DEPARTMENT OF MATHEMATICAL SCIENCES

FACULTY OF PHYSICAL SCIENCES

BAYERO UNIVERSITY, KANO

STUDENTS' HANDBOOK

FOR

B.Sc. MATHEMATICS & B.Sc. STATISTICS PROGRAMS

Bayero University, Kano PMB 3011, Kano, Nigeria

Table of Contents

Contents

The University Crest

The Crescent and the Star

The Crescent: *Jamiatu Bayero Kano*

(Symbol & Unit Time) Bayero University Kano

The Star: Motto *"Wa Fawqa Kulli Dhi Ilmin Alim"*

(Guiding Light) "… But over all endowed with knowledge is one, the All-knowing"

University Color: Blue

Philosophy and Cardinal Principles of the University

Abdullahi Bayero College was reconstituted into University College with effect from October 1st, 1975 and into Bayero University in October 1977.

The Academic Development Committee outlined a philosophy consistent with traditions and character, which the College acquired during its years of existence. Briefly, it is that the University is to pay due respect to human values. It is to:

"be built on those beliefs, values and tradition that the society holds most sacred. The University should strive to be symbol of the spirit of its community, the guardian of its moral, the formulator of its hopes, be they spiritual or material. It should monitor the inevitable changes that come with time and, in assimilating these essential values and nuances, the University recognizes the need to:

1. Deepen individuals' awareness of the value of the cultural heritage;
2. Foster and reinforce the moral, ethical and spiritual values sacred to the culture;
3. Provide the knowledge, skills and technology required for the benefit of wider community;
4. Further the objectives of a united, fair and just community, society and nation".

In pursuing its aims and objectives, the University will be constantly guided by the requirements of the national plans, manpower needs and sheer physical and environmental factors.

Brief history of the Department

The Department of Mathematical Sciences was established in 1976 as one of the pioneer departments of the then new Faculty of Science. It was called Department of Mathematics. The name was changed to Mathematical Sciences in the early 1990's due to the recommendation by an NUC special panel that more degree programmes should be introduced, particularly B.Sc. Computer Science and B.Sc. Statistics. Due to staffing and other logistics problems, such new programmes could not be introduced until 2002/2003 session when the B.Sc. Computer Science degree was established.

The Department had been running two (2) undergraduate programmes; B.Sc Mathematics and B.Sc. Computer Science and three (3) postgraduate programmes; Postgraduate Diploma in Computer Science, M.Sc. Mathematics and Ph.D. Mathematics. In addition, the department serves other departments/faculties in the University. With the establishment of new faculty in the University, B.Sc. Computer Science was moved to new Faculty of Computer Science and Information Technology in 2011/2012 session.

Currently, the Department is running two (2) undergraduate programmes; B.Sc. Mathematics and B.Sc. Statistics; five (5) postgraduate programmes; postgraduate Diploma in Mathematics, M.Sc. Mathematics, M.Sc. Applied Mathematics, M.Sc. Computational Mathematics and Ph.D. in Mathematics.

The Department had 4 teaching staff at inception but now has 33 including 6 females. At present the Department has 197 undergraduate and 114 postgraduate students and is headed by Dr. Abbas Jaafar Badakay.

PART A

B.Sc. Mathematics

Philosophy of the Programme

The philosophy of this programme is based on the belief that:

1. Education is an instrument for national development;
2. Education fosters the worth and development of the individual into a sound and effective citizen for the individuals sake, and for the general development of the society;
3. Through provision of functional education, the individual can be fully integrated into the society;
4. Mathematics provides the knowledge and skills needed in the pursuance of the technological advancement in modern information age;

Objectives of the Programme

Considering;

- The relevance of Mathematics in providing a solid base upon which scientific knowledge is built;
- The importance of Mathematics in providing the necessary skills and training for the attainment of societal development;
- Necessity to train Mathematicians with the attendant multiplier effects in the pursuance of interdisciplinary studies/research;

And in view of the

- Importance placed by governments in the training of Mathematicians at all levels of education;
- The high demand of Mathematicians in both public and private sectors of the society;

The programme has the following objectives:

1. Give high-level manpower training in the field of Mathematics with a view to producing the needed human resources.
2. Produce highly skilled individuals who would be self-reliant and useful members of the society
3. Further popularize the importance of Mathematics knowledge and its relevance to personal/national progress.
4. Prepare students intellectually to pursue research and graduate studies in all areas of Mathematics.
5. Identify, recruit and or attract the finest staff manpower to carry out its vital traditional functions of teaching, research and community service.
6. To encourage the advancement of learning and to hold out all person without distinction of race, creed, sex or political conviction, the opportunity of acquiring higher and liberal education.
7. To provide courses of instruction and other facilities for the pursuit of learning in all its campuses, and to make those facilities available on proper terms to such persons as are equipped to benefit from them.
8. To encourage, promote scholarship and conduct research in all field of learning and human endeavour.
9. To relate the activities to the social and economic needs of the people of Nigeria.
10. To undertake any other activities appropriate for a University of the highest other.

Admission Requirements:

Candidates with the following qualifications are eligible for admission:

A: Level I

Five passes at credit level three of which must be in Mathematics, Physics and English, and the remaining from Biology/Agricultural Science, Chemistry, and Geography. In addition to obtaining a minimum score required in the UTME.

B: Level II

1) Diploma in Mathematics/Mathematics Education.
2) Diploma in Statistics.
3) IJMB (relevant subjects- Mathematics/Physics).
4) N.C.E. (relevant subjects Mathematics/Physics).
5) Any other equivalent qualification deemed appropriate by the Senate.

Course Numbering

Each course offered in the Department of Mathematical Sciences is prefixed by one of the letter-groups **MTH** or **STA** indicating that it is a Mathematics or Statistics, course respectively. This is followed by a four-digit number. The first digit indicates the level to which the course belongs; the second digit indicates the credit value of the course; while the last two digits are for identification purposes.

Course Assessment

Each course is assessed by continues assessment and an end-of-semester examination. The continues assessment normally accounts for 30% to 40%, while end of semester examination accounts for 60% to 70% of the overall marks for each course.

Regulations:

The concurrent General Regulations of the University and the Regulations of the Faculty of Physical Science apply. In addition to such regulations, the following regulations also apply for the BSc Mathematics Programme:

i. In addition to the compulsory Mathematics courses, every Level I Mathematics student must register Physics courses and all level I courses from ***one*** of Biology or Chemistry.
ii. Every Level I student is to take the Level I *General Studies* courses: **GSP 1201: Use of English and GSP 1202: Use of Library, Study Skills and ICT** offered by the School of General and Entrepreneurship Studies, while Level II students are to take the Level II GSP courses open to science students: **GSP 2204: Foundation of Nigerian Culture, Government and Economy, GSP 2205: Philosophy and Logic and GSP 2206: Peace and Conflict Resolution**. In addition, all Direct Entry students should register **GSP 2201: Use of English and GSP 1202 Use of Library, Study Skills and ICT.** Level IV students are to take: **EEP3201: Entrepreneurship and Innovation and EEP 4201: Venture Creation and Growth.**
iii. Unless the contrary is stated, all Mathematics courses are ***core*** courses. All GSE courses are also ***core*** courses.

iv. The *minimum* duration of the programme is **four (4) academic sessions for UTME students (three (3) for DE students)** and the *maximum* is **six (6) academic sessions for UTME students (five (5) for DE students)**. Where a student fails to satisfy the minimum graduation requirement after exhausting the maximum time, he/she will be withdrawn from the programme.

v. To qualify for the award of BSc degree in Mathematics, a **UTME** student must pass all core courses and obtain at least ***34, 35, 30 and 33 credits*** each from Level I, II, III and IV courses respectively (and **39, 30 and 33 credits** each from Level II, III and IV courses respectively for **DE** students). This is in addition to the normal University Requirement of obtaining a minimum of 30 credits per level.

The Current Summary of the Minimum Requirement for Graduation is as follows:

LEVEL/COURSES	MTH/STA Credits	CSC Credits	GSP Credits	Other Credits	Total
LEVEL I	12	02	04	16	34
LEVEL II	26	03	06	-	35
LEVEL III	30	-	-	-	30
LEVEL IV	29	-	04	-	33
TOTAL	97	05	14	16	132

List of Courses

Level I Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH1301	ELEMENTARY MATHEMATICS I	CORE
2	MTH1302	ELEMENTARY MATHEMATICS II	CORE
3	MTH1303	ELEMENTARY MATHEMATICS III	CORE
4	STA1311	PROBABILITY I	CORE
5	PHY1210	MECHANICS	CORE
6	PHY1220	ELECTRICITY AND MAGNETISM	CORE
7	PHY1230	BEHAVIOUR OF MATTER	CORE
8	PHY1170	PHYSICS PRACTICAL I	CORE
9	PHY1180	PHYSICS PRACTICAL II	CORE
10	CSC1201	INTRODUCTION TO COMPUTER SCIENCE	CORE
11	GSP1201	USE OF ENGLISH	CORE
12	GSP1202	STUDY SKILLS & ICT	CORE
13	CHM1231	INORGANIC CHEMISTRY	OPTIONAL*
14	CHM1241	ORGANIC CHEMISTRY	OPTIONAL*
15	CHM1251	PHYSICAL CHEMISTRY	OPTIONAL*
16	CHM1261	PRACTICAL CHEMISTRY	OPTIONAL*
17	BIO1201	GENERAL BIOLOGY I	OPTIONAL*
18	BIO1202	GENERAL BIOLOGY II	OPTIONAL*
19	BIO1203	GENERAL BIOLOGY III	OPTIONAL*
20	BIO1204	GENERAL BIOLOGY IV	OPTIONAL*

*****Students are to take either the CHM option ***only*** or BIO option ***only***.

Level II Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH2301	MATHEMATICAL METHODS	CORE
2	MTH2302	ELEM. DIFF. EQUATIONS	CORE

3	MTH2203	LINEAR ALGEBRA I	CORE
4	MTH2204	LINEAR ALGEBRA II	CORE
5	MTH2306	INTRO. TO NUMER. ANALYSIS	CORE
6	MTH2307	REAL ANALYSIS I	CORE
7	MTH2208	VECTOR ANALYSIS	CORE
8	MTH2310	INTRODUCTION TO MATHEMATICAL COMPUTING	OPTIONAL
9	MTH2213	ELEMENTS OF SET THEORY	CORE
10	MTH2214	LOGIC AND ALGEBRA	CORE
11	STA2211	PROBABILITY II	CORE
12	STA2212	PROBABILITY III	CORE
13	CSC2320	PROGRAMMING IN C++	CORE
14	GSP2201	FUNDATION OF NIG. CULTURE, ECONOMY & GOVT.	CORE
15	GSP2204	PEACE AND CONFLICTS STUDY	CORE
16	GSP2205	PHILOSOPHY AND LOGIC	CORE

Level III Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH3301	ABSTRACT ALGEBRA I	CORE
2	MTH3302	ABSTRACT ALGEBRA II	CORE
3	MTH3303	NUMERICAL ANALYSIS I	OPTIONAL
4	MTH3304	COMPLEX ANALYSIS I	CORE
5	MTH3305	COMPLEX ANALYSIS II	CORE
6	MTH3306	METRIC SPACE TOPOLOGY	CORE
7	MTH3307	VECTOR AND TENSOR ANALYSIS	CORE
8	MTH3308	DIFFERENTIAL EQUATIONS I	CORE
9	MTH3310	REAL ANALYSIS II	CORE
10	MTH3311	INTRO. TO MATHEMATICAL MODELLING	CORE
11	MTH3312	OPTIMIZATION METHODS	OPTIONAL
12	MTH3314	DISCRETE MATHEMATICS	OPTIONAL
13	MTH3315	DIFFERENTIAL EQUATIONS II	CORE
14	MTH3316	INTRODUCTION TO DIFFERENTIAL GEOMETRY	OPTIONAL

Level IV Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH4301	DIFFERENTIAL EQUATIONS III	CORE
2	MTH4302	DIFFERENTIAL EQUATIONS IV	CORE
3	MTH4303	FUNCTIONAL ANALYSIS	CORE
4	MTH4304	GENERAL TOPOLOGY	CORE
5	MTH4205	RESEARCH METHODOLOGY	CORE
6	MTH4306	DYNAMICAL SYSTEMS	OPTIONAL
7	MTH4307	OPERATION RESEARCH I	OPTIONAL
8	MTH4308	OPERATION RESEARCH II	OPTIONAL
9	MTH4309	LINEAR SYSTEM THEORY	OPTIONAL
10	MTH4310	STOCHASTIC PROCESS	OPTIONAL
11	MTH4311	CLASSICAL THEORY OF NUMBERS	OPTIONAL
12	MTH4312	GROUP THEORY	OPTIONAL
13	MTH4313	LEBESGUE MEASURE & INTEGRATION	CORE
14	MTH4314	NUMERICAL ANALYSIS II	OPTIONAL
15	MTH4600	RESEARCH PROJECT	CORE
16	EEP3201	ENTREPRENEURSHIP AND INNOVATION	CORE
17	EEP4201	VENTURE CREATION AND GROWTH	CORE

Note: Students must register **a minimum of 6 credit units** from the optional courses.

The Syllabi

Level I Courses

MTH 1301: Elementary Mathematics I (Sets, Algebra and Trigonometry) (3 Credit Units)
Pre-requisite: None
Core-requisite: MTH 1303
Elementary set theory; subsets, union, intersection, complements; Venn diagram; Real numbers, integers, rational and irrational numbers, real sequences and series; theory of quadratic equations, polynomials, partial fractions; binomial theorem; circular measure; trigonometric functions of angles of any magnitude, trigonometric formulae.

MTH 1302: Elementary Mathematics II (Vectors and Geometry) (3 Credit Units)
Pre-requisite: None.
Core-requisite: MTH 1301
Geometric representation of vectors in 1, 2 and 3 dimensions; components, direction cosines, addition, scalar multiplication of vectors; linear independence; scalar and vector product of vectors. Two-dimensional co-ordinate geometry: Straight lines, circles, parabola, ellipse, hyperbola, tangents, normal. Introduction to Complex Numbers: Algebra of the complex numbers, the Argand diagram, De Moivre's theorem, the roots of unity, mathematical Induction.

MTH 1303: Elementary Mathematics III (Calculus I) (3 Credit Units)
Pre-requisite: None
Core-requisite: MTH 1301
Function of a real variable, graphs, limits and idea of continuity, the derivative as limit of rate of change. Techniques of differentiation, extrema, curve sketching; Integration as an inverse of differentiation; Methods of integration; definite integrals, application to areas, and volumes.

STA 1311: Probability I (3 Credit Units)
Pre-requisite: None. Core-requisite: MTH 1301
Generation of Statistical events from set-theory and combinatorial methods and elementary principles of probability. Types and distribution of random variables; the binomial, Poisson, hyper-geometric and normal distributions. Exceptions and moments of random variables; probability sampling from tables of random numbers, selected applications. Correlation and regression.

Level II Courses

MTH 2301: Mathematical Methods (Calculus II) (3 Credits Units)
Pre-requisite: MTH 1302, 1303
Real-valued functions of a real variable. Differentiation and Integration of vector functions with respect to scalar variables. Taylor series. Real-valued functions of two or three variables. Partial derivatives; Chain rule, extrema, Lagrange's multipliers. Increments, differentials and linear approximations, Line integrals, Multiple integrals, Infinite Sequences and Series. Tests of convergence.

MTH 2302: Elementary Differential Equations (Calculus III) (3 Credits Units)
Pre/Core-requisite: MTH 2301
First order ordinary differential equations with constant coefficients. General theory of n-th order linear equations. Laplace transform Solutions of initial value problems by Laplace Transform Method. Applications of Ordinary Differential Equations to physical, life and social sciences.

MTH 2203: Linear Algebra I (2 Credits Units)
Pre-requisite: MTH 1301, 1302
Core-requisite: MTH 2213, 2214
Matrices: Theory and Algebra; Systems of Linear Equations; Vector Spaces over the real field: Subspaces, Linear Combination, Linear Dependence/Independence, Basis and Dimension.

MTH 2204: Linear Algebra II (2 Credits Units)
Pre-requisite: MTH 2203
Core-requisite: MTH 2213, 2214,
Coordinates and Isomorphisms: Change of Basis, Rank and Row (Column) Rank of a Matrix; Inner Product Spaces: Scalar Products and Orthogonality; Linear Transformations and matrices: Kernel and Image (Range) of a Linear Transformation; Eigenvalues and Eigenvectors: Diagonalization and Similar/Symmetric) Matrices; Bilinear and Quadratic forms.

MTH 2306: Introduction to Numerical Analysis (3 Credits Units)
Pre-requisite: MTH 1301, 1303
Core-requisite: MTH 2310
Error in numerical computations; Solution of algebraic and transcendental equations, Algorithms and convergence; Iterative solutions of linear system of equations; Interpolation and approximation; Numerical differentiation and integration.

MTH 2307: Real Analysis I (3 Credits Units)
Pre-requisite: MTH 1301, 1303, 2214
Core-requisite: MTH 2301
Bounds of real numbers, convergence of sequence of numbers. Monotone sequences, the theorem of nested intervals. Cauchy sequences, tests for convergence of series. Absolute and conditional convergence of series and rearrangements. Completeness of reals and incompleteness of rationals. Continuity and differentiability of functions. Rolles's and mean value theorems for differentiable functions.

MTH 2208: Vector Analysis (3 Credits Units)
Pre-requisite: MTH 1302
Core-requisite: MTH 2203
Elementary Vector Algebra, Vector and Triple vector Products (more application solution of vector equation, plain curves and space curves. Geometrical equation of lines and planes. Linear independence of vectors; components of vectors, direction cosines; position vector and scaler products; senent frenent formulae; differential definition of gradients, divergent and simple multiplication).

MTH 2310: Introduction to Mathematical Computing
Pre-requisite: CSC 1201
Core-requisite: CSC 2320
Introduction to problem solving methods and algorithm development; designing, coding, debugging and documenting programs using a good programming language, such as (Visual) Fortran. Introduction to the use of mathematical aided tools for solving mathematics problems. Computer packages such as Maple and Mathematica for symbolic computing, MATLAB and SCILAB for numerical computing should be used.

STA 2211: Probability II (2 Credit Units)
Pre-requisite: MTH 1301, STA 1311.
Combinatorial analysis. Probability models for study of random phenomena in finite sample spaces.
Probability distributions of discrete and continuous random variables. Expectations and moment generating functions. Chebychev's inequality.

STA 2212: Probability III (2 Credit Units)
Pre-requisite: MTH 1301, STA 1311. Core-requisite: STA 2211.
Bivariate, marginal and conditional distributions and moments. Convolution of two distributions, the central limit theorem, and its uses.

MTH 2213: Elements of Set Theory (2 Credit Units)
Pre-requisite: MTH 1301
Core-requisite: MTH 2214
Basic set theory; type of sets, basic set laws, mapping, relations, equivalence and other relations. Cardinals numbers and Barnestein theorem, cartesian products, infinite sets and countability.

MTH 2214: Logic and Algebra (2 Credit Units)
Pre-requisite: MTH 1301
Core-requisite: MTH 2213
Propositional logic, quantification theory, binary logic, methods of proofs. Algebraic properties of numbers; integers, rationals, real and complex numbers. Divisibility and unique factorizations of integers.

Level III Courses

MTH 3301: Abstract Algebra I
Pre-requisite: MTH 2213, 2214
Binary operations. Algebraic structures; semigroups, rings, integral domains fields. Groups, subgroups, normal subgroups, homomorphisms, rings, ideals, quotient rings, integral domains, fields, fields of quotients, Euclidean domain, and divisibility in integral domains; Ring homomorphisms.

MTH 3302: Abstract Algebra II (3 Credit Units)
Pre-requisite: MTH 2213, 2214.
Core-requisite: MTH 3301.
The isomorphism theorems, permutation groups, Cayley's theorem, Group actions, Sylow's theorem, maximal ideals irreducible and prime elements, PID and UFD'S, polynomial rings over fields. Irreducibility; field extensions; degree of an extension; minimum polynomials; algebraic and transcendental extensions; straightedge-and-ruler constructions.

MTH 3303: Numerical Analysis I (3 Credit Units)
Pre-requisite: MTH 2203, 2204, 2302, 2306.
Numerical solution of initial value and boundary valued problems for ordinary differential equations; Polynomial and splines approximation; Orthogonal polynomials and Chebyshev polynomials; Matrix analysis; Eigenvalues and Eigenvector, vector and matrix norms, matrix diagonalization, orthogonal matrices, Singular value decomposition, QR decomposition, Least square approximations; Eigenvalue problem's power methods, inverse power methods.

MTH 3304: Complex Analysis I (3 Credit Units)
Pre-requisite: MTH 2301
Complex number arithmetic. Functions of a complex variable. Limits and continuity of a function of complex variable. The Cauchy-Riemann equations. Analytic functions; bilinear transformations; conformal mappings; contour integrals. Cauchy's theorem and its main consequences. Convergence of sequences and series of a complex variable. Power series; Taylor series.

MTH 3305: Complex Analysis II (3 Credit Units)
Pre-requisite: MTH 2301.
Core-requisite: MTH 3304.
Laurent expansion. Isolated singularities and residues. Residue theorem; calculus of residues and its applications to calculations of integrals and summation of series. Maximum Modulus Principle. Argument

principle; Rouche's theorem. The fundamental theorem of algebra. Analytic continuation. Multiple valued functions and Riemann surfaces.

MTH 3306: Metric Space Topology (3 Credit Units)
Pre-requisite: MTH 2213, 2307.
Core-requisite: MTH 3310.
Set, metrics and examples. Open spheres (or Balls). Open sets and neighborhoods. Closed sets. Interior, exterior, frontier, limit points and closure of a set. Dense subsets and separable spaces. Convergence in metric space. Homomorphisms. Continuity and compactness; connectedness.

MTH 3307: Vector and Tensor Analysis (3 Credit Units)
Pre-requisite: MTH 2301, 2203, 2208
Vector algebra. Vector, dot and cross products. Equation of curves and surfaces. Vector differentiation and applications. Gradients, divergence and curl. Vector integration line; surface and volume integrals. Green's Stoke's and divergence theorems. Tensor products of vector spaces. Tensor algebra Symmetry. Cartesian tensors.

MTH 3308: Differential Equations I (ODE) (3 Credit Units)
Pre-requisite: MTH 2302.
Series solutions of second order linear equations. Bessel, Legendre and hypergeometric equations and functions. Gamma Beta function. Sturm-Liouvelle problems. Orthogonal polynomials and functions. Fourier, Bessel and Fourier-Legendre Series. Fourier transformation and application to initial value problems.

MTH 3310: Real Analysis II (3 Credit Units)
Pre-requisite: MTH 2307.
Core-requisite: MTH 3306.
Riemann integral of functions, continuous monopositive functions. Functions of bounded variation. The Riemann Strieltjes integral. Pointwise and uniform convergence of sequences and series of functions. Effects on limits (sums) when the functions are continuous differentiable or Riemann integrable power series.

MTH 3311: Introduction to Mathematical Modelling (3 Credit Units)
Pre-requisite: MTH 2301, 2302, 2203
Core-requisite: MTH 3307, 3308.
Methodology of model building; identification and solution of problems, cause-effect diagrams, Equation types; Algebraic, differential (ordinary and partial) difference, integral and functional equations. Application of mathematical models to the physical, biological, social and behavioral sciences.

MTH 3312: Numerical Analysis II (3 Credits Units)
Pre-requisite: MTH 3303
Differential and difference equations problems; Discrete and continuous methods for solving IVP-ODE'S; Stability and truncation error analysis; Numerical solutions to partial differential equations; Finite difference and finite elements methods; Convergence analysis and error estimates.

MTH 3313: Introduction to Differential Geometry (3 Credits Units)
Pre-requisite: MTH 2301, 2208.
Core-requisite: MTH 3307.
Curves, curvature, torsion, the Serret-Frenet apparatus, the fundamental theorem of curves, rotation index, the four-vertex theorem, Fenchel's theorem, total curvature, the Fray-Milnor theorem. Surfaces (simple surfaces only). Co-ordinate patches, first and second fundamental forms of surfaces, the Weingarten map, Gauss theorems egregium, the Gauss-Bonnet formula, the Gauss-Bonnet theorem. Calculus on Euclidean

space; Tangent Vectors; Directional Derivatives; curves; 1-form differential forms and mappings; diheomorphisms.

MTH 3314: Discrete Mathematics
Core-requisite: MTH 3301.
Graphs; Directed and un-directed graphs, subgraphs, cycles, connectivity, Application (flow Charts) and state transition graphs; lattices and Boolean Algebra, Finite fields: Mini-polynomials. Irreducible polynomials, polynomial roots, Application (error-correcting codes, sequences generators).

MTH 3315: Differential Equations II (PDE) (3 Credits Units)
Pre-requisite: MTH 2302.
Core-requisite: MTH 3308.
Sturm-Liouville problem. Orthogonal polynomials and functions. Partial differential equations; first and second order equations, classification of second order linear equations, solution of boundary and eigenvalue problems of partial differential equations, Laplace's equations, Poisons equation. Green's function, Poisson's formula, the wave equation and diffusion equation.

Level IV Courses

MTH 4301: Differential Equations III (3 Credit Units)
Pre-requisite: MTH 3308.
Differential equations: existence and uniqueness theorems dependence of solution on initial data and parameters. Properties of solutions. Sturm separations and comparison theorems. Linear and non-linear systems of equations. Integral equations: classification, volterra and fredlhom types Neumann series. Fredholm alternative for degenerate Hilbert- Schmidt kernels. Reduction of ordinary differential equations to integral equations. Applications of Fourier transform and Laplace transform to linear integral equations.

MTH 4301: Differential Equations III (Theory of ODE)
Pre-requisite: MTH 3308.
Core-requisite: MTH 4302.
Differential equations: existence and uniqueness theorems dependence of solution on initial data and parameters. Properties of solutions. Sturm comparison and Sonin-Polya theorems. Linear and non-linear systems. Floguet's theory and stability theory. Integral equations: classification, volterra and fredlhom types Neumann series. Fredholm alternative for degenerate Hilbert-Schmidt kernels. Reduction of ordinary differential equations to integral equations. Symmetric kernels, Eigen function expansion with application.

MTH 4302: Differential Equations IV (3 Credit Units)
Pre-requisite: MTH 3309. Core-requisite: MTH 4301.
Theory and Solutions of General linear, almost-linear and quasi-linear first-order Partial Differential Equations (PDEs) with two or more independent variables: classification, canonical forms, characteristics; Theory and Solutions of General linear second-order PDEs with two independent variables: classification, canonical forms, characteristics; Methods of Fourier Transformation, Laplace Transformation and Green's functions for
the Initial Boundary Value Problems (IBVPs) of Hyperbolic, Parabolic and Elliptic equations.

MTH 4303: Functional Analysis (3 Credit Units)
Pre-requisite: MTH 2307, 3306.
Normed spaces and Banach spaces, Hilbert spaces, spaces of continuous functions, Stone-Weierstrass approximation theorem, differential calculus for Banach spaces, differential operators, implicit function theorem, rank theorem, differential equations, Theorem of Frobenius, elementary spectral theory.

MTH 4304: General Topology (3 Credit Units)
Pre-requisite: MTH 3306, 2307.
Topological spaces, defining open and closed sets; neighborhoods. Coarse and finer topologies. Basis and sub-basis. Separation axioms. Compactness, local compactness. Connectedness. Construction of new topological spaces from given ones, Sub-spaces, product spaces quotient spaces. Continuous functions; Point-wise and uniform convergence.

MTH 4205: Research Methodology (2 Credit Units)
Pre-requisite: CSC 2320.
Definition of Research, Basic concept of Mathematical research; Misconception about research. Research Proposal; Basic component of research to proposal; Introduction to scientific reading and writing, major parts of project writing; Article review and Research Talk. (Presentation).

Introduction to Latex; Structure of Latex document and commands; Characters in Latex; text, sectioning, titles footnotes and marginal notes; Environments, poetry, lists and tabular data; Cross references and simple bibliographies; Defining new commands and changing fonts; simple diagrams in LaTeX; Mathematical aspects; inserting figures, graphs, pictures; Power point presentation using latex.

MTH 4306: Dynamical Systems (3 Credit Units)
Pre-requisite: MTH 2302.
Deterministic Linear and Non-linear Dynamical Systems: Continuous and Discrete; Stability Analyses and Theorems; Bifurcation Theory; Chaos.

MTH 4307: Operations Research I (3 Credit Units)
Modelling, linear programming, integer programming, non-linear programming, quadratic programming, Kuhn-Tucker system, deterministic dynamic programming, network analysis.

MTH 4308: Operations Research II (3 Credit Units)
Core-requisite: MTH 4307.
Probabilistic methods; theory of games, decision theory, stochastic dynamic programming finite Markov chains, Markovian birth death process, queuing system.

MTH 4309: Linear Systems Theory (3 Credit Units)
Classical Control Methods; Modern Control Methods; Systems Representations; Stability Analyses; Controllability and Observability, Reachability, Stabilizability and Detectability; Applications: In Science, Engineering, Economics, etc,.

MTH 4310: Stochastic Processes (3 Credit Units)
Simple random walk models, Markov chains recurrent events, discrete branching processes, Markov process in continuous time, homogenous birth and death processes, some non-homogenous process, multi-dimensional processes, queuing processes.

MTH 4311: Classical Theory of Numbers (3 Credit Units)
Pre-requisite: MTH 2214.
Congruencies and residues, Diophantine problems, Fermat's theorem, congruence to composite moduli, continued fractions and real numbers, arithmetical functions, the zeta function, partitions, and Waring's problems.

MTH 4312: Group Theory (3 Credit Units)
Pre-requisite: MTH 3301.
Homomorphism theorems, Sylow's theorems, direct product of Groups, Introduction to finite Abelian Groups, nilpotent and solvable groups, representation theory of groups, characters.

MTH 4313: Lebesgue Measure and Integration (3 Credit Units)
Pre-requisite: MTH 3310.
Core-requisite: MTH 4303.
Outer measure, measurable sets and Lebesgue measure. Examples of a non-measurable set. Measurable functions. The Lebesgue integral. Functions of bounded variation. Lp spaces. Holder and Minikowski inequalities. Convergence and completeness. Bounded linear functional on Lp spaces.

MTH 4314: Optimization Methods (3 Credit Units)
Pre-requisite: MTH 2203, 2305, 2310.
Core-requisite: MTH 3303, 3307.
Simple variable optimization; Feasibility and optimality conditions for unconstrained optimization; Convexity; Constrained optimality conditions and Lagrange multipliers;
Gradient and descent methods; search techniques; Conjugate direction methods; qausi-Newton's methods.

MTH 4600: Research Project
Project is a six credits course unit. It is offered by all final year students. Project gives students the opportunity to study in depth a topic in Mathematics that particularly interest them. This may include reading Mathematical works, using advenced methods tom solve a given problem, explore new topics, etc.

Career for Mathematics Graduates

A degree in Mathematics does not train students for a specific job. Rather it gives them a range of skills which gives them the opportunity to enter a wide range of careers. It is therefore a versatile qualification. Employers tend to be keen on Mathematics students because they are regarded as logical, numerate and committed. All of these are highly sought-after skills in the jobs market. In short a mathematics graduate can fit into everything from computer programming to accountancy, and biomedical research to business management.

Majority of all jobs requiring graduates are open to students of any discipline. Of course, mathematicians are eligible for these jobs. In addition, there are careers for which a degree in mathematics is either essential or a strong advantage. These fall into a number of general areas:

1. **Computing**
   Mathematicians are in high demand from software companies. If you can prove you can program, you are likely to be in as strong a position as a computer science or IT graduate when applying for roles with these organisations.

2. **Financial work**
   In recent years, many mathematics graduates have taken up a career in finance.
   a. **Accountancy**
      Firms of chartered accountants - the main employers - do not normally specify degree disciplines of entrants. They are particularly keen though to recruit mathematics graduates, because of their numeracy skills and logical thought, because they are normally very successful in the professional examinations. *So to become an accountant, you do not need to take a degree in accountancy.* A mathematics degree allows many openings in accountancy, should you wish to follow them after graduation, as well as all the other opportunities.
   b. **Actuarial work**
      This has long been a popular field for mathematics graduates. The work involves the application of probability and statistics to financial affairs such as life assurance, pensions and social security.
   c. **Other openings in finance**
      There are some opportunities in banking, particularly with the head offices of major banks, or

with merchant banks. Mathematicians have frequently been successful candidates for the Tax Inspectorate.

3. **Postgraduate Study:** A sizeable proportion of graduates choose to continue for higher qualifications such as MSc and PhD before entering the job market. A good honours degree is normally required for entry to such courses. The course provides training in the fundamental processes of research and so is particularly useful for those aiming to work in industrial research and academic environments.
4. **Scientific research, design and development:** Large companies and government research establishments are actively involved in research and development. They employ mathematicians and statisticians, usually along with other scientists in interdisciplinary research teams. The problems being solved require a flexible approach and speedy solutions. Projects of this type require high mathematical skill, ability to analyse complex problems in order to formulate them mathematically and to use computers in their solution (a skill developed during mathematics degree courses), willingness to work to deadlines, and ability to communicate findings to others.
5. **Aircraft Industry:** In the aircraft industry, there is work on aerodynamical design, providing theoretical results which predict or complement those from (for example) experimental wind tunnels.
6. **Pollution Control**
   In pollution control, mathematicians would develop ``models'' (Mathematical equations) predicting dispersal rates of chimney effluents under different meteorological conditions.

7. **Statistical work:** Statistical work is carried out in many organisations - the Civil Service (economics and agriculture in particular), research establishments, large industrial firms and market research agencies. The work involves analyses and interpretations of data, collection of information and analysing it using statistical methods and computer programs such as SPSS.
8. **Telecommunications:** In telecommunications, Mathematicians may work on improved communications links, computer-recognition of handwriting and speech patterns, and distortion in digital transmission.
9. **Biometrists**: A Biometrists work as statisticians in the pharmaceutical industry, as researchers in medical schools and hospitals and in agricultural institutes.
10. **Management services:** The problems of coping with rapid changes in technology and market conditions in large and complex organisations make it essential for managers to call on specialist services. Management services are often mathematical, involving an area of Mathematics known as *Operational Research*. It might involve designing a more efficient transportation programme for deliveries to a supermarket chain, warehouses, or a stock control pattern for a car franchise holder.
11. **Forecasting:** Maths graduates can also put their skills to good use in planning and forecasting of various sorts, such as meteorology, logistics or transport planning, as well as careers such as quantity surveying and IT.
12. **Epidemiologist:** Developing and using mathematical models to reduce public health risks by studying the pattern of spread of diseases or health risks in populations.

Finally, there are many people with Mathematics training working in NNPC, plant biology, finance, energy, defence, computer game design etc. In short **the possibilities for mathematicians are endless.**

PART B

B.Sc. Statistics

Philosophy of the Programme

The philosophy of the proposed programme is based on the need to:

1. Achieve the national development goals;
2. Produce graduates with high academic standard, sufficient skills for self-reliance and immediate value to the nation and world at large.

Aim

The overall aim is to produce world-class Statisticians that will help in realization of national needs and aspirations vis- a-vis educational, industrial and technological developments.

Objectives of the Programme

The objectives of Bachelor degree in Statistics are to:

- Instill in students a sense of enthusiasm for Statistics, an appreciation of its application in different areas such as industrial planning, economic planning, environmental and social planning. And to involve them in an intellectually stimulating and satisfying experience of learning and studying;
- Provide students a broad and balanced foundation in knowledge of Statistics and practical skills ;
- Develop in students the ability to apply their Statistics knowledge and skills to the solution of theoretical and practical problems in statistics;
- Develop in students, through an education in Statistics, a range of transferable skills of values in Statistics related and non-Statistics related employment;
- provide students with knowledge and skills- base from which they can proceed to further studies in specialized areas of Statistics or multi-disciplinary areas involving statistics.

Admission Requirements

Level I

The entry requirements shall be at least credit level passes in five subjects including, English Language, Mathematics, Physics and any two of the following: Chemistry, Biology/Agric. Science and Geography at the Senior Secondary School Certificate or its equivalent. Any other qualification deemed appropriate by the university.

Level II

Candidates with A level pass in any of the following qualifications are eligible for admission:

1) Diploma in Mathematics Education.
2) Diploma in Statistics.
3) HND in Statistics at Lower Credit level.
4) ND in Statistics at Upper Credit level.
5) IJMB relevant subjects.
6) NCE relevant subjects.
7) Any other relevant qualification deemed appropriate by the university.

Regulations:

The concurrent General Regulations of the University and the Regulations of the Faculty of Physical Science apply. In addition to such regulations, the following regulations also apply for the B.Sc. Statistics Programme:

i. In addition to the compulsory Statistics courses, every Level I Statistics student takes Mathematics and one of Physics, Chemistry or Biology among his/her two subsidiary courses.

ii. Every Level I student is to take the Level I *General Studies* courses: **GSP 1201: Use of English and GSP 1202: Use of Library, Study Skills and ICT** offered by the School of General and Entrepreneurship Studies, while Level II students are to take the Level II GSE courses open to science students: **GSP 2204: Foundation of Nigerian Culture, Government and Economy, GSP 2205: Philosophy and Logic and GSP 2206: Peace and Conflict Resolution**. In addition, all Direct Entry students should register **GSP 2201: Use of English and GSP 1202: Use of Library, Study Skills and ICT.** Level III students are to take: **EEP3201: Entrepreneurship and Innovation,** while Level IV students are to register **EEP 4201: Venture Creation and Growth.**

iii. Unless the contrary is stated, all Statistics courses are ***core*** courses. All GSP courses are also ***core*** courses.

iv. The *minimum* duration of the programme is **four (4) academic sessions for UTME students (three (3) for DE students)** and the *maximum* is **six (6) academic sessions for UTME students (five (5) for DE students)**. Where a student fails to satisfy the minimum graduation requirement after exhausting the maximum time, he/she will be withdrawn from the programme.

v. To qualify for the award of BSc degree in Statistics, a **UTME** student must pass all core courses and obtain at least ***32, 35, 32 and 39 credits*** each from Level I, II, III and IV courses respectively (and **35, 32 and 39 credits** each from Level II, III and IV courses respectively for **DE** students). This is in addition to the normal University Requirement of obtaining a minimum of 30 credits per level.

The Current Summary of the Minimum Requirement for Graduation is as follows:

LEVEL/COURSES	MTH/STA Credits	CSC Credits	GSP Credits	Other Credits	Total
LEVEL I	20	02	04	06	32
LEVEL II	24	05	06	-	35
LEVEL III	32	-	-	-	32
LEVEL IV	35	-	04	-	39
TOTAL	111	07	14	06	138

List of Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH1301	ELEMENTARY MATHEMATICS I	CORE
2	MTH1302	ELEMENTARY MATHEMATICS II	CORE
3	MTH1303	ELEMENTARY MATHEMATICS III	CORE
4	STA1311	PROBABILITY I	CORE
5	STA1412	DESCRIPTIVE STATISTICS	CORE
6	STA1221	STATISTICAL INFERENCE I	CORE
7	STA1231	STATISTICAL COMPUTING	CORE
8	PHY1210	MECHANICS	CORE
9	PHY1220	ELECTRICITY AND MAGNETISM	CORE
10	PHY1230	BEHAVIOUR OF MATTER	CORE
11	PHY1170	PHYSICS PRACTICAL I	CORE
12	PHY1180	PHYSICS PRACTICAL II	CORE
13	CSC1201	INTRODUCTION TO COMPUTER SCIENCE	CORE
14	GSP1201	USE OF ENGLISH	CORE
15	GSP1202	STUDY SKILLS & ICT	CORE

Level II Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	MTH2301	MATHEMATICAL METHODS	CORE
2	MTH2302	ELEMENTARY DIFFERENTIAL EQUATIONS	CORE
3	MTH2203	LINEAR ALGEBRA I	CORE
4	MTH2306	INTRODUCTION TO NUMERICAL ANALYSIS	CORE
5	MTH2307	REAL ANALYSIS I	CORE
6	STA2221	STATISTICAL INFERENCE II	CORE
7	STA2231	STATISTICAL COMPUTING II	CORE
8	STA2241	INTRODUCTION SOCIAL & ECONOMIC STATISTICS	CORE
10	STA2211	PROBABILITY II	CORE
11	STA2212	PROBABILITY III	CORE
12	CSC2253	DATA STRUCTURES AND ALGORITHMS	CORE
13	CSC2320	PROGRAMMING IN C++	CORE
14	GSP2201	FUNDATION OF NIG. CULTURE, ECONOMY & GOVT.	CORE
15	GSP2204	PEACE AND CONFLICTS STUDY	CORE
16	GSP2205	PHILOSOPHY AND LOGIC	CORE

Level III Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	STA3312	DISTRIBUTION THEORY I	CORE
2	STA3321	STATISTICAL INFERENCE III	CORE
3	STA3222	REGRESSION AND ANALYSIS OF VARIANCE	CORE
4	STA3323	DESIGN & ANALYSIS OF EXPERIMENT I	CORE
5	STA3324	SURVEY METHODS & SAMPLING THEORY	CORE
6	STA3231	STATISTICAL COMPUTING III	OPTIONAL
7	STA3232	LAB./FIELD-WORK FOR EXPERIMENTAL DESIGN	CORE
8	STA3342	DEMOGRAPHY I	CORE
9	STA3343	OPERATION RESEARCH I	CORE
10	STA3351	BIOMETRIC METHODS I	CORE
11	STA3699	SIWES	CORE

Level IV Courses

S/N	COURSE CODE	COURSE TITLE	STATUS
1	STA4311	PROBABILITY IV	CORE
2	STA4312	DISTRIBUTION THEORY	OPTIONAL
3	STA4313	STATISTICAL INFERENCE IV	OPTIONAL
4	STA4314	STOCHASTIC PROCESS	CORE
5	STA4315	REGRESSION ANALYSIS	CORE
6	STA4316	PROBABILITY V	OPTIONAL
7	STA4321	TIME SERIES ANALYSIS	CORE
8	STA4322	STATISTICAL BACKGROUND & DECISION THEORY	CORE
10	STA4323	DESIGN AND ANALYSIS OF EXPERIMENT II	CORE
11	STA4324	SAMPLING TECHNIQUES	CORE
12	STA4341	MULTIVARIATE DATA ANALYSIS	CORE
13	STA4342	NON-PARAMETRIC METHODS	CORE
14	STA4344	ECONOMETRIC METHODS	OPTIONAL
15	STA4351	BIOMETRIC METHODS II	OPTIONAL
16	STA4352	PYSCHOMETRIC METHODS	OPTIONAL
17	STA4353	BAYESIAN INFERENCE & DECISION THEORY	OPTIONAL
18	STA4354	ENVIROMENTAL STATISTICS	OPTIONAL
19	STA4355	EDUCATIONAL STATISTICS	OPTIONAL
20	STA4356	HEALTH STATISTICS	OPTIONAL
21	STA4357	MEDICAL STATISTICS	OPTIONAL
22	STA4358	ENERGY STATISTICS	OPTIONAL
23	STA4359	DEMOGRAPHY II	OPTIONAL
24	STA4361	ACTURIAL SCIENCE	OPTIONAL
25	STA4600	RESEARCH PROJECT	CORE
26	MTH4313	LEBESGUE MEASURE AND INTEGRATION	OPTIONAL
27	EEP3201	ENTREPRENEURSHIP AND INNOVATION	CORE
28	EEP4201	VENTURE CREATION AND GROWTH	CORE
29	MTH4205	RESEARCH METHODOLOGY	CORE

The Syllabi

STA 1412: Descriptive Statistics
Pre-requisite: None
Core-requisite: STA1311
Statistical data: types, sources and methods of collection. Presentation of data: tables chart and graphs. Errors and Approximations. Frequency and cumulative distributions, Measures of location, partition, dispersion, skewness and Kurtosis. Rates, ratios and index numbers. Basic probability concepts; binomial, normal, Student's t and chi-square distributions. Hypothesis testing and confidence intervals for one and two means and proportions**.** Regression.

STA 1311: Probability I
Pre-requisite: None
Core-requisite: MTH 1301, MTH 1303
Generation of Statistical events from set-theory and combinatorial methods and elementary principles of probability. Types and distribution of random variables; the binomial, Poisson, hyper-geometric and normal distributions. Exceptions and moments of random variables; probability sampling from tables of random numbers, selected applications. Correlation and regression.

STA 1221: Statistical Inference I
Pre-requisite: None
Core-requisite: STA1412
Population and samples. Random sampling distributions, estimation (Point and interval) and Tests of hypotheses concerning population mean and proportion (one and two large sample cases). Regression and correlation. Elementary time series analysis.

STA 1231: Statistical Computing I
Introduction to computer: structure, involving, type, uses and applications. Computations (using computers and calculators), involving topics in STA1311 and 1221. Organizations of computations to access, transform, explore, analyse data and produce results. Concepts and vocabulary of statistical computing.

STA 2211: Probability II
Pre-requisite: MTH 1301, STA 1311
Combinatorial analysis. Probability models for study of random phenomena in finite sample spaces. Probability distributions of discrete and continuous random variables. Expectations and moment generating functions. Chebychev's inequality.

STA 2212: Probability III
Pre-requisite: MTH 1301, STA 1311
Core-requisite: STA 2211
Bivariate, marginal and conditional distributions and moments. Convolution of two distributions, the central limit theorem, and its uses. Sampling with and without replacement. Inclusion-exclusion theorem. Allocation and matching problems. Probability generating function. Bernoulli trials, binomial, Poisson, Hypergeometric negative binomial and multinomial distribution, Poisson process.

STA 2241: Introduction to Social and Economic Statistics
Pre-requisite: STA1412, 1311
Statistics systems. Nature, types, sources, methods of collection and problem of official statistics. Index numbers, theory, construction and problems. Descriptive statistics ; Basic principles of probability; discrete and continuous random variables (binomial, normal, t, chi-square, Poisson, other univariate distributions); joint distributions; sampling distributions; central limit theorem; properties of estimators; linear combinations of random variables; testing and estimation; maximum likelihood principle, basics of hypotheses testing. Socio-economic indicators: nature, types, uses and computation. Nature, sources, contents and problems of official statistics in selected sectors.

STA 2221: Statistical Inference II
Pre-requisite: STA1221
Sampling and sampling distribution. Point and interval estimation. Principles of hypotheses testing. Tests of hypotheses concerning population means, proportions and variances of large and small samples, large and small sample cases. Goodness –fit tests. Analysis of variance.

STA 2231: Statistical Computing II
Pre-requisite: STA1231
Uses of computers in statistical computing. Introduction to various statistical packages. Use of statistical packages in solving problems in statistics.

STA 2212: Probability III
Joint marginal and conditional distributions and moments. Limiting distributions. Discrete and continuous random variables, standard distributions, moments and moment-generating functions, laws of large numbers and the central limit theorem.

STA 3312: Distribution Theory
Pre-requisite: STA2211, 2212
Distribution and frequency functions. Documents, cumulants and their generating functions. Some special univariate distribution. Laws of large numbers. Central limit theorem. Distribution: Stochastic independence. Bivariate moment generating functions of random variable. Bivariate distribution: Stochastic independence. Bivariate moment generating functions. Bivariate normal distributions. Distribution associated with the normal, X^2, t and F distribution.

STA 3321: Statistical Inference III
Pre-requisite: STA2221
Criteria of estimation consistency unbiasedness, efficiency, minimum variance and sufficiency, Methods of estimation; maximun likelihood, least squares and method of moments. Confidence intervals. Simple and composite hypotheses. Likelihood ratio test. Inferences about means and variance.

STA 3322: Regression and Analysis of Variance I
Total, partial and multiple correlation ratio. Simple and multiple linear regression, variable selection techniques, stepwise regression, analysis of covariance, influence measures, polynomial regression. Orthogonal polynomials. Simple non-linear way classification.

STA 3323: Design and Analysis of Experiments I
Two-way classification. Three-way classification. Balanced and unbalanced two factor nested (hierarchical) classifications. Multiple comparisons component or variance estimates and tests. Computing packages. Basic principles of experimentation, Randomisation, replication and blocking. Local control. Basic designs: completely randomised, randomised blocks, Latin squares, Balanced incomplete blocks, split plot. Missing values. Relative efficiency. Estimation and tests of variance components. Multiple comparisons. Departures from underlying assumptions. Applications to agriculture, biology and industry.

STA 3324: Survey Methods and Sampling Theory
Survey design, planning and programming. Methods of data collection. Design of form and questionnaires. Data processing, analysis and interpretation. Errors and biases, Probabilities and non-probability sampling: selection procedure. Estimation of mean, totals, ratios and proportions in simple random, systematic, stratified cluster and two-stage sampling. Probability proportion-to-size sampling. Nigeria's experience in sampling survey.

STA 3231: Statistical Computing III
Pre-requisite: STA2231
Use of advanced statistical computing packages. Analysis of statistical and numerical algorithms. Introduction to Monte Carlo Methods.

STA 3232: Laboratory/Field work on Experimental Design I
Computations based on field and laboratory appraisal of some of the techniques and problems on experimental design.

STA 3342: Demography I
Types and sources of demographic data. Methods of collection of Population censuses, sample surveys and vital registration. Evaluation of the quality of demographic data. Measures of fertility, mortality, nuptiality and migration. Standardization and Decomposition. Life tables: construction and application. Framework for developing demographic information systems.

STA 3343: Operations Research I
Nature and scope of operations research. Linear programming and graphical, simplex (including big M and two-phase) methods. Sensitivity analysis. Duality theory. Transportation and assignment problems. Network analysis: CPM and PERT. Inventory theory and applications. Sequencing and scheduling.

STA 3351: Biometric Methods I
Introduction to population genetics. Statistical methods in Biology. Sampling and estimating biological populations. Design and analysis of biological experiments. Design and analysis of clinical trials Bioassays: types and nature. Direct and indirect assays: Parallel line assays, slope ratio assays.

STA 3699: Industrial Attachment (24 Weeks)
Students should be attached to some relevant organizations for additional 24 Weeks at the 300 Level preferably during the long vacation for industrial experience. Students to be assessed based on seminar presentation, their reports and assessment by supervisors.

STA 4311: Probability IV
Pre-requisite: MTH2307
Probability spaces measures and distribution. Distribution of random variables as measurable functions. Product spaces; Products of measurable spaces, product probabilities. Independence and expectation of random variable. Convergence of random variables: Weak convergence almost everywhere, convergence in path mean. Central limit theorem, laws of large numbers. Characteristic function and Inversion formula.

STA 4312: Distribution Theory II
Distribution of quadratic forms. Fisher – Cochran theorem, Multivariate normal distributions. Distribution of order Statistics from continuous populations. Characteristic and moment generating functions. Uniqueness and inversion theorems. Limit theorems.

STA 4313: Statistical Inference IV
General linear hypothesis and analysis of linear models. Further treatment of estimation and hypothesis testing extension of uni-parameter results to multi-parameter situation. Basic ideas of distribution-free test. Bayesian Inference.

STA 4314: Stochastic Processes
Generating functions: tail probabilities and convolutions. Recurrent events. Random walk (unrestricted and restricted). Gamblers ruin problem. Markov processes in discrete and continuous time. Poisson, branching, birth and death processes. Queuing processes: M/M/I, M/M/s, M/a/I queues and their waiting time distributions.

STA 4315: Regression and Analysis of Variance II
Multicollinearity, autocorrelation and heteroscedasticity. Residual analysis. Transformations. Comparison of intercepts and slopes. Simple non – linear regression. Logistic regression. Use of dummy variables. Departures from ANOVA assumptions. Transformations. Missing values. Analysis of covariance in one-way, two-way, three-way and nested (hierarchical) classifications. Analysis of covariance with two concomitant variables.

STA 4321: Time Series Analysis
Estimation and isolation of components of time series. Time series relationships, cyclical behaviour, periodicity, spectral analysis, coherence, filtering, regression. Non-stationary and stationary processes: theoretical moments, auto – correlation and partial auto-correlation; Sample moments: auto-correlations; partial auto-correlations; univariate Time Series model: identification and estimation - Auto-regressive (AR), Moving Average (MA) and Auto regressive Moving (ARMA). Diagnostic checking of models, linear prediction and forecasting analysis.

STA 4322: Statistical Background and Decision Theory
Empirical sources of knowledge-hypothesis, observation and experiment. Deductive sources of knowledge and scientific attitude. The concept of causation. Probability, a brief historical treatment to show conflicting definitions. Bayesian statistics and the notion in inverse probability. The place of statistical methods in

science. Principles of decision making. Utility functions and their properties. Role of uncertainty. Bayes Strategies. Problems of prior and posterior distributions: value of prior information Minimax strategies. Statistical inference. Theory of games.

STA 4323: Design and Analysis of Experiments II
Further split plot design and nested designs, unbalanced designs, incomplete block designs, 2'' factorial designs, Yates – Algorithm confounding and fractional replication. Diallel cross Analysis. Introduction to response surface methodology.

STA 4324: Sampling Techniques
Ratio, regression and difference estimation procedures. Double sampling. Interpreting scheme. Multiphase and multistage sampling, cluster sampling with unequal sizes; problem of optimal allocation with more than one item. Further stratified sampling.

STA 4600: Research Project
Research finding into selected topics in statistics. Each student will be expected to carry out independent research into an assigned or selected topic and produce a report. Student should be subjected to oral examination on the project.

STA 4341: Multivariate Data Analysis
Multivariate normal and related distributions. Inference about mean vectors. Mahalanobis distance, sampling distributions of the mean vector and covariance matrix; Hotelling's T^2; simultaneous inference Multivariate analysis of variance. Tests of independence and homogeneity. Discrimination and classification. Principal components and factor analysis. Canonical correlation analysis. Cluster analysis.

STA 4342: Non-Parametric Methods
Order statistics and their distributions. Tests based on runs. Tests of Goodness of Fit. One sample and two sample linear ranks tests for location and scale. Tests for independent samples. Measure of association for bivariate samples and multiple classifications.

STA 4343: Operations Research II
Integer programme problem: formulations and solution methods. Non-linear programming: search methods Newton-Raphson method, Frit-John optimality conditions and Lagrangian multipliers. Network analysis. Path methods including Bellman's equations, cyclic and network with positive paths. Dynamic programming: routine of problems, resource allocation and equipment replacement.

STA 4344: Econometric Methods
Nature of econometric. Econometric models: nature, types and characteristics. Econometric problems related to single equation models. Construction estimation and tests. Models involving lagged variables. Simultaneous equation systems; structural form, reduced form, identification, estimation and test. Application of econometric models: demand analysis, production functions, consumption and investment function.

STA 4351: Biometric Methods II
Stability models, simultaneous selections models. Path analysis. Discriminant analysis. Parallel line and slope ratio assays in completely randomized block and incomplete block designs. Logistic curve and logic transformations in relation to bio-assays.

STA 4352: Psychometric Methods
The foundations of mental measurement theory: Measurement in psychology and education. The construction of true and error scores. The classical test theory model: fixed length, variables length: Some estimates of parameters of the classical model. Other weak type – score models: parallel measurements.

Types of reliability co-efficient and their estimation. Some test theory for equivalent measurements. Item, sampling in test theory and in research design.

STA 4353: Bayesian Inference and Decision Theory
Subjective probability, Bayes Theorem, conjugate priors, non-informative priors, estimation, testing, prediction, empirical Bayes methods, properties of Bayesian procedures, comparisons with classical procedures, approximation techniques, Gibbs sampling, hierarchical Bayesian analysis. Principles of decision-making. Roles of uncertainty, utility functions and their properties. Theory of games.

STA 4354: Environmental Statistics
Scope, nature and sources of environmental statistics. Assessment of environmental quality and measurement of air and water pollution. Sampling methods in natural and applied sciences. Environmental Impact Assessment. Requirement for environmental reporting system. Characteristics and uses of the United Nations frame work for the development of environmental statistics. Capacity development for environmental reporting system.

STA 4355: Educational Statistics
Scope, nature and uses of educational statistics. Sources and methods of collection of educational statistics. Educational indicators, Design of education information systems, Education flow models and performance evaluation, Multivariate methods in educational analysis, operations research in educational management.

STA 4356: Health Statistics
Scope and types of health statistics. Classification of disease; injuries and causes of death. Sources and methods of collecting health statistics; census, sample surveys, vital registration and administrative statistics. Health indicators: types, uses and problems. Health systems. Health planning and financing. Health information systems. Operations research in the health services.

STA 4357: Medical Statistics
Scope and nature of medical statistics. Epidemiology methods: relative risks and odds ratios, adjustment of data with and without use of multivariate models, cohort studies (life tables). Competing risks, survival analysis. Sequential methods in clinical trials. Stochastic models epidemiology.

STA 4358: Energy Statistics
Energy sources: renewable and non-renewable, Nature, scope and uses of energy statistics. Concepts, definitions, and units of measurements in use in energy statistics. Energy production and consumption surveys. Data requirements and the procedure for developing an energy database. Constructing an energy balance sheet with Nigeria as a case study. Modelling energy supply and demand.

STA 4359: Demography II
Estimating fertility, mortality and nuptiality from limited and defective data. Stationary, stable and quasi-stable population models: theory and applications. Multiple decrement life tables. Population projections: mathematical models, component methods and matrix analysis. Path analysis and multiple classification analysis.

STA 4361: Actuarial Statistics
The time value of money; compound interest and discounting; present values and accumulated values of streams of payments. Decremental rates and other indices; Annuities and sinking funds; solving equations of value; Investment and Appraisal Techniques; Analysis of experiments data and derivation of exposed to risk formulae. Graduation methods (and their applications to curve fitting). Construction of mortality, sickness, multiple decrements and similar tables with applications to life insurance. National social security and pension schemes.

Examinations and Assessments

All courses are examined at the end of the semester and examinations are set by the course lecturers. All question papers are moderated internally and then externally. Examinations are conducted in conjunction with the faculty examinations office. Students are assessed by combination of class test, assignments or its equivalent and end of semester examinations. Semester *grade point average* (GPA) and *cumulative grade point* averages (CGPA) appear on each student semester/session report form and also the final academic record (transcript). Below we illustrates how the GPA and CGPA are calculated.

Grading system

The University adopts the following grading system:

Range of Marks	Lettered Grade	Grade
0-39	F	0
40-44	E	1
45-49	D	2
50-59	C	3
60-69	B	4
70-100	A	5

Table3.3:Grading system

To calculate a student's GPA, the score for each course is first converted to grade (see table 3.3). The credit value for each course is then multiplied by the corresponding grade point to get the weighted grade point (WGP) for that course.

The sum of the WGP for all the courses is then divided by the sum of the Credits for all courses to get the GPA. Table 3.4 gives an illustrative example for Garba a 100 Level student.

STUDENT NAME Garba

COURSE CODE	CREDIT VALUE	SCORE (%)	GRADE	GRADE POINT	WEIGTED GRADE POINT
MTH 1301	3	90	A	5	15
STA 1311	3	72	A	5	15
CSC 1201	2	48	D	2	4
CHM 1201	2	43	E	1	2
BIO 1201	2	51	C	3	6
GSP 1401	4	40	E	1	4
PHY 1101	1	31	F	0	0
TOTAL	**17**				**46**

GPA = 46/17=2.71

Assuming that in the second semester Garba obtained the results tabulated as demonstrated in the table below

STUDENT NAME: Garba

COURSE CODE	CREDIT VALUE	SCORE (%)	GRADE	GRADE POINT	WEIGTED GRADE POINT
MTH 1304	3	63	B	4	12
MTH 1302	3	78	A	5	15
CHM 1202	2	45	D	2	4
CHM 1204	2	23	F	0	0
BIO 1204	2	57	C	3	6
PHY 1202	2	64	B	4	8
TOTAL	**14**				**45**

GPA = 45/14 = 3.21

CGPA=(46+45)/(17+14)=2.94

Generally, CGPA is calculated as $\text{CGPA}=\frac{\text{sum of grade points for all semesters}}{\text{sum of credit valuess for all semesters}}$

Academic Probation

Any student whose CGPA is below 1.00 in a given session, is said to be in academic probation. He/She will be given one more session to make it up above 1.00 otherwise the student is to be withdrawn.

Degree classification

Degrees are classified based on the CGPA at the point of graduation, as describe in the table below:

CGPA	DEGREE CLASS
4.5-5.0	First Class
3.5-4.49	Second Class Upper
2.40-3.49	Second Class Lower
1.50-2.39	Third Class
1.00 -1.49	Pass
Below 1.00	Fail

Appendices

Appendix A1: List of Staff (Last Update: October 2019)

A: Teaching Staff

S/N	Name	Rank	Qualification	Research Area
1.	Prof. M. Y. Bello	Professor	BSc, MSc, PhD	Algebra
2.	Prof. B. M. Yakasai	Professor	BSc, MSc, PhD	Operation Research
3.	Prof. A. H. Abubakar	Professor	BSc, MSc, PhD	Nonlinear Analysis (CHAOS)
4.	Prof. Bashir Ali	Professor	BSc, MSc, PhD	Nonlinear Operator Theory
5.	Prof. S. I. Bala	Professor	BSc, MSc, PhD	Fluid Dynamics
6.	Dr. S. M. Umar	Assoc. Prof.	BSc, MSc, PhD	Multivariate Analysis
7.	Dr. M. Y. Waziri	Assoc. Prof.	BSc, MSc, PhD	Numerical Optimization
8.	Dr. A. J. Badakaya	Senior Lecturer	BSc, MSc, PhD	Differential Games
9.	Dr. Nafiu Hussaini	Senior Lecturer	BSc, MSc, PhD	Mathematical Biology
10.	Dr. Abdul Iguda	Senior Lecturer	BSc, MSc, PhD	General Topology
11.	Dr. H. A. Shitu	Senior Lecturer	BSc, MSc, PhD	Mathematical Biology
12.	Dr. Ibrahim Idris	Senior Lecturer	BSc, MSc, PhD	Mathematical Physiology
13.	Dr. S. L. Bichi	Senior Lecturer	BSc, MSc, PhD	Integral Problems in HDS
14.	Dr. A. I. Kiri	Senior Lecturer	BSc, MSc, PhD	Algebra/Number Theory
15.	Dr. M. S. Minjibir	Senior Lecturer	BSc, MSc, PhD	Optimization Theory
16.	Dr. A. M. Lawan	Senior Lecturer	BSc, MSc, PhD	Number Theory
17.	Dr. J. H. Hassan	Lecturer I	BSc, MSc, PhD	Differential Equations
18.	Dr. M. M. Zubairu	Lecturer I	BSc, MSc, PhD	Semigroup Theory
19.	Dr. H. Mohammad	Lecturer I	BSc, MSc, PhD	Numerical Linear Algebra
20.	Shehu Bala	Lecturer I	BSc, MSc	Design & Analysis of Experiment
21.	K. I. Usman	Lecturer I	BSc, MSc	Convex Optimization
22.	Dr. I. A. Baba	Lecturer II	BSc, MSc, PhD	Mathematical Epidemiology
23.	B. B. Mika'il	Lecturer II	BSc, MSc	Operations Research
24.	S. A. Rano	Lecturer II	BSc, MSc	Numerical Optimal Control
25.	Mustapha Muhammad	Lecturer II	BSc, MSc	Financial Mathematics
26.	A. H. Usman	Lecturer II	BSc, MSc	Mathematical Statistics
27.	Jewaidu Rilwan	Lecturer II	BSc, MSc	Differential Games
28.	A. B. Abubakar	Lecturer II	BSc, MSc	Optimization/Compressive Sensing
29.	A. Y. Inuwa	Asst. Lecturer	BSc, MSc	Operator Theory

B: Non-Teaching Staff

S/N	Name	Rank	Qualification
1.	Zubairu H. Danjuma	Senior Programmer	HND Computer Science
2.	Usman M. Madaki	Principal Comp. Operator	B.Sc. Computer Science
3.	Laraba Yakubu	Senior Comp. Operator	ND Computer Science
4.	Ahmad S. Adamu	Asst. Exec. Off.	OND English/Hausa
5.	Auwalu Sani	Head Cleaner/Messenger	WAEC Certificate
6.	Sani H. Yahaya	Head Cleaner/Messenger	WAEC Certificate

Appendix A2: Departmental Responsibilities (2018/2019 Session)

Head of Department: Dr. Abbas Ja'afar Badakaya
Examination Officer: Shehu Bala
Asst. Examination Officer: Dr. Hassan Muhammad
Admission Officer: Khalid Ismail Usman
Departmental Secretary (Academic): Adamu Yusuf Inuwa
Financial Officer: Ibrahim Yusuf Ibrahim
Postgraduate Degree/Seminar Coordinator: Prof. Saminu Iliyasu Bala
Postgraduate Diploma Coordinator: Dr. Sirajo Lawan Bichi
Undergraduate Project Coordinator: Dr. Hassan Muhammad
Spill Over II (Mathematics) Coordinator: Prof. Saminu Iliyasu Bala
Spill Over I (Mathematics) Coordinator: Malama Sadiya A. Rano
Level IV (Mathematics) Coordinator: Dr. Muhammad Mansur Zubairu
Level III (Mathematics) Coordinator: Ibrahim Yusuf Ibrahim
Level II (Mathematics) Coordinator: Khalid Ismail Usman
Level I (Mathematics) Coordinator: Dr. Isa Abdullahi Baba

Appendix A3: Departmental Committees

1. Admission Committee (AC)
2. Appointment & Promotion Committee (A&PC)
3. Computer & Information Technology Committee (CIT)
4. Curriculum Review & Academic Standard Committee (CRAC)
5. DTLC/Finance Committee (DTLC)
6. Library Committee (LC)
7. Quality Assurance Committee (QAC)
8. Research Committee (RC)
9. Staff/Student Consultative Committee (SSC)
10. Examination/Time-Table Committee (ETC)
11. Welfare Committee (WC)