in Transportation, Assignment problems, etc.. Duality Theorem and Complementary Slackness Principle. Elements of Unconstrained and Constrained Non-Linear Programming in Rn, n > 1. Network Analysis, Inventory Control, Queuing Theory,

*MATH 468: Stochastic Processes (3, 1, 3)
Basic Concepts of Probability Theory; Characterisation of Stochastic Processes; Properties and practical relevance of the following processes: Markov Chain, Markov Processes with Discrete State Space in Continuous Time. Diffusion Processes; Applications in Queuing Theory.

*MATH 470: Calculus of Variations and Optimal Control Theory (3, 1, 3)
Classical Variational Problem, Extremum of a Functional. Fixed End Points. Fundamental Lemma of the Calculus of Variations. Euler-Lagrange Equation and Extensions. Controllability of a Linear Problem. Pontryagin's Maximum Principle.

*MATH 472: Tensor Calculus and Differential Geometry II (3, 1, 3)
Tensor differentiation. Weigarten's formulae, Gauss-Codazzi Equation. Geodesic Curvature, Geodesics, Geodesic Triangles, the Gauss-Bonnet formula, Geodesic Polar; Coordinates. Surface of Constant Curvature.
*MATH 474: Mathematical Economics II (Prerequisite: MATH 473) (3, 1, 3)
Micro-Economic Theory is treated with a Mathematical approach in the following areas: Simple model of Income Determination, Consumption and Investment, the Investment Savings(IS) Curve. Monetry 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.

*MATH 476: Introductory Quantum Mechanics (3, 1, 3)

Introduction-Hamilton-Jacobian equation. Canonical transformation. Poisson and Lagrange Brackets. Foundations of quantum theory including the Bohr-Somerfeld Quantisation rules. The operator and matrix representation of dynamical variables. Schrodinger equation. Pauli spin-matrix variational techniques and time independent perturbation theory for non-degenerate and degenerate states.

*MATH 480: Differential Manifolds (3, 1, 3)

Differentiable Manifolds. Topology on a Manifold, Differentiation on a Manifold. Sub Manifolds. Immersions and Submersion. Quotient Manifold, Vector fields, Defferential Equations of the second order. Distributions, Lie Groups and Lie Transformation Groups.

MATH 482: Project (0, 4, 2)

Students continue to work on the selected topics and submit research reports as their project works for defence.

*MATH 484: Design of Experiments (3, 1, 3)

Basic Concepts: Objective, Definitions and Role of Randomisation and Replication; Experiments involving Paired Data. Fixed Effects, Random Effects and Mixed Effects Models. Analysis of Variance (ANOVA). Special Designs: Completely Randomised design (CRD); Assumptions, Randomisation, Multiple comparisons, Estimations of Parameters, Unequal Sample Size; Randomised Complete Block Design (RCBD), Estimation and Effects of Missing Observation, Relative Efficiency; Latin Square and Pair-Wise Orthogonal Latin Square Design. Split-plot Design; Analysis of covariance (ANCOVA); Factorial Experiments, Rules of Calculation of Mean Square and Expected Mean Square and Tests of Significance; Confounding; Fractional Replication; Use of Statistical Computer Packages for Data Analysis.

*MATH 486: Galois Theory (3, 1, 3)

Extension of Fields especially Finite Extension and Algebra Extension. Gauss's 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.

*CSM 488: PC Computing II (3, 1, 3)

Database programming using Visual Basic, C++, Visual C++ or Delphi`

*MGT 472: Principles of Management II (3, 0, 3)

Organizational behaviour/human relations – interpersonal and group processes, the application of concepts, like leadership, motivation, communication, morale, to the management of people and organizations, time management, analysis of causes, of change, managing change, innovation, management control.

*Optional. Candidates must choose at least three courses.