MATHEMATICS DEPARTMENT
BACHELOR OF SCIENCE IN EDUCATION B.Sc. (Ed.) PROGRAMME
DEGREE COURSE OUTLINE / DESCRIPTION

MTH 101- Elementary Mathematics 1
4-1-0 (5 units) Harmattan Semester

Set Theory: Sets, Union, intersection, empty set and universal set, complement of a set, subset, finite and infinite sets, Venn diagrams, Mappings and Functions.

Operations with real number: The real numbers **R** and its extension to the set of complex numbers, **C**. Equations involving and valuable, the reminder Theorem and the factor Theorem, Equations in two variables, inequalities, partial fractions, surds, indices and logarithms.

Operations with real number: The real numbers **R** and its extension to the set of complex numbers, **C**. Equations involving and variable, the remainder Theorem and the factor Theorem. Equations in two variables, inequalities, partial fractions, surds, indices and logarithms.

Theory of Quadratic Functions and Equations: The quadratic function and the relation between the roots of a quadratic equation and the inefficient.

Sequences and Series: Finite Sequences and series, the arithmetic sequence and series, the finite and infinite geometric sequences and series.

The Binomial Theorem: Elementary examples in the use of induction, permutation and combination and their applications. The Binomial Theorem for a positive integral index. The use of the expansion $(1+x)^n$, where n is fractional or negative; simple approximations.

Matrices: Definition of $m \times n$ matrices, $1 \le m, n \ge 3$; addition of matrices, matrix multiplication and inversion. Determinant of a matrix. Applications to simple linear equations. Stationary and Linear dependence.

References:

1. New General Mathematics Bk 1-3, Kalejaiye, Ilori S.A.
2. Engineering Mathematics Straud, K.A.

MTH 102-Elementary Mathematics II
4-1-0 (5 units) Rain Semester

Course Outline:

Trigonometry: Circular measure, small angles, definition and properties of sine, cosine, tangent, etc. Formulae for $Sin(A+B)$, $Cos(A+B)$, $Sin(A-B)$, $Sin\frac{A}{2}$, $Cos\frac{A}{2}$, $Tan\frac{A}{2}$, etc., Sine and Cosine formulae, Factor formulae, inverse trigonometric functions. General solution of trigonometric equations such as $a\cos\theta + bSin\theta = c$, etc.

Calculus: Differentiation of algebraic, exponential, trigonometric, product and quotient functions, applications of differentiation to cure sketching, etc. Maxima and minima. Definite and indefinite integrals with applications to areas and volume. Simple techniques of integration such as integration by parts etc. Simple first order Ordinary differential equations.

Coordinate Geometry: coordinate equations of lines, Circles ellipse, hyperbolic, parabola.

Statistics: Finite simple spaces, definition of probability on finite sample spaces and examples.

Probability as proportion of areas, conditional probability of events. Independence, tree diagrams, variables and cumulative. Frequency distribution, mean median, variance and co-variance conditional expectation and linear correlation, using scatter diagram.

References:

1. Pure Mathematics by Bunday Mulholland
2. Further Mathematics Project 1- 3

MTH 104 - Vector :

2-0-0 - (2 units) Rain Semester

Course Outline:

Introduction to vectors, vector addition components of a vector, unit vectors, $\underline{i}, \underline{j}, \underline{k}$ magnitude of a vector. Vector multiplication- scalar, vector, scalar triple and vector triple products. Applications to geometry and kinematics, (including relative velocity), Solutions of simple vector equations. Differentiation and integration of vectors.

References:

1. K.A. Stroud,Engineering Mathematics

MTH 105 – Elementary Mathematics for Biological Sciences I

3-1-0 - (4 units) Harmattan Semester

Course Outline:

Elementary set theory, Quadratic functions and equations, Solution of linear equations in three unknowns. Simple properties of determinants. Indices and logarithms; surds, permutation and combination; binomial theorem for positive and negative integral and fractional indices. Factor and Remainder theorems, inequalities. Circular measure, compound angles, of angles between 0 and 360. Graphs of Trigonometrical, functions. Limits: Differentiation of algebraic, Trigonometrical exponential, logarithmic, product and quotient functions. (Not for students offering MTH 101).

References:

1. Engineering Mathematics by Harvard. K. Days, 2014.

MTH 106 – Elementary Mathematics for Biological Science II

3-1-0 - (4 units) Rain Semester

Course Outline:

Applications of differentiation to gradient of curves and to maxima and minima of functions and physical quantities. Definite and indefinite integrals and their applications to areas and volumes. Simple integration by substitution and by parts. Equations of the straight line and the circular in Cartesian coordinates. First order ordinary differential equations with separable variables and application to first and second order chemical reactions, radio activity and Clausus Clapeyron equation. Collection, tabulation and representation of data. Frequency distribution, histograms, ogive, mean, mode and median, Measure of dispersion. Sample spaces and examples. Probability and proportion of areas, conditional probability of events. Applications.

References:

1. Engineering Maths by Harvard. K. Dass, 2014.

DEGREE TWO

MTH 201 – Mathematical Method I
3-1-0 - (4 units) Harmattan Semester
Course Outline:
Sequences and Series: Limits, Continuity, Differentiability, implicit functions, sequences and series of functions.
Calculus: Partial differentiation, total derivative, Implicit functions, sequences, series, tests for convergence. Sequences and series of functions.
Calculus: Partial differentiation, total derivatives, Implicit functions, cbange of variables. Taylor's theorem and maxima and minima of function 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.
Differential Equations: 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 equation s with constant coefficients. **Pre-requisite: MTH 101**
References:

1. Engineering Mathematics Straud, K.A.
2. Balogun F.O & Adenegan, K.E. Mathematical Methods

MTH 202 – Mathematical Method II
3-1-0 - (4 units) Rain Semester
Course Outline:
Vector Theory: Vector and Scalar field functions. Grad. Div, curl, directional derivatives, Orthogonal curvilinear coordinates.
Complex Numbers: The algebra and geometry of complex numbers; de'Moivre's theorem. Elementary transcendental functions. The nth root of unity and of a general complex number.
Linear Algebra: Vector spaces, Linear independence. Basis change of basis and dimension. Linear equations and matrices.
Elementary Matrix: The inverse matrix. Rank and nullity, Determinants. Confactors, inverse matrix, Determinantal rank. Crammer's rule, canonical forms, similar matrices, Eigenvalues and eigenvectors, quadratic forms. **Pre-requisite**: **MTH 102.**
References:

1. Advanced Engineering Maths by K.A Stroud Dexter J. Booth.
2. Balogun F.O& Adenegan, K.E. Mathematical Methods.
3. Akinyele &Ilori S.A Linear and Abstract Algebra.

MTH 205- Introduction to Algebra
2-1-0 - (3 units) Harmattan Semester
Course Outline:
Set: Binary operations mappings, equivalence relations.
Integers: Fundamental theorem of arithmetic, congruences, linear congruence equations, Euler's function o(n).
Group Theory: Definition and examples of groups. Sub-groups, coset decomposition, Lagrange's theorem. Cayley's theorem.
Rings: Definition and examples of rings, Commutative rings, integral domain, Order, well-ordering principle, Mathematical induction. I_n, division rings, Field, construction of the field of fractions of an integral domain and the embedding theorem. **Pre-requisite: MTH 102.**
References:

MTH 206 – Introduction to Numerical Analysis
2-1-0 - (3 units) Rain Semester
Course Outline:
Solutions of Equations:Graphical method, simple iterative methods for systems of linear equations. Grauss elimination method, Gauss – Jordan method.
Interpolation: Lagrange's and Hermite interpolation formulae, divided differences and difference schemes. Interpolation formulae by use of divided differences.
Approximation: Least square polynomials approximation, Chebyshev's polynomials.
Numerical integration: Newton-Cote's formuiae Gausian quadrature.
Matrices and Related Topics: Eigenvalues and eigenvectors, Algebraic eigenvalue problems. Power **method and Jacobi method. Pre-requisite: MTH 201.**
References:

1. Numerical Methods
2. Balogun F.O& Adenegan, K.E. Mathematical Methods
3. Introduction to numerical analysis.

MTH 207 – Logic, Sets and the Real Number System.
2-1-0 - (3 units) Harmattan Semester
Course Outline:
Logic: Statements, symbols for the three simplest connectives $(\wedge, \vee, \square$; truth-tables, tautology and equivalence. Laws of the algebra of statements, viz commutative, associative, distributive, idempotent, identity, the complement and De-Morgan's laws.
Sets and Functions: Cartesian products of sets; family of sets. A function as a triple (F,X,Y). Direct and inverse images, subjective functions, injective functions and one-one correspondence. Unipotent sets. Finite sets. Countable sets. Existence of uncountable sets.
The Real Number System: R = $(\mathbf{R}, +, ----, \leq)$
R as an ordered field. Axioms for addition and axioms of multiplication (the distributive laws). Mathematical induction. Definition of the natural numbers, the rational numbers. Upper bounds, lower bounds, supreme and infima. The Completeness Axiom. Open intervals, open sets. Density of the rationals in the real number system. Every open set is a countable union of disjoint open intervals.
Pre-requisite: MTH 101 & MTH 102.
References:

1. Elementary Abstract and Linear Algebra by Ilori & Akinyele
2. Introduction to Real Analysis by olubumo
3. Introduction to Real Analysis by Bartle

MTH 208 – Introduction to Real Analysis
2-1-0 - (3 units) Rain Semester
Course Outline:
Sequences and Series: Functions and sequences. Elementary properties of limits, convergence of sequences, Cauchy Convergence Principle, convergence of series. Tests for convergence, absolute convergence, conditional convergence, uniform convergence, power series.
Continuity and Differentiability: Real valued functions, periodic functions, bounded functions, continuity of functions using neighborhood. Elementary properties of continuous functions. Differentiability of functions, partial differentiation, total derivatives, Implicit functions, change of variables, Derivatives of higher orders, Rolle's Theorem, Mean value Theorem, Taylor's Theorem and maxima and minima of functions of two variables. Lagrange multiplier method.
Pre-requisite: MTH 207.
References:

1. Introduction to Real Analysis by Goke Olubumo

2. Introduction to Real Analysis by Bartle
3. Real Analysis by Royden

MTH 211 – Introduction to Mechanics
2-0-0 - (2 units) Harmattan Semester
Course Outline:
Statics: Moments and couples. Equilibrium of a particle and a rigid body under the action of a system of coplanar forces. Centre of mass of simple bodies. Moment of inertia of simple bodies. Dynamics: Newton's laws. Forces, work, power, energy and momenturn.
Rectilinear Motion: Constant acceleration, Force as a function of time, distance and velocity. Impulsive Motion: Elastic and inelastic collisions. **Pre-requisite: MTH 104.**
References:

1. **Nelson E.W., Charles B. and Mclean, W.G. (1962).** Schaum's outline of theory and problems in Engineering Mechanics (Statics and Dynamics). Publisher: Schaum Publishing company. ISBN 0-07-046193-7.

2. **David M. (2008).** Introduction to classical Mechanics. Publisher: Cambridge University Press, Cambridge, New York, USA. ISBN 978-0-521-76223.

3. **Edward A.D. (1982).** Classical Mechanics, Vol. 1. Publisher: John Wiley and sons, Inc. USA ISBN 0-471-09144-8.

4. **Edward A.D. (1982).** Classical Mechanics, Vol. . Publisher: John Wiley and sons, Inc. USA ISBN 0-471-09145-6.

5. **Gregory R.D. (2006).** Classical Mechanics. Publisher: Cambridge University Press, Cambridge, New York, USA.

6. **Gerd B. (2005).** Classical Mechanics and Non linear Dynamics. Publisher: Springer Science + Business Media Inc., New York USA. ISBN-13: 978-0387-01674-0.

7. **Godman A. and Talbert J.F. (2018).** Additional Mathematics : Pure and Applied. Publisher: Study BIUe Inc. A Chegg Servise. www.studyblue.com. ISBN 0582265118.

MTH 212-Mechanics
2-1-0 - (3 units) Rain Semester
Course Outline:
Statics: System of line vectors. Couples and wrenches. Principle of virtual work. Stability of equilibrium.
Dynamics of System of Particles: Elastic strings. Hooke's Law Motion in resitting media. Changing mass. Motion along a curve Frenet's formulae.
Coplanar Motion: Energy equation. Motion in a vertical circles simple pendulum.The cycloid and cycloidal motion. Orbital motion-disturbed orbits and stability. **Pre-requisite: MTH211.**
References:

1. **Nelson E.W., Charles B. and Mclean, W.G. (1962).** Schaum's outline of theory and problems in Engineering Mechanics (Statics and Dynamics). Publisher: Schaum Publishing company. ISBN 0-07-046193-7.

2. **David M. (2008).** Introduction to classical Mechanics. Publisher: Cambridge University Press, Cambridge, New York, USA. ISBN 978-0-521-76223.

3. **Edward A.D. (1982).** Classical Mechanics, Vol. 1. Publisher: John Wiley and sons, Inc. USA ISBN 0-471-09144-8.

4. **Edward A.D. (1982).** Classical Mechanics, Vol. . Publisher: John Wiley and sons, Inc. USA ISBN 0-471-09145-6.

5. **Gregory R.D. (2006).** Classical Mechanics. Publisher: Cambridge University Press, Cambridge, New York, USA.

6. **Gerd B. (2005).** Classical Mechanics and Non linear Dynamics. Publisher: Springer Science + Business Media Inc., New York USA. ISBN-13: 978-0387-01674-0.

7. **Godman A. and Talbert J.F. (2018).** Additional Mathematics : Pure and Applied. Publisher: Study BIUe Inc. A Chegg Servise. www.studyblue.com. ISBN 0582265118.

MTH 213 – History of Mathematics
2-0-0 - (2 units) Harmattan Semester
Course Outline:
Topics in the history of Mathematics with emphasis on the development of modern mathematics.
References:
1. The History of Mathematics, by Florian Carolyn 2010

DEGREE THREE

MTH 301 – Functions of a complex Variable
2-0-0 - (2 units) Harmattan Semester
Course Outline:
The Cauchy Riemann equations. Conditions for functions to be analytic. Conformal transformations. Particular examples of one – one mapping including the bilinear transformation. integration on the complex plane. Cauchy's theorem. Cauchy's inequality. Liouville's theorem. Morera's theorem. Taylor's and Laurent's series, singularities and zeros. The Residue Theorem and the evaluation of integrals.
References:

1. Advanced Engineering Math by K.A Stroud and Dexter J. Booth

MTH 302 – Differential Equations
2-1-0 - (3 units) Rain Semester
Course Outline:
Ordinary Differential Equations: The concept of existence and uniqueness of solutions. Operational methods of solution of linear equations. Sturm-Liouville theory, Green's functions and some of their elementary properties. Gamma and Beta functions. Legendre and Bessel functions. Expansions in orthogonal functions; Fourier Series.
Partial Differential Equations: Solution of boundary and eigenvalue problems of partial differential equations by various methods which include separation of variables, transform techniques. Sturm-Liouvillie theory; Green's functions, method of characteristics. **Prerequisite; MTH 201.**
References:

MTH 303 – Advanced Calculus
2-0-0 - (2 units) Harmattan Semester
Course Outline:
Functions of Several Variables: Jacobian, functional dependence and independence, multiple integrals, line integrals , improper integrals
Integral Transforms: Fourier Series and Fourier and Laplace transforms; convolution properties and their applications which include linear integral equations with displacement kernel.
Prerequisite: MTH 201.
References:

1. Advanced Calculus by Hiderbrand
2. Advanced Calculus by Schaum Series

MTH 305 – Vectorial Mechanics
2-1-0 - (3 units) Harmattan Semester
Course Outline:
Rotating Axes: Motion relative to the earth, Foucault's pendulum. Rigid Body Dynamics: Moments and Products of inertia. Principal axes – momental ellipsoid. Energy and angular momentum. Two dimensional problems. Three dimensional problems – Euler's equations. Pollode Cone. Eulerian angles. Precessional Motion. Analytical Mechanics; Lagrange's equation for holonomic and non-holonomic systems, ignorable coordinates, impulses, Small oscillations, Expressions for kinetic and potential energies. Normal coordinates. Principal modes of oscillation. **Prerequisite: MTH212.**
References:

MTH 306 – Groups and Rings
2-1-0 - (3 units) Rain Semester
Course Outline:
Groups: Normal subgroups and quotient groups. The isomorphism theorem. Symmetric groups, automorphisms, conjugate classes, Normalisers. The Sylow theorems. Normal and composition series. The Jordan-Holdertheorem. Direct product. Solvable groups.
Rings: Isomorphism theorems for rings. Ideals and quotient rings. Eudidean rings. Principal ideal Domain and Unique Factorization Domain. **Prerequisite: MTH 205.**
References:

MTH 307 – Introduction to Topology
2-1-0 - (3 units) Rain Semester
Course Outline:
Definitions and Examples, open sets, closed sets; Convergerce, Completeness, Vaire's theorems; continuous mapping of metric spaces. Spaces of contiuous functions CX,R) as a Banach space. Euclidean and unitary spaces, Cauchy's inequality, Minkowski's inequality. Compact metric spaces Sequential Compactness, the Boizano-Weierstrass property. Lebesgue covering Lemma; total boundedness. Ascoli's theorem. Prerequisite: **MTH 208.**
References:

MTH 309 – Electromagnetic Theory 1
2-0-0 - (2 units) Harmattan Semester
Course Outline:
The electrostatic field of force, conductors and condensers. Continuous distributions. Method of images. Dielectrics. Electrostatic Stress and Energy.
Magnetism. The energy and interactions between two dipoles. Induced magnetism, Steady electric current in linear conductors and in a continuous media. Prerequisite: MTH 204 .
References:

1. Electromagnetic Theory by V. C. Ferraro
2. Mathematical Physics by B. D. Gupta
3. Electromagnetic Theory by Julius A. Stratton 1st Edition. (1941)
4. Electromagnetism: Principle and Application by Paul Lorrain, D. R. Corson
5. Electromagnetism by Pollack and Stump
6. http://www.howmagnetswork.com
7. http://en.wikipedia.org/wiki/ Electromagnetism
8. http://abyss.uoregon.edu/~js/21st_century_science/lecture/lec04.htm

MTH 310- Continuum Mechanics
2-1-0 - (3 units) Harmattan Semester
Course Outline:
Introduction: The fundamental postulate of a continuum-physical properties of a continuum. Elements of tensor. Theory of stress: Body force, surface force, Cauchy stress. Theory of deformation: particles and continuum configuration. Eulerian (or observer) description, Langrangian (or follow) description. Displacement, strain, infinitesimal (classical) strain. Kinematics: Material derivative, velocity, acceleration, pathlines and streamlines, steady motion, rate of deformation, vorticity.
Conservation (Universal) laws of continuum mechanics: Conservation of mass-continuity equation. Linear momentum principle-motion and equilibrium equations. Moment of momentum(angular momentum) principle. Conservation of energy, first and second laws of thermodynamics. The clasius-Dehem inequality, dissipation function. **Constitutive laws of**

continuum mechanics: solid medium- Generalized Hooke's law, elastic constants, isotropic elastic medium, motion and static equations. Examples of elastostatic and elastodynamic problems. **Fluid medium** – Newtonian and Stokesian fluids. Navier-Stokes equations, Bernoulli's equation. Hydrostatics. Steady flow, irrotational flow, potential flow and circulation. **Electrostatic field** – electrostatic stress and energy, diploes, dielectrics, induced magnetism, steady electric current in linear conductors. **Prerequisite: MTH 305.**

References:

1. Schaum's Series Outline, TATA McGRAW-HILL Third Edition by William F. H. and John A. B.
2. Yih, C. S. (1969). Fluid Mechanics, McGraw-Hill, New York, 622.
3. Schlichting, H. (1979). Boundary-Layer Theory, 7th edition, McGraw-Hill, New York.
4. Genick, B. (2013), Basic Fluid Mechanics, Last modied: version 0.3.4.0 March 17, 2013, www.potto.org, 7779 North Washtenaw Avenue, Chicago, 377 - 382.
5. Bird, R. B., Stewart, W. E. and Lightfoot, E. N. (2006), Transport Phenomena, 2nd Edition, Nice Printing Press, Delhi-110051, 333 - 772.

MTH 311 – Linear Algebra
2-1-0 - (3 units) Rain Semester
Course Outline:

Vector Spaces: Definition and Examples. Elementary basic concepts. Linear independence, Dual spaces, linear product spaces. Modules. The algebra of linear transformations, characteristics vectors. Matrices, canonical forms, triangular forms, Nipoltent transformations and Jordan form. Rational canonical form. Trace and transpose. Determinants, Hermitian, Unitary and normal transformations. Real quadratic forms. **Prerequisite: MTH 203.**

References:

1. Introduction to Linear Algebra by Seymour Lipschuts.

MTH 312-Electromagnetic Theory II
2-1-0 - (3 units) Rain Semester
Course Outline:

Current sheets. Magnetic interaction of currents. The potential Biot Savart Law. Selonoids, Magnetic field of current sheets. Energy of , and force acting on a circuit in a magnetic field. Electromagnetic induction in one of two circuits involving condensers. Maxwell equations. Electromagnetic waves. The Electromagnetic potentials. Guides relativistic formulation. Motion of Electric changes in a magnetic and Electric fields. **Prerequisite MTH 309.**

References:

MTH 314- Real Analysis
2-1-0 - (3 units) Rain Semester
Course Outline:

Integration: The integral as the area of the ordinate set of a function. Definitions of the Riemann integral of bounded functions conditions for integrability. Properties of the integral. Relations between the integrals and their derivatives. Approximation to integrals by sum. Functions of bounded variations, Riemann- Stieltjes integral. Integration with respect to functions of bounded variation. Rectifiable curves. **Sequences and series of function:** convergence of sequences and series of functions. Uniform convergence. Tests of convergence and uniform convergence. Continuity of sum of a uniform convergent series of continuous functions. Applications to power series of continuous functions. Application to power series. **Prerequisite: MTH 208.**

References:

MTH 316-Waves
2-1-0 - (3 units) Rain Semester
Course Outline:
Nature of waves. Equation of wave motion. Waves of strings, finite and infinite strings. Waves in membrane, longitudinal waves, sound waves. Water waves-tidal waves, surface waves. **Prerequisite : MTH 305.**
References:

MTH 318- Theory of Numbers
2-1-0 - (3 units) Rain Semester
Course Outline:
Divisibility, Congruences and residues, Linear congruences, Diophantine analysis, selected topics in the theory of primes, algebraic number theory. Diophantine equations. $x^2+y^2=z^2$ and $x^4+y^4=z^4$. Partition function p(n). **prerequisite: MTH 205**
References:
1. Number Theory by A.J.White.

MTH 320 – Introduction to Differential Geometry
Course Outline:
Curves in 3- spaces. Frenet formulae in 3-spaces, normal curvature. Congruences of curves and of surface. Intrinsic geometry. Gauss-Bonet theorems. **Prerequisite: MTH 302.**
References:

MTH 321 – Tensor Analysis
2-1-0 - (3 units) Harmattan Semester
Course Outline:
Manifold of points. Tensors, Summation convention, Contravariant and covariant vectors; Scalars; tensors of higher rank, Krkonecker delta; contraction. Determinants of tensors of second rank; integrals and tensor densities. Riemannian space; line-element; metric tensor; signature of metric. **Prerequisite: MTH 201**.
References:

MTH 322 – Introduction in Mathematical modeling.
2-1-0 - (3 units) Rain Semester
Course Outline:
Methodology of model building; identification, formulation and solution of problems, cause effect diagrams. Equation types. Algebraic, ordinary and partial differential, difference, intgegral and functional equations. Applications of Mathematical Models to plural, biological, social and behavioural sciences.
References:

DEGREE FOUR

MTH 401-GENERAL TOPOLOGY
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Topological spaces. Definition and Examples. Open bases, open sub-bases. Topologizing of sets, G,F sets. Continuous maps, open maps and closed maps. Homeomorphisms. Weak topologies, Function algebras C(X,R), C(X,C). Compact spaces, product of spaces. Tychonoff's theorem. Locally compact spaces. The approximation theorem. **Prerequisite: MTH 304**
References:

1. Theory and problems in General Topology, Schaum outline series
2. S. Morris, Topology without tears.
3. U.S. Idiong, Fundamental Concepts in Topology

MTH 402-Algebraic Topology
2-1-0 -(3 units) Rain Semester
Course Outline:
Fundamental Groups: Definition of the fundamental groupps of a space. Continuous mapping and fundamental groups. The fundamental group of a circle is infinite cyclic. Applications: The Brower fixed point theorem in 2-dimensions. The fundamental group of a product space.
COVERING SPACES: Definitions and examples. Lifting of paths to a covering space. The fundamental group of a covering space. Homomorphism and automorphism covering spaces.
References:

1. A. Hatcher, Algebraic Topology
2. U.S. Idiong, Fundamental Concepts in Topology.

MTH 403-Measure Theory and Integration
2-1-0 -(3 units) Harmattan semester
Course Outline:
Measure Theory: Measure of open, closed sets. Outer and inner measure. Measurable sets. Properties of measure, 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). Lebegue 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. **Prerequisite: MTH 314.**
References:

MTH 404- NORMED LINEAR SPACES
2-1-0 (3 units) Rain Semester
Course Outline:
Normed Linear Spaces: Definition and examples. Convex sets. Normed. Holder's and Minkowski's Inequaliies. Riez-Fisher Theorem. Linear Operators on finite dimensional spaces. Linear functional space. Banach spaces, examples. Quotient spaces. Inner product spaces, . Topological Linear spaces. Hilbert spaces, examples. Linear operators in Hilbert spaces. Adjoint oprators. Hermitian operators. Orthogonality, orthogonal complement and projections in Hilbert spaces: **Prerequisite: MTH 403**
References:

MTH 405- GALOIS THEORY
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Polynomials over fields. Irreducibility criterion especially over 0,, the rational number fields. Field extensions. Finitely generated, finite and simple extensions, algebraic extensions. Automorphisms of fields. F-automorphisms, and normal extensions. Fundamental theorem of Galois theory. Applications. **Prerequisites: MTH 202 and MTH 306.**
References:

MTH 406-Commutative Algebra
2-1-0 -(3 units) Rain Semester
Course Outline:
Rings and ideals. Extension and contraction of ideals. The mild radical and the Jacobs on radical, Modules and their properties. Restriction and extension of scalars. Exact sequences and additive functions. Multiplicatively closed subsets, rings of fractions, local rings and localizations contracted ideals in rings of fractions. Primary decomposition. Neotherian and Aetonian rings. **Prerequisite: MTH 306.**
References:

MTH 407- COMPLEX ANALYSIS I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Topological index and properties: some topological properties of the index chains and cycles. Simple topological properties of the index chains and cycles. Simple connectivity. Local and conformal Mapping Theory: The Argument Principle. Maximum Modulus theorem. Schwartz Lemma. Normal families Riemann-Mapping Theorem. Analytical continuation: General Theory Singularities. Riemann-surfaces. Functions defined by integrals. The Gamma-function. The Zeta-function. The principle of reflection. Function with natural boundaries. Power series: uniform convergence **Prerequisite: MTH 301.**
References:

MTH 408- COMPLEX ANALYSIS II
2-1-0 -(3 units) Rain Semester
Course Outline:
Integral functions: Factorisation of integral functions. Construct of different kinds of integral function. Maximum modulus of an integral function. The order of an integral function. Integral function of finite orders. Canonical products. Borel's theorems of Canonical products. The phragmen-Lindel of principle. The proximate order of an integral function. elliptic functions: definitions. The irreducible poles and zeros of an elliptic function. weistrass's elliptic function p(Z). Meromorphic functions. **Prerequisite: MTH 407.**
References:

MTH 409- Ordinary Differential Equations I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Existence of solutions. Uniqueness of solutions. Method of successive approximations. Continuation of solutions. Systems of differential equations. The nth order equation. Extension of the idea of a solution, maximum and minimum solutions on initial conditions and parameters. Variation of solutions with respect to initial conditions and parameters. **Prerequisite: MTH 382 and MT|H 314.**

References:

MTH 410-Ordinary Differential Equation II
2-1-0 -(3 units) Rain Semester
Course Outline:
Linear homogenous and non-homogeneous systems. Linear systems with periodic co-efficient. Linear differential equation of order n. linear systems with isolated singularities of the first and second order: formal solutions, Asymptotic Series. Self-adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems for second-order linear equations. Asymptotic behaviours of non-linear systems; Stability. Lyapunov's methods. **Prerequisite: MTH 409.**
References:

MTH 411- Homology Theory
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Basic definitions of homology equivalence ideas of category theory and functions Axiomatic approach to cohomology homology theory. Chain complexes and singular homology. Applications to (1) Euclidean spaces (2)degree of a map (3) local homology. Filtration and C.W. complexes calculation of the homology groups. Simplicial homology. Singular homology and cohomology with general coefficients
Pre-requisites: **MTH 203, MTH 306 and enrolment in MTH 401.**
References:

MTH 413- Differential Geometry I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Curve in Frenet-Serret Formulae; Manifolds. Vector fields and forms. Tensor algebra, Grassmann algebra, Exterior differentiation. Interpretation of the Jacobian Transformation of vector fields. Effect on Differential forms. Affine connections, parallelism, the exponential mapping, covariant differentiation, structural equations, Riemannian connection
Prerequisites: MTH 301, MTH 306.
References:

MTH 414- Differential Geometry II
2-1-0 -(3 units) Rain Semester
Course Outline:
Complete Riemannian manifolds, Isometrics, Sectional Curvature, Riemannian manifolds of negative curvature, totally geodesics sub-manifold, Affine locally symmetric spaces, almost complex manifolds, complex Tensor fields, the Rici curvature, Bounded domains, the kernel functions. **Prerequisite: MTH 413**
References:

MTH 415-Quantum Mechanics I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Classical Dynamics in Hamiltonian form and its application to atomic problems. The Bohr Theory. The ideal of Hesenberg and Schrodinger. Dynamical variables as operators and the states of a system. Examples of energy eigen functions. The representation of states in function space. **Prerequisite: MTH 302 and MTH 305**
References:

MTH 416- Quantum Mechanics II
2-1-0 -(3 units) Rain Semester
Course Outline:
Transformation of representations. Elements of linear operator theory. The Schrodinger and Heisenberg representations. the motion of a particle in three dimensions. Angular momentum relations. The hydrogen atoms. The elements of perturbation theory. Ritz variation method of bounded states. **Prerequisite: MTH 302 and MTH 310**
References:

MTH 417- Fluid Dynamics I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Stresses and strains. Navier Stokes Equation. Energy equation, simple exact solutions. Dynamics similarity. Slow flows: Stoke's and Oseens. Lubrication theory. Laminar boundary layer. Thickness, skin friction and heat transfer. Blasius solution for the flat plate and similar solutions. Laminar boundary layer separation. **Pre-requisites: MTH 302 and MTH 310**
References:

MTH 418- Fluid Dynamics II
2-1-0 -(3 units) Rain Semester
Course Outline:
Thermodynamics, compressibility effects. Equations of continuity and motion. Energy equation. One dimensional unsteady flow. Small disturbance theory. Normal and obliques shock waves. Flow produced in a tube by a moving piston. Differential equations satisfied by velocity potential in steady irrotational motion. Linearized form of the equation in subsonic and supersonic flows, (small disturbance treatment for 2 dimensional flows) **Pre-requisites: MTH 302 and MTH 310**
References:

MTH 419- Elasticity I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Tensor: introduction to the elements of tensor calculus.
Elasticity: Strain, Stress, Finite deformation of an elastic solid. Infinitesimal theory. Isotropic and non-isotropic elastic media. Solution of simple problems. Elementary concept of heterogeneous media. **Pre-requisites: MTH 301** and **MTH 305**
References:

MTH 420- Elasticity II
2-1-0 -(3 units) Rain Semester
Course Outline:
Two dimensional problems of elasticity. Plane strain, plain stress, generalized plane problem. Theory of membranes and torsion problems: bending of flat plates.
The Airy's Stress – functions and displacement function. The complex stress-function and complex stress potential 305ls. Simple solution for a circular boundary.
Pre-requisites: MTH 419 and MTH 305
References:

MTH 421-Electromagnetic Theory III
2-1-0 -(3 units) Harmattan Semester
Course Outline:
Maxwell's equations within matter, refraction and reflection of plane waves including total reflection. Transmission lines. Transmission of waves in (I) wave Guides; (II) Homogeneous conductors. **Pre-requisite: MTH 302** and **MTH 309**
References:

MTH 422- Electromagnetic Theory IV
2-1-0 -(3 units) Rain Semester
Course Outline:
Special theory of Relativity andapplications to the electromagnetic field and motion of charged particles. Maxwell's tensor: Electromagnetic momentum; pressure of radiation .
Pre-requisite: MTH 421
References:

MTH 423- Numerical Analysis I
2-1-0 -(3 units) Harmattan Semester
Course Outline:
The approximation of the solution of ordinary differential equations. Solutions of First order ordinary differential equations- Taylors expansion approach, Euler's methods, Runge-Kutta methods, predictor-corrector methods, other integration formulas. Boundary value problems. Eigenvalue and Eigenvectors, Cayley-Hamilton theorem. Characteristics equations. Krylor's methods. Fundamental properties of the characteristic polynomial. Newtons formula for the coefficient of the characteristic equation. Calculation of eigenvalues and eigenvectors. Matrix iteration method. method of finding largest and smallest eigenvalues. The Von Mises theorem. The Rayleigh Quotient. Matrix deflation; similarity and equivalence of matrices.
Interpretation: General problem of the finite interpretation, systems possessing the interpolation property. General remainder systems possessing the interpolation property. General remainder theorems for interpolation in linear spaces. Best real error theorems for interpolation in linear spaces. Best real error estimates. Convergence theorem.
Pre-requisites: MTH 206.
References:
1. Advanced engineering Mathematics by K.A Stroud and Dexter J. Booth
2. Advanced Engineering Mathematics by ERWIN Kreyszig,Herbert Kreyszig and Edwards.
Norminton.

MTH 424- Numerical Analysis II
2-1-0 -(3 units) Rain Semester
Course Outline:
Difference Equations: Notations and definitions. Formation of difference equations. The solution concept of a difference equation. Linear homogeneous difference equations. Formation of difference equations. Bernolli's method. partial difference equations.
Approximation of the solution of partial differential equations
Classification of partial differential equations. The approximation of derivatives by finite differences. Simple parabolic differential equations. The explicit form of the difference equation and its convergence. Stability and consistency. The Crank-Nicolson method.
Introduction to finite elements method
Variational formulations, Engineers point of view of finite element methods. Boundary conditions. Weighted Residual methods. The Gelerkin method. **pre-requisite: MTH 423.**
References:
1. Advanced Engineering Mathematics by K.A Stroud and Dexter J.Booth

2. Advanced Engineering Mathematics by Erwin Kreyszig,H. Kreyszig and E. Norminton

MTH 425 – Non-Associative Binary Systems II
2-1-0 -(3 units) Harmattan SemesterS
Course Outline:
Commutative Moufang Loops. Hamiltonian loops. Isotopy. Milpotency. Holomorphy. Universal Algebra. Centrality. Quasigroup Modules. **Pre-requisite: MTH 425.**
References:

MTH 426- NON-ASSOCIATIVE BINARY SYSTEMS II
2-1-0 -(3 UNITS) RAIN SEMESTER
Course Outline:
Commutative Moufang Loops. Hamiltonian Loops. Isotopy. Nilpotency. Holomorphy. Universal Algebra. Centrality. Quasigroup Modules. **Pre-requisite: MTH 425.**
References:

MTH 427 – Group Representation
2-1-0 -(3 units) Harmattan Semester
Course Outline:
General Theory: definitions. Reducibility. Complete reducibility. Schur's Lemma.
Finite Groups: character relations. Regular representations. Character table. Finite abelian groups. Factor groups. Linear characters. Induced representations. Computation of Character tables. **Pre-requisite: MTH 306**
References:

MTH 428- Introduction to Group Rings.
2-1-0 -(3 UNITS) Rain Semester
Course Outline:
The fundamental theorem of finitely generated abelian groups. Torsion groups. Torsion free groups. Divisible groups. Presentation of groups. Torsion free groups. Divisible groups. Definition of group rings. Examples. Group rings offinitely- generated torsion-free rings. Ideals of Group Rings. Twisted Group Rings. Tensor products. The Trace map. **Pre-requisite: MTH 306**
References:

MTH 499 – Project in Mathematics
2-1-0 -(3 units) Harmattan Semester
Course Outline:
The Honours project in Mathematics will consist of a typewritten report on some approved and supervise topic(s) in the field of mathematics. The student is expected to either give a short seminar or be examined orally on the approved report.
References: