AHMADU BELLLO UNIVESITY, ZARIA
DEPARTMENT OF MATHEMATICS

STRATEGIC PLANNING GUIDE FOR THE DEPARTMENT OF MATHEMATICS

2013-2017

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STRATEGIC PLANNING GUIDE FOR 2013 TO 2017

AHMADU BELLO UNIVERSITY, ZARIA,
STRATEGIC PLAN, 2013-2017

In Respect of the Department of Mathematics

2013

Preamble

This Strategic Plan has been designed with topics which were arranged into steps and transforming the data provided for them into ideas, concepts, formats, etc relevant to each step and its components (where applicable). Also this Strategic Plan revolves around the strategic deployment of resources for the attainment of set goals and objectives in a process that involves action and review.

The plan is current, coherent, progressive and flexible so as to maintain depth and breadth in conformity with the Nigerian Universities Commission's Benchmark minimum academic standard. Also the Plan revolves around the strategic deployment of resources for the attainment of set goals and objectives in a process that involves action and review. Our mission is to produce best graduates who would contribute selflessly towards nation building.

Vision

To be recognized internationally for excellence in research and teaching, and nationally for high-quality service so as to be a world class Department comparable to any other Department.

Mission

The Department of Mathematics is committed to provide effective and innovative graduates and undergraduate education to Mathematics students, Computer Science students and statistics students in order to prepare them to succeed in their further studies and careers, to produce high-level human power and enhance capacity building through retraining, in order to meet the needs and challenges of the nation and to establish and foster national and international integration and development.

Values

In the context of this Plan, values are regarded as inbuilt ideas, shared practices, perceptions and outlook. The values for our Department are;

1. Quality Academic and Research Programmes and facilities based on NUC requirement.
2. Cosmopolitan Staff and Student Composition.
3. Reputation for Departmental Discipline and Harmony
4. Quality of Learning and Research.
5. Quality and Variety of Learning and Research Facilities.
6. Dynamic and Interactive Leadership for the Department.

Organizational Assessment and SWOT Analysis

This organizational assessment involves the determination of Strengths and Weaknesses, the identification of the Opportunities open to it and the threats that may retard or even destroy it. This is the so called SWOT analysis.

Strengths of the Department

- Pioneering role as the first generation Department
- Diversity of staff and students
- Dynamic leadership
- Nationally and internationally well-trained academic staff
- Nationally accredited programmes
- University ownership and funding
- Retaining the best Departmental graduates
- Many computer laboratories

Weaknesses of the Department

- Lack of strong assets base
- Lack of offices, classrooms and lecture theatres
- Low morale/motivation of staff
- Declining productivity
- Lack of internal revenue generation
- Lack of enough funds for conferences

Opportunities for the Department

- Four sources of funds for Departmental development; specific charges, DTLC, PG Account and operating expenses
- Research funding potential from agencies and organizations
- Taking advantage of global information and communication technology
- Linkage and collaboration potentials within / outside Nigeria

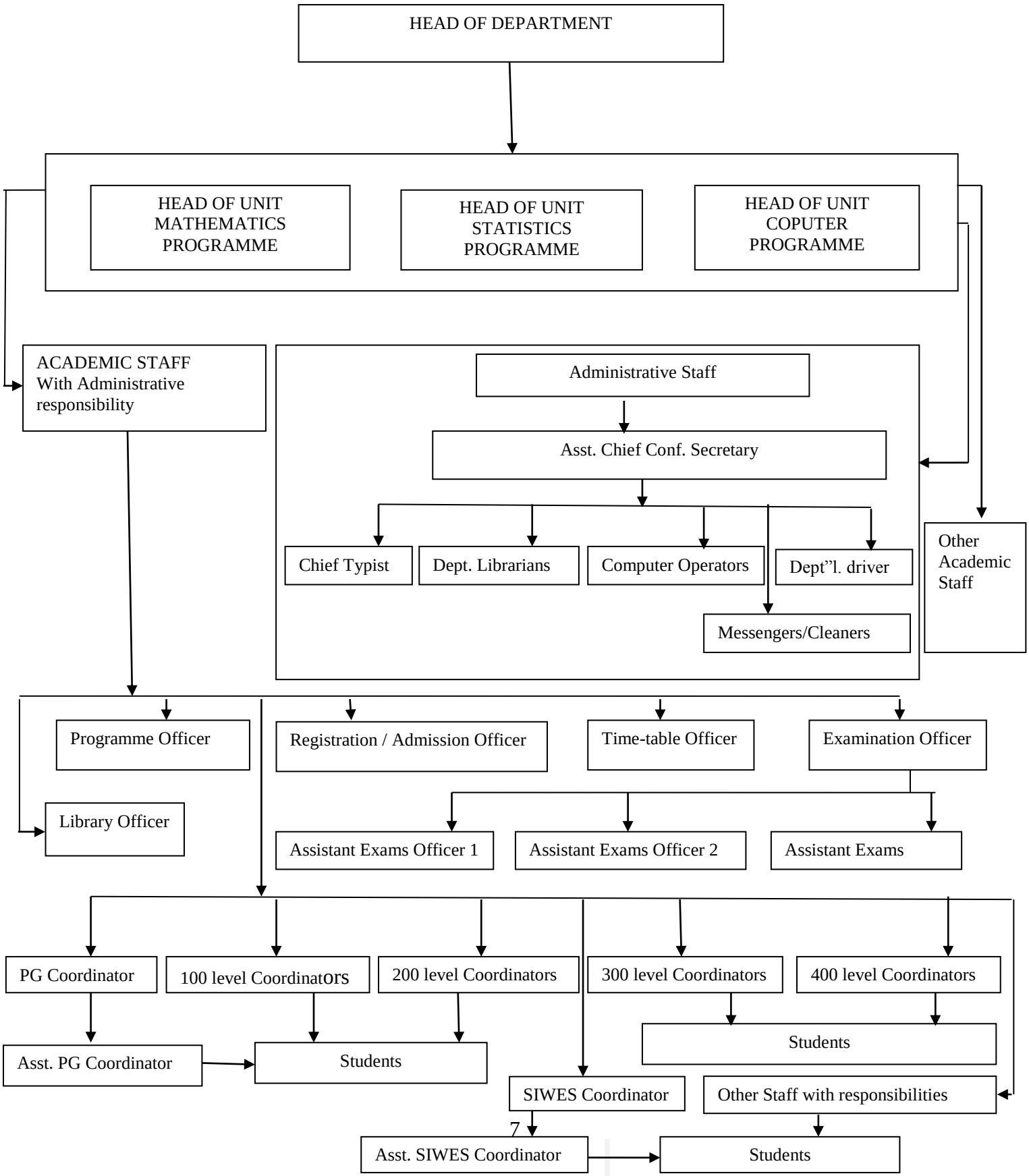
Threats to the Department

The threats within the external environment that can affects our Department are:

- Emergence of Departments of Mathematics in State and Private Universities and competition over quality staff and students
- Political instability and insecurity

- Cultism and other forms of counter-culture
- Unemployment of our graduates
- Inadequate and unstable power supply
- High cost of petroleum products

Stakeholder Flow Chart



Strategic Options

From the Organizational Assessment/SWOT Analysis strategic options were generated through the juxtaposition of the SWOT; how its strengths can be used to take advantage of opportunities (S-O strategic options); how opportunities can be used to overcome weaknesses (O-W strategic options); how Strengths can be used to counteract threats (S-T strategic options) and how overcoming weakness can counteract threats (W-T strategic option). The strategic options are provided in the table below.

Juxtaposition S and W of the Department with the O and T of its External Environment

Strengths	**Weaknesses**
• Pioneering role as the first generation Department • Diversity of staff and students • Dynamic leadership • Nationally and internationally well-trained academic staff • Nationally accredited programmes • University ownership and funding • Retaining the best Departmental graduates • Many computer laboratories	• Lack of strong assets base • Lack of offices, classrooms and lecture theatres • Low morale/motivation of staff • Declining productivity • Lack of internal revenue generation • Lack of enough funds for conferences

Juxtaposition S and W of the Department with the O and T of its External Environment

Opportunities	**Threats**	**S-O Strategic Options;** (how can strengths be employed to take advantage of opportunities?)
• Four sources of funds for Departmental development; specific charges, DTLC, PG Account and operating expenses • Taking advantage of global information and communication technology • Linkage and collaboration potentials within / outside Nigeria • Research funding potential from agencies and organizations	• Emergence of Departments of Mathematics in State and Private Universities and competition over quality staff and students • Cultism and other forms of counter-culture • Political instability and insecurity • Unemployment of our graduates • Inadequate and unstable power supply • High cost of petroleum products	• Utilization of the sources of funds • Reviewing of enabling instrument to sustain dynamic leadership in the Department • Establishment of lobby groups for liaison with high net-worth individuals for support • Creation of linkages and networks for enhanced learning • The introduction of unique course(s)/topics in areas of need • Review of curriculum to sustain a balance between demand driven and knowledge-driven education

Juxtaposition S and W of the Department with the O and T of its External Environment

W-O (Strategic Options): How can weaknesses be overcome by taking advantage of opportunities.	S-T (Strategic Options): How can strengths be used to counteract threats that tend to hinder achievement of goals and pursuit of opportunities	W-T (Strategic Options): How can weaknesses be overcome to counteract threats that hinder the achievement of goals and the pursuit of opportunities
1. Exploring linkages and collaboration potentials from within and outside in addition to internal mechanisms for rewarding hard-work to reduce industrial unrest and improve productivity. 2. Update, review and reactivate teaching/ research facilities and publications, Utilizing global information and communication technology and system and services. 3. Providing an effective Local Area/Wide Area/ Storage Area Networks (LAN/WAN/SAN)	1. Creating programmes to meet the demands of the job market as well as inject elements of job creation in the mentality of the graduates 2. The diversity of staff and students can counter political instability, incerity and anti-intellectual orientation of the elites by utilizing the cultural diversity of staff and students and political contacts, backgrounds/influence. 3. Dynamic leadership practice can used to overcome the unstable industrial climate, cultism and other counter-cultures and unstable relations with our immediate communities.	1. Improve revenue generation through mentaining our sources of funds and proper financial control to prevent fraudulent practices. 2. Improving of welfare facilities for staff by providing good offices and adequate teaching materials. 3. Improving administrative style by ensuring Transparency and Accountability.

History of the Department

Department of Mathematics, Ahmadu Bello University, Zaria, was established in October 1962. In its early years, the Department was mainly offering combined honours degree such as B.Sc. (Hons) Mathematics with Physics. The B.Sc. single (honours) programmes in Mathematics, Mathematics with Computer Science and Mathematics with Statistics started in the early 1970's. By the end of the 1970's and early 1980's, the Department had graduated Masters and Ph.Ds. in Computer Science, Mathematics and Statistics. However, Statistics and Computer Science programmes got discontinued due to lack of manpower. B.Sc. (Hons) in Mathematics with Computer Science was resuscitated in 2001 with eight students selected from the B.Sc. (Hons) Mathematics at 300 level. Also, B.Sc. (Hons) Statistics programme was resuscitated during the 2001/2002 academic session. M.Sc. and Ph.D. programmes in Statistics and Computer Science were also revived during the same session. Presently, the Department offers the following courses:

i. B.Sc (Hons) Mathematics
ii. B.Sc (Hons) Computer Science
iii. B.Sc (Hons) Statistics
iv. Postgraduate Diploma in Computer Science
v. Postgraduate Diploma in Statistics
vi. M.Sc and Ph.D. in Mathematics, Computer Science and Statistics

How Staff are involved in the decision-making process and in general administration

Staff are involved in decision making through monthly Departmental meetings in order to run the general administration of the Department smoothly and efficiently. The Department has also appointed a number of coordinators and officers for discharging specific functions in the Department. These include, Programme Coordinator, Postgraduate Coordinator, Level Coordinators, Registration Officers, Examination officers, Time Table Officer, computer Laboratory Coordinators, SIWES Coordinator, and so on, as shown on the organizational structure chart of the Department. Other pressing problems are sorted out administratively in consultation with other staff.

Policy and practice on staff development.

Staff training and development is taken up both internally and externally through the organization of M.Sc. programmes for Graduate Assistants and Ph.D. Programmes for others. The University encourages its staff by paying the relevant P.G. fees and postgraduate studies allowances. In order to improve the capacity of staff to meet modern challenges many staff members are sponsored to attend local and international conference/workshops once in a year.

The University sponsors staff to selected institutions abroad for short visit under the Mc/Arthur and Carnegie foundations. Staff are also sponsored for special PG programmes through the PTDF and TETFUND scholarships. Staff also benefit from grants by University Board of Research.

Staff that are enrolled for various Postgraduate Degree Programmes within and outside the country as follows:

- Mal. I. A. Fulatan has gone far in his Ph.D Programme at A.B.U
- Mal. Y.M. Baraya is about to finish his Ph.D Programme at A.B.U.
- Mrs. M.I. Yakubu has started her Ph.D Programme at A.B.U.
- Mal. A. Alkali has gone far in his Ph.D Programme at A.B.U
- Mrs. A. Umar has gone far in her Ph.D Programme at A.B.U
- Mr. N.C. Ngene has gone far in his Ph.D Programme at A.B.U
- Mal. M.M. Lawal has started his Ph.D Programme at A.B.U.
- Mrs. B.F. Abdullahi has started her Ph.D Programme in the U.K.
- Mr. A.F. Kana-Danfack is about to finish his Ph.D Programme at U.I.
- Mrs. S.O. Yisah has started her Ph.D Programme at A.B.U.
- Mal. U. Danbaba is currently in his M.Sc. Programme in Pretoria University, South Africa
- Mal. Imam A Tanko has just finished his M.Sc. Programme at A.B.U.
- Mal. Mustapha A. Bagiwa has been nominated for JAPANESE scholarship to go to Japan for his Ph.D
- Mal. Jamilu Garba has just finished his M.Sc. Programme at A.B.U.
- Mrs. A. H. Abubakar has started her Ph.D Programme at A.B.U.
- Mal. Aliyu Salisu has started his Ph.D Programme at A.B.U.
- Mal. Umar Shehu is currently on his second Masters degree at A.B.U.
- Mal. Ibrahim K. Muhammad has been nominated for TETFUND scholarship to go to Malysia for his Ph.D.

- Mal. S.I. Dishing has been nominated for TETFUND scholarship to go to Malysia for his Ph.D.
- Mal Isyaku Umar Abdullahi has been nominated for TETFUND scholarship to go to Malysia for his Ph.D.
- Mal. Shehu Bala has applied to UNILORIN for his Ph.D.
- Mal I. Baroon Ahmad has gone far with his Ph.D Programme in Malysia.
- Mal Yusuf A. Sahabi has just finished his M.Sc. Programme at AUST.
- Mal. AbdulNasir A. Isah is currently in his M.Sc. Programme in A.B.U.
- Mal. Abba Junaidu is currently in his M.Sc. Programme in A.B.U.
- Mal. Mohammed Abdullahi has been nominated for TETFUND scholarship to go to Malysia for his Ph.D
- Mal. Aminu O. Abdussalami is currently in his M.Sc. Programme in A.B.U.
- Mal. Muhammad Aliyu Kufena is currently in his M.Sc. Programme in A.B.U.
- Mal. Aliyu Yakubu is currently in his M.Sc. Programme in A.B.U.
- Mal. Nura Abdullahi is starting his M.Sc. Programme in A.B.U.

Staff Promotion

Staff promotion exercise is done on a yearly basis. The promotion is done through assessment of the staff in relation to the promotion guidelines of the University in order to encourage staff to be more productive. The promotion exercise is done through the Appointment and Promotion Sub-complex to the Central A &PC. The promotion exercise for 2011 has been concluded, and we have now finished with preparing that of 2012.

Goals of the Department

1. To develop an Academic Brief for the Department in order to ensure that the Department remains focused, efficient and effective in academic activities.

2. To rehabilitate, upgrade and expand learning and research facilities for quality scholarship, training and research.

3. To put into effect a LAN/WAN for the effective working of the Department's information and communication system.

4. To complete the review, rationalization, redesigning and refocusing of the philosophy and the structure of all curricula with a view to producing high quality graduates that will meet the challenges of the catchment area, Nigeria and the world.

5. To utilize our computer laboratories for quality research and learning.
6. To ensure gender balance and equity in admission, recruitment and training for fairness and justice.
7. To continue the Pg programmes (PGDCS & PGDS) for increased access to education and revenue generation.
8. To upgrade expand and reform post graduate programmes for the enhancement of man power and revenue generation.
9. To develop a comprehensive quality control mechanism to deal with quality of staff, students, facilities, lecturing and conduct of exams.

Objectives of the Department:

This Strategic plan is designed to meet the following objectives

- To provide training in the theory and application of Mathematics, Computer Science and Statistics to the real world systems.
- To provide qualified manpower in Mathematics, Computer Science and Statistics to Schools and institutions of higher learning.
- To involve the students in an intellectually stimulating and satisfying experience of learning, application and entrepreneurship in Mathematics and related Areas.
- To provide a broad and balanced foundation in Mathematics, Computer Science and Statistics knowledge and practical skills.
- To develop in students a range of applicable and transferable skills of information technology to all aspects of human endeavor.
- To generate in students an appreciation of the importance of Mathematics, Computer Science and Statistics in industrial, economical, technological and social contexts.
- To provide students the ability to analyze, evaluate and propose alternative solutions to given software and/or algorithm designs.
- To develop students' abilities in self management and teamwork.

- To provide students the ability to conduct experiments, collect data, perform analysis and interpret results to draw conclusions.
- To prepare students to communicate effectively both orally and in writing.
- To provide students with the ability to engage in life-long learning and growth in Mathematics, Computer Science and Statistics and to understand professional and ethical responsibilities.

Programmes

Academic and research programme

This programme deals with the enhancement of the Department's learning and research activities and capacity especiaaly with regards to curriculum review and the introduction of new courses.

Justification

Due to dynamic changes in the world of knowledge and increase in the requirements of end- users, it is necessary for the Department to review, update, refocus and restructure its academic and research programmes in order to remain up-to-date and in tune with new developments.

Methodology

This will be achieved through completion of the curriculum review; introduction and approval of new courses; production and publication of research policy.

Admission Requirements

a. The Department admits students into 100 level as well as 200 level for the B.Sc (Hons.) Mathematics, B.Sc (Hons.) Computer Science and B.Sc (Hons.) Statistics programmes as follows:

    I. **100 level:** Candidates must satisfy the general University and Faculty of Science requirements of five O'Level credits which must include: Mathematics, English and any two science subjects from the following: Chemistry, Physics, Biology, Geography and so on, at Senior Secondary School Certificate level or equivalent examination in at most two sittings. However, computer science students must have credit in physics.

II. **For 200 level:** Candidates must in addition to (1) above have an Advanced level (A'Level) or its equivalent in Mathematics and any other science subject.

b. For a student to be given admission for the PGDCS and PGDS programme, he/she must satisfy the above requirement and also must have:

I. A bachelor's degree or its equivalent, with at least a third class, from a recognized institution in physical sciences, engineering and related areas.

II. HND in relevant area (Physical Sciences, Engineering, Accountancy, Business Administration and Economics with proven adequate background).

c. The entry requirement for the M.Sc. Computer Science, M.Sc. Mathematics and M.Sc. Statistics is a first degree with at least a second class lower in Computer Science, Mathematics with Computer Science, Statistics with Computer Science, Mathematics, Statistics or equivalent from any recognized University. However, candidates having a third class degree may also be considered if he / she has spent at least five years in some relevant institution after graduation. Candidates with a first degree and the 2-year Postgraduate Diploma in Computer Science (PGDCS) of Ahmadu Bello University, Zaria, are considered for admission into M.Sc. Computer Science programme.

d. To be eligible for admission into Ph. D. degree Programme, a candidate must have obtained M. Sc. Degree in Computer Science, Mathematics or Statistics with a research thesis component (not project) or its equivalent from a recognized university. Candidates with a CGPA score of less than 3.0 are not eligible for PhD admission. Where a PhD applicant is judged to be deficient or has a professional master's degree, he/she may be considered for an M. Phil admission. Applicants who earn a minimum CGPA of 3.5 at the end of the M. Phil. programme shall automatically proceed with the PhD programme.

Duration of the programmes

a. The duration of B.Sc. (Hons.) programmes is four years for candidates admitted into 100 level and three years for those admitted into 200 level. There are two semesters of formal University Studies in each academic session except at 300level where students are required to undergo Students' Industrial Work Experience Scheme (SIWES) programme for 6 months. At the end of the programme, each student is required to write, present and defend a report on what he/she learned in the industry. At 400 level, students undertake a one year project in any field of interest.

b. The duration for PGDCS and PGDS programmes are two years and one year respectively with each year consisting of two semesters.

c. The minimum duration for M.Sc. Computer Science, M.Sc. Mathematics and M.Sc. Statistics programmes is not less than three semesters (18 months) while the maximum is not more than six semesters (three academic sessions).

d. The duration of a Ph.D. Programme is three years for a full time student and five years for a part time student.

COMPUTER SCIENCE PROGRAMME

Details of Course Structure

a. B.Sc. Computer Science Programme

The table below gives the structure of the programme in terms of the number of core Departmental courses, General Studies courses, restricted and unrestricted elective courses for each of the four years of study.

Summary: B.Sc. Computer Science

	100 Level	200 Level	300 Level	400 Level	TOTAL
Core Courses (Departmental)	22	27	20	31	100
Cognate Courses (GENS)	3	2	2	0	7
Restricted Electives	2	3	6	6	17
Unrestricted Electives	8	9	2	6	25
TOTAL	35	41	30	43	149

The above summary table shows that *for a student to graduate he/she needs to earn a total of at least 149 credit units of which 109 credits must be core.*

The following gives a detailed breakdown of the courses in the curriculum on a semester-by-semester basis.

100 Level – A Minimum of 35 Credit Units.

- Core courses (Departmental) : 22
- Core courses (General Studies) : 03
- Restricted Elective : 02
- Unrestricted Electives : 08
- Total : 35

Core Courses (Departmental)

1ST Semester

Code	Course Title	Credit Units	Prerequisite
MATH101	Sets and Number Systems	2	O/L Maths
MATH103	Trigonometry and Co-ordinate Geometry	2	"
MATH105	Differential and Integral Calculus	2	"
COSC101	Introduction to Computer Science	2	"
PHYS111	Mechanics	2	O/L Physics
PHYS131	Heat and properties of matter	2	"

2ND Semester

Code	Course Title	Credit Units	Prerequisite
MATH102	Algebra	2	O/L Maths.
MATH104	Conic Sections and Application of Calculus	2	"
MATH106	Vectors and Dynamics	2	"
STAT102	Introductory Statistics	2	"
PHYS124	Geometric and Wave Optics	2	"

Restricted Elective

PHYS122	Electricity, Magnetism and Modern Physics	2	O/L Physics.

Cognate Courses (General Studies)
1st /2nd Semester

Code	Course Title	Credit Units	Prerequisite
GENS101	Nationalism	1	
GENS103	English and Communication Skills	2	

Electives at 100 Level

1st/2nd Semester
A minimum of eight (8)-credit units chosen from the following subject areas: Biology, Chemistry, STAT 101, GENS102 and GENS107

200 Level – A Minimum of 41 Credit Units

- Core courses (Departmental) : 27
- Core courses (General Studies) : 02
- Restricted Electives : 03
- Unrestricted Electives : 09
- Total : 41

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH201	Mathematical Methods I	3	MATH105 or equiv.
MATH207	Linear Algebra I	3	MATH 102 or equiv.
COSC211	Object-Oriented Programming I	3	COSC101 or equiv.
COSC203	Discrete Structures	3	MATH101 or equiv.
COSC205	Digital Logic Design	3	COSC101 or equiv.

2nd Semester

Code	Course Title	Credit Units	Prerequisite
COSC212	Object-Oriented Programming II	3	COSC101 or equiv.
COSC204	Computer Organization and Assembly Language	3	COSC101 or equiv.
STAT202	Continuous Probability Distributions and Distribution Techniques	3	STAT101 or equiv.

Code	Course Title	Credit Units	Prerequisite
COSC208	Introduction to Artificial Intelligence	3	COSC101

Cognate Course (General Studies)

GENS202	Entrepreneurship and Innovation	2	

Restricted Departmental Electives

MATH209	Numerical Analysis I	3	MATH104 or equiv.

Unrestricted Electives

COSC206	Human Computer Interaction	2	COSC101 or equiv.
MATH208	Linear Algebra II	3	MATH102 or equiv.

A minimum of four (4) credit units chosen from any of the following subject areas: Biology, Chemistry, Mathematics, Statistics and Physics.

300 Level – A Minimum of 24 Credit Units

- Core courses (Departmental) : 20
- Core courses (General Studies) : 02
- Restricted Electives (Departmental) : 06
- Unrestricted Electives (minimum) : 02
- Total : 30

Core Courses

1st Semester

Code	Course Title	Credit Units	Prerequisite
COSC301	Data Structures and Algorithm	3	COSC211
COSC303	Computer Architecture	3	COSC 205
COSC305	Systems Analysis and Design	2	COSC101
COSC309	Database Management systems	3	COSC203
COSC311	Organization of Programming Languages	3	COSC211

2nd Semester

COSC300	SIWES	6	

Cognate Course (General Studies)

GENS302	Business Creation and Growth	2	

Restricted Electives

COSC307	Web Application Engineering I	3	COSC101
MATH311	Mathematical Modeling	3	MATH201

Unrestricted Electives
A minimum of two (2) credit units chosen from any of the following:
Any relevant 300 level course in the Faculty of Science, Department of Electrical Engineering, Department of Economics, and Department of Business Education.

400 Level – A Minimum of 44 Credit Units

- Core courses (Departmental) : 31
- Restricted Electives : 06
- Unrestricted Electives (minimum) : 06
- Total : 43

Core Courses

1st Semester

Code	Course Title	Credit Units	Prerequisite
COSC400	Project	3	COSC300
COSC401	Algorithms and Complexity Analysis	3	COSC301
COSC403	Software Engineering	3	COSC305
COSC405	Web Application Engineering II	2	COSC307
COSC407	Data Communications and Networks	3	COSC205
COSC411	Operating Systems	3	COSC204

2nd Semester

Code	Course Title	Credit Units	Prerequisite
COSC400	Project	3	COSC300
COSC402	Formal Methods and Software Development	3	MATH201

Code	Course Title	Credit Units	Prerequisite
COSC404	Network Design and Management	3	COSC307
COSC406	Advanced Database Systems	2	COSC309
COSC408	Compiler Construction	3	COSC311

Restricted Electives

COSC409	Professional and Social Aspects of Computing	3	COSC206
COSC416	Simulation Methodology	3	STAT202

Unrestricted Electives

A minimum of 6 credit units, chosen from any of the following 400 level subject areas – Computer Science (COSC415,COSC413,COSC414,COSC412), Electrical Engineering, Physics, Electronics, Economics, Business Administration, Mathematics, Statistics or other relevant sciences depending upon the availability of facilities and resources.

Course outline for computer science;

COSC 101 Introduction to Computer Science

Prerequisite: ***none***

Introduction to computer systems. Components of computer systems and their functions. Windows operating system and its utilities. Hands-on exposure to Office application software (MS Office or Open Office): Word processing, spreadsheets, presentation graphics and databases. Introduction to the use of Internet tools and technologies.

Suggested Lab work

Lecturers should develop laboratory exercises and assignments targeted at providing hands-on practical experience on all topics in the syllabus. The exercises should cover the typical tasks that students do with computers throughout their studies.

COSC 203 Discrete Structures

Prerequisite: MATH101 or Equivqlent

Functions and relations. Basics of counting: inclusion-exclusion principle, pigeon-hole principle, permutations, recurrence relations, generating functions. Graphs

and trees: definitions, properties and applications. Discrete probability: computing probabilities, dependent and independent events, applications.

COSC 204 Organization and Assembly Language

Prerequisite: COSC 101 or Equivalent

Introduction to computer organization. Signed and unsigned number representation, character representation, ASCII codes. Assembly language programming, instruction format and types, memory and I/O instructions, dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Datapath and control unit design. RTL, microprogramming, and hardwired control. Practice of assembly language programming.

Suggested Lab work

Programming assignments to practice MS-DOS batch programming, Assembly Process, Debugging, Procedures, Keyboard input, Video Output, File and Disk I/O and Data Structure.

COSC 205 Digital Logic Design

Prerequisite: COSC101 or Equivalent.

Introduction to information representation and number systems. Boolean algebra and switching theory. Manipulation and minimization of completely and incompletely specified Boolean functions. Physical properties of gates: fan-in, fan-out, propagation delay, timing diagrams and tri-state drivers. Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design, basic flip-flops, clocking and timing diagrams. Registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGA.s.

COSC 206 Human Computer Interaction

Prerequisite: COSC 101 or Equivalent

Foundation of HCI, principles of GUI, GUI toolkits. Human-centered software evaluation and development; GUI design and programming.

COSC 208 Introduction to Artificial Intelligence

Prerequisite: COSC 101 or Equivalent

Introduction to the types of problems and techniques in Artificial Intelligence. Problem-Solving methods. Major structures used in Artificial Intelligence programs. Study of knowledge representation techniques such as predicate logic, non-monotonic logic, and probabilistic reasoning. Examples of expert systems.

Introduction to natural language understanding and various syntactic and semantic structures. Expert systems. Introduction to computer image recognition.

COSC 211 Object-Oriented Programming I

Prerequisite: ***COSC101 or Equivalent***

Overview of computers and computing; Introduction to object-orientation as a technique for modeling computation. Introduction of a typical object-oriented language, such as Java; Basic data types and operators; Basic object-oriented concepts; Introduction to Strings; Simple I/O; Logical expressions, control structures, algorithms and problem solving; Arrays; Simple recursive algorithms; inheritance; polymorphism.

Suggested Lab work

Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting. Practice in developing and tracing simple recursive algorithms. Developing programs involving inheritance and polymorphism.

COSC 212 Object-Oriented Programming II

Prerequisite: COSC 102 or Equivalent

Advanced object-oriented programming - polymorphism, abstract classes and interfaces; Program organization using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Recursion; Event-driven programming.

Suggested Lab work

Programming assignments leading to extensive practice in problem solving and program development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

COSC 301 Data Structures and Algorithm

Prerequisite: COSC 212 or Competence in Programming

Review of object-oriented concepts; Basic algorithm analysis - the big-O notation; Fundamental data structures – implementation strategies for stacks, queues and lists; Recursion; Implementation strategies for tree and graph algorithms; Hash tables; Application of data structures.

Suggested Lab work
Programming assignments leading to extensive practice in problem solving and program development involving the use of the various data structures implemented in the course.

COSC 303 Computer Architecture

Prerequisite: COSC 205
Memory hierarchy and cache memory. Integer and floating point arithmetic. Instruction and arithmetic pipelining, super scalar architecture. Reduced instruction set computers. Parallel architectures and interconnection networks.

COSC 305 Systems Analysis and Design

Prerequisite: COSC 211 or Competence in Programming
The software development life cycle: conception, business case, business context, system requirements, requirements analysis, systems analysis, design, implementation, testing, deployment, maintenance. The Unified Modeling Language (UML): models, use case diagrams, activity diagrams and state chart diagrams, sequence and collaboration diagrams, class diagrams, component diagrams. Managing the process: customers, organization types, project management, teams and team dynamics, computer assisted software engineering (CASE) tools, documentation.

Suggested Lab Work
Analysis and design assignments leading to extensive practice in the use of UML and CASE tools.

COSC 307 Web Application Engineering I

Prerequisite: COSC 211 or Competence in Programming
The Internet (brief history, Internet protocols and Internet services) ; The Web architecture (Client-server architecture, multi-tier architecture, URL) ; XHTML; DHTML (Cascaded Style Sheet, JavaScript, DOM) ; Web interface and interactivity design principles and practice. Incorporating multimedia content into Web pages (using Photoshop, Flash or similar tools).

COSC 309 Database Management Systems

Prerequisite: COSC 211
Basic database concepts. Conceptual modeling. Relational data model. Relational theory and languages. Database Design. Database security and integrity.

Introduction to query processing and optimization. Introduction to concurrency and recovery.

Suggested Lab work
Programming assignments to learn database design using CASE tools. Introduction to back-end/Server-based Relational Data Base Management System (RDBMS). Learning Standard SQL (interactive/embedded). Introduction and programming assignments on Front-End tools. Programming team projects to design and develop real life database systems using the learned tools.

COSC 311 Organization of Programming Languages

Prerequisite: COSC 211 or Competence in Programming
Concepts of Programming languages: Syntax and semantics. Data types. Control structures. Sub-Programs. Exception handling. Run-time Storage Management. Programming Paradigms: Imperative, functional, logic, object-oriented, and concurrent.

COSC 400 Project

Prerequisite: COSC 300
The project aims to provide experience with planning, executing and formally reporting on a substantial computing task within a set time. Students will develop their understanding of relevant areas of computing and their capabilities in the practical engineering and writing activities involved, and demonstrate their competence as candidate computing professionals.

COSC 401 Algorithm and Complexity Analysis

Prerequisite: COSC 301
Introduction to algorithms and review of data structures; fundamentals of algorithm analysis; Analysis of recursive and non-recursive algorithms; Algorithm design techniques: brute-force, divide-and-conquer, greedy algorithms, dynamic programming, search techniques; NP-complete problems and approximation algorithms.

COSC 402 Formal Methods in Software Development

Prerequisite: COSC 212
Mathematical foundations for formal methods. Formal languages and techniques for specification and design, including specifying syntax using grammars and finite state machines. Analysis and verification of specifications and designs. Use of assertions and proofs. Automated program and design transformation.

COSC 403 Software Engineering

Prerequisite: COSC 305

Fundamental design concepts, design notations, and architectural design methods for large-scale software systems. Several design: examples of their use, comparisons among them. Concepts of information hiding, data abstraction, concurrency, and object-oriented software construction.

COSC 404 Network Design and Management

Prerequisite: COSC 205

Overview of network design and management; Design methodologies; Network management strategies; Network configuration management; Network management protocols: SNMP, and RMON; Network management tools and systems; Network management applications; Desktop and web-based network management; Network troubleshooting.

Suggested Lab Work

A closed lab with hands-on exercises using state-of-the-art tools in the design, analysis and troubleshooting computer networks.

COSC 405 Web Application Engineering II

Prerequisite: COSC 307

Review of client-side application development. Server-side application development. Adding content to Web applications dynamically. Input validation and use of regular expressions. Defining and managing sessions. Cookies. Working with databases. Web application security.

Assignments and projects should be given to enable students design and implement non-trivial data-driven Web applications.

COSC 406 Advanced Database Systems

Prerequisite: COSC 309

Advanced data models. Conceptual Database design. Concurrency control techniques. Recovery techniques. Query processing and optimization. Integrity and security. Client-server architecture. Distributed database systems. Current trends in database systems.

COSC 407 Data Communications and Network

Prerequisite: COSC205

Introduction to computer networks and layered architectures: connectivity, topology, circuit and packet switching, TCP/IP and ISO models; Application layer:

C/S model, DNS, SMTP, FTP, WWW, socket programming and network security; Transport layer: TCP and UDP, congestion control; Network layer: internetworking, addressing and routing algorithms and protocols; Data link layer: framing, flow and error control protocols, PPP, MAC and LANs; Physical layer: principles of data communications, circuit switching, coding, multiplexing and transmission media. Network security: fundamentals of cryptography, secret and public key algorithms, authentication protocols.

Suggested Lab work

The lab involves several projects to gain hands-on experience with network devices, programming and tools. More specifically, it provides students with the opportunity to: Setup various servers such as DNS, DHCP, Web Servers on Windows/Linux platforms; Develop simple client/server network applications using sockets; Create simple web pages; Simulate network; Analyze various protocols by capturing packets; Measure network utilization under varied situations; Use various network-related commands; Configure switches and routers.

COSC 408 Compiler Construction

Prerequisite: COSC 212

Design and implementation of compilers, principles of languages translation. Each student implements a complete compiler for a small but substantial language. The stages of a compiler. Boot-strapping a compiler. Lexical analysis, regular expressions, finite state machines. Syntactic analysis, context free grammars, parsers. Semantic analysis, type checking, symbol tables. Syntax-directed translation. Data flow analysis, peephole optimization. Code generation.

COSC 409 Professional and Social Aspects of Computing

Prerequisite: COSC 206

Professional aspects; professions and the professional; professional institutions; professional ethics and responsibilities; the computer professional as expert witness. Standards, best practice. Legal background, sources of law; civil and criminal law. Intellectual property rights, software copyright, patents, designs, trademarks and passing off; copyright and web pages, Internet domain names, protection of computer imagers and icons, jurisdiction; confidentiality. Data protection law; freedom of movement of personal data; privacy in telecommunications. Computer crime; fraud; computer misuse; viruses; threatening emails; pornography; grooming in chat rooms. Social aspects of the workplace/society at large. The impact of IT on society.

COSC 411 Operating Systems

Prerequisite: COSC 301

Fundamentals of operating systems design and implementation. History and evolution of operating systems; Types of operating systems; Operating system structures; Process management: processes, threads, CPU scheduling, process synchronization; Memory management and virtual memory; File systems; I/O systems; Security and protection; Case-study.

Suggested Lab work

Implementation of user-defined utilities/commands for UNIX by writing systems programs using different types of system calls including those for file/directory management, process management, signal management, and client/server management. Also involve practice on various aspects of shell environment and shell programming.

COSC 413 Computational Science and Numerical Methods

Prerequisite: MATH209

History and importance of computational science, overview of application areas, review of required skills. High-performance computing: processor architectures, memory systems for high performance, input/output devices, pipelining, parallel languages and architectures. Scientific visualization: presentation of results, data formats, visualization tools and packages. Application of high-performance computing to scientific and engineering problems.

b. Postgraduate Diploma in Computer Science

COURSE		TITLE	LT[1]	LB	CR		COURSE		TITLE	LT	LB	CR
PGCS	711	Introduction to Computing	2	0	2		PGCS	714	Data Structures and Algorithms Analysis	3	0	3
PGCS	733	Systems Analysis and Design	2	0	2		PGCS	734	Software Engineering	3	0	3
PGCS	721	Computer Organization	3	0	3		PGCS	722	Computer Architecture	3	0	3
PGCS	743	Web Applications Engineering I	2	3	3		PGCS	744	Web Application Engineering II	2	0	2
PGCS	761	Object Oriented Programming I	2	3	3		PGCS	762	Object Oriented Programming II	3	0	3
PGCS	751	Database Management Systems	2	3	3		PGCS	772	Operating Systems	2	3	3
PGCS	713	Discrete Structures	3	0	3		PGCS	79X	Elective II	2	0	2
PGCS	741	Data Communications and Networks	2	3	3		PGCS	700	Project	3	0	3
PGCS	79X	Elective I	2	0	2							
			20	**12**	**24**					**21**	**03**	**22**
Total credits required: 46												

Course Synopsis

Detailed catalog descriptions of the courses are provided in this section. Pre-requisite information and reference textbooks are also provided for each course.

PGCS 700 Project 3CU

Students will be expected to carry out a study in a relevant area of Computer Science and submit a report which involves the extensive use of programming and Computers. The project should lay emphasis on the application part of Computers in the society.

[1] **LT** stands for Lecture, **LB** stands for Laboratory and **CR** stands for the total credit units. As is standard, a three-hour lab is equivalent to one credit unit.

PGCS 711 Introduction to Computing 2CU

Information Concepts and Processing. Elements of a Computer System. Operating Systems. Computers and Communication. Programming Languages. Classification. Principles of Data Security. Maintenance and Trouble Shooting. Information Technology Applications.

PGCS 712 Discrete Structures 3CU

Functions and relations. Basics of counting: inclusion-exclusion principle, pigeon-hole principle, permutations, recurrence relations, generating functions. Graphs and trees: definitions, properties and applications. Discrete probability: computing probabilities, dependent and independent events, applications.

PGCS 714 Data Structures and Algorithm Analysis 3CU

Review of object-oriented concepts; Basic algorithm analysis - the big-O notation; Fundamental data structures – implementation strategies for stacks, queues and lists; Time and space analysis; Recursion; Time and space analysis; Implementation strategies for tree and graph algorithms; Hash tables; Time and space analysis;

PGCS 721 Computer Organization 3CU

Introduction to computer organization. Number system, Signed and unsigned number representation, character representation, ASCII code and UNICODE. Von Newman and bus model. Instruction format and types, memory and I/O instructions, Addressing Modes, Stack operations and interrupts. Datapath design and control unit design. Register Transfer Language, Microprogramming and Hardwire control. Reduced Instruction set and Complex instruction set computers

PGCS 722 Computer Architecture 3CU

Number system, Symbolic logic and truth functional calculus. Boolean Algebra and logic Gates ; minimization of completely and incompletely specified Boolean function; Combination circuits design; Combination logic with MSI and LSI; basic flip flops ; SR, JK, D & T Sequential circuits analysis and design. Sequential machine minimization. Registers. Counters and the memory units. Memory hierarchy and cache memory. Instruction pipelining, superscalar architecture. Parallel architectures and interconnection networks

PGCS 733 Systems Analysis and Design 2CU

The software development life cycle: conception, business case, business context, system requirements, requirements analysis, systems analysis, design,

implementation, testing, deployment, maintenance. The Unified Modeling Language (UML): models, use case diagrams, activity diagrams and state chart diagrams, sequence and collaboration diagrams, class diagrams, component diagrams. Managing the process: customers, organization types, project management, teams and team dynamics, computer assisted software engineering (CASE) tools, documentation.

PGCS 734 Software Engineering 3CU

Fundamental design concepts, design notations, and architectural design methods for large-scale software systems. Several designs: examples of their use, comparisons among them. Concepts of information hiding, data abstraction, concurrency, and object-oriented software construction.

PGCS 741 Data Communications and Networks 3CU

Introduction to computer networks and layered architectures: connectivity, topology, circuit and packet switching, TCP/IP and ISO models; Application layer: C/S model, DNS, SMTP, FTP, WWW, socket programming and network security; Transport layer: TCP and UDP, congestion control; Network layer: internetworking, addressing and routing algorithms and protocols; Data link layer: framing, flow and error control protocols, PPP, MAC and LANs; Physical layer: principles of data communications, circuit switching, coding, multiplexing and transmission media. Network security: fundamentals of cryptography, secret and public key algorithms, authentication protocols.

Suggested Lab work

The lab involves several projects to gain hands-on experience with network devices, programming and tools. More specifically, it provides students with the opportunity to: Setup various servers such as DNS, DHCP, Web Servers on Windows/Linux platforms; Develop simple client/server network applications using sockets; Create simple web pages; Simulate network; Analyze various protocols by capturing packets; Measure network utilization under varied situations; Use various network-related commands; Configure switches and routers.

PGCS 743 Web Application Engineering I 3CU

The Internet (network layers, TCP/IP, HTTP, Internet services) ; The Web architecture (Client-server architecture, multi-tier architecture, URL) ; XHTML; DHTML (Cascaded Style Sheet, JavaScript, DOM) ; Web interface and

interactivity design principles and practice. Incorporating multimedia content into Web pages (using Photoshop, Flash or similar tools).

PGCS 744 Web Application Engineering II 2CU

Server-side programming. Tools for dynamic Web Applications development. Integrating databases into Web applications. Developing Web applications with multiple users and multiple privileges. Cookies. Security issues in Web applications.

PGCS 751 Database Management 3CU

Basic database concepts. Conceptual modeling. Relational data model. Relational theory and languages. Database Design. Database security and integrity. Introduction to query processing and optimization. Introduction to concurrency and recovery.

Suggested Lab work

Programming assignments to learn database design using CASE tools. Introduction to back-end/Server-based Relational Database Management System (RDBMS). Learning Standard SQL (interactive/embedded). Introduction and programming assignments on Front-End tools. Programming team projects to design and develop real life database systems using the learned tools.

PGCS 761 Object Oriented Programming I 3CU

Overview of computers and computing; Introduction to object-orientation as a technique for modeling computation. Introduction of a typical object-oriented language, such as Java; Basic object-oriented concepts; Basic program building blocks; Arrays; Simple recursive algorithms; inheritance; polymorphism.

Suggested Lab work

Programming assignments leading to extensive practice in problem solving and program development involving the use of the various data structures implemented in the course.

PGCS 762 Object Oriented Programming II 3CU

Advanced object-oriented programming - polymorphism, abstract classes and interfaces; Program organization using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Recursion; Event-driven programming.

PGCS 772 Operating Systems 3CU

Fundamentals of operating systems design and implementation. History and evolution of operating systems; Types of operating systems; Operating system structures; Process management: processes, threads, CPU scheduling, process synchronization; Memory management and virtual memory; File systems; I/O systems; Security and protection; Case-study.

Suggested Lab work

Implementation of user-defined utilities/commands for UNIX by writing systems programs using different types of system calls including those for file/directory management, process management, signal management, and client/server management. Also involve practice on various aspects of shell environment and shell programming.

PGCS 791 Introduction to Artificial Intelligence 2CU

Introduction to the types of problems and techniques in Artificial Intelligence. Problem-Solving methods. Major structures used in Artificial Intelligence programs. Study of knowledge representation techniques such as predicate logic, non-monotonic logic, and probabilistic reasoning. Examples of expert systems. Introduction to natural language understanding and various syntactic and semantic structures. Expert systems. Introduction to computer image recognition.

PGCS 792 Introduction to Human Computer Interaction 2CU

What is HCI and why is it needed? Human information processing and human error Models of the user and interaction, Principles and application of user-oriented design, User-centered design methodologies, Interface technology, devices, styles and applications. Upstream usability engineering, task, user and situation analysis, Downstream usability engineering, experimental, interpretive and predictive evaluation. Visual and interface design guidelines, standards and metrics, Usability issues and the World Wide Web, Groupware and computer supported cooperative work.

PGCS 793 Simulation Methodology 2CU

Introduction to Simulation: terminology, types, models, classification, application areas, steps, merits/demerits. Discrete-event simulation, examples. Statistical models. Queuing models. Random numbers. Random variants. Input modeling.

PGCS 794 Professional and Social Aspects of Computing 2CU

Professional aspects; professions and the professional; professional institutions; professional ethics and responsibilities; the computer professional as expert witness. Standards, best practice. Legal background, sources of law; civil and criminal law. Intellectual property rights, software copyright, patents, designs, trademarks and passing off; copyright and webpages, Internet domain names, protection of computer imagers and icons, jurisdiction; confidentiality. Data protection law; freedom of movement of personal data; privacy in telecommunications. Computer crime; fraud; computer misuse; viruses; threatening emails; pornography; grooming in chat rooms. Social aspects of the workplace/society at large. The impact of IT on society.

c. M.Sc. Computer Science

1st Semester courses

Course Code	Course Title	Credit Units
COSC 801	Operating Systems	3
COSC 803	Advanced Computer Algorithms	3
COSC 805	Computer Communications and Networks	3
COSC 807	Modeling and Simulation of Computing	3
COSC 809	Advanced Database Systems	3
SCI 801	Management and Entrepreneurship	2
COSC881	Seminar (1 CU/Semester)	1
COSC891	Research/Thesis (3 CU/Semester)	3

2nd Semester

Course Code	Course Title	Credit Units
COSC 802	Software Engineering Methodologies	3
COSC 804	Advanced Computer Architecture	3
COSC 806	Design and Implementation of Programming Languages	3
COSC 808	Data Security and Encryption	3
COSC 812	Application Development for Internet Based Services (Elective)	3
SCI 802	ICT and Research Methodology	2
COSC882	Seminar (1 CU/Semester)	1
COSC892	Research/Thesis (3 CU/Semester)	3

COSC 801 Operating Systems 3CU

Structural design aspects of an operating system: process model, inter-process communication, synchronization mechanisms, resource management, and scheduling. Protection issues. Implementation issues of modern operating systems. Distributed operating systems. Deadlock detection, recovery, and avoidance. Case studies. Project(s).

COSC 802 Software Engineering Methodologies 3CU

Software engineering and its place as an engineering discipline. Life cycle of software system: Requirements analysis, development, operation and maintenance. Software metrics: Portability, Reusability, Correctness, Reliability, Efficiency, Usability, Integrity, Maintainability and Flexibility. Software quality and testing. Software architecture: architecture description languages, pattern-oriented software architecture, component based development, distributed software architecture using middleware, enterprise application integration, architecture for mobile and pervasive systems and model driven architecture. Advanced Modeling: UML extensions mechanisms, object constraint language and model checking. Software project management: Study of interpersonal process decision making styles, problem solving concepts and procedures, creative effort, conflict resolution, leadership and assessment. Concepts of motivation, team work and group dynamics. Software engineering and law: intellectual property law, professional ethics and code of conduct. Patents, trademarks, copyright, trade secrets, privacy, confidentiality, contracts and licensing, government regulations, global legal issues including internet law and cybercrime. Overview of open source software.

COSC 803 Advanced Computer Algorithms 3CU

Review of data structures; linear data structures, hashing, trees, graphs, recursion. Complexity classes; empirical measurement of performance; time and space tradeoffs analysis. Algorithmic strategies: Brute force algorithms; greedy algorithms; divide and conquer, back tracking; branch and bound; minimum spanning tree, heuristics; pattern matching and string/text algorithms; numerical approximation algorithms. Tractable and intractable problems

COSC 804 Advanced Computer Architecture 3CU

Advanced computer architecture including discussion of instruction set design (RISC and CISC), virtual memory system design, memory hierarchies, cache memories, pipelining, vector processing, I/O sub systems, co-processors, and multiprocessors architectures. Case studies of current systems.

COSC 805 Computer Communication and Networks 3CU

Channels and channel capacity, introduction to information theory; sharing network resources: telecommunications history; circuit switching and packet switching; multiplexing; FDM, TDM, statistical multiplexing; virtual circuits and datagrams; advantages and disadvantages; sharing the medium: Aloha, CSMA (persistent and non-persistent), CSMA-CD, token passing, CDMA, wireless LANs and simple performance analysis; dealing with errors: errors, coding and redundancy; hamming theory and codes; CRCs ARQ protocols: CR selective retransmission and flow control; internetworking and the internet: ISPs, datagram forwarding and the DNS; IPV4; addressing and forwarding; encapsulation and address resolution; TCP and UDP; ports and congestions controls; example applications; modeling data networks: services and protocols; layered architectures; the OSI 7-layer model; introduction to queue theory; physical media; LANs and bridging; WANs and point to point links; routing; addressing and routing in the internet; end to end communication in the internet; and application protocols. Cyber space technology: Cyber Crime, Cyber Security, and models of Cyber Solution

COSC 806 Design and Implementation of Programming Languages 3CU

Comparative study of the organization and implementation of a variety of programming languages and language features. Design principles are explored and applied in a historical review of major languages. Procedural, functional, logic based, object-oriented and parallel languages. Research issues such as polymorphism, formal semantics and verification explored in depth.

COSC 807 Modeling And Simulation Of Computing Systems 3CU

Basic probability and statistics. Review of discrete-event simulation tools and methodologies. Simulation languages. Random Number generation. Developing Simulation Models. Simulation Validation. Output Data Analysis. Applications to computer systems. Project(s).

COSC 808 Data Security and Encryption 3CU

Mathematical principles of cryptography and data security. A detailed study of conventional and modern cryptosystems. Zero knowledge protocols. Information theory, Number theory, complexity theory concepts and their applications to cryptography.

COSC 809 Advanced Database Systems 3CU

A brief introduction to database concepts: file systems and databases, and the relational database model; design concepts and implementation: entity relationship (E-R) modeling; normalization of database tables and structured query language; database design and implementation. Transaction management and concurrency control and distributed database management systems; database privacy, security, failure and recovery. Object oriented databases; client/server systems; data warehouse; data mining; databases in electronic commerce; web databases development and database administration

COSC 812 Application Development for Internet-Based Services 3CU

Introduction to internet, standards and specifications; survey of contemporary internet technologies; current internet tools; Designing and publishing a web server; WWW programming markup languages; Using alternative protocols in WWW, Adding multimedia features to the WWW; Server side programming, client programming and database programming for the web; Security and Privacy.

SCI 801 Management and Entrepreneurship 2CU

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

SCI 802 ICT and Research Methodology 2CU

Essentials of Spreadsheet, Internet Technology, Statistical Packages, precision and accuracy of estimates, principles of scientific research, concept of hypotheses formulation and testing, organization of research and report writing.

MATHEMATICS PROGRAMME

Details of Course Structure

a. B.Sc. Mathematics Programme

The table below gives the structure of the programme in terms of the number of core Departmental courses, General Studies courses, restricted and unrestricted elective courses for each of the four years of study.

Summary: B.Sc. Mathematics

	100 Level	200 Level	300 Level	400 Level	TOTAL
Core Courses (Departmental)	18	30	24	36	108
Cognate Courses (GENS)	3	2	2	0	7
Restricted Electives	2	3	0	0	5
Unrestricted Electives	11	6	3	6	26
TOTAL	34	41	29	42	146

The above summary table shows that *for a student to graduate he/she needs to register a total of at least 146 credit units of which 108 credits must be core.*

The following give a detailed breakdown of the courses in curriculum on a semester-by-semester basis.

100 Level – A minimum of 34 credit units

- Core courses (Departmental) : 18
- Cognate courses (General Studies) : 3
- Restricted Electives : 2
- Electives : 11
- TOTAL : 34

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH 101	Sets and Number Systems	2	O/L Maths
MATH103	Trigonometry and Co-ordinate Geometry	2	”
MATH105	Differential and Integral Calculus	2	”
COSC101	Introduction to Computer and Programming in Basic	2	”
PHYS111	Mechanics	2	O/L Physics.

2nd Semester

Code	Course Title	Credit Units	Prerequisite
MATH102	Algebra	2	O/L Maths.
MATH104	Conic Sections and Applications of Calculus	2	”
MATH106	Vectors and Dynamics	2	”
STAT102	Introductory Statistics	2	”

Cognate Courses (General Studies)

1st / 2nd Semester

Code	Course Title	Credit Units
GENS101	Nationalism	1
GENS103	English and Communication Skills	2

Restricted Elective

PHYS131	Heat and properties of matter	2	“

Unrestricted
1st / 2nd Semester
A minimum of thirteen (11) credit units chosen from any two (2) of the following subject areas: Biology, Chemistry, Geography, Geology, Physics, GENS102 and GENS104.

200 level – a minimum of 37 credit units

- Core Courses (Departmental) : 30
- Cognate Courses (General Studies) : 2
- Restricted Electives : 3
- Electives : 6
- Total : 41

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Unit	Prerequisite
MATH201	Mathematical Methods I	3	MATH105 or equiv
MATH203	Real Analysis I	3	MATH101 or equiv
MATH205	Abstract Algebra I	3	MATH101or equiv
MATH207	Linear Algebra I	3	MATH102 or equiv
MATH209	Numerical Analysis I	3	MATH104 or equiv

2nd Semester

Code	Course Title	Credit Unit	Prerequisite
MATH204	Real Analysis II	3	MATH105 or equiv
MATH206	Abstract Algebra II	3	MATH102 or equiv
STAT 202	Continuous Probability Distribution and Distribution techniques	3	STAT 102
COSC202	FORTRAN and Structured Programming	3	COSC 101 or equiv
MATH208	Linear Algebra II	3	MATH102 or equiv

Cognate Courses (General Studies)

Code	Course Title	Credit Unit	Prerequisite
GENS202	Entrepreneurship and innovation	2	

Restricted Elective

STAT211	Probability and probability Distributions	3	STAT102 or equiv

Electives at 200 Level

1st/2nd Semester
A minimum of six (6) credit units chosen from any two (2) of the following subject areas: GENS201, Biology, Chemistry, Education, Geography, Geology, Physics, Statistics and Computer Science, Education.

300 level – a minimum of 27 credit units

- Core Courses : 24
- Cognate Courses(General) : 2
- Electives : 3
- Total : 29

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH301	Mathematical Methods II	3	MATH201
MATH303	Advanced Real Analysis I	3	MATH203
MATH305	Theory of Rings and Fields	3	MATH205
MATH307	Complex Analysis I	3	MATH203
MATH309	Analytical Dynamics I	3	MATH106
MATH311	Mathematical Modeling	3	MATH105

Restricted Elective (General Courses)

GENS302	Business Creation and Growth	2	

Unrestricted Electives for 300 Level First Semester

Code	Course Title	Credit Units	Prerequisite
MATH313	Axiomatic Set Theory	3	MATH205
MATH315	Number Systems And Algebraic Structures	3	MATH205
MATH317	Numerical Analysis II	3	MATH104
and any other 300 level first semester courses in Statistics, Computer Science and other relevant Sciences.			

2nd Semester

Code	Course Title	Credit Units	Prerequisite
MATH300	SIWES	6	24/48ECU

400 level – a minimum of 42 credit units

- Core Courses : 36
- Electives : 6
- Total : 42

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH400	Project	3	MATH300
MATH401	Theory of Differential	3	MATH201
MATH403	General Topology I	3	MATH303
MATH405	Theory of Finite Groups	3	MATH305
MATH407	Advanced Real Analysis II	3	MATH303
MATH413	Hydrodynamics I	3	MATH301

List of Electives for 400 Level First Semester

Code	Course Title	Credit Units	Prerequisite
MATH415	Quantum Mechanics	3	MATH309
MATH417	Bio-Mathematics	3	MATH311
MATH425	Graph Theory and Combinatorics	3	MATH303
and any other 400 level first semester courses in Statistics, Computer Science and other relevant Sciences.			

2nd Semester

Code	Course Title	Credit Units	Prerequisite
MATH 400	Project	3	MATH300
MATH402	Functional Analysis	3	MATH303
MATH408	Measure and Integration	3	MATH304
MATH412	Partial Differential Equations	3	MATH201
MATH416	Complex Analysis II	3	MATH307
STAT412	Operations Research	3	STAT201

List of Electives for 400 Level Second Semester

Code	Course Title	Credit Units	Prerequisite
MATH404	General Topology II	3	MATH204
MATH406	Group Representations and Characters	3	MATH 206
MATH414	Hydrodynamics II	3	MATH301
MATH422	Differential Geometry	3	MATH204
MATH424	Electromagnetic Theory and Waves	3	MATH301
MATH428	Analytical Dynamics II	3	MATH309
and any other 400 level second semester courses in Statistics, Computer science and other relevant Sciences.			

Undergraduate syllabus for B. Sc. (hons.) Mathematics

100 Level Courses

MATH101 – Sets and Number Systems (2 Credit Units)

Prerequisite – O/Level Mathematics

Sets: Definition of a set, finite and infinite sets, equality of sets, subsets, union, intersection, universal set, complements, empty set, Venn diagram. Symmetric difference, power sets and De-Morgan theorems. Inclusion-Exclusion principle. Elements of relations and functions.

Some Properties of number systems: Natural numbers, integers, rationals, irrationals and reals. Order relations in the set of real numbers. Open and closed intervals on the number line.

Complex Numbers: Definition of a complex number, addition, multiplication and division. Geometric interpretation modulus and conjugation. Polar representation, De- Moivre's theorem, n^{th} roots of a complex number, n^{th} roots of unity.

MATH102 – Algebra (2 Credit Units)

Prerequisite – O/Level Mathematics

Quadratic and other polynomial functions: Elementary properties of quadratic expressions, roots of quadratic equations, application to symmetric functions, polynomial functions of third and fourth degrees, remainder theorem, location of roots.

Permutation and combination: Notion of Factorials, ${}^{n}P_{r}$, ${}^{n}C_{r}$, and simple applications, mathematical induction principle and applications.

Binomial Theorem: Expansion of all rational index, interval of convergence, approximations and errors.

MATH103 – Trigonometry and Coordinate Geometry (2 Credit Units)

Prerequisite – O/Level Mathematics

Circular Measures: Trigonometric ratios of angles of any magnitude, inverse trigonometric functions.

Addition formulae: Sin (A+B), cos(A+B), tan(A+B) and their proofs. Multiple and half angles, solutions of simple trigonometric equations. Factor formulae. Solution of triangles, heights and distances (including three-dimensional problems)

Plane Polar Coordinates: Relation between polar and Cartesian coordinates, plotting and sketching of simple curves whose polar equations are known.

Coordinate Geometry of lines and Circles: Pair of straight lines and system of circles. (Emphasis on concepts rather than formulae).

MATH104 – Conic Sections and Applications of Calculus (2 Credit Units)

Prerequisite – O/Level Mathematics.

Conics: Properties of parabola, ellipse, hyperbola, rectangular hyperbola, their Cartesian and parametric equations, problems involving elimination of parameters, tangents and normals.

Rate of Change: Velocity, acceleration and other rates.

Curve Sketching: Asymptotes, maxima and minima. Small increments, approximations and errors. Newton's approximation, simple application of integration to areas and volumes.

Differential equations: First order differential equations only.

MATH105 – Differential and Integral Calculus (2 Credit Units)

Prerequisite – O/Level Mathematics.

Functions of a real variable: Odd, even, periodic functions and their symmetries, graphs, limits and continuity (Intuitive treatment only)

Differentiation: First principle, techniques of differentiation in general. Higher derivatives.
Integration: Integration as the inverse of differentiation, techniques of integration in general, definite integral (Evaluation only).

MATH106 – Vectors and Dynamics (2 Credit Units)

Prerequisite – O/Level Mathematics

Vectors: Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar multiplication, linear independence and dependence of vectors. Scalar and vector products of vectors. Differentiation and integration of vectors w.r.t a scalar variable.
Dynamics: Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, elastic strings, simple pendulum, impulse. Impact of two smooth spheres, and of a sphere and a smooth sphere.

200 Level Courses

MATH201 – Mathematical Methods - I (3 Credit Units)

Prerequisite – MATH105 or equivalent

Applications of Calculus: Revision of different techniques of differentiation, successive differentiation, Leibnitz's theorem, Taylor and Maclaurin series. Tangents and normals to plane curves, curvature. Definite integrals: Methods of integration, reduction formulae, lengths of arc of a plane curve. Area enclosed by a plane curve.
Differential Equations: Concept of differential equations. Revision of solution of first order ordinary differential equations of the forms; variable separable, homogeneous, exact and linear. Second order ordinary linear differential equations with constant coefficients, auxiliary equation, and cases of auxiliary equations having distinct, equal, and complex roots, complementary functions and particular integrals in connection with non-homogeneous equations. Uses of the operator D = d/dx and the method of undetermined coefficients for calculating particular integrals. Differential equations of Euler's type of second order. Solutions of systems of two linear differential equations. Second order Ordinary Linear Differential Equations with variable coefficients; reduction of order, variation of parameters.
Partial Differentiation: Real valued functions of two and three variables. Partial derivatives, chain rule, Jacobian. Extrema, Lagrange's multipliers, increments, differentials and linear approximations.

MATH 203 – Real Analysis I (3 Credit Units)

Prerequisite – MATH105 or equivalent

Preliminaries: Properties of real numbers, algebraic and topological properties, identity theorem, density theorem for Q and R. Ordering and properties.

Boundedness: Boundedness and related simple results.

Relations and Functions: Cartesian products of sets.

Relations: equivalence relations, equivalence classes.

Functions: injective, surjective, bijective, inverse, composition of functions, monotone functions, graph of functions, algebraic operations on functions.

Sequences and series of Real Numbers: Sequences of real numbers, subsequences, bounded and unbounded sequences.

Limit of a sequence; limit superior and limit inferior, improper limits. Algebraic operations on sequences and their limits; Monotone sequences and properties. Cauchy sequences and related results.

Series of real numbers: partial sums, convergence, absolute and conditional convergences. Convergence tests: comparison, ratio, Ra'abe, De-Morgan and Betrand, logarithmic, Cauchy root test. Cauchy condition for the convergence of series, rearrangement of series.

MATH204 – Real Analysis - II (3 Credit Units)

Prerequisites – MATH 105 or equivalent

Real Functions of one Variable: Limits of functions. Improper limits (limits at + ∞ and -∞). Algebraic operations on limits of functions. Continuity of functions on sets and related results. Uniform continuity.

Derivatives: derivative of functions derivative of composition of functions. Higher order derivatives. Algebraic operations on derivatives of functions. Differentiability and some related results. Rolle's and Mean value theorems, Taylor's formula, L'Hospital's rule, local and global extrema, saddle points, monotonicity, geometrical interpretations.

Riemann Integration: Partition of an interval, refinement, Riemann sums, Riemann integrals, uniqueness of Riemann integral, Darboux integral of a real valued function, relation between Riemann and Darboux integrals.

MATH205 – Abstract Algebra I (3 Credit Units)

Prerequisite – MATH101 or equivalent

Logic and Methods of Proof: Sentential logic; statements, sentential connectives (negation, disjunction, conjunction, implication, equivalence), truth tables,

tautologies (or valid statement formulae), quantifiers. Methods of proof; indirect (or proof by contradiction) method, contrapositive proof, natural deduction.
Boolean algebra; basic definitions and some simple theorems.
Elementary Notion of Groups: Binary operations, closure, associativity, semigroup, identity, inverse, group axioms, commutativity. Elementary properties of a group. Abelian groups, symmetric group of degree n, permutations and permutation groups, symmetric group of regular polygon.

MATH206 – Abstract Algebra II (3 Credit Units)

Prerequisites – MATH102 or equivalent.

Group: Review of definition of a group, subgroups, criteria for subgroups, special subgroups, centralizer of an element, centre of a group, cosets, normal subgroups, quotient groups, conjugate elements and conjugacy relation, congruence relation modulo and subgroup H. Lagranges theorem. The class equation and applications.
Homomorphism of groups: Definition and examples of homormorphism, kernel, image, epimorphism, monomorphism, isomorphism. Isomorphic groups. Fermat and Cayley theorem. First isomorphism theorem.
Algebraic structures: Definition and examples of rings, fields, vector spaces and modulus.

MATH207 – Linear Algebra I (3 Credit Units)

Prerequisite – MATH102 or equivalent

Matrices: Definition, types of matrices, algebra of matrices, matrix as a sum of symmetric and skew symmetric matrices. Elementary operations of matrices and echelon form, equivalent matrices. Inverse of a matrix.
Systems of linear equations and matrices: Systems of m linear equations in n unknowns and their solutions. Gaussian elimination by pivot method and matrix representation. Solution of the system using Gaussian elimination and Gauss-Jordan reduction.
Determinants: Definition, evaluation of determinants. Cofactor expansion, inverse of a non-singular matrix. Solution of systems of linear equations using Cramer's rule.

MATH208 – Linear Algebra II (3 Credit Units)

Prerequisite – MATH102

Vector Spaces: Review of basic definitions and examples of vector spaces. Subspaces, linear dependence and independence. Bases, dimension of a vector space. Homomorphism and quotient space. Direct sum, Dual spaces.

Linear Mappings and Matrices: General linear transformation of n-dimensional into m-dimensional space, matrix representation of a linear map, similar matrices and change of basis. Eigenvalue and eigenvectors. Characteristic polynomial and characteristic equation. Caley-Hamilton theorem. Orthogonal diagonalisation
Canonical Forms: Primary decomposition theorem, Triangular Jordan and Rational forms for linear operator (square matrices). Quadratic and bilinear forms.

MATH209 – Numerical Analysis I (3 Credit Units)

Prerequisite – MATH105

Accuracy in numerical calculations: errors and their sources, error accumulation in different operations.
Finite differences: difference operators and difference table.
Evaluation of functions: using series approximation, solution of polynomial, algebraic and transcendental equations, curve fitting.
Interpolation: Newton's difference formulae, central difference formulae, Lagrange's formula. Numerical differentiation. Numerical Integration.

300 LEVEL COURSES

MATH301 – Mathematical Methods II (3 Credit Units)

Prerequisites – MATH201

Vector Fields: Revision of definitions and elementary results related to vectors; gradient, divergence and curl in different co-ordinate systems. Multiple integrals; areas and volumes, Surface and Line integrals; Stokes, Divergence theorem. Green's theorem.
Fourier Series: Definition, computation of Fourier coefficients, expansions of even and odd functions, change of period, half period expansion, Fourier transform.
Laplace Transform: Definition, elementary formulae, convolution theorem, application of solutions of ordinary differential equations.

MATH 303 – Advanced Real Analysis I (3 Credit Units)

Prerequisite – MATH 203

Point Set Theory: Theorem of nested intervals, accumulation and isolated points, Bolzano – Weierstrass theorem, closed and open sets, interior, exterior and boundary points of a set and related theorems. Cantor's decreasing set theorem. Lindeloff covering theorem and Heine-Borel theorem, Perfect sets, Cantor's ternary set and some of its properties.

Metric Spaces: Definition and examples of metric spaces, bounded sets, diameter of a set and distance between sets, open spheres or balls, open sets, neighbourhoods, interior, exterior, frontier, closed sets, accumulation point, closure of a set, convergence in metric spaces; Equivalent metrices, Cauchy sequence in metric spaces, complete metric spaces.
Real Functions of Several Variables: Introduction to n-dimensional Euclidean space R^n or E^n, neighbourhoods in R^n, Norm of a point in R^n, Minkowski's and Cauchy-Schwartz's inequalities, open balls and boundedness in R^n . Functions from R^n to R^m $(m < n)$, component
functions, linearity and related results. Limit of a function in R^n , notion of inner limits, simultaneous and repeated limits, existence theorems, uniform limit and Moore-Osgood theorem, continuity of functions in R^n, partial derivatives and differentiability, uniform partial derivatives. Higher order partial derivatives, Young's and Schwartz's theorems, Implicit function and Inverse function theorems. Mean Value theorems and Taylor's formula.

MATH305 – Theory of Rings & Fields (3 Credit Units)

Prerequisite – MATH206

Structure of Integers: Euclidean algorithm, g.c.d, primes, relative primes, unique factorization theorem (or Fundamental theorem of arithmetic).
Modules: Review of Definition, Abelian group as module over ring of integers. Submodules direct sum of submodules. Homomorphism of modules.
Rings: Review of basic definitions, types of rings, integral domains, skew fields and fields, subrings. Concrete examples of rings, homomorphism, isomorphism of rings, kernels, ideals, quotient rings. Integral domain, characteristics of an integral domain, finite integral domain as a field, example of an integral domain that is not a field. Prime fields and field of fractions. Euclidean rings, polynomial rings, division algorithm for polynomial rings, factorization theorems, unique factorization domains, rational test and Einstein criterion for irreducibility.
Quotient Rings and Fields: Ideals, Principal ideal domains. Quotient rings. Maximal ideals, Prime ideals.

MATH307 – Complex Analysis I (3 Credit Units)

Prerequisite – MATH203

Sequences and Series of Complex Numbers: Definition of sequences and series of complex numbers, properties of convergence, uniform and absolute convergence of sequences of complex numbers. Algebraic operations on limits of sequences.
Limit, Continuity and Differentiability of Complex Functions:
Definition of complex function. Properties of continuous complex functions.

Limit of a complex function and its properties. Continuity of a complex function. Differentiation of a complex function. Analytic and entire functions. Laplace and Cauchy-Riemann equations. Elementary functions (exponential, trigonometric, logarithmic, rational, power and hyperbolic functions). Harmonic functions.
Complex Integration: Definition and properties of complex integration. Contour integration: Integration of complex functions along a continuously Differentiable arc, along a piece wise differentiable arc and along a rectifiable arc. Cauchy integral theorem, Cauchy formulae, and Cauchy-Goursat theorem.

MATH309 – Analytical Dynamics I (Credit Units)

Prerequisite – MATH201

Introduction: Velocity and acceleration of a particle along curve, Radial and Transverse components of velocity and acceleration, Velocity and acceleration in 3-dimensional motion. Angular velocity Relative velocity.
Newtonian Mechanics: Newtonic law, Equation of motion for a particle. Conservation theorems for a system of particles.
Dynamical System: Representation of motion; constants; rigid body kinematics mechanics problems, the nature of Newtonian Mechanics.
Variational Principle: The principle of virtual displacement and virtual work. D'Alemberts principle.
Constraints:holomonic and non-holomonic constraints. Hamilton's principle. Generalized coordinates; Lagrange's equations, embedding constraints, formulation and Solution of problems by using Lagrange.

MATH311 – Mathematical Modelling (3 Credit Units)

Prerequisite – MATH201

Methodology of Model building: Identification, formulation and solution of problems. Cause-effect diagrams. Modeling using graphs and proportionality: modeling by interpolation using polynomials. Modeling using Least squares and Linear programming. Modeling deterministic behavior and probabilistic processes. Modeling using derivatives: applications using differential equations.

MATH 313 – Axiomatic Set Theory (3 Credit Units)

Prerequisite MATH 205

Elements of First Order Logic, Cantorian Set Theory, Intuitive Notion of Cardinals and Paradoxes, Evaluation of Axiomatic Method, Properties of Axiomatic: Consistency, independence, and completeness. Examples.
Axioms of Set Theory: Extensionality, Pairing, Comprehensions, Power Set, Infinity, Replacement, Regularity, and Choice.

MATH315 – Number Systems and Algebraic Structures (3 Credit Units)

Prerequisite-MATH 205

Division and Factorization properties for positive integer multiplicative arithmetical functions e.g Euler's φ-function.The mobius function μ. Linear congruences, residue sets (mod m). Euler's theorem. Fermat's theorem. Chinese remainder theorem. The ring Z_m of residue classes (mod m).

Algebraic congruences, primitive roots, indices with respect to a primitive root. Quadratic and high power residues. The Legendre and Jacobi symbols. Gauss Law of quadratic reciprocity. Representative of integers by binary quadratic forms. Diophantine equation like ax +by =c, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$, e.t.c.

MATH317 – Numerical Analysis II (3 Credit Units)

Prerequisite – MATH 209

Solution of simultaneous equations and other linear system of equations: Eigenvalues and Eigenvectors. Numerical solutions of ordinary differential equations: Euler's, Picard's, Taylor's and Runge-Kutta methods, prediction – corrector methods. Matrices and Determinants. Introduction to numerical solution of partial differential equations.

400 Level Courses

MATH401 – Differential Equations (3 Credit Units)

Prerequisite – MATH 201

Sturm-Liouville Problem; orthogonal polynomials and functions. Gamma and Beta functions of complex variables.

Ordinary Differential Equations; Series solutions of second order linear differential equations. Solutions of Legendre and Bessel (first kind only) equations; Legendre and Bessel's polynomials. Problem of existence of solutions, existence and uniqueness theorems. Dependence of solutions on initial parameters. Linear and non-linear systems.

Integral Equations; classification, Volterra and Fredholm types. Solutions using Laplace and Fourier transform. Reduction of an O.D.E. to an Integral Equation. Stability; Lyapunov function.

MATH402 – Functional Analysis (3 Credit Units)

Prerequisite: MATH303

Metric Spaces: Separability, Completeness and compactness, contraction mapping theorem. Arzela – Ascoli lemma. Stone-Weierstrass theorem.
Normed Spaces: Linear spaces, Norm function, Normed Linear boundedness principle. Open mapping and closed graph.
Hilbert Spaces: Definition and examples of Inner product spaces and Hilbert spaces, projection theorem, Riez representation theorem.

MATH 403 – General Topology I (3 Credit Units)

Prerequisite MATH303

Topological Spaces: Definition and examples of topological spaces, open and closed sets, neighborhoods, limits (cluster) points, interior and closure of a set, boundary, coarser and finer topologies, Bases and Sub-basis. Subspaces of Topological spaces. Product topology. Quotient topology. First and second countable spaces. Separable spaces. Separation axioms. Topology of metric spaces. Convergence of sequence in a topological space, pointwise and uniform convergence, limit of functions at given points. Limit of functions in first countable Hausdorff spaces.
Continuous mappings: Continuity in metric spaces, Open and closed mappings, Homeomorprohism. Topological invariants.
Connectedness: Union, product, closure of connected sets Intervals as connected subsets of the real line. Image of connected sets under continuous mappings. Connected components.

MATH404 – General Topology II (3 Credit Units)

Prerequisite – MATH 303

Compactness: Lindeloff spaces, finite intersection property. Bolzano – Weierstrass property, sequential compactness, countable compactness, Relatively compact sets, compact subspaces of T_2 – spaces, local compactness and compactification theorem. Continuous mappings of compact sets; images of compact sets , continuous mappings on compact sets ranged in R^n. Closed subspaces of compact spaces; compact subset of R^n.
Metrizable spaces: Urysohn's Lemma, Urysohn's metrization theorem.

MATH405 – Theory of Finite Groups (3 Credit Units)

Prerequisite MATH 305

Arithmetic Structures of groups: Definition and example of p-groups. Sylow p-subgroup, Sylow's theorems (proofs and applications). Determination of all groups of low order, up to order 15.
Isomomorphism theorems: First, second and third isomorphism theorems, Free groups, Groups of automorphisms. Group action on a set. Burnside lemma. Structure theory of Abelian groups. Free Abelian groups.
Normal Structure of groups: Composition series, derived series, Jordan – Hölder theorem. Soluble and Nilpotent groups.

MATH406 – Group Representations and Characters (3 Credit Units)

Prerequisite – MATH305

Introduction: Historical background. Types of representations, permutations, automophism and matrix (principle, linear and faithful), equivalent representations, G – submodules, G – homomorphisms.
Reducible representation: Reducibility and G – submodules, irreducibility, Maschke's theorem. Complete reducibility and direct sum of G – submodules. Canonical decomposition of representations. The regular representation. The Schur's Lemma. The commutant algebra. Tensor products of matrices. The group algebra (KG). Decomposition of the regular representations. Number of inequivalent irreducible representations of a group is equal to the number of the distinct conjugacy classes. Lifting process, induced representation.
Character Theory: Definition and elementary properties of characters, class function, orthogonality relations, character relations of the first and second kind. Linear characters, irreducible characters. The character table, induced characters, lifted characters.

MATH 407 – Advanced Real Analysis II (3 Credit Units)

Prerequisite – MATH303

Uniform Convergence of Sequences and Series of Functions: Pointwise and uniform convergences, Cauchy's general principle of uniform convergence, test for uniform convergence; M_n -test, Weistrass M-test, Abel's test, Dirichlet's test. Uniform convergence and continuity, Dini's theorem. Integrability of uniform limit of a uniformly convergence series of integrable functions, term by term integration.
Uniform convergence and differentiability. Weierstrass's continuous non-differentiable function. Uniform convergence of power series.

Functions of Bounded Variation and their Properties: Variation function of a function of bounded variation, Jordan's theorem.
Riemann – Stieltjes Integral: Stieltjes integral and its various generalizations, conditions of integrability, integration by parts. First mean value theorem, second mean value theorem. Differentiation under the integral sign.

MATH408 – Measure and Integration (3 Credit Units)

Prerequisite – MATH 303

The Lebesgue Measure on the real line: Outer measure, measurable sets, σ-algebra. Measurability of sets. Measurability of open sets, properties of Lebesgue measure and Lebesgue measurable sets, construction of a non-measurable sets. Cantor's set. Measurable functions.
Lebesgue Integral: Review of Riemann Integral. The Lebesgue integral of a bounded measurable function. Lebesgue theorems of boundeded monotone and dominated convergence. Egoroff's theorem. Fatou's Lemma. Extension of definition of Lebesgue integral to an unbounded measurable function. The analogues for infinite series. Integral over an unbounded set.

MATH 412 – Partial Differential Equations (3 Credit Units)

Prerequisite - MATH 201

Basic concepts. Theory and solutions of first and second order linear equations; wave, heat and Laplace equations in Cartesian and polar coordinates, classifications, characteristics, canonical forms. Cauchy problems. Elliptic equations; Laplace and Poisson formulae, solution in cylindrical, polar and spherical coordinates. Hyperbolic and parabolic equations. Green's function, harmonic function, properties.

MATH413 – Hydrodynamics I (3 Credit Units)

Prerequisite – MATH301

Kinematics of Fluids: Lagrangian and Eulerian methods of treating motion of fluids. Steady and unsteady flows. Streamlines. Resolution of fluid motion into translation, rotation and deformation. Irrotational motion. Velocity potential. Fluid acceleration in Eulerian method. Acceleration components in Cartesian cylindrical and spherical polar coordinates. The significance of the operator D/Dt. V. condition for a boundary surface.
Conservation of Mass: Principle of conservation of mass of a fluid element. Equation of continuity in Cartesian, cylindrical and spherical polar coordinates. The Laplacian equation $V^2 = 0$ for steady, irrotational and incompressible flows. The concepts of stream function for steady two-dimensional, incompressible flows.

Cauchy-Riemann relations and the complex potential $w = \phi + i\psi$. Equation of streamlines as ψ = constant. Circulation.
Sources, Sinks, Doublets, Vortices: Definitions of source and sinks in two and three dimensions. Velocity potentials due to (i) a three dimensional source (or sink), (ii) a three dimensional doublets. Complex potentials due to two dimensional sources and doublets. Complex potential due to a two-dimensional vortex. Concept of image of a simple source with regard to a plane.
Equations of Motion: Euler's dynamical equations. Lagrange's integration of Euler's equations (so called Bernoulli's equation) Bernoulli's equation for (I) steady incompressible flows, and (ii) steady, compressible adiabatic flows.
Irrotational Motion in Two Dimensions: Introduction. Boundary conditions for a moving cylinder. Flow due to translation motion of a right circular cylinder. Flow of liquid past a circular cylinder. Force on a cylinder due to a uniform stream past it. D'Alembert's paradox. Effect of a constant circulation about a circular cylinder placed in a uniform stream. Initial motion due to sudden movement of two co-axial cylinder.

MATH414 – Hydrodynamics II (3 Credit Units)

Prerequisite – MATH301

Irrotational Motion in Three dimensions: Motion symmetrical about an axis Stokes's tream function. Values of Stokes's stream function in case of simple source and of a doublet. Motion of a sphere through a liquid at rest and at infinity. Liquid streaming past a fixed sphere. Motion of liquid inside a rotating ellipsoidal shell.
Water Waves: Introduction. Mathematical representation of a wave motion. Preliminary definitions, Standing or stationary waves. Surface waves. Simple harmonic surface waves. Paths of particles below surface waves. Deep water surface waves. Paths of particles below stationary waves. Group velocity. Wavelength and wave velocity.
Viscous Flows and Boundary-Layer Theory: Viscosity. Stresses in fluid motion. Stress-strain relation for a Newtonian fluid, Navier-stokes equations. Equation of motion in cylindrical and spherical polar coordinates. Reynolds number Steady flow of viscous fluids between parallel plates. Hagen-Poiseulle flow. Couette flow. Flow in tubes of cross-section other than circular. Steady motion of fluid due to a slowly rotated sphere. Boundary-layer concept. Boundry-layer equations and flow along a flat plate. Boundary-layer thickness. Dependence of boundry-layer on Reynolds number. Some simple exact solutions of boundary-layer equation. Unsteady flow due to a suddenly accelerated plane wall-Stokes's first problem.

MATH415 – Quantum Mechanics (3 Credit Units)

Prerequisite- MATH309

Experimental observations. Bohr's model of the atom and classical quantization. Uncertainty and complementary principles. Hermitian operators. Eigenvalues and eigenvectors. The commutation relation $[x,y]=ih/2\pi$. Schrödinger equation. One-dimensional square-well potential, infinite barriers. Differential equation and operator methods for linear harmonic oscillator. 3-dimensional central potentials, hydrogen atoms. Differential and scattering cross-sections. Laboratory and centre of mass frames. Partial wave analysis of the scattering amplitude.

MATH416 – Complex Analysis II (3 Credit Units)

Prerequisite – MATH307

Taylor and Laurent series expansions. Isolated singularities and residue. The residue theorem and some of its consequences. Maximum modulus principle. Argument principle. Rouche theorem. The fundamental theorem of algebra. Principle of analytic continuation. Morera's theorem. Cauchy-Liouville theorem. Conformal and bilinear mappings. Multiple-valued functions and Riemann surfaces.

MATH417 – Biomathematics (3 Credit Units)

Prerequisite – MATH311

The role of Mathematics in Biology and Medicine: Introduction and examples of some models.

Mathematical Ecology: Mathematical models in ecology; Growth and decay of populations, isolated populations poisoned by their own metabolic products; Prey-predator models; Models for competition between the species. Differential equations of ecology. Stochastic models in ecology.

Mathematical genetics: Genetic matrices. Hardy-Weinberg law. Baye's theorem and its application in genetics. Mathematical theory of epidemics. Some simple epidemic models. Determinstic models (i) with removal and (ii) with no removal and migration. Stochastic models.

Mathematical models for the brain: Moculloch and Pitts models Stochasitc models.

MATH422 – Differential Geometry (3 Credit Units)

Prerequisite – MATH301

Curves: Type of curves, Serret-Frenet formulae, natural equations, Local surfaces; fundamental forms, curves on surfaces, porallelism, normal forms, principal, Gauss and mean curvatures, special sufaces, Gauss and Codazzi-Mainardi equations, geodesics, isometries. Global surfaces; surfaces in Euclidean space, ovaloids, Gauss-Bonnet theorem, shortest connecting curves, convex surfaces.

MATH424 – Electromagnetic Theory and Waves (3 Credit Units)

Prerequisite – MATH301

Electrostatics; conductor, surface charge, capacitors, uniqueness theorem, minimum energy theorem, Green's reciprocal theorem, Dielectrics, Magnetostatics; two dimensional problems, steady currents, Fields, field energy, reciprocal theorem, circuits, magnetic media. Electrodynamics; Maxwell's equations, energy, forces and momentum relations in the electromagnetic field. Electromagnetic waves; wave equation and place waves.

MATH425 Graph Theory and Combinatorics (3 Credit Units)

prerequisite- MATH 303

Graphs: Varieties of graphs, degrees, Extrema graphs, intersection graphs, operations on graphs.
Trees: Characteristics, centers and centroids, matroids.
Transversality: Eularian and Hamiltonian graph, line graphs and Transversality.
Enumeration of Graphs: Labeled graphs, polya's enumeration theorem.
Enumeration of graphs and trees.
Digraphs: Digraphs and connectedness. Directional duality and acyclic diagraphs. Digraphs and matrices. Tournaments.

MATH428 – Analytical Dynamics II (3 Credit Units)

Prerequisite- MATH309

Integrals: The meaning of integrals, Jacobi's integral. Noetherian forms and moment integral.
Stability: Definition and variational equation, indirect and direct methods of Lyapunov. Applications.
Celestial Problems: Central force problem, Apsidal, The n-body problem, the 2-body problem. Impulsive motion. Fundamental EQUATION. Impulsive motion theorem, Lagrange's equations of impulsive motion.

b. MS.c Mathematics

1st Semester

Course Code	Course Title	Credit Units
MATH801	Algebra	3
MATH803	Functional Analysis	3
MATH805	Partial Differential Equations	3
MATH807	Space Dynamics	3
SCI801	Management and Entrepreneurship	2
MATH881	Seminar (1 CU/Semester)	1
MATH891	Research/Thesis (3 CU/Semester)	3

2nd Semester

MATH802	Algebraic Topology	3
MATH804	Advanced Complex Analysis	3
MATH806	Advanced Set Theory	3
MATH808	Computational Fluid Dynamics_	3
SCI 802	ICT and Research Methodology	2
MATH882	Seminar (1 CU/Semester)	1
MATH892	Research/Thesis (3 CU/Semester)	3

Electives

1. MATH 809: Linear and Non-Linear Programming 3 Credit Units
2. MATH 812: Group Representation Theory 3 Credit Units
3. MATH 814: Algebraic Theory of Semigroup 3 Credit Units
4. MATH 816: Advanced Differential Equations 3 Credit Units

Syllabus For M.Sc. Mathematics

The details of the topics to be covered under the courses mentioned above are given below.

MATH 801 Algebra 3CU

Sylow theorems, direct products, fundamental theorem of finite Abelian groups, field of quotients, Euclidean rings, Polynomial rings over commutative rings, inner product spaces, theory modules, sub-modules, quotient modules, modules over principal ideal domains. Applications finitely generated Abelian group fields extension fields elements of Galois theory, solvability radicals.

MATH 802 Algebraic Topology 3CU

Review of categories and functors. Homology, fundamental group, covering transformation, simplical complexes. Singular homology, Universal co-efficient theory for homology and cohomology. Spectral sequence.

MATH 803 Functional Analysis 3CU

Measures and integration. Outer measure. Lesbegue Measure. Basic properties of Banach and Hilbert spaces. Operators, Duality. Basic theorems in functional analysis. Classical Banach spaces. Spectral theory of Operators in Hilbert spaces. $\boldsymbol{L}_2$ space as a Hilbert space. Banach algebras. Gelfand theory, compact operators. Examples and applications to classical analysis.

MATH 804 Advanced Complex Analysis 3CU

Periodic functions, Weierstrass functions, elliptic curves. Modular forms. Algebraic functions, Reimann surfaces. Covering surfaces, covering transformations. Discontinuous groups of linear transforms, automorphic forms.

MATH 805 Partial Differential Equations 3CU

Basic examples of linear partial differential equations and their fundamental equations and their fundamental solutions. Existence and regularity of solutions (Local or Global) of the Cauchy problems; boundary value problems and mixed boundary value problems. The fundamental solutions of their partial differential equations.

MATH 806 Advanced Set Theory 3CU

Review of Naive (Cantorian) Set Theory, Paradoxes, Type Structures, Culmination into axiomatic. Introduction to first-order logic: Syntax and Semantics. Axioms of Set Theory (ZF - Axioms) Extensionality, pairing, power set, comprehension, replacement, foundation, infinity, choice, arguments for these axioms. Intuitive theory of cardinals: countable and uncountable sets, fundamental theorem for demonstrating countability, Proof of Schroeder - Bernstein Theorem, cardinal arithmetic, continuum hypotheses. Ordered Relations and Ordered sets properties of orderings, lattices and Boolean algebra, well-ordered sets. The Axiom of choice, Well-ordering theorem, Maximal principles and Zorn's Lemma. Some consequences of the axiom of choice, the axiom of determinacy, introductory concept of forcing.

MATH 807 Space Dynamics 3CU

The Solar System, The general three-body problem, Equations of motion, integrals of 3-body problem, The restricted three-body problem, Equations of motion, Liberation points, Hill & limiting surface Stability of liberation points, The N-body problem, Equations of motion, Integrals of the N-body problem. Perturbation Theory, Equations of pertubated motion, Evolution of orbit due to atmospheric resistance, Influence of the celestial bodies on the motion of the satellites. Artificial Satellites.

MATH 808 Computational Fluid Dynamics 3CU

Basic concepts in flow through porous media, convection, numerical solution of fluid flow in a vertical channel filled with porous matrix: Using fixed grid and variable grid finite difference technique, under thermal boundary condition of first, second and third kind. Solution of fluid flow in a composite vertical channel partially filled with porous matrix and partially filled with clear fluid: using finite difference technique, flow behaviour in a vertical annulus filled with porous matrix having thermal boundary condition of mixed kind, mathematical modeling of wall conduction effect on flow mechanism in a composite vertical channel, some closed form solution of flow through porous media.

MATH 809 Linear and Non-Linear Programming 3CU

Optimization Problems – types, size, solution, algorithms and convergence of algorithms. Linear programming problems–definitions, connected with LPPs, formulation of LPPs, examples, diet problems, manufacturing problems, transportation problems, fundamental theorem of linear programming. The simplex algorithms – computational procedure and optimality condition theorem, two phase and big M methods, procedures of resolving cycling due to degeneracy. The revised simplex algorithms–Computational procedures and algorithms.

Duality in LPPs – Interpretation and examples, interpretation of duality in diet, manufacturing and transportation problems etc., duality theorem of LPP, simplex multipliers and sensitivity complimentary slackness theorems. Dual simplex method – Computational procedure and examples. Primal dual algorithm - Computational procedure and examples**,** primal dual optimality theorem Nonlinear programming – general NLPP and Lagrange multiplier method for problems having equality constraints, Kuhn – Tucker conditions for non-equal constraints. Quadratic programming – Wolfe's modified simplex method and examples, Beale's method and examples. Separable Convex programming – Piecewise linear approximations and separable programming algorithms, examples.

MATH 812 GROUP REPRESENTATION THEORY 3CU

Representations of groups by linear transformations; group algebras, character theory and modular representations. Representation theory of algebraic groups; representation of finite groups; representation of compact and locally compact groups; representation of Lie groups. Unitary representation theory.

MATH 814 Algebraic Theory of Semigroups 3CU

Regular Semigroups 0-Simple Semigroups, completely 0-Simple Semigroups, Clifford Semigroups, Inverse Semigroups, free Semigroups, free products Semigroups, locally inverse Semigroups, Bisimple inverse Semigroups, Representation of Semigroups, amalgamation Semigroups, congruence on Semigroups, Transformation Semigroups.

MATH 815 Advanced Differential Equations 3CU

General First Order Differential Equation: Initial value problem. Existence of Approximate solution. Ascoll's Theorem and Cauchy-Peano Theorem on the existence of solutions of the initial value problem. Lichchitz condition and uniqueness of solution. Picard iterates and Picard-Lindel Theorem. Higher Order equations, Formulation as a system of first order equation. Existence and uniqueness of solution. System of Linear Differential Equations. Different metrics on matrices. Consistent norms on matrices. Exponential and logarithms of matrices. Fundamental matrices for linear homogeneous system of differential equation. Non-homogeneous system and solution in terms of fundamental matrices. Linear Differential Equations with constant coefficients. Stability Theory for Linear System. Concepts of stability, uniform stability, asymptotic stability and uniform asymptotic stability and their relationship for linear system.

SCI 801 Management and Entrepreneurship 2CU

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving

SCI 802 ICT And Research Methodology 2CU

Essentials of Spreadsheet, Internet Technology, Statistical Packages, precision and accuracy of estimates, principles of scientific research, concept of hypotheses formulation and testing, organization of research and report writing.

STATISTICS PROGRAMME

Details of Course Structure

a. B.Sc. Statistics Programme

The table below gives the structure of the programme in terms of the number of core Departmental courses, General Studies courses, restricted and unrestricted elective courses for each of the four years of study.

SUMMARY: B.Sc. Statistics

	100 Level	200 Level	300 Level	400 Level	TOTAL
Core Courses (Departmental)	16	30	21	33	100
Core Courses (GENS)	3	2	2	0	7
Restricted Electives	0	0	3	0	3
Unrestricted Electives	13	8	3	6	30
TOTAL	32	40	29	39	140

The above summary table shows that ***for a student to graduate he/she needs to rigister a total of at least 143 credit units of which 100 credits must be core.***

The following give a detailed breakdown of the courses in curriculum on a semester-by-semester basis.

100 Level – A Minimum of 32 Credit Units.

- Core courses (Departmental) : 16

- Core courses (General Studies) : 3
- Electives : 13
- Total : 32

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH 101	Sets and Number Systems	2	O/Level Maths
MATH 103	Trigonometry and Co-ordinate Geometry	2	”
MATH 105	Differential & Integral Calculus	2	”
COSC 101	Introduction to Computing	2	”

2nd Semester

Code	Course Title	Credit Units	Prerequisite
MATH102	Algebra	2	0/Level Maths
MATH104	Conic Sections and Application of Calculus	2	”
MATH106	Vectors and Dynamics	2	”
STAT 102	Introductory Statistics	2	”

Cognate Courses (General Studies)

1st / 2nd Semester

Code	Course Title	Credit Units
GENS101	Nationalism	1
GENS103	English and Communication Skills	2

Electives at 100 Level

1st / 2nd Semester

A minimum of thirteen (13) credit units chosen from any two (2) 100 level courses of the following subject areas: Biology, Chemistry, Geography, Geology, Physics and STAT 101, GENS102and GENS104, depending upon the resources available.

200 Level – A Minimum of 40 Credit Units

- Core courses (Departmental) : 30
- Core courses (General Studies) : 2
- Electives : 8
- Total : 40

Core Courses (Departmental)

1st Semester

Code	Course Title	Credit Units	Prerequisite
MATH201	Mathematical Methods I	3	MATH 105
MATH203	Real Analysis I	3	MATH101
MATH207	Linear Algebra I	3	MATH 103
MATH209	Numerical Analysis I	3	MATH105
STAT201	Discrete probability Distributions	3	STAT102

2nd Semester

CODE	Course Title	Credit Units	Prerequisite
STAT 202	Continuous Probability Distribution and Distribution techniques	3	STAT 102
STAT 204	Biometry I	3	STAT 102
MATH 204	Real Analysis II	3	MATH105
MATH 208	Linear Algebra II	3	MATH 102
COSC 202	Fortran and Structured Programming	3	COSC 101

Cognate Courses (General Studies)

CODE	Course Title	Credit Units
GENS 202	Entrepreneurship and innovation	2

Electives at 200 Level

1st / 2nd Semester

A minimum of eight (8) credit units chosen from any two (2) of the following subject areas: Biology, Chemistry, Education, Geography, Geology, Physics, Mathematics and Computer, GENS201, science depending upon the resources available.

300 Level – A Minimum of 29 Credit Units

- Core courses : 21
- Restricted electives : 3
- Cognate Courses(General) : 2
- Electives : 3
- Total : 29

Core Courses

1st Semester

Code	Course Title	Credit Units	Prerequisite
STAT 301	Sampling Distribution And Testing Of Hypothesis	3	STAT 201
STAT 303	Linear Statistical Inference and Analysis of Variance	3	STAT 102
STAT 305	Design and Analysis of Experiments I	3	STAT 102
STAT 307	Advanced Probability Theory I	3	STAT 201
STAT 311	Sampling Techniques I	3	STAT 102

2nd Semester

Code	Course Title	Credit Unit	Prerequisite
STAT300	SIWES	6	ECU 24/48

Cognate Elective

MATH311	Mathematical Modeling	3	MATH 105

Cognate Courses (General Studies)

Code	Course Title	Credit Unit	Prerequisite
GENS302	Business Creation and Growth	2	

Electives at 300 Level

1st Semester

Code	Course Title	Credit Units	Prerequisite

STAT309	Industrial statistics	3	STAT202
STAT 313	Decision Theory	3	STAT 102
STAT 315	Educational Statistics	3	STAT 102
STAT 317	Biometry II	3	STAT 204
or any other 300 level first Semester courses in Computer Science, Mathematics, and other relevant sciences			

400 Level – A Minimum of 42 Credit Units

- Core Courses : 33
- Electives : 6
- Total : 39

Core Courses

1st Semester

Code	Course Title	Credit Units	Prerequisite
STAT 400	Project	3	STAT300
STAT 401	Non Parametric Statistical Methods	3	STAT 301
STAT 403	Regression Analysis	3	STAT 303
STAT 405	Stochastic Processes	3	STAT 307
STAT 407	Design and Analysis of Experiment II	3	STAT 305
STAT 409	Demography	3	STAT 102

2nd Semester

Code	Course Title	Credit Units	Prerequisite
STAT 400	Project	3	STAT300
STAT 402	Multivariate Analysis	3	STAT 201
STAT 404	Time Series Analysis	3	STAT 303
STAT 406	Sampling Techniques II	3	STAT 311
STAT 408	Statistical Inference	3	STAT 201

Electives at 400 Level

1st Semester

Code	Course Title	Credit Unit	Prerequisite
STAT 411	Bayesian Inference	3	STAT 303
STAT 413	Psychometrics	3	STAT 301
STAT 415	Advanced Probability Theory II	3	STAT 307
STAT 417	Econometrics	3	STAT 301

MATH417	Bio-Mathematics	3	MATH 311
Or any other 400 level first semester courses in Mathematics, Computer Science and other relevant sciences.			

2nd Semester

Code	Course Title	Credit Unit	Prerequisite
STAT 412	Operation Research	3	MATH 311
STAT 414	Actuarial Science	3	
STAT 416	Industrial Statistics II	3	STAT 309
or any other 400 level second semester courses in Mathematics, Computer Science and other relevant sciences.			

Syllabus for B.Sc. (Hons.) Statistics

STAT 102 Introductory Statistics II (2 Credit Units)

Prerequisite – O/Level Mathematics.

Random experiment, Sample space, event space, definitions of probability, conditional probability, addition and multiplication theorems, definition of random variable (discrete and continuous), mathematical expectations of a random variable, addition and multiplication theorems of expectation, definition of moment, relationship between raw moments and central moments, the bivariate frequency distribution, fitting of curves by method of least squares, concepts of correlation and regression and their coefficients, the rank correlation coefficient.

200 LEVEL COURSES

STAT 201 – Discrete Probability Distributions (3 Credit Units)

Prerequisite – STAT 102.

Brief revision of various definitions of probability. Baye's theorem, concepts of probability function, probability density function, cumulative probability density function and moment generating function. Univariate discrete probability distributions such as Bernoulli distribution, Binomial and Poisson distribution, type I and type II, geometric distributions, negative binomial distribution, hyper geometric distribution, various properties of all these distributions, fitting of binomial, Poisson and geometric distributions.

STAT 202 –Continuous Probability Distribution and Distribution techniques (3 Credit Units)

Prerequisite – STAT 102

Univariate continuous probability distributions such as Normal, Uniform, exponential, type I and type II, beta and gamma distributions, various properties of these distributions, fitting of normal distribution. Concept of Bivariate probability distribution; joint, marginal, conditional probability distribution covariance and variance of bi-variate r.v. Sampling distribution and standard errors of statistics. Distribution functions of random variables using the techniques such as cumulative distribution, moment generating function techniques and transformation techniques.

STAT 204 – Biometry – I (3 Credit Units)

Prerequisite – STAT 102

Purpose, history and structure of biological assays. International standards. Statistical science and biological assays. Types of biological assays. Nature of direct assays. The dose-response curves, parallel line assays, potency ratio and calibration curves.

300 Level Courses

STAT 300 SIWES

It is a six months practical training course to be undertaken by each student in an industry after the completion of the first semester of 300 level. The scheme is called Students Industrial Work Experience Scheme (SIWES). At the end of the training the student is required to submit a report about what he/she has learnt during this practical industrial training.

STAT 301 – Sampling Distribution and Testing of Hypothesis (3 Credit Units)

Prerequisite – STAT 202

The chi-square, t and F distributions, properties of these distributions and inter-relationship between them. Concept of statistical hypothesis, null hypothesis, alternative hypothesis (one sided and two sided), level of significance and critical region. Basic steps of testing hypothesis, simple and composite hypothesis, type I and type II errors, power of a test, Neyman-Pearson fundamental lemma, Large sample tests such as normal test for testing of proportions and means, applications of chi-square, t and F distributions in testing of hypothesis.

STAT 303 – Linear Statistical Inference and Analysis of Variance (3 Credit Units)

Prerequisite – STAT 102

Estimation of regression parameters under linear models, testing of hypothesis about regression parameters. The Gauss-Markov theorem, selection of best regression (case of only one predictor variable), analysis of variance (ANOVA), fixed, random and mixed effect models, assumption underlying ANOVA, one-way, two-way and incomplete three-way classifications, analysis of covariance.

STAT 305 – Design and Analysis of Experiments I (3 Credit Units)

Prerequisite – STAT 102

Basic concepts such as experiment, treatment, experimental unit, experimental error, basic principles, randomization, replication and local control, the completely randomized design (CRD), randomized block design (RBD) and latin square design (LSD), layout and analysis, missing plot technique in RBD and LSD, Orthogonal Latin square design, layout and analysis of 2^n factorial experiments carried out in RBD, confounding, simple notion of balanced incomplete block design (BIBD).

STAT 307 – Advanced Probability Theory I (3 Credit Units)

Prerequisite – STAT 102

The axiomatic approach to the theory of probability as developed by Kolmogorov, probability inequalities such as Markov's inequality. Chebychev's inequality, Jensen's inequality and Cauchy-Schwartz inequality, generating functions such as probability generating function, characteristic function and their properties, inversion theorem, convergence concepts and weak and strong law of large numbers, various forms of central limit theorem.

STAT 309 – Industrial Statistics - I (3 Credit Units)

Prerequisite – STAT 202

Process Control, Concept of statistical quality control, types of quality measures, control charts for variables and attributes ($\bar{x}$, R) and ($\bar{x}$, S) charts, control charts for standard deviation, range, fraction defectives, number of defectives and number of defects per unit (under standard given and not given for all charts).

Product control: acceptance sampling, basic concepts, producers' risk and consumers' risk, acceptable quality level (AQL), rejectable quality level (RQL), average outgoing quality (AOQ), average outgoing quality limit (AOQL), O.C. function, A.S.N. functions LTPD and ATI, single and double sampling inspection plans.

STAT 311 – Sampling Techniques I (3 Credit Units)

Prerequisite – STAT 102 or equivalent

Basic concepts, sampling versus complete enumeration, principal steps of a sample survey, probability sampling, purposive sampling and mixed sampling procedures, simple random sampling (with and without replacement) determination of sample size, stratified sampling, ratio and regression methods of estimation, systematic sampling, cluster sampling with equal cluster size

STAT 313 – Decision Theory (3 Credit Units)

Prerequisite – STAT 102

Basic Concepts related to a decision problem, states of nature, parametric space, decision space, action space, randomized and non randomized decisions, pay offs, optimal decision such as maximim, minimax and Baye's decision rules, decision tree analysis, introduction to the theory of games, saddle point, two-person zero sum game.

STAT 315 – Educational Statistics (3 Credit Unit)

Prerequisite – STAT 102

Scope, nature and use of educational data resources and methods of collection of data related to education, educational indicators designed for educational information systems, education flow models and performance evaluation, multivariate methods in educational data analysis, the role of operations research in educational management.

STAT 317 – Biometry II (3 Credit Units)

Prerequisite – STAT 204

Feller's theorem and fiducial limits. The Behren's distribution, dilution assays design and criticism of direct assays, indirect assays, dose-response regression, assay validity, individual effective dose, quantal response, relation between the individual effective dose and quantal response, Probit transformation, logit transformation.

400 Level Courses

STAT 400 – Statistical Project (6 Credit Units)

Prerequisite – STAT 300

Individual work on a selected topic illustrating applications of some of the theories and techniques covered in the course.

STAT 401 – Non-parametric Statistical Methods (3 Credit Units)

Prerequisite – STAT 301

Definition, concepts of non-parametric estimation and testing of hypothesis, non parametric tests such as: sign test, run test, median test, Mann-Whitney - Wilcoxon test. Wilcoxon signed rank test, Kolmogorov – Smirnov test, Wald - Wolfowitz test, Cochran O test, the Friedman test, Kruskal - Wallis test.

STAT 402 – Multivariate Analysis (3 Credit Units)

Prerequisite – STAT 202

Multivariate data structure, the multiple and partial regression and correlation, multivariate normal distribution, the marginal and conditional distribution, Hotellings T^2 and Mahalanobis D^2 distribution, the Wishart distribution, concept of canonical correlation, discriminant function. Principal components and cluster analysis.

STAT 403 – Regression Analysis (3 Credit Units)

Prerequisite – STAT 303

Concept of regression and least squares method of fitting of a regression curve, the matrix approach to linear regression, selecting the best regression equation, multiple linear regression models, polynomial models of various orders, models involving transformation, non – linear models that are intrinsically linear, use of dummy variables in multiple regression, introduction to non - linear estimation, partial and conditional regression models, canonical correlation, test of independence of regression coefficients, Multicollinearity and other problems associated with best Regression models.

STAT 404 – Time Series Analysis (3 Credit Units)

Prerequisite – STAT 303

Concept of time series, its components such as secular trend, seasonal and cyclic components, random components and various measures of these components, harmonic analysis, serial correlation and correlogram, stationary time series, correlation between two time series, lag correlation, forecasting in time series.

STAT 405 – Stochastic Processes (3 Credit Units)

Prerequisite – STAT 307

Introduction, definition, basic concepts, Markov chain, transition and absolute probabilities, classification of states, classification of Markov chain, random walk, random walks in presence of absorbing and reflecting barriers, definition of Markov process, classification, special Markov process such as birth - death process, birth process and Poisson process, queuing process, its classification, the

simplest queuing process (M/M/1) and waiting time distribution along with simple application.

STAT 406 – Sampling Techniques II (3 Credit Units)

Prerequisite – STAT 311

Sampling with varying probabilities (with and without replacement), procedure of selecting a sample with varying probabilities, estimation of population mean and variance and their sampling variances. The two-stage and multistage sampling schemes with equal first and second stage units multivariate ratio estimation, double sampling.

STAT 407 – Design and Analysis of Experiment II (3 Credit Units)

Prerequisite – STAT 305

Split plot and strip plot designs, balanced incomplete block design (BIBD), partially balanced incomplete block design (PBIBD), the cross over design, lattice design, notion of response surface designs.

STAT 408 – Statistical Inference (3 Credit Units)

Prerequisite – STAT 202

Theory of point estimation, methods of estimation such as method of moments, method of maximum likelihood and method of least squares, properties of point estimators: unbiasedness, consistency, efficiency, Cramer - Rao inequality and its extension, sufficiency, Fisher – Neyman criterion and factorization theorem, concept of completeness, Rao - Blackwell theorem, Interval estimation.

STAT 409 – Demography (3 Credit Units)

Prerequisite – STAT 102.

The scope and importance of demographic studies, vital events and vital statistics, collection of vital statistics, Mortality and its measures, the crude death rate and its limitations, age specific death rates, infant mortality rate, standardized death rates, fertility and its measures, the crude birth rate, general fertility rate, age specific fertility rates, total fertility rate, standardized birth rates, gross and net reproduction rates, elements of life table.

STAT 411 – Bayesian Inference (3 Credit Units)

Prerequisite – STAT 303

Bayesian estimation technique, prior and posterior distribution, posterior Baye's estimator, loss – function approach, Baye's risk, Baye's estimator – Bayesian interval estimates, Bayesian tests, prediction problem.

STAT412 – Operations Research (3 Credit Units).

Prerequisite – MATH 312

Classical methods of optimization, Maxima and minima, Lagrange multipliers. Linear programming: Convex sets and functions, simplex and revised simplex methods, duality theory, applications. Linear programming applications to diet problems, transportation problems, manufacturing problems etc

STAT 413 – Psychometrics (3 Credit Units)

Prerequisite – STAT 301

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, variable length, some estimates of parameters of the classical model, other weak true-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.

STAT 414 – Actuarial Science (3 Credit Units)

Prerequisite – MATH 312

The time value of money, compound interest and discounting, present value and accumulated values of streams of payments, decremental rates and other indices, annuities and sinking funds, solving equation of value, invest and appraisal techniques, analysis of experimental data and derivation of exposed to risk formulae, graduation method and its application to curve fitting. Construction of mortality, sickness, multiple decrements and similar tables with applications to life insurance, national social security and pension schemes.

STAT 415 – Advanced Probability Theory II (3 Credit Units)

Prerequisite – STAT 307

Basic theory of sets and set functions, construction and properties of measures, extension theorem, Lebesgue measures, complete measures, Lebesgue Stieltjes measures, definition and properties of the integral, simple function, measurable functions, Lebesgue integral, Lebesgue-Stieltjes integral, condition for integrability, Probability as measure, probability space, theorems related to probability space, random variables as measurable function, distribution of random variables, convergence of random variables, week convergence, convergence almost everywhere, convergence in data mean.

STAT 416 – Industrial Statistics II (3 Credit Units)

Prerequisite – STAT 309
Special process control procedures, concept of reject – limits, modified control limits relationship between control chart limits and specification limits, charts for subgroup totals and individual measurements, control charts for medians, specification and tolerances aspects.
Acceptance sampling: the multiple and sequential sampling, Dodge Ramig system for lot by lot inspection, acceptance sampling by attributes, some basic aspects of life testing and reliability.

STAT 417 – Econometrics (3 Credit Units)

Prerequisite – STAT 301
The nature of Econometrics, relationship between economic variables, roles of econometrics, two variable linear model, least squares estimators, analysis of variance in regression, two – variable non – linear relationships, relation between three variables, fitting of regression plane, partial and multiple correlations, intra – class correlation, general linear model, multicollinearity, generalized least squares, autocorrelation, conventional tests for autocorrelation, Theil BLUE procedure, lagged variables, simultaneous equation methods, identification problem.

b. Postgraduate Diploma in Statistics

Core Courses
PGDS 700 Project (4 CU)
PGDS 703 Statistical Methods (3 CU)
PGDS 704 Applied Multivariate Analysis (2 CU)
PGDS 705 Designs and Analysis of Experiments (3 CU)
PGDS 711 Mathematical Statistics (3 CU)
PGDS 712 Nonparametric Statistics (3 CU)
PGDS 722 Statistical Inference (3 CU)

Cognate Elective Courses
PGDS 709 Demography (3 CU)
PGDS 710 Mathematical Programming (3 CU)
PGDS 713 Mathematical Modelling (3 CU)

Syllabus for PGDS
The details of the topics to be covered under the courses mentioned above are given below.

PGDS 700 Project 4CU

Students will be expected to carry out a study in a relevant area of statistics and submit a report which involves the extensive use of statistical analysis. The project should lay emphasis on the application part of statistics in the society.

PGDS 703 Statistical Methods 3CU

Hypothesis testing, estimation, confidence intervals, analysis of variance, linear regression, correlation. Survival analysis and odds ratio. Practical application

PGDS 704 Applied Multivariate Analysis 2CU

Basic concepts and statistical reasoning which underline the technique of multivariate analysis, matrix algebra, multivariate normal distribution, exponential family and structural equations models. Acquaintance with the use of existing computer programs in the multivariate analysis areas, correspondence analysis, multidimensional scaling, principal component analysis, correspondence analysis, cluster analysis and latent variable models.

PGDS 705 Design and Analysis of Experiments 3CU

Concepts of randomization, blocking, confounding, transformations, replications block designs, factorial and fractional methodology, evolutionary operation and response surface methodology.

PGDS 709 Demography 3CU

The scope and importance of demographic studies, vital events and vital statistics, collection of vital statistics. Mortality measures, the crude death rate and its limitations. Age specific death rates, infant mortality rates, standardized death rates. Fertility and its measures, crude birth rate, general fertility rate, age specific fertility rates, total fertility rate, standardized birth rates, gross and net reproduction rates. Elements of life table.

PGDS 710 Mathematical Programing 3CU

Introduction to theory and the solution of linear and nonlinear programming problems; simplex and interior point algorithms, integer linear programing methods (branch and brand, enumeration, cutting planes), decomposition methods, quadratics programming. An introduction to the mathematical foundation of mathematical programming

PGDS 711 Mathematical Statistics 3CU

Random variable, discrete and continuous distributions, conditional distributions, mass and density functions, expectation, variance, covariance, correlation and dependence. Probability generating functions: moment generating functions, factorial generating functions, weak and strong laws of large numbers central limit theorem and applications limit theorems. Convergence of sequences of measurable functions. Borel Cantelli lemma and Fubini's theorem.

PGDS 712 Nonparametric Statistics 3CU

Distribution free statistical procedures counting methods; order statistics, ranks, distribution free tests and associated interval and point estimates sign test, signed rank test, Mann Whitney-Wilcoxon test, Wilcoxon signed rank test, Kolmogorov-Siminov test, Wald-Wolfowitz test, Cochran Q test, Friedman test, and kruskal-Wallis test.

PGDS 713 Mathematical Modelling 3CU

Methodology of model building: identification, formulation and solution of problems. Cause effect diagrams. Modeling using graphs and proportionality. Modeling by interpolation using polynomials. Modeling using least square and linear programming. Modeling deterministic behaviour and stochastic processes. Modeling using derivatives: application using differential equations.

PGDS 722 Statistical Inference 3CU

Parametric point estimation, estimation, methods of finding estimations: methods of moments, maximum likelihood Baye's method, invariance property of maximum likelihood. Properties of estimation, risk function, factorization criterion, K-parameter exponential family, UMVE and interval estimation.

c. M.Sc. Statistics

M.Sc. Statistics courses

1st Semester

Course Code	Course Title	Credit Units
STAT 801	Statistical Inference	3
STAT 803	Design and Analysis of Experiments	3
STAT 805	Non-Parametric Statistical Methods	3
STAT 807	Biostatistics	3
STAT 809	Multivariate Analysis	3
SCI801	Management and Entrepreneurship	2

STAT881	Seminar	1
STAT891	Research/Thesis	3

2nd Semester

Course Code	Course Title	Credit Units
STAT 802	Advanced Probability Theory	3
STAT 804	Categorical Data Analysis	3
STAT 806	Statistical Computing/Consulting	3
STAT 808	Sample Survey Techniques	3
Course Code	Course Title	Credit Units
STAT 812	Time Series Analysis	3
SCI 802	ICT and Research Methodology	2
STAT 882	Seminar	1
STAT 892	Research/Thesis	3

Syllabus for M.Sc. Statistics

The details of the topics to be covered under the courses mentioned above are given below.

STAT 801 Statistical Inference 3CU

Conditioning, distribution theory, approximation to distributions, modes of convergence, limit theorems, statistical models, parameter estimation, properties of estimators, confidence sets, theory of hypothesis tests, introduction to Bayesian inference and nonparametric estimation.

STAT 802 Advanced Probability Theory 3CRU

Introduction to measure theoretic probability, derivation and transformation of probability distributions, generating functions and characteristic functions, conditional expectation, sufficiency, and unbiased estimation, methods of large sample theory including laws of large numbers and central limit theorems and order statistics.

STAT 803 Design and Analysis of Experiments 3CU

General linear models; Generalized inverse of a matrix, factorial experiments; symmetric and asymmetric; balanced and partially balanced incomplete Block Designs. Resolvable row-column designs. Response surface methodology. Construction of designs.

STAT 804 Categorical Data Analysis 3CRU

Probability mass functions for 2×2 tables measures of association for 2×2 tables and general $c \times c$ tables. Probability mass functions for $r \times c$ tables. Goodness of fit tests. Square tables and their applications, structural models for two and higher dimensions; Log-linear models and estimate of parameters. Logistic regression and bio-assays.

STAT 805 Non Parametric Statistical Methods 3CU

Distribution-free methods. Distribution of order statistics and quintiles. One and two sample tests. Confidence intervals. Transformation of statistics and their asymptotic properties. OC and ASN functions of SPRT. SPRT for composite hypotheses. Elements of sequential estimation stein's two stage sampling methods for point and interval estimate.

STAT 806 Statistical Computing/Consulting 3CU

The design and use of existing statistical software, methods of simulation of random processes, numerical methods of fitting linear models, multivariate analysis, methods for nonlinear modelling. Introduction of key aspects of statistical consulting and data analysis activities, report writing and presentation.

STAT 807 Biostatistics3CU

Advanced Regression, Bio-essays, Probit and Logit models, Growth Curves; Logistic Regression, Potency/efficacy determination. Theory of clinical trials, Ethical Issues in Medical Data Collection.

STAT 808 Sample Survey Techiniques 3CU

Construction and choice of strata, frames and various equal and unequal probability sampling schemes with properties. Estimation of means, proportion and their variances. Successive sampling scheme. Problems of non-sampling error and non-response: application to some selected specialized survey.

STAT 809 Multivariate Analysis 3CU

Multivariate normal distribution, estimation of mean and covariance matrix; Wishart distribution; distribution of partial and multiple correlation coefficients; Hotelling's T^2, Principal components.

STAT 812 Time Series Analysis 3CU

Theory of stochastic models and their forecasting. Model building: identification, estimation. Diagnostic checking. Analysis of stationary Data Co-integration and error correction techniques.

SCI 801 Management and Entrepreneurship 2CU

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving

SCI 802 ICT And Research Methodology 2CU

Essentials of Spreadsheet, Internet Technology, Statistical Packages, precision and accuracy of estimates, principles of scientific research, concept of hypotheses formulation and testing, organization of research and report writing.

Research areas for our Ph.D. Programmes

a. Ph.D. computer Science

1. Machine Intelligence
2. Database Systems
3. Software Engineering
4. Network and Distributed Systems
5. Computer Architecture
6. Logic Programming
7. Computer Graphics
8. Memory management
9. Information Technology Security

b. Ph.D. Mathematics

1. Quantum Mechanics
2. Numerical Analysis
3. Operator Algebras
4. Computational Fluid Dynamics
5. Logic / Set theory/Multiset Theory
6. Operations Research/Mathematical Programming
7. Semigroup Theory
8. Group Representations Theory
9. Analytical Dynamics
10. Magneto hydrodynamics

11. Heat and Mass Transfer
12. Stability
13. Differential Equation
14. Rhotrix Algebra

c. Ph.D. Statistics

1. The Generalized Probability Models
2. Stochastic Models of Human Fertility Behaviour
3. Applications of Statistics in Bio-Medical Sciences
4. Design of Experiments
5. Industrial Statistics
6. Time Series
7. Biostatistics
8. Multivariate Analysis
9. Operations Research
10. Sampling Theory

Laboratory Facilities

This Programme involves designing, developing, linking and integration of Computer laboratories for the Computer, Mathematics and Statistics students for high quality research in the Department.

Justification

Over the years the Department has relied on only one computer lab with twenty two computers but now there are five Computer laboratories available for conducting practicals for Computer Science Students, Mathematics Students and Statistics Students.

The laboratories are well-equipped with 125 computers. The laboratories are networked using Star topology via two twelve port switches. The Department is fully connected to the Internet through wired and wireless connections.
There are six graduate assistants available in the laboratory throughout, coordinating along with assistant laboratory coordinator who is responsible for the overall lab management.

Software related to Windows programming, Internet programming, Web design, graphic and animation design are installed on specific machines. There are both Windows XP and Fedora Core 2 operating system environments available on these

computers. There are also the following software packages used by Statistics students; SPSS, STATISTICA, Graphica, MINITAB, MATLAB and EXCEL.

A number of courses in the Department have a laboratory component. Each laboratory session for these courses is timetabled and separately manned with academic staff members leading the conduct of these lab sessions. Junior academic staff, who have taken these courses in the recent past, are used to lead and guide students in carrying out the laboratory exercises.
Other computer laboratories used by the Department are

I. Iya Abubakar Computer Centre Laboratory

The University Computer Centre (Iya Abubakar Computer Centre) has facilities jointly utilized by all Departments of the university. The Mathematics programme is given a special consideration for using the large laboratories in the centre. We have been officially allocated a slot of between 2PM to 6PM every day for use with our students,

II. Kashim Ibrahim Library (KIL) Training Laboratory

This laboratory is located in the First Floor at the KIL. It is primarily used for the training programs of the library. The laboratory contains 20 PCs with all relevant software for our practicals, as listed above. The laboratory is owned by the library but nine hours are formally allocated to us, weekly, for use with our students.

III. Department of Electrical Engineering Laboratory

This is located in the second floor of the Department and contains about 30 PCs. The Department has assured to provide us use of the laboratory, as much as we need, on sufficient prior notice. Currently, our needs have not exceeded that of the resources available in (i) – (iii) and, therefore, are yet to start using this laboratory for our practicals.

Facilities Programmes

The Facilities Programmes aim to rehabilitate, upgrade and expand research, learning and welfare facilities for staff and students as well as the conservation and beautification of the Department for conducive, vibrant and sustainable learning environment. These facilities include library, conference room, projector etc.

Library

The Department has a library for the use of students and staff where many collection of books in various fields of mathematics, statistics and computer science are reserved, like other libraries, it is divided into two sections; Open shelf section (where students are free to take any book of their interest) and Reserve section (in this section, students must present their identity card in order to have access to books in this section). Other research materials in the library include; Journals, dissertations, theses, projects, etc.

There are also 2 laptops computers and 4 desktop computers under the care of Library coordinator who is an academic staff and Departmental librarians who are non teaching staff.

Conference Room

The Departmental conference room has 30 seating chairs and conference table where Departmental meeting is conducted. In this room, we have a smart board and white board for seminar presentation and other academic activities.

Monitoring and Evaluation

The following monitoring and evaluation system is provided to ensure that the plan is effectively implemented and kept under regular review. Monitoring involves the continuous assessment of programmes in the context of implementation schedules. It examines the difference between the planned (programme) and the actual (achievement) as well as provides information to the Department for analysis and action.
Evaluation on the other hand, would be the assessment of the Department and its activities in relation to set goals and objectives over a period of time. It would measure the progress in the implementation of the plan, and the mode by which the strategy, the programmes and projects should be altered, aborted or measured. In order to ensure an effective implementation of this Strategic Plan, the following mechanisms for monitoring and evaluation are provided;

Monitoring

The Department intends to assess planned activities against actual implementation through:

1. Inspection of projects- at the end of each semester.
2. Assessment report.

3. Feedback from staff and students

Evaluation

This involves the assessment of overall performance through:

1. Programme review (every 4years) by the Department.
2. End of Plan Review and putting in place another Strategic Plan.
3. Conducting tests, assignments, practicals and examinations every semester so as to evaluate the students.

ACTION PLAN AND BUDGET FOR THE ACADEMIC AND RESEARCH PROGRAMMES

Goal	Objectives	Activities	time	Responsibilities	Status	Cost 1st year	Cost per 5 yrs	Remarks /Comments
Goal 4; To complete the review, rationalization, redesigning and refocusing of the philosophy and the structure of all curricula with a view to producing high quality graduates that will meet the challenges of the catchment area, Nigeria and the world.	To review the curriculum after every 5 years To rationalize and eliminate courses and topics that are no longer relevant	Publicity through Departmental meetings		Curriculum review committee				
Goal 7; To continue the PG programmes (PGDCS & PGDS) for increased access to education and revenue generation	To strengthen the PG programmes	Publicicity through school of PG studies	Every year	school of PG studies				
Goal 8; To upgrade expand and reform post graduate programmes for the enhancement of man power and revenue generation	To redesign and realign the PG programmes	Submission of PG programmes to PG school and other relevant bodies To develop a PG handbook	Every 5years	PG coordinator PG coordinator	Stationary Stationary			
Goal 9; To develop a comprehensive quality control mechanism to deal with quality of staff, students, facilities, lecturing and conduct of exams	To develop the process of monitoring the performance of staff To monitor staff attendance at lectures, & completion of course outlines To develop a process and mechanism for monitoring the performance of students To ensure compliance with NUC Benchmark for our programmes	Develop draft evaluation form Implement the evaluation process Develop criteria for academic advisers To write/submit semester report to the Dean of Science	Every semester	Departmental representative to the Faculty monitoring committee	Being Done			

ACTION PLAN AND BUDGET FOR THE LABORATORY PROGRAMMES

Goal	Objectives	Activities	Time	Responsibilities	Status	Cost 1st year	Cost per 5 yrs	Remarks/Comments
Goal 5; To utilize our computer laboratories for quality research and learning	To recruit and train personnel for the laboratory To equip the laboratory To advertise and produce a working manual for the laboratory	Identification of suitable personnel Appointment, orientation and training Identification of suitable equipment and vendors Procurement of equipment and installation Production of operating manuals	Immediately	VC through the HOD	Some have been done and some are in the process			

ACTION PLAN AND BUDGET FOR THE COMPUTERIZATION, MULTI-MEDIA COMMUNICATION AND LINKAGE PROGRAMMES

Goal	objectives	Activities	Time	Responsibilities	Status	Cost 1st year	Cost per 5 yrs	Remarks/Comments
Goal 3; To put into effect a LAN/WAN for the effective working of the Department's information and communication system.	To design and produce LAN/WAN for the Department	Production of LAN/WAN	Immediately	University management through the Head of Department	Done			

ACTION PLAN AND BUDGET FOR THE FACILITIES PROGRAMMES

Goal	Objectives	Activities	Time	Responsibilities	Status	Cost 1st year	Cost per 5 yrs	Remarks/Comments
Goal 2; To rehabilitate, upgrade and expand learning and research facilities for quality scholarship, training and research.	To assess and determine the extent and scope of repairs/rehabilitation To refurbish/rehabilitate lecture theatres/class rooms To upgrade research/learning equipment for the Department	Assessment and rehabilitation proposal Implementation of rehabilitation package in respect of lecture theatres/class rooms Implementation of rehabilitation package in respect of uPGrading research & learning equipment	Always	Head of Department	Being done			

ACTION PLAN AND BUDGET FOR THE GOVERNANCE AND MANAGEMENT OF PROGRAMMES

Goal	Objectives	Activities	time	Responsibilities	Status	Cost 1st year	Cost per 5 yrs	Remarks/Comments
Goal 1; To develop an Academic Brief for the Department in order to ensure that the Department remains focused, efficient and	To develop an Academic Brief for the Department	To develop an Academic Brief for the Department	Every 5 years	Programme Officer	Done			

effective in academic activities.								
Goal 6; To ensure gender balance and equity in admission, recruitment and training for fairness and justice.	To sustain gender mainstreaming in the admission, recruitment and training in the Department	Implement gender policy/guidelines Draw up a monitoring system for gender policy implementation	Every year	Admission Officer	Being done			