PROGRAMME PROFILE

Programmes in Mathematics Department

1. **Programme: B.Sc. Mathematics**

Programme Code: 5208

A BRIEF HISTORY OF THE Department

Mathematics Department is one of the pioneer units in the Faculty of Sciences that was established as a servicing unit at the inception of the University in 2004. The unit continued in its servicing capacity until the 2008 academic session when the full B.Sc. (Mathematics) programme took off.

PHILOSOPHY

The BSc. Mathematics programme is designed to equip the undergraduate students with the basic requirement for serving in a professional capacity in most areas of computation Mathematics as well as develop knowledge in theory of applied Mathematics. The degree programme would explore all the basic rudimentary or foundation knowledge of computing technology not known to most of students with the tools for computational techniques and thinking, as they would be exposed to the fundamentals of computing processes.

AIMS

The BSc. Mathematics programme is aimed at taking you through the fundamental of the sciences of computation and the latest technologies that make the application of Mathematical Science an all-round catalyst in the design of any new market driven technological designs and devices without the constraints of face to face teaching.

OBJECTIVES

- To produce competent graduates of Mathematics with sound knowledge and skills the rapid technological growth of the Nigerian society and the word at large.

- To produce competent graduates who will seek to advance and exploit entrepreneurial opportunities in the field of Mathematics.

- To produce graduates who will utilize their Mathematics knowledge, skills and abilities to enhance safety, health and welfare of the public through the simulation, construction and maintenance of industrial equipment.
- To produce graduates that will satisfy the manpower needs of our society in sectors of energy, industry, communication, science, engineering and research.

ADMISSIONS REQUIREMENTS

To be admitted into the B.Sc. Mathematics programme, a candidate is expected to possess at least one of the following:

1. Five (5) credit passes in Senior School Certificate Examination (SSCE) or at the School Certificate (SC), General Certificate of Education (GCE) Ordinary Level, National Examinations Council (NECO) or 6 merit passes in National Board for Technical Education (NABTEB) or Teachers Grade Two Certificate (TC II) examinations. The credit passes must include Mathematics and Physics. Credit pass in English language is required.
2. General Certificate of Education (GCE) Advanced level in Mathematics and Physics for entry into 200 level of the programme.
3. National Certificate in Education (NCE) with merit passes in Mathematics and Physics or Physics and Chemistry for entry into 200 level of the programme
4. National Diploma (N.D.) in the Mathematical sciences or equivalent qualification from an institution recognized by Senate for entry into 200 level of the programme.
5. Degree or Higher National Diploma (HND) or equivalent qualification in any physical science from an institution recognized by Senate for entry into 200 level of the programme.

Note: All direct entry candidates must satisfy the ordinary level requirement.

DEGREE REQUIREMENT

Evaluation: There are two aspects to the assessment of this programme. First, there are tutor marked assignments (TMA) which is 30% of the total course mark. At the end of the course, 100 – 200 level students would sit for Computer Based Test CBT (e-examination) and 300-400 level students would sit for written examination called Pen on Paper (POP) which has a value of 70% of the

total course grade.

Structure of the Programme:

- **Course Credit System**

Subjects taught in the Unit are based on the 'course system' in which the subject areas are broken down into courses which are examinable. The courses are organized into levels (100-400 levels) in an order according to the academic progress.

- **Classification of Courses**

The courses in the Unit are classified as follows:

1. **Compulsory courses:** These are the core courses that must be offered and passed by students at a grade not below E
2. **Elective Courses:** These are optional courses which may be offered based on the interest of the student or for the purpose of fulfilling the minimum requirement for the award of the degree.
3. **General Studies Courses:** These consist of the university general studies courses coded GST. They are compulsory courses for all students of the university and are being offered by the University in compliance with the National University Commission (NUC) minimum Bench Mark.

- **Criteria for the award of B.Sc (Mathematics) degree**

The student is required to **pass all compulsory courses** and complete a minimum of 140 credits units of core courses and at least 12 units of electives for 8 semesters to qualify to be admitted into the B.Sc. Mathematics degree. Direct entry must pass minimum of 110 credit units of core courses and at least 10 units of elective courses for a 6 semesters to qualify to be admitted into the B.Sc. Mathematics degree. The compulsory courses are made up of those courses specifically labeled as compulsory (C) and the required elective courses labeled as elective (E).

1. **OUTLINE PROGRAMME PROPOSAL (OPP)**

Outline of Course Structure Mathematics Programme

100 Level 1st Semester

Course Code	Course Title	Unit(s)	Status

BIO101	General Biology I	2	C
BIO191	General Biology Practical I	1	C
CHM101	Introductory Inorganic Chemistry	2	C
CHM103	Introductory Physical Chemistry	2	C
CHM191	Introductory Practical Chemistry I	1	C
CIT104	Introduction to Computer Science	2	C
MTH101	Elementary Mathematics I	3	C
MTH103	Elementary Mathematics II	3	C
PHY101	Elementary Mechanics, Heat and Properties of Matter	2	C
PHY191	Introductory Practical Physics I	1	C
GST101	Use of English and Communication Skills	2	C
GST107	The Good Study Guide	2	C
	Total Credit Units	**23**	

100 Level 2nd Semester

Course Code	Course Title	Unit(s)	Status
BIO102	General Biology II	2	C
BIO192	General Biology Practical II	1	C
CIT102	Software Application Skills	2	C
CHM102	Introductory Organic Chemistry	2	C
CHM192	Introductory Practical Chemistry II	1	C
MTH102	Elementary Mathematical II	3	C
STT102	Introductory Statistics	2	C
PHY102	Electricity, Magnetism and Modern Physics	3	C

PHY192	Introductory Physics Laboratory II	1	C
GST102	Use of English and Communication Skills II	2	C
		19	

200 Level – 1st Semester

Course Code	Course Title	Unit(s)	Status
CIT215	Introduction to Programming Languages	3	C
MTH211	Abstract Algebra	3	C
MTH213	Numerical Analysis I	3	C
MTH241	Introduction to Real Analysis	3	C
MTH281	Mathematical Methods I	3	C
STT211	Probability Distribution I	3	C
GST201	Nigerian Peoples and Culture	2	C
GST203	Introduction to Philosophy and Logic	2	C
	Elective	2	E
	Total Credit Units	**24**	

Elective Courses

PHY207	Thermodynamics	2	E
PHY201	Classical Dynamics	3	E

200 Level – 2nd Semester

Course Code	Course Title	Unit(s)	Status
MTH212	Linear Algebra II	3	C
MTH232	Elementary Differential Equation	3	C
MTH210	Introduction to complex analysis	3	C
MTH251	Mechanics	3	C
MTH282	Mathematical Methods II	3	C
GST202	Fundamentals of Peace Studies and Conflict Resolutions	2	C
	Elective	2	E
	Total Credit Units	**19**	

Elective Courses

PHY204	Electrodynamics	2	E
PHY206	Optics I	2	E

300 Level – 1st Semester

Course Code	Course Title	Unit(s)	Status
MTH301	Functional Analysis I	3	C
MTH304	Complex Analysis I	3	C
MTH311	Calculus of Several Variables	3	C
MTH341	Real Analysis	3	C
MTH381	Mathematical Methods III	3	C
MTH303	Vector and Tensor Analysis	3	C

GST301	Entrepreneurial Studies	2	C
	Elective	3	E
	Total Credit Units	**23**	

Elective Courses

MTH307	Numerical Analysis II	3	E
STT311	Probability Distribution II	3	E

300 Level 2nd Semester

Course Code	Course Title	Unit(s)	Status
MTH302	Elementary Differential Equation II	3	C
MTH305	Complex Analysis II	3	C
MTH308	Introduction to Mathematical Modeling	3	C
MTH312	Abstract Algebra II	3	C
MTH382	Mathematical Methods IV	3	C
	Elective Course	3	E
		18	

Elective Courses

MTH309	Optimization Theory	3	E
MTH315	Analytical Dynamics I	3	E

400 Level – 1st Semester

Course Code	Course Title	Unit(s)	Status
MTH401	General Topology I	3	C
MTH411	Measure Theory and Integration	3	C
MTH421	Ordinary Differential Equation	3	C
MTH423	Integral Equation	3	C
	Elective Course	3	E
	Total Credit Units	**15**	

Electives Courses

MTH417	Electromagnetic Theory	3	E
CIT425	Operation Research	3	E

400 Level – 2nd Semester

Course Code	Course Title	Unit(s)	Status

MTH402	General Topology II	3	C
MTH412	Functional Analysis II	3	C
MTH422	Partial Differential Equation	3	C
MTH499	Project	6	C
	Total Credit Units	**15**	

1. **SYNOPSES OF COURSES AND DETAILED PROGRAMME PROPOSAL (DPP)**

BIO101: GENERAL BIOLOGY I (2 UNITS)

Characteristics of living things; cell as the basic unit of living things, cell structure, organization, cellular organelles, tissues, organs and systems.

Classification of living things, general reproduction and concept of inter-relationships of organism. Heredity and evolution. Elements of ecology (introduction) and habitats.

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BIO102 GENERAL BIOLOGY II (2 UNITS)

Systematic studies of diversity of life including monera, protista, plants (Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and angiosperms) and animals (Protozoa, Platyhelminthes, Annelids, Arthropods, Fishes, Amphibians, Reptiles, Birds and Mammals) based on similarities and differences in external morphology. Taxonomic divisions of plant and animal kingdoms. Ecological adaptations of these forms.

BIO191 GENERAL BIOLOGY PRACTICAL I (1 UNIT) What practical work in biology involves. Laboratory organization. Handling common laboratory equipment. Microscopic handling and maintenance. Making microscopic measurements. Procuring animal materials for practicals. Killing, preserving and maintaining animal materials. Procuring plant materials. External features of plants (differences and similarities). Preparation of temporary slides. Preparation of stains and reagents. Techniques for microbial culture and grain staining. Setting up demonstration for physiological processes in plants. Setting up apparatus for demonstrating physiological processes in animals. Preparation required for dissection.

BIO192 GENERAL BIOLOGY LABORATORY II (1 UNIT) Observation and description of the morphological and diagnostic features as well as the differences among the different phyla of the plant, animal, archebacteria, eubacteria, fungi and protista kingdoms. Identification of the taxonomic hierarchy of the members of the above groups. Study of the structure and functions of their parts and habitats specifications

CHM101: Introductory Inorganic Chemistry (2 units)

Hypothesis, theory and law with appropriate illustrations, Nature of matter – 3 states of matter, Atomic structure, electronic energy levels and orbital. Periodic classification of elements and its relationship to their electronic configurations, Chemical bonding, Survey of properties and trends in groups I, II, IV, VI and transition metal,

CHM102: introductory organic chemistry (2 units)

Simple reactions of hydrocarbons, alcohols, and acids. Petroleum chemistry, Oils and fats, hydrogenation of oils, polymer and biologically important molecule.

CHM103: Introductory Physical Chemistry (2 units)

Mole concepts and calculations based on it, methods of expressing concentrations, Chemical Kinetics and equilibrium, and related calculations, Important application of equilibrium – pH, solubility products and solubility of ionic solids, Thermo chemistry and simple calculations based on Hess's law, Electrochemistry and working of various cells, Brief mentions of corrosion; chemical thermodynamics; DG = DH – TDS

CHM191: Introductory practical chemistry I (1 unit)

Practical based of CHM 101 and CHM 103: Cations and anions – identification, Acid- base titrations, Redox reactions and determinations

CHM192: Introductory practical chemistry II (1 unit)

Practical based on general chemistry CHM 101 and introductory organic chemistry I CHM 102- Determination of melting and boiling points and reaction of functional groups.

GST101: USE OF ENGLISH AND COMMUNICATION SKILLS I (2 UNITS)

Listening enabling skills, listening and comprehending comprehension, note taking and information retrieval. Including data, figures, diagrams and charts. Listening for main idea, interpretation and critical evaluation. Effective reading. skimming and scanning. Reading and comprehension at various speed levels. Vocabulary development in various academic contexts. Reading diverse texts in narratives and expository. Reading and comprehension passages with tables, scientific texts. Reading for interpretation and critical evaluation.

GST102: USE OF ENGLISH AND COMMUNICATION SKILLS II (2 UNITS)

Writing paragraphs: Topic sentence and coherence. Development of paragraphs: illustration, Description, cause and effect including definitions. Formal letters; essential parts and stylistic forms, complaints and requests; jobs, ordering goods, letters to government and other organizations. Writing reports; reporting event, experiments. Writing summaries: techniques of summarizing letters and sounds in English, vowels and consonants. Interviews, seminar presentation, public speech making, articles, concord and sentences including tenses. Gerund, participles, active, passive and the infinitive. Modal auxiliaries.

GST105 HISTORY AND PHILOSOPHY OF SCIENCE (2 UNITS)

Nature of science, scientific methods and theories; Law of nature,; History of science. Lost sciences of Africa, science, technology and inventions. Nature and scope of philosophy in science. Man, nature and his origin. Man, environment and resources. Great Nigerian Scientists.

GST107: THE GOOD STUDY GUIDE. (2 UNITS)

Getting started: How to use the book, why read about skills, getting yourself organised ; what is studying all about, reading and note taking; Introduction, reactions to reading, your reading strategy, memory, taking notes, conclusion. Other ways of studying: Introduction, learning in groups, talks and lectures, learning from TV and radio broadcasts, other study media. Working with numbers; Getting to know numbers, describing the world, describing with the tables, describing with diagrams and graphs; What is good writing? The Importance of writing, what does an essay look like, what is a good essay? Conclusion. How to write essays: Introduction, the craft of writing, the advantages of treating essay writing as a craft, making your essay flow, making a convincing case, the experience of writing. Preparing for examination.

MTH101 ELEMENTARY MATHEMATIC I: (3 Units)

(ALGEBRA AND TRIGONOMETRY)

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers; integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the

Argand Diagram. Re Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formalae.

MTH102 ELEMENTARY MATHEMATICS III: (3 UNITS) CALCULUS:

Function of a real variable, graphs, limits and idea of continuity. The derivative as limit of rate of change, Techniques of differentiation, Extreme curve sketching. Integration as an inverse of differentiation, Methods of integration, Definite integrals; Application to areas and volumes

MTH103 ELEMENTARY MATHEMATICS III: (3 Units) PRE-REQUISITE – MTH 101

(VECTORS, GEOMETRY AND DYNAMICS)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition and Scalar multiplication of vectors and linear independence. The Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals.

STT102 INTRODUCTORY STATISTICS (2UNITS)

Measures of Central Tendency and dispersion, (grouped and ungrouped); mean: – arithmetic and geometric, harmonic, median, mode quartiles, deciles, modes, relative and absolute dispersion, sample space and events as sets. Finite probability space properties of probability. Statistical independenceand conditional probability. Tree diagram. Bayes theorem. Discrete and continuous random variables. Expectation, independent Bernoulli trials. Binomial Poisson and Normaldistributions. Normal approximation to binomial and Poisson distribution, Hyper geometric.

PHY101: Elementary Mechanics, Heat and Properties of Matter (3 UNITS)

Space and Time: Physical quantities: Units and dimensions of physical quantities; Kinematics: Uniform velocity motion, uniformly accelerated motion; Dynamics: Newton's laws of motion; Impulse and Linear Momentum, Linear Collision, Newton's universal law of gravitation; Work, energy and power; Conservation laws; Concept of mechanical equilibrium; Centre of mass and centre of gravity; Moment of a force; Rotational kinematics and dynamics: Torque; Moment of Inertia; angular momentum; Total mechanical energy. Simple harmonic motion

Heat and temperature, work and heat, Quantity of heat: heat capacities, latent heat; Thermal expansion of solids, liquids and gases; Gas laws, heat transfer; Laws of thermodynamics: Isothermal and Adiabatic changes, Carnot cycle; Application kinetic theory of gases; van der Waals gas.

Classification of matter into (solids, liquids and gases, forces between atoms and molecules, molecular theory of matter, Elasticity, plasticity, Hook's Law, Young's Shear and bulk Moduli)

Crystalline and non-crystalline materials, Hydrostatics: pressure, buoyancy, Archimedes' principle; Hydro-dynamics-streamlines, Bernouli and Continuity equations, turbulence, Reynold's number, Viscosity, laminar flow, Poiseuille's equation; Surface tension, adhesion, cohesion, capillary, drops and bubbles.

PHY102: ELECTRICITY, MAGNETISM AND MODERN PHYSICS (3 UNITS)

Electrostatics: Coulomb's law, Gauss's law, potential and capacitance, dielectrics, production and measurement of static electricity. Current: Ohm's law, resistance and resistivity, heating. Galvanometers, Voltmeters and Ammeters; D.C. circuits: sources of emf and currents, Kirchhoff's laws; Electrochemistry; The Earth's magnetic field; Magnetic fields and induction, Faraday's and Lenz's laws; Force on a current-carrying conductor. Biot-Savart law. Flemming's right and left-hand rules, motors and generators. A.C. Theory. Atomic structure; Production and properties of X-rays; Radioactivity; Photoelectric emission.

PHY191: Introductory Practical Physics I (1 unit)

Graphs, Measurement, Error Analysis, Determination of Acceleration due to Gravity by Means of Simple Pendulum, Determination of force constant of a spiral spring, Determination of effective mass of a spiral spring and the constant, Determination of surface tension of water, Determination of specific latent heat of fusion of ice, Determination of the co-efficient of limiting static friction between two surfaces, Determination of the co-efficient of static friction on two surfaces using an inclined plane, Determination of Relative Density of kerosene using the specific Gravity Bottle, Determination of the Relative Density of a Granular substance not soluble in water using the specific gravity bottle.

PHY192: Introductory Practical Physics II (1 unit)

Refraction through the glass block; Image formed by a concave mirror; Determination of the focal length of the convex mirror; Refraction through the triangular prism; Determination of the focal length of a converging lens and the refractive index of groundnut; Determination of resistance of resistors in series and in parallel in simple circuits; Determination of internal resistance of a dry cell using a potentiometer; To compare the E.M.F. of cells using potentiometer; Determine the unknown resistance of a resistor using Wheatstone Bridge; To determine the relationship between current through a Tungsten and a potential applied across it.

CIT215: INTRODUCTION TO PROGRAMMING LANGUAGES (3UNITS)

FORTRAN programming language; Comparison of various versions of the language. Programming exercises using FORTRAN with emphasis on scientific application problems. Elements of Pascal language. Exercises in Pascal Program structures and programming concepts; Structured design

principles; abstraction, modularity, stepwise refinement, structured design techniques teaching of a structured programming language, e.g. PASCA/JAVA, C^{++}.

GST203: INTRODUCTION TO PHILOSOPHY AND LOGIC (2 UNITS)

General introduction to logic; clarity of thought; expression and arguments as basis for conclusion. Fundamentals of logic and critical thinking, types of discourse, nature of arguments; validity and soundness ; distinction between inductive and deductive inferences etc; illustrations from familiar texts, including literature materials, novels, law reports and newspaper publications.

MTH210: INTRODUCTION TO COMPLEX ANALYSIS (3UNITS)

Complex number, the topology of complex plane. Limits and continuity of function of complex variables, properties and example of analytic functions, branch-points, Cauchy-Riemann equations. Harmonic function.

MTH211: ABSTRACT ALGEBRA I (3UNITS)

Set: Binary operations, mapping, equivalence relations integers: Fundamental theorem of arithmetic, congruence equations, Euler's function (n) Group Theory: Definition and examples of groups. Subgroups, coset decomposition, Lagrange's theorem. Cyclic groups. Homeomorphisms, isomorphism. Odd and even permutations. Cayley's theorem. Rings: Definition and examples of rings. Commutative rings. Integral domain. Order, well-ordering principles. Mathematical induction.

MTH212: LINEAR ALGEBRA II (3UNITS)

Vector spaces. Liner independence. Basis, change of basis and dimension. Linear equations and matrices. Linear maps. The diagonal, permutation, triangular matrices. Elementary matrix. The inverse of a matrix. Rank and nullity. Determinants. Adjoint, cofactors, inverse matric. Determinant rank. Crammer's rule. Canonical forms, similar matrices, Eigen values and vectors, quadratic forms.

MTH213: NUMERICAL ANALYSIS I (3UNITS) PRE-REQUISITE – MTH 102

Interpolation: Lagrange's and Hermite interpolation formulae, divided differences and difference schemes. Interpolation formulas by use of divided differences. Approximation: Least-square polynomial approximation, Chebychev polynomials continued fraction and rational fraction orthogonal polynomials.

Numerical Integration: Newton's-cotes formulae, Gaussian Quadrature. Solution of Equations: Graffe's method (iterative method) Matrices and Related Topics: Definitions, Eigenvalue and Eigenvectors, Algebraic Eigenvalue problems-power method, Jacobi method.

Systems of linear Equations: Gauss elimination, Gauss-Jordan method. Jacobi iterative method, Gauss-field iterative method.

MTH232: ELEMENTARY DIFFERENTIAL EQUATION (3UNITS)

PRE-REQUISITE – MTH 103

Introduction, equation of first order and first degree, separable equations, homogeneous equations, exact equations, linear equations, Bernoulli's and Riccati equations. Applications to mechanics and electricity. Orthogonal and oblique trajectories. Second order equations with constant coefficients.

MTH241: INTRODUCTION TO REAL ANALYSIS (3UNITS)

Sets: Cartesian products, functions and mappings direct and inverse images. Countable sets. Limits: Elementary properties of limits. Upper and lower bounds, supremum, infimum, convergence of sequences. Limit of monotone functions and sequences. Cauchy convergence principles. Continuity: Real-Valued functions of a real variable Monotone functions, periodic functions, bounded functions. Continuity of functions using neighborhood. Elementary properties of continuous functions. Uniform continuity. Series: convergence of series, tests for convergence, absolute convergence, power series, uniform convergence.

MTH251: MECHANICS

Static: System of live vectors. Coyoles and wrenches. Principles of virtual work. Stability of equilibrium. Dynamics of systems of particles: Elastic strings. Hooks law. Motion in resisting media. Changing mass. Motion along a curve. Frenets formulae.

Coplanar Motion: Energy equation. Motion in a vertical circle. Simple pendulum. The cycloid and cycloidal motion. Orbital motion-disturbed orbits and stability.

MTH281: MATHEMATICAL METHOD I (3UNITS) PRE-REQUISITE – MTH 103

Sequences and Series: Limits, continuity, Differentiability, implicit functions, sequences. Series, test for convergence sequences and series of functions. Calculus: partial differentiation, total derivatives, implicitly functions, change of variables. Taylor's theorem and maxima and minima functions, of two variables. Lagrangian multiplier. Numerical Methods: Introduction to iterative methods, Newton's method applied to finding roots. Trapezium and Simpson's rules of integration.

MTH282: MATHEMATICAL METHODS II (3UNITS) PRE-REQUISITE – MTH 281

Vector Theory: Vector and scalar field functions. Grad, divi, curl, directional derivatives. Orthogonal curvilinear coordinates.

Complex Numbers: The algebra and geometry of complex numbers; de'moivre's theorem. Elementary transcendental functions. The n^{th} root of unity and of a general complex number.

PHY202: MODERN PHYSICS I (3 UNITS) PREREQUISITES: PHY102

Atomic structure: Experimental basis of quantum theory: Black body radiation; electrons and quanta; Charge quantization, Mass spectra, the plum pudding model, Rutherford model and Bohr models of the atom, Hydrogen spectra, Magnetic moment and Angular momentum of an atom, Electron spin, Pauli Exclusion Principle and electronic configuration, X-ray spectra, De Broglie hypothesis, the uncertainty principle; Wave-particle duality, Schrodinger's equation and simple applications; Nuclear Structure: nomenclature, binding energy and stability, Radioactivity, The radioactive series, Accelerators, Detectors. Bohr's theory of atomic structure.

PHY204: ELECTROMAGNETISM (2 UNITS) PREREQUISITES:PHY102,

Macroscopic properties of dielectrics: polarisation, Gauss's law in a dielectric, the displacement vector, boundary conditions on **D** and **E**, dielectric strength and breakdown; Capacitor: capacitance, the parallel plate capacitor, effect of a dielectric, energy stored in a dielectric medium, capacitors in series and parallel, practical capacitors; Microscopic properties of dielectrics: microscopic picture of a dielectric in a uniform electric field, determination of local field, Clausius-Mossotti equation, behaviour of dielectric in alternating fields; Magnetism of materials: response of various substances to a magnetic field, magnetic moment and angular momentum of an atom, diamagnetism and paramagnetism, Lamor precession, magnetization of paramagnets, ferromagnetism, magnetic field due to a magnetized material, magnetic intensity, relationship between **E** and **H** for magnetic material, magnetic circuits.

development.

PHY206: OPTICS I (2 UNITS)

Nature of light: the corpuscular model, the wave model, light as an electromagnetic wave; Reflection and refraction of light: electromagnetic waves at the interface separating two media, idealization of waves as light rays, Fermat's principle; Perception of light: human vision, colour vision; Polarization of light: simple states of polarized light, principles of producing linearly polarized light, wave plates.

STT211: PROBABILITY DISTRIBUTION I (3UNITS) PRE-REQUISITE – STT 102

Discrete sample spaces: Algebra and probability of events, combinatorial analysis. Sampling with and without replacement. Conditional probability, Bayes theorem and stochastic independence. Discrete distributions: Binomial, Poisson, negative binomial-hyper geometric and multinomial. Normal approximation to binomial and Poisson, Poisson approximation to binomial. Random variables and expectations: mean, variance, covariance. Probability generating function and moment generating function. Cheycher's inequality. Continuous joint distributions: marjind as conditional density. Expectations: movement, movement generating functions. Uniform normal, beta Cauchy and hop-normal distributions.

MTH301: FUNCTIONAL ANALYSIS I (3UNITS) PRE-REQUISITE – MTH 241

Metric Spaces – Definitions and examples. Open Sphere of (balls) closed sets, interior, exterior, frontier, limit points and closure of a set. Dense subsets and separable space. Convergence in metric space, homeomorphism, continuity and compactness.

MTH302: ELEMENTARY DIFFERENTIAL EQUATION II (3UNITS)

PRE-REQUISITE – MTH 282

Series, solution of second order linear equations. Bessel, legendry and hyper geometric equations and functions. Gamma and Beta functions. Storm Lionvelle problems. Orthogonal polynomial and functions, Fourier, Fourier, Bessel and Fourier – legendry series. Expansion in series of orthogonal functions. Fourier transformation. Laplace transforms solution of wave and heat equations by Fourier method.

MTH303: VECTOR AND TENSOR ANALYSIS (3UNITS) PRE-REQUISITE – MTH 103

Vector algebra, Vector dot and cross products. Equation of curves and surfaces. Vector differentiation and application. Gradient, divergence and curl. Vector integration, line, surface and volume integrals, Green stoke's and divergence theorems. Tensor products and vector spaces tensor algebra, symmetry, Cartesian tensors.

MTH304: COMPLEX ANALYSIS I (3UNITS) PRE-REQUISITE – MTH 101

Functions of a complex variable. Limits and continuity of functions of a complex variables. Deriving the Cauchy-Riemann equations. Analytic functions. Bilinear transformations, conformal mapping. Contour Integrals, Cauchy's theorems and its main consequences. Convergence of sequences and series of functions of complex variables.Power Series, Taylor Series.

MTH 305: COMPLEX ANALYSIS II (3UNITS) PRE-REQUISITE – MTH 304

Laurent expansions, isolated singularities and residues, residue theorem, calculus of residue and application to evaluation of integrals and to summation of series. Maximum modulus principle. Argument principle. Rouche's theorem. The fundamental theorem of algebra. Principle of analytic continuation, multiple valued functions and Riemann surfaces.

MTH307: NUMERICAL ANALYSIS II (3UNITS) PRE-REQUISITE – MTH 213

Polynomial and Splines approximations: Orthogonal polynomials and chebychev approximations, least squares, cubes spline, Hermits approximations, Numerical Integration. Boundary value problem. Introduction to numerical solution of partial differential equations.

MTH308: INTRODUCTION TO MATHEMATICAL MODELING (3UNITS)

Methodology of the Model building. Identification, formulation and solution of problems, cause – effect diagrams, equation types, algebraic, ordinary differential, partial differential, difference, integral and functional equations. Application of Mathematical model to physical, biological, social and behavioural sciences.

MTH309: OPTIMIZATION THEORY (3UNITS)

Linear programming models. The simplex method, formulation and theory. Duality, integer programming. Transportation problem, two-person zero-sum games. Non – linear programming, quadratic programming Kuhn tucker methods, optimality criteria simple variable optimization. Multivariable techniques, Gradient methods.

MTH311: CALCULUS OF SEVERAL VARIABLES (3UNITS) PRE-REQUISITE – MTH 282

Value, Limit and Continuity of functions of several variables. Partial derivatives of function of several variables. Total derivative of a function. Partial Differentials and Total Differentials of $f(x,\ldots\ldots x_n))$. Composite differentiation. Fuller's Theorem. Implicit Differentiation. Taylor's Series for function of two variables. Maxima and Minima of functions of several variables. Lagrange's Multipliers. Differentials under integral sign, The Jacobians

MTH312: ABSTRACT ALGEBRAII (3UNITS) PRE-REQUISITE – MTH 241

Normal subgroups and quotient groups. The isomorphism theorem. Symmetric groups, automorphism, conjugate classes, Normalisers. The sylow theorems. Normal and composition series. The Jordan-Holder theorem. Direct product. Solvable group. Isomorphism theorems for rings. Ideals and quotient rings. Commutative ring, maximal ideals. Euclidean rings, principal ideal domain and unique factorization domain.

MTH315: ANALYTICAL DYNAMICS I (3UNITS) PRE-REQUISITE – MTH 251

Degrees of freedom, Holonomic and non-holonomic constraint. Generalized coordinates. LaGrange's equation for holonomic systems, force dependent on coordinates only, force obtainable from a potential, Impulsive force, variational principles, calculus of variation, Hamilton principles. Canonical transformation, normal modern of variation, Hamilton Jacobi equation.

The notion of displacement, speed, velocity and acceleration of a particles. Newton's law of notions and applications to simple problems. Work, power and energy. Application of the principle of conservation of energy to notion of particles and those involving elastic string and springs. Simple Harmonic motion. Resultant of any number of forces acting on a particle. Reduction of coplanar forces acting on a rigid body to a force and a couple. Equilibrium of coplanar forces, parallel forces, couples Laws of friction. Application of the principle of moments. Moments of Inertia of simple bodies.

MTH318: FLUID MECHANICS I (3UNITS) PRE-REQUISITE – MTH 251

Real and Ideal fluid. Differentiation following the motion of fluids particles, Equation of continuity. Equation of motion for incompressible in viscid fluids. Velocity potential and stoke's stream function. Bernoulli's equation with applications. Kinetic Energy. Sources, sinks, doublets in 2 and 3 dimensions stream lines. Images. Use of conformal transformation.

MTH341: REAL ANALYSES (3UNITS) PRE-REQUISITE – MTH 312

Integration: The integral as the area of the ordinate set of a function. Definition of the Riemann integral of bounded functions. Conditions for integrality. Properties of the integral. Relations between integrals and derivatives. Approximation to integrals by sum.

The Riemann Integral: Riemann-Sieltejes integral. Properties, functions of bounded variation and extension to the notion of integration. Sequences and Series of Functions: Convergence of sequences and series of functions. Uniform convergence. Continuity of sum of a uniform convergent series of continuous functions. Terms by term integration and differentiation of a series of continuous functions. Applications to power spaces metric spaces.

MTH381: MATHEMATICAL METHODS III (3UNITS) PRE-REQUISITE – MTH 303

Functions of several variables: Jacobian, functional dependence and independence. Multiple integrals, line integrals. Improper integrals. Vector Field theory: Relations between vector field functions. Integral theorems. Gauss's. Stoke's and Green's theorems. Elementary tensor calculus. Functions of a complex variable: The Cauchy-Riemann equations. Integration of complex plane. Cauchy's theorem Cauchy's inequality. The residue theorem and the evaluation of integrals. Integral Transforms: Fourier and Laplace transforms. Convolution properties and their applications.

MTH382: MATHEMATICAL METHODS IV (3UNITS) PRE-REQUISITE – MTH 281

Ordinary Differential Equations: The concept of existence and uniqueness of solutions. Operational methods of solution of linear equations. Sturm-Lionvelle theory, Green's functions, series solution. Special functions and some of their elementary properties; Gamma and Beta functions. Partial Differential Equations: Solutions of boundary and eigenvalue problems of partial differential equations by various methods which include: Separation of variables, transform techniques. Sturn-Liouville theory; Green's functions; method of characteristics.

STT311: Probability Distribution II (3units) PRE-REQUISITE – STT 211

Probability spaces measures and distribution. Distribution of random variable spaces. Product probabilities. Independence and expectation of random variables. Convergence of random variables. Week convergence almost everywhere, laws of large numbers. Characteristic function and inversion formula.

STT316: MULTIVARIATE ANALYSIS AND APPLICATION (3UNITS)

PRE-REQUISITE – STT 311

Vector random variables. Expectations of random vectors and matrices. Multivariate normal distribution and distribution of quadratic forms. Application to linear models: Tests of general linear hypothesis and estimation. Least square theory: Guass-Markoff and general linear hypothesis with applications to regression and experimental design models. Estimation: partial and multiple correction coefficients, mean vector and co-variance matrix. Hatelting's T^2 and Wishart distribution: multivariate ANOVA.

MTH401: GENERAL TOPOLOGY I (3UNITS) PRE-REQUISITE – MTH 301

Point Set Topology: The space $\mathbf{R}^n$ Euclidean metric. Metrics, open spheres, metric topologies, metric spaces, properties of metric topologies. Equivalent metric. Heine-Borel theorem. Bolzano-wierstress theorem. Properties of separable, complete, compact, locally-compact and connected spaces. Cantor's set. Continuity and uniform continuity of mappings on metric space. Topological spaces: Definitions, examples, accumulation points, closes sets, closure, interior, exterior and boundary of a set. Neighborhoods and neighborhood systems. Coarser and finer topologies, subspaces and relatives topologies. Base for a topology sub bases.

MTH402: GENERAL TOPOLOGY II (3UNITS) PRE-REQUISITE – MTH 401

Separation axioms: T-spaces, Hausdorff spaces, Regular spaces. Normal spaces, Urgsohn's lemma. Category and seperability: Dense sets, nowhere dense sets. Sets of the first and second categories. Perfectly separable spaces. Separable spaces. The axiom of count ability. Compactness: Covers, compact sets, subsets of compact spaces. Sequentially, count ably and locally sets. Compactification. Product spaces: product topology. Base for a finite product topology. Tychonoff product theorem. Connectedness: separated sets, connected sets, connected spaces. Connectedness of the real line. Components. locally-connected spaces. Homotopic paths. Homotopy relations. Simple connected spaces.

MTH411: MEASURE THEORY AND INTEGRATION (3UNITS)

PRE-REQUISITE – MTH 301

Measure Theory: Measure of open, closed sets. Outer and inner measure. Measurable sets. Properties of measure. Non-measurable sets. Measurable in the scene of Borel. Measurable space. Measurable functions. Simple function Algebra. The Lebesgue integral: Lebesgue measure. Integral of non-negative function. Integral as measure of ordinate set, as a limit of approximate sums. Integral of an unbounded function. Integral over an infinite range. Simple properties of the integral. Sequences of integral (Positive functions; functions with positive and negative values). Lesbesgue monotone convergence theorem. Fatou's Lemma, Dominated

convergence. Bepo's Lemma-Bounded Convergence. Sets of measure zero. Integration by parts. Fubini's theorem and applications to multiple integrals.

MTH412: FUNCTIONAL ANALYSIS II (3UNITS) PRE-REQUISITE – MTH 411

Normal Linear Space: Definition and examples. Convex sets. Norms. Holder's minkowski's inequalities. Riese-Fisher theorem. Linear operations on finite dimensional spaces. Linear functionals spaces. Banach spaces, examples. Quotient spaces. Inner product spaces. Topological linear spaces. Hilbert space, examples. Linear operators in Hilbert spaces. Adjoint operators. Hermitian operators. Orthogonality; orthogonal complement and projections in Hilbert spaces.

MTH414: ANALYTICAL DYNAMICS II (3UNITS) PRE-REQUISITE – MTH 315

Lagrange's equations for non-holonomic systems. Lagrangran multipliers. Variational principles. Calculus of variation, Hamilton's principle, Lagrange's equation from Hamilton's principles. Canonical transformation Normal modes of vibrations. Hamilton-Jacobian equations.

MTH415: SYSTEM THEORY (3UNITS) PRE-REQUISITE – MTH 341

Lyapunov theorems. Solution of Lyapunov stability equation

$A^T P + PA = -Q$. Controllability and observability. Theorems on existence of solution of linear systems of differential operations with constant coefficient.

MTH416: ALGEBRAIC NUMBER THEORY (3UNITS)

Algebraic numbers; quadratic and cyclotomic fields. Factorization into irreducible, ideals, Murkowski's theorem, class-group and class number, Fermat's last theorem Dirichilet's unit theorem.

MTH417: ELECTROMAGNETIC THEORY (3UNITS) PRE-REQUISITE –PHY 204

Maxwell's field equations. Electromagnetic waves and electromagnetic theory of lights. Plane detromagnetic waves in non-conducting media, reflection and refraction of plane boundary. Wave guide and resonant cavities. Simple radiating systems. The Lorentz-Einstein transformation. Energy and momentum. Electromagnetic 4-Vectors. Transformation of (E.H) fields. The Lorentz force.

MTH421: ORDINARY DIFFERENTIAL EQUATIONS (3UNITS)

Existence and uniqueness theorems, dependence of solution on initial data and parameters. Properties of solutions. General theory for linear differential equation with constant coefficients, the two-point Sturm-Liouville boundary value problem, self-adjointness, linear and non-linear equations, Theorems and solution of Lyapunov equation. Controllability and observability.

MTH422: Partial Differential Equation (3units) PRE-REQUISITE – MTH 421

Theory and solutions of first order equations. Second order linear equations. Classification,

characteristics canonical forms, Cauchy problem. Elliptic equations. Laplace's and Poisson's formulae, properties of harmonic functions. Hyperbolic equations, retarded potential transmission line equation, Riemann methods, parabolic equation, diffusion equation, singularity function boundary value and initial value problems.

MTH423: INTEGRAL EQUATION (3UNITS) PRE-REQUISITE – MTH 103

Integral Equation: Classification – Volterra and Fredholm types. Transformation of Differential Equations. Neumann series. Fredholm alternative for degenerate Hilbert – Schmidt Kernels. Reduction of ordinary differential equation to Integral equations. Symmetric Kernels, eigen function expansion with applications.

MTH424: ABSTRACT ALGEBRA III (3UNITS) PRE-REQUISITE – MTH 341

Minimal polynomial of an algebraic number. Eisenstein's irreducibility criterion. Splitting fields and normal extension. Primitive element theorem. Galois group of a polynomial. Field degrees and group orders. The Galois group of a polynomial. Field degrees and group orders. The Galois correspondence. The fundamental theorem

MTH418: FLUID MECHANICS II (3UNITS) PRE-REQUISITE – MTH 318

Governing equations of viscous flow, exact solutions, Low Reynolds's number solutions, Boundary layers, compressible flows.

MTH499: PROJECT

Individual or Group projects of approved topics related to the current research interests in the department.