OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA.

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS

2019-2022 HANDBOOK

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1.0 INTRODUCTION

1.1 Members of Staff of the Department

(A) Academic Staff Members

S/n	Name	Qualification	Designation	Specialization	Room No.
1	O.O. Fadodun	B.Sc., M.Sc., Ph.D. (Ife)	Senior Lecturer (HoD)	Continuum Mechanics	MBB 210
2	A.P. Akinola	M.Sc., Ph.D. (MSU)	Professor	Solid and Composite Mechanics	MBB 005
3	S.S. Okoya	B.Sc., M.Sc., Ph.D. (Ife)	Professor	Fluid Dynamics and Combustion Theory	MBB 018
4	T.O. Obilade	M.Sc, Ph.D (Dublin)	Professor	Queuing Theory, Stochastic Processes and Application	MBB 014
5	O.A. Adesina	B.Sc. (Ago - Iwoye), M.Sc., Ph.D (Ife)	Professor	Differential Equations, Non-Linear Analysis	MBA 205
6	S.O. Ajadi	B.Sc., M.Sc., Ph.D. (Ife)	Professor	Fluid Dynamics and Combustion Theory	MBA 206
7.	A.K. Olapade	B.Sc., M.Sc., Ph.D. (Ife)	Professor	Distribution Theory and its application	MBB 001
8.	M.O. Olatinwo	B.Sc., M.Sc. (Ibadan), M.Sc., Ph.D. (Ife)	Reader	Cybernetics, Functional Analysis	MBC 203
9	O.P. Layeni	B.Sc., M.Sc., Ph.D. (Ife)	Reader	Solid Mechanics; Free Boundary Problems	MBA 204
10	T.G. Jaiyeola	B.Sc., M.Sc., Ph.D (FUNAAB)	Reader	Algebra (Loop Theory)	MBC 209
11	P.F. Fasogbon	B.Sc. (Ilorin), M.Sc., Ph.D. (Ife)	Senior Lecturer	Fluid Mechanics	MBC 205
12	G. Akinbo	B.Sc.(Ago–Iwoye), M.Sc., Ph.D. (Ife)	Senior Lecturer	Functional Analysis	MBC 218

13	B.S. Ogundare	B.Sc. Ago-Iwoye), M.Sc. (Ife), Ph.D. (Alice)	Senior Lecturer	Differential Equations, Non-Linear analysis	MBC 208
14	M.O. Ogundiran	B.Sc., M.Sc., Ph.D. (Ibadan)	Senior Lecturer	Functional analysis	MBB 010
15	D.O. Makinde	B.Sc., M.Sc. (Ibadan), Ph.D (Ilorin)	Senior Lecturer	Complex Analysis	MBB 113
16	A.A. Olosunde	B.Sc., M.Sc., Ph.D. (Ife)	Senior Lecturer	Distribution Theory and Statistical inference	MBB 107
17	A.T. Ademola	B. Sc.(Ilorin), M. Sc., Ph.D. (Ibadan)	Senior Lecturer	Ordinary Differential Equation	MBB 007
18	A.A. Aderogba	B.Sc., M.Sc. (Ife), Ph.D.	Senior Lecturer	Fluid Mechanics	MBA 210
19	A.J. Saka	B. Tech, (Minna), M.Sc.(Ilorin), Ph.D. (Ilorin)	Lecturer I	Design and Analysis of Experiment	MBB 102
20	O.K. Agunloye	B.Sc., M.Sc. (Ibadan), Ph.D. (Gaborone)	Lecturer I	Time Series Analysis	MBB 212
21	O.O. Fabelurin	B.Sc., M.Sc., Ph.D. (Ife)	Lecturer I	Real Analysis	MBB 208
22	I.O. Ayodeji	B.Sc., M.Sc., Ph.D. (Ife)	Lecturer I	Econometric	MBB 211
23	O.O. Oyadare	B.Sc., M. Sc., Ph.D. (Ibadan)	Lecturer I	Harmonic Analysis	MBB 104
24	I.E. Ireka	B.Sc., M.Sc. (Ife), Ph.D.	Lecturer I	Fluid Mechanics	MBB 013
25	K.A. Adeleke	B.Sc (Ago-Iwoye), M.Sc. (Ibadan) Ph.D.(Ilorin)	Lecturer I	Survival Analysis	MBB 106
26	A.A. Osuntuyi	B.Sc.,(Ife), M.Sc., Ph.D.	Lecturer I	Queuing Theory	MBB 110
27	S.O. Akindeinde	B. Sc. (FUNAAB), M.Sc.(Kaiserslautern) Ph.D. (Wuerzburg)	Lecturer I	Numerical Analysis and Optimization	MBB 108

28	B. A. Olokuntoye	B.Sc., M.Sc., Ph.D. (Ife)	Lecturer I	Solid and Composite Mechanics	MBB 209
29	A.S. Borokinni	B.Sc., M.Sc., Ph.D. (Ife)	Lecturer I	Continuum Mechanics	MBA 208
30	A. O. Adewumi	B.Sc.(Ed)., M.Sc., Ph.D. (Ilorin)	Lecturer I	Numerical Analysis	MBB 217
31	K.A. Olurode	B.Sc. (Ife), M.Sc. (Ibadan)	Assistant Lecturer	Algebra	MBB 009
32	S.O. Ezeah	B.Sc., M.Sc. (Ife)	Assistant Lecturer	Survival Analysis	MBB 103
33	R. A. Adetona	B.Sc., M.Sc. (Ife)	Assistant Lecturer	Fluid Dynamics	MBA 207
34	Y.T. Lawal	B.Sc. (Ife)	Graduate Assistant	Fluid Dynamics	MBC 101
35	A. R. Babalola	B.Sc. (ABU), M.Sc. (Ife)	Graduate Assistant	Queuing Theory, Stochastic Processes and Application	MBA 209
36	*E. O. Ajoge	B.Tech. (FUTA), M.Sc.(Ife)	Junior Research Fellow	Solid Mechanics	CERD

*Associate and Junior Research Fellow, Centre for Energy Research and Development, Obafemi Awolowo University.

(B) Non-Teaching Staff Members

S/N	Name	Designation
1	Mrs. S.O. Yusuff Adeleke	Senior Confidential Secretary
2	Miss. F.C. Famose	Senior Laboratory superintendent
3	Mr. T. A. Adisa	Asst. Chief Clerical Officer
4	Mrs. B. F. Olanrewaju	Secretarial Assistant III
5	Mrs. C. N. Adeleke	Senior Office Assistant

1.2. HISTORICAL NOTES.

1.2.1 History of the University

Obafemi Awolowo University, Ile-Ife is one of three Universities established in Nigeria between 1961 and 1962 as a result of the report submitted to the Federal Government in September, 1960, by a Commission it appointed in April 1959 under the Chairmanship of Sir Eric Ashby, Master of Clare College,

Cambridge, to survey the needs of post-secondary and higher education in Nigeria over the next twenty years. On 8th June, 1961 the Law providing for the establishment of the Provisional Council of the University was formally inaugurated under the Chairmanship of Chief Rotimi Williams.

On 11th June, 1970, an Edict known as the University of Ife edict, 1970 was promulgated by the Government of the Western State to replace the Provisional Council Law of 8th June, 1961. This Edict has since been amended by the Obafemi Awolowo University, Ile-Ife (Amended) Edict No. 112 of 1975 (Transitional Provisions) Decree No.23 of 1975. This new Decree effected a takeover of the Obafemi Awolowo University by the Federal Military Government and established a Provisional Council as an interim governing body of the University which shall subject to the general direction of the Head of the Federal Government, control the policies and finances of the University and manage its affairs. This Provisional Council has since been replaced by a Governing Council.

The University started with five Faculties – Agriculture, Arts, Economics and Social studies (now Social Sciences), Law and Science. Six new Faculties have since been added, namely the Faculty of Education (established on 1st October, 1967), the Faculty of Pharmacy (established on 1st October, 1969), the Faculties Technology and Health Sciences (now College of Health Sciences) (both established on 1st October, 1960), Faculty of Administration with effect from 1st October 1979) and Faculty of Environmental Design and Management (established on April 6, 1982).

In 1992, the University established a collegiate system with five Colleges. The system did not function effectively and was abandoned after two years. However, the Postgraduate College and the College of Health Sciences were retained. The College of Health Sciences now comprises of the Faculties of Basic Medical Sciences, Clinical Sciences and Dentistry. The following other Institutes and major units exist in the University:

- The Adeyemi College of Education located in Ondo
- The Institute of Agricultural Research and Training, Ibadan
- The Natural History Museum
- The Institute of Ecology and Environmental Studies
- The Centre for Gender and social Policy Studies
- The Centre for Industrial Research and Development
- The Institute of Public Health
- The Institute of Cultural Studies
- The Technology Planning and Development Unit
- The Computer Centre
- The Drug Research and Production Unit
- The Equipment Maintenance and Development Centre
- The Central Technological Laboratory Workshop
- The Central Science Laboratory
- Centre for Gender and Social Policy Studies
- Centre for Distance Learning
- Entrepreneurship and Development Studies (IFEDS)
- Obafemi Awolowo University Investment Company Limited

Finally, some other agencies over which the University has no direct, or, in some cases limited control, have premises within the University.

- African Regional Institute for Geospatial Information Science and Technology (AFRIGIST) formerly RECTAS
- The National central for Technology Management
- The Centre for Energy Research and Development
- The African Regional Centre for Space Science and Education in English.

The student population has rising steadily from 244 in 1962/63 to over 30,000 at present.

1.2.2 Mission, Vision, Major Thrusts of the University

Mission

To nurture a teaching and learning community; advance frontiers of knowledge; engender a sense of selfless public service; and add value to African culture.

Vision
A top rated university in Africa.

The **major thrusts** of the University Strategic Plan for 2016 – 2020 are:

- Teaching,
- Research and Innovation,
- Governance,
- Fund Generation and Management,
- Human Resources Development and
- Infrastructure and Estate Development.

These major thrusts involve the following broad objectives:

- The modernisation of the University's teaching programmes, through a continuous review of the curricula and teaching support services
- The pursuit of a research agenda that will deepen the University's contribution to national development through research outputs and products uptake,
- The preparation of students for self-employment and entrepreneurship.
- The continued development and expansion of Information and Communication Technology (ICT) for all aspects of the institution's functions.
- An expanded revenue base backed by improved financial management capability.
- The development of strategic linkages and partnerships

1.2.3 History of Faculty of Science

The Faculty of Science was one of the foundation faculties established at the inception of the University of Ife in 1962. It was located at the Ibadan Campus up till January 1970 when it moved in its entirety to its present facilities at Ile-Ife.

The student's population within the Faculty has grown rapidly from the initial intake of 80 in 1962 to 2,768 registered students at

the end of 2005/2006 session. It is thus the Faculty with the largest number of students in the University.

Similarly, the range of programmes offered by the Faculty has increased considerably from five, Physics, Chemistry, Mathematics, Botany and Zoology in 1962. The Faculty offers academic programmes leading to the B.Sc., M.Sc., M.Phil. and Ph.D degrees in eleven major discipline areas (Applied Geophysics, Botany, Biochemistry, Engineering Physics, Geology, Mathematics, Microbiology, Physics, Zoology, Statistics and Mathematics) within eight Departments namely Biochemistry, Botany, Chemistry, Geology, Mathematics, Microbiology, Physics and Zoology.

Apart from the above, there are three vital services units, the Natural History Museum, the Technology Training Scheme and the Biological Gardens within the Faculty.

Apart from the Faculty academic programmes, it is completely responsible for teaching basic science courses to all new entrants to the Science-oriented Faculties and offers in addition, services courses to the Faculties of Agriculture, Education, Environmental Design and Management, Health Sciences, Pharmacy, Social Sciences and Technology.

The Faculty has at present over 208 academic staff.

1.2.4 History of the Department of Mathematics

The Department of Mathematics, Obafemi Awolowo University is one of the foundational Departments in this University. Established in 1962, it remains a principal stakeholder in achieving the aspirations and dreams of the founding fathers of this great University. Such dreams as delivering quality teaching, rendering good research and serving selflessly to the development of the community and the nation at large are tremendously observed and held in high esteem by the Department. With its current establishment for academic staff position of 66 members, however, its present academic strength is above 30.

From inception, the Department runs large class courses, servicing various Faculties in the University, thereby equipping the part one and part two students of these faculties with foundational courses in Mathematics methods and its numerous applications to life. Furthermore, the Department trains students both at undergraduate and Post graduate levels awarding two distinct degrees of B.Sc. (Mathematics) and B.Sc. (Statistics) at the undergraduate level, and M.Sc. (Mathematics/Statistics) and Ph.D. (Mathematics/Statistics) at the Masters and Ph.D. level respectively.

In 1965, the Department graduated her first set of students (three in Number) and since then to date have graduated over 800 students at B.Sc., M.Sc. and Ph.D. level. At the undergraduate level, students are continually exposed to the fundamental of mathematical processes and principles in Pure, Applied Mathematics and Statistics. With a formidable panoply of experts in Algebra, Real Analysis, Complex Analysis, Functional Analysis, Differential Equations, Cybernetics, Computational Mathematics, Distribution Theory, Queuing Theory, Stochastic Processes, Fluid and Solid Mechanics, who are reputable researchers active and current in their various fields. Staff from various generation continues to win recognition through meritorious award, International grants and association from many renowned research institute.

Furthermore, our Alumni and colleagues are heading various units, not only in the academic environments, but also in various sectors (both Private and Government) where they find themselves. Recently, the Department, recognizing the need for interdisciplinary research and improvement in teaching and learning process for our students, have initiated monthly seminars inviting erudite scholars from various Departments with and without the country to foster collaborative research with other scientists, engineers environmentalists, Health Scientists and the likes. With respect to improving teaching and learning to our students, the Department has initiated a relationship with the Developing Countries Strategic Group under the auspices of

International Mathematical Union (IMU) in collaboration with CIMPA and the U.S. National committee for Mathematics. The Department is also in collaboration with the Laboratory for Interdisciplinary Statistical analysis (LISA) in University of Colorado, Boulder, Colorado, USA. These initiatives are largely to mentor young Mathematicians and Statisticians in various respective fields of Mathematics and Statistics from all over the world, to give lectures on relevant topics so as to enhance the students' view and foster their interest in further studies in Mathematics and Statistics.

The Department carries out periodic reviews of its Curriculum in line with the National Universities Commission guidelines, which is in response to the needs of Nigeria as a nation as well as the outside world to be in consonance with the 21st Century so that the graduates we produce would be employable and can also employ themselves.

1.2.5 Mission, Vision, Objectives of the Department of Mathematics

Mission:
To create a teaching and learning community for imparting appropriate mathematical and statistical skills and knowledge, behavior and attitude, advance frontiers of knowledge that are relevant to national and global development; engender a sense of selfless public service and to promote and nurture the African culture and tradition.

Vision:
The vision is of a top class Department of Mathematics within a top rated University in Africa, ranked among the best in the world, whose product occupy leadership position in public and private sectors of the Nigerian and global economy that has harnessed modern technology, social economics and financial strategies, build strong partnership and linkages within and outside Nigeria and whose research contributed a substantial proportion of innovation to Nigeria economy.

Objectives:

The short-term strategic objectives of the Department are to:

(i) provide the nation's manpower in all aspects of abstract and applicable Mathematics;

(ii) produce highly experienced personnel as advisors, globally, in matters relating to contemporary application of Mathematics which for instance include but is not limited to (a) the design of, and Mathematical formulation of the constituents and dynamics of smart materials; (b) the study of stock exchange dynamics; (c) quantitative analyses of insurance and risk management; and (d) rigorous quantitative studies of the dynamics of interdisciplinary interaction; and invariably

(iii) build a world-class Department of Mathematics despite the limitations of the third world.

The long-term strategic objectives of the Department are to:

(i) continually encourage academic members of staff to undertake training and research in Mathematics and Statistics both locally and internationally;

(ii) ensure and sustain high levels of teaching of all Mathematics and Statistics courses offered at both undergraduate and postgraduate levels in the Obafemi Awolowo University;

(iii) continually attract seasoned top scholars from foreign institutions to the Department of Mathematics, Obafemi Awolowo University with or without the cooperation of Mathematical societies such as the Nigerian Mathematical Society, American Mathematical Society, or the International Mathematical Union;

(iv) provide ambience and atmosphere for cutting-edge high-level abstract or applicable research in Mathematics and Statistics;

(v) continually establish linkages through appropriate agreements with top-rated Universities in the global North;
(vi) continually provide and promote prominence to Statistics programmes of the Department;
(vii) promote the Executive Master of Actuarial Science programme of the Department; and
(viii) train and attract world-class Mathematicians and Statisticians.

1.2.6 Members of the University

The members of the University as defined on statute 2(1) are:

(a) the Officers of the University;
(b) the members of the Council;
(c) the members of the Senate;
(d) the members of the Academic Staff;
(e) the Graduates;
(f) the students; and such other persons as may by Statute be granted the status of members.

A person shall remain a member of the University only as long as he is qualified for such membership under any of the sub-paragraphs of paragraph (1) of this Statute.

1.2.7 Officers of the University

The Officers of the University as contained in Statute 3 shall be:

(a) the Chancellor;
(b) the Pro-Chancellor;
(c) the Vice-Chancellor;
(d) the Deputy Vice-Chancellor (Academic);
(e) the Deputy Vice-Chancellor (Administration);
(f) the Registrar;
(g) the Librarian;
(h) the Bursar; and
(i) such other persons as may by Statute be granted the status of officers.

1.2.8. Establishment of the University Council

(a) Functions

The University Council to be known as the Council of the Obafemi Awolowo University, Ile-Ife was established by the Edict. The Edict states that Council shall be the governing authority of the University and shall have the custody, control and disposition of all the property and finances of the University and, except as may otherwise be provided in the Edict and the Statutes, shall manage and superintend generally the affairs of the University and, in any matter concerning the University not provided for or under this Edict, the Council may act in such manner as appears to it best calculated to promote the interests, objects and purposes of the University.

The Council, subject to the provisions of the Edict and Statutes has the following functions among others:

(i) to determine, in consultation with Senate, all University fees;

(ii) to establish, after considering the recommendation of the Senate on that behalf, Faculties, Institutes, Schools, Boards, Departments and other units of learning and research; to prescribe their organization, constitution and functions and to modify or revise the same;

(iii) to authorize, after considering the recommendations of the Senate in that behalf, the establishments for the academic in the University, and with approval of the Senate, to suspend or abolish any academic post except a post created by this Edict or the Statutes;

(iv) to authorize the establishments for the administrative staff and other staff in the University and to suspend or abolish any such posts other than posts created by the Edict or the Statutes;

(v) to make the appointments authorized by this Edict and the Statutes;

(vi) to exercise powers of removal from office and other disciplinary control over the academic staff, the

administrative staff and all other staff in the University;

(vii) to supervise and control the residence and discipline of students of the University and to make arrangements for their health and general welfare.

(b) Composition of the Members of Council

The Council as contained in Statute 10(1) as amended by Decree No. 11 of 1993 and Decree 25 of 1996 shall consist of the following members:

(i) Ex-Officio Members: Pro-Chancellor
The Vice-Chancellor
The Deputy Vice-Chancellors

(ii) 1 member from the Federal Ministry of Education

(iii) 4 members appointed by National Council of Ministers

(iv) 4 members of Senate appointed by Senate

(v) 2 members of the Congregation elected by the Congregation

(vi) 1 member of Graduates Association elected by Graduates Association

The Senate shall prescribe which Departments and subjects of study shall form part or be the responsibility of each of the Faculties. The next level of organization is the Faculty where the teaching and other activities of the Departments are co-ordinated. Proposals generally come from Departments to the Faculty Board although they can also be initiated at the Faculty level in which Departments normally have an opportunity to consider them before the Faculty Board takes a decision. The membership of the Faculty Board is stipulated in Statute 13(3) thus:

(a) The Vice-Chancellor
(b) The Deputy Vice-Chancellors
(c) The Dean of the Faculty
(d) The Professors and Heads of Departments comprising the Faculty;

(e) Such other full-time members of the academic staff of the Departments comprising the Faculty as the Senate may determine after considering the recommendation of the Faculty Board;
(f) Such other Professors and other Heads of Departments, as the Senate may determine after considering the recommendation of the Faculty Board;
(g) Such other persons within or outside the University as the Senate may appoint after considering the recommendation of the Faculty Board.

The next level is that of Departments which consist of groups of teachers and sometimes Research Fellows in a single subject with a Head who is usually although not always a Professor generally appointed by the Vice-Chancellor.

The Department is the normal basic unit of academic organization. It is at this level that the organization of teaching and the use of research facilities are primarily worked out. Senate may however recommend the creation of Institutes for groups of specialized subjects or discipline that require interdisciplinary research efforts and thus, cut across Faculties in scope.

1.3 Organization, Administration and Control

The Vice-Chancellor is the Chief Executive Officer of the University and five other Principal Officers of the University, namely; the Deputy Vice-Chancellors (2), the Registrar, the University Librarian and the Bursar report to him. The University Librarian is in charge of the University Library while the Bursar takes charge of the University finances. The Registrar is the Secretary to Council and the Chief Administrative Officer of the University and he assists the Vice-Chancellor in the day-to-day administration of the University. He is also the Secretary to Senate and heads the Registry, comprising the Directorate of Academic Affairs, the Directorate of Council Affairs, Division of Corporate Services and the Director of Personnel Affairs. The Planning, Budgeting, Monitoring/Management Information System Unit

takes care of the academic planning, budgeting and monitoring needs of the University and is under the Vice-Chancellor's Office.

The University Central Administration also includes some Units providing common services. They are the Medical and Health Services, the Division of Maintenance Services, the Physical Planning and Development Unit and the Computer Centre, Heads of these units report to the Vice-Chancellor.

1.3.1 Congregation

The Congregation comprises all full-time members of the academic staff and every member of the administrative staff who holds a degree of any recognized University. It discusses and declares an opinion on any matter whatsoever relating to the well being of the University. It has twelve elected members in Senate and two elected members in the University Council.

1.3.2. Information on Facilities

A. Hezekiah Oluwasanmi Library

(i) **PLAN OF THE LIBRARY**

The Library consists of the North and South wings, which are connected by walkways on two levels.

(ii) **MEMBERSHIP**

Membership of the Library is available, on completion of a registration card, to all students, members of the senior staff of the university and such other persons as may be determined by the Library Committee or the University librarian on behalf of it.

Students are required to renew their registration at the beginning of each academic year. Library Cards and Borrower's Tickets are not transferable; books issued on them remain the responsibility of the person whose name appears on them.

A Lost Library Card or Borrower's Ticket may be replaced on submission of a written application.

(iii) THE LIBRARY COLLECTION

Hezekiah Oluwasanmi library now contains over 380,000 volumes. It consists of two main areas:

(a) The Undergraduate Areas and
(b) The Research Areas.

1. Serial Collection

The Serials Collection consists of:

(i) Current journals, the most current issues of which are shelved in the display section of the Serials Room.
(ii) Latest back files i.e. the latest 10 years of journals which are on open access to registered senior staff and postgraduate students.
(iii) Older back files i.e. journals older than ten years are on closed access to all categories of readers who must obtain and complete request forms at the serials hatch.

2. African Special Collection

The African Special Collection is a collection of rare and other books primary interest to people whose fields of interest are in African Studies. Staff publications and theses submitted for hither degrees of the University as well as of other Universities are also housed there. The Collection is closed access.

3. Documents Collection

The Documents Collection includes official publications of the Federal Government of Nigeria, the old regional governments, the present state governments and the Federal Capital Territory. It also includes publications of other African governments and international organizations.

4. Reference Collection

Dictionaries, encyclopedia, handbooks, directories, atlases, University Calendars, etc. are shelved in the Reference Room. Bibliographies, indexes and abstracts are available in the Bibliography Room. Reference books do not ordinarily circulate.

A newspaper clippings file (*post-October; 1985)* and a vertical file of reprints and other pamphlet type material is kept in the Reference Room.

5. **Reserve Collection**

(i) **Day reserve collection**

Multiple copies of textbooks, particularly some of those recommended for specific courses, are shelved in the Reserve Books Room on Floor 3 North Wing East.

(ii) **Two Hour Reserve**

Some other materials, periodical articles in particular, are placed on 2-hour reserve. These may be obtained on request (signature and seat number required) and retained for a period of two hours at a time, subject to renewal, provided other readers have not demanded the materials.

6. **Recent Accessions**

A selection of books added to the Library stock is normally displayed for several days before being put in the main collection. The books may not be borrowed while on display but may be reserved at the loans Desk.

CATALOGUES

A library catalogue is a finding list of books and other materials available in the library. The following catalogues can be found in the Catalogue Hall:

(i) The Author/Title Catalogue
(ii) The Subject Catalogue
(iii) The Shelf list
(iv) The Serials Catalogue
(v) The Documents Catalogue

HOW TO BORROW A BOOK

When you have found the book you want to borrow, you will be required to sign your name and address on the book card provided

in duplicate. You must surrender a Borrower's Ticket for each book borrowed.

When you return a book, you must ensure that you receive your Borrower's Ticket back
immediately.

RESERVATION
A book can be reserved by filling a reservation slip; in which case, it will not be renewed for the present borrower when returned, and, if it is already overdue, it will be recalled at once.

INTER-LIBRARY LOAN
If the book you require is not in stock, it is often possible to borrow it from another library. This service is dependent on goodwill and cooperation between libraries, and readers who benefit from it are required to observe the regulations applying to each loan.

PHOTOCOPYING SERVICES
Within the limitations imposed by copyright, the library is able to supply readers with photocopies of periodical articles and parts of books at moderate charges.

PENALTIES FOR OVERDUE OR LOST BOOKS
Penalties for overdue books will be imposed as follows:-

(a) N5.00 per day for the first 30 days; thereafter all loan privileges will stop.

(b) Books specially recalled by the university Librarian will attract a fine of N10.00 per day after third day from the date of recall.

(c) Books lost or damaged will attract a fine five times the current cost of the books.

(d) No student will be allowed to attend the Graduation Ceremony or receive his/her certificate without a clearance certificate from the University Library to the effect that no book or fine is outstanding against him or her.

LIBRARY OPENING AND CLOSING HOURS

Monday – Friday	8.00 a.m.	-	10.00 p.m.
Saturday	8.00 a.m.	-	4.00 p.m.
Sunday	2.00 p.m.	-	10.00 p.m.
Vacation Period			
Monday – Friday	8.00 a.m.	-	6.00 p.m.

B. Division of Students' Affairs.

1. **Guidance and Counseling Unit:**

The Division of Students' Affairs has Professional Counselors who are committed to helping students grow in self-understanding in the process of integrating their personal and academic experiences. The services are free to students and are confidential (i.e. not used as part of his/her other University records). The services include personal counseling, group counseling, study skills improvement, tests anxiety reduction, personal crisis intervention, psychological testing, career and occupational counseling and settlement of grievances between students. Where necessary, consultations are made with campus organizations, specialists and academic Departments, to ensure that students' problems are resolved satisfactory.

The Counselors can be contacted in Rooms 9 and 10 Division of Students' Affairs between 10.00 a.m. and 2.00 p.m. Monday to Friday.

2. **Scholarship and Financial Assistance:**

The Division of Students' Affairs serves as a link between students and sponsoring authorities, both within and outside Nigeria. Students are advised to check the Notice Boards in their respective faculties as well as those at the Division of Student Affairs Building for advertisements and other relevant information.

Liaison is also maintained between students and governments at various levels for scholarship and bursaries.

1.3.3 Roll of Honours for Students

Senate at a Special Meeting held on Wednesday, 1st November, 2006 decided that Roll of honours for Students be instituted in the University to enhance discipline and good performance among students.

All students are enjoined to strive to be on the Honours Roll.

The details are as follows:

(i) The Honours Roll should be at three levels, namely:
   - (a) Departmental Honours Roll
   - (b) Provosts/Deans Honours Roll
   - (c) University/Vice-Chancellor's Honours Roll

(ii) The beneficiaries must have a minimum CGPA of 4.0 for Departmental Honours Roll; 4.25 for Provost/Deans honours Roll and 4.5 for Vice-Chancellor/University Honours Roll in all the Faculties except the Faculty of Pharmacy and College of Health Sciences where the candidates are expected to have a cumulative average of 60% and 62% respectively.

(iii) The beneficiary must maintain this grade annually to continue to enjoy the award.

(iv) The recommendations must be processed along with results of Rain Semester examinations.

(v) The student must be of good conduct.

(vi) He/she must not have outstanding or carry-over courses and must not be repeating the year.

(vii) No student on Leave of Absence shall enjoy the Annual Roll of Honours Award.

(viii) No student that has a disciplinary problem shall enjoy the award.

(ix) The award shall be based on the recommendation of the Departmental Board of Examiners and the Faculty Board of Examiners, while that pertaining to the Vice-Chancellor/University shall be processed through the Committee of Deans.

(x) Names of beneficiaries shall be displayed as follows;

Departmental Honours	-	Departmental Notice Board
Provost/Deans Honours	-	Faculty Notice Board
Vice-Chancellor/University Honours	-	Floor `0' Secretariat Building

(xi) Each beneficiary shall be given a certificate.

1.4 University Examination Regulations

Some University Examination Regulations students should note as contained in University Examination Regulations for first Degrees, Diplomas and Certificates are:

1.4.1. Registration for University Examinations

(a) A candidate for a University examination must have registered the courses in the prescribed format not later than the closing date prescribed for registration for such courses. Any candidate who fails to register for courses at the appropriate time as prescribed by Senate will not be allowed to take any examination in such courses. Any examination taken without course registration shall be null and void.

(b) Students who register for courses are committed to the number of units registered for and are expected to take examinations in such courses. If a student failed to take an examination he would be scored '0F' for the number of units he had registered for and in which he had failed to take the prescribed examination.

(c) Any student who does not have any course to offer in a particular semester should apply for leave of absence.

(d) A candidate who has less than 15 units in a particular semester to graduate should apply to his/her Faculty Board for permission to register for less than 15 Units. Failure to do so constitutes a breach of regulation which may result in the non-processing of the candidate's results.

(e) A candidate, who cannot register for courses during the prescribed period for registration because of an illness, must ensure that medical report on his illness is forwarded by him or his parents/sponsors to reach the Dean of his Faculty not later than four weeks after the end of the normal registration period as scheduled in the University Calendar. Such a medical report should be forwarded for authentication by the Director of Medical and Health Services for it to be considered valid. Such a candidate shall be exempted from the penalties of late registration. All applications should be routed through the Head of Department.

(f) Students must attend a minimum of 75% of course instructions including lectures, tutorials and practicals where required to qualify to sit for examination in any course.

1.4.2 Absence from Examination

Candidates must present themselves at such University examinations for which they have registered. Candidates who fail to do so for reason other than illness or accident shall be bound by the following regulations:

(a) Any student who fails to register for courses during one semester without permission should be deemed to have scored "0F" in the minimum number of units required for full time students (i.e. 15 Units).

(b) Candidates who registered for courses, attended classes regularly, did all practical and tests but did not take required semester examinations should be given a

continuous assessment grade in each of the affected courses and a grade of "0F" in the examination which they should have taken, but which they did not take.

(c) Candidates who have less than 15 units to graduate but fail to take the required examinations should be deemed to have scored "0F" in the outstanding courses only provided such candidates obtained permission to register for less than 15 units.

(d) Any candidate who on account of illness, is absent from a University examination may be permitted by the Senate on the recommendation from the appropriate Faculty Board, to present himself for such examination at the next available opportunity provided that:

(i) A full-time student in the University shall report any case of illness to the University Health Centre at all times.

(ii) When a student falls ill during examination he should report to the Director, Medical and Health Services before attending any hospital outside the University. A report of sickness should be made to the Registrar within a week and a medical certificate of validation of his illness within three weeks.

(iii) When a student falls ill before an examination he shall be under an obligation to send a medical report countersigned by the Director, Medical and Health Services within one week of such illness. Any time outside this period, shall be considered on its merit.

(iv) The Director of Medical and Health Services should within 48 hours, submit a medical report on a candidate who is ill during an examination and is taken to the Health Centre or referred by it to the hospital for treatment.

(v) A candidate applying for leave of absence on medical grounds must forward his application together with a medical report to the Dean of his Faculty through his Head of Department. The

Medical Report must be countersigned by the Director, Medical and Health Services. All applications for Leave of Absence must be taken by the appropriate Faculty Board.

1.4.3 Examination Offences and Penalties

(a) A candidate shall not be allowed during an examination to communicate by word or otherwise with any other candidates nor shall he leave his place except with the consent of an invigilator. Should a candidate act in such a way as to disturb or inconvenience other candidates, he shall be warned and if he persists he may, at the discretion of the invigilator be excluded from the examination room. Such action by the invigilator must also be reported in writing through the Head of Department to the Vice-Chancellor within 24 hours.

(b) It shall be an examination offence for any student, staff or any person whatsoever, to impersonate a candidate in any University examination. Any student or staff of the University found guilty under this regulation shall be subjected to disciplinary action by the appropriate authority of the University.

(c) No candidate shall take into an examination room or have in his possession during examination any book or paper or printed or written documents, whether relevant to the examination or not, unless specifically authorized to do so. Any invigilator has authority to confiscate such documents.

(d) Mobile phones are not allowed in examination halls.

(e) A candidate shall not remove from an examination room any papers, used or unused, except the question paper and such book and papers, if any, as he is authorized to take into the examination room.

(f) Candidates shall comply with all “direction to candidates” set out on an examination answer book

or other examination materials supplied to them. They shall also comply with duration given to them by an Invigilator.

(g) Candidates shall not write on any paper other than the examination answer books. All rough work must be done in the answer books and crossed out neatly. Supplementary answer books, even if they contain only rough work must be tied inside the main answer books.

(h) When leaving the examination room, even if temporarily, a candidate shall not leave his written work on the desk but he shall hand it over to an invigilator. Candidates are responsible for the proper return of their written work.

(i) Smoking shall not be permitted in examination room during examination sessions.

(j) Any candidate or staff who attempts in any way to unlawfully have or give pre-knowledge of an examination question or to influence the marking of scripts or the award of marks by the University examiner shall be subject to disciplinary action by the appropriate authority of the University.

(k) If any candidate is suspected of cheating, receiving assistance or assisting other candidates or of infringing any other examination regulation, a written report of the circumstance shall be submitted by the invigilator to the Vice-Chancellor within 24 hours of the examination session. The candidate concerned shall be allowed to continue with the examination.

(l) Any candidate suspected of examination malpractice shall be required to submit to the invigilator a written report immediately after the paper. Failure to make a report shall be regarded as a breach of discipline. Such report should be forwarded along with the Invigilators report to the Vice-Chancellor.

(m) Where a Head of Department fails to forward a report on examination malpractice to the Vice-Chancellor such action would be considered a misconduct.

1.5 The Course Unit System and the Computation of Grade Point Average (GPA) as Operated in Obafemi Awolowo University.

1.5.1 Introduction

The course unit system is a system whereby programmes are designed with courses, which are weighted and classified into various levels for students in the institution of higher learning. Courses are assigned units depending on the volume of work required to complete the course and this includes lectures, tutorials and practicals. Any student can take the courses at any level provided there are no (constraints) prerequisites for these courses. For instance, a Part I student can offer a course at any level provided the student has the prerequisites required for that course, while a Part IV student can still offer a Part I course if such a student so desires. However, it is generally desirable that lower level core courses are taken and passed before proceeding to high level ones.

The system allows a student to spread his programme evenly over the semesters provided such a student keeps to the rules and regulation of the system. For instance there are minimum and maximum numbers of units a student can register for in a semester. Every semester is as important as the other. A wise student is encouraged to attempt a reasonable number of units he/she can cope with to ensure a qualitative performance.

It is compulsory for every student to interact with his/her Part Adviser (See the Departmental notice board for list) to discuss his/her programme and courses before proceeding to register during any semester. This is extremely important to ensure that the student registers appropriately. There are many issues that are

linked to registration; therefore, proper interaction with an Adviser will guarantee that a student does not register for more courses than he/she can cope with among other issues. In the past, many students have found themselves in avoidable situations resulting in withdrawal advice from the University arising from failure to interact with the Part Advisers prior to registration. The Adviser is expected to patiently attend to students allocated to him/her, check through all the previous coursework result of the individual students to be able to guide him/her on the course he/she should register for in a particular semester.

Apart from the end of semester examination, there are continuous assessments during each semester. These tests and the end of semester examination make up the set of semester examinations for each course. Appropriation of scores to make the final mark of 100% varies from one Faculty to another, but continuous assessment scores cannot be more than 40% of the 100%.

1.5.2 Calculation of Grade Point Average (GPA)

This section is designed to acquaint students with the procedure for computing the Grade Point Average (GPA) for each set of semester examinations and for upgrading the computations to obtain the Cumulative Grade Point Average (CGPA) at any point in time during each student's course of study.

It is strongly advised that every student should learn how to compute (and actually do compute his own) GPA and CGPA. By thus computing and keeping a record of his CGPA, the student will be fully aware of what effort he must put in to remain in the University or to graduate in a desired class. This is the only way you can be in a position to be on your guard and monitor the quality of your efforts.

1.5.3 Definition of Terms

It is necessary to first understand and be thoroughly familiar with certain terminologies and abbreviations that are commonly used in the computation of Grade Point Average. These are defined as follows:

(i) **Student Workload**: This is defined in terms of course units. One unit represents one hour of lecture or one hour of Tutorial or 2-4 hours of practical work per week throughout a semester. Thus for example, a course in which there are 2 hours of lectures and 1 hour of Tutorial per week is a 3 unit course.

(ii) **Total Number of Units (TNU)**: This is the total number of course units carried by a student in a particular semester. It is the summation of the load Units on all Courses carried during the semester. For example, a student who is carrying 6 courses of 3 units each has a TNU of 18 for that semester.

(iii) **Cumulative Number of Units (CNU)**: This is the summation of total number of Load Units over all the semesters from the beginning to date. A student who is prone to repeating courses will finish (if he does not drop out) with a higher CNU than his non-repeating colleague and will most likely require a longer time to complete requirements for the award of Degrees.

(iv) **Level of Performance Rating:** This is the rating of grades obtained in terms of credit points per load unit. The rating used is as follows:

Level of Performance		Rating (credit points per unit)
A = Excellent	(70 – 100%)	5
B = Very Good	(60 – 69%)	4
C = Good	(50 – 59%)	3
D = Satisfactory	(45 – 49%)	2
E = Adequate	(40 – 44%)	1
F = Failure	(0 – 39%)	0

Based on the above, a student who obtained a grade of 'A' in a 4-unit course has scored 20 Credit points and one who obtained a grade of C in that course has scored 12 credit points.

(v) **Total Credit Points (TCP)**: This is the sum of the products of the course units and rating in each

course, for the entire semester period. For example, consider a student who took 4 courses of 5 units each. Let's say the grade obtained in the four courses were C, B, F, D, respectively. The TCP of this student is obtained as

5 X 3+5 X 4+5 X 0 +5 X 2 = 45.

(vi) **Cumulative Credit Point (CCP)**: This is the summation of Total Credit Points over all semesters from beginning to date.

(vii) **Grade Point Average (GPA)**: This is the total credit points' (TCP) divided by the total units (TNU). For example, consider the student's scores referred to above. His TCP is 45 and of course, his TNU is 20 (i.e. 4 courses at 5 units each for the semester). The highest GPA that can be earned is 5.0 and that is when a student has earned a grade of 'A' in every course during the semester. The lowest GPA obtainable is 0.0 and this would happen if the student has F all round during the semester.

(viii) **Cumulative Grade Point Average (CGPA):** This summation of TCPs for all semesters divided by the summation of TNUs for the said semesters. Like the GPA, CGPA, obtainable ranges from 0 to 5.

1.5.4 GPA and CGPA sample computations

i. **Sample Computations:** Consider a student who has enrolled in a course programme in Mathematics and has just completed 2 full semesters in the University. His course programme and GPA and CGPA could be as follows:

Part I - Harmattan Semester

Course Code	Units	Grades	Credit Points	GPA/CGPA
MTH 101 PHY 107 CHM 101 CHM 103 PHY 101 BIO 101	5 1 4 1 4 3	68%B 74%A 52%C 60%B 56%C 42%E	5 x 4 = 20 1 x 5 = 5 4 x 3 = 12 1 x 4 = 4 5 x 3 = 15 3 x 1 = 3	GPA = 59/18 = 3.28 CCP = 59 + 0 = 59 TLU = 18 + 0 = 18 CGPA = 59/18 = 3.27
	TNU 18		TCP 59	

Part I - Rain Semester

Course Code	Units	Grades	Credit Points	GPA/CGPA
MTH 102 MTH 104 CHM 102 CHM 104 PHY 102 PHY 108	5 2 4 1 4 1	72%A 70%A 65%B 60%B 48%D 57%C	5 x 5 = 25 2 x 5 = 10 4 x 4 = 16 1 x 4 = 4 4 x 2 = 8 1 x 3 = 3	GPA = 66/17 = 3.88 CCP = 66 + 59 = 125 TLU = 17 + 18 = 35 CGPA = 125/35 = 3.57
	TNU 17		TCP 66	

ii. Notes on the Sample Computations:

(a) If the Student had obtained a grade of F in MTH 101 in the first semester and a grade F in PHY 102 at the end of Second Semester, these courses would contribute to his TNU but zero would be added to TCP for these courses. He will then have to repeat the course MTH 101 and PHY 102 in the subsequent semesters.

(b) During subsequent semesters, the students may have to drop other courses in order to accommodate MTH 101 and PHY 102 which he had failed (and must repeat sooner or later) previous semesters. If he had tried to take MTH 101 without dropping anything, his TNU for semester may exceeds the allowable number of registered courses. In this case he must drop some courses to be able to register for the maximum allowable TNU of courses for the semester. Overloads are not normally allowed. There are no more Examination Re-sits in almost all the Faculties, therefore any course failed has to be repeated when it is available and must be passed before graduation.

(c) Students are strongly advised to consult with their course advisers before registering for courses and on other academic problems that they may have.

1.6 Miscellaneous Notes on the Course Unit System

(i) Withdrawal from the University: A student whose CGPA falls below 1.0 at the end of a semester shall be placed on probation during the following semester, if he/she fails to achieve a CGPA of at least 1.0 at the end of that semester, he/she shall be required to withdraw from the University.

(ii) Final Assessment and Class of Degree: A student who has satisfactorily completed all requirements for the degree with CGPA of not less than 1.50 may be awarded an Honours degree as follows:

Class	**CGPA**
First Class	4.50 and above
Second Class (Upper Division)	3.50 – 4.49
Second Class (Lower Division)	2.40 – 3.49
Third Class	1.50 – 2.39
Pass	1.00 – 1.49

(iii) Passes in 12 Units of Special Electives is a requirement for graduation.

(iv) A candidate who does not reach a CGPA of 1.50 but whose CGPA is not less than 1.00 at the end of the programme is awarded a pass degree (i.e. without Honours). ****CGPA calculation is on all courses, but excluding Special Electives.

1.7 Transfer within the University and Length of Stay in the University

(a) To qualify for a degree, a candidate will normally be required to spend a minimum of two academic years at the Obafemi Awolowo University.

(b) If a student transfers from one Faculty to another, the transfer would be treated as if he/she is just being admitted into the University since as part of the requirement for graduation the student has to take all the foundation/compulsory courses in the new Faculty/Department. In that case his/her stay in the new Faculty/Department should be 1½ times the number of semesters required to complete a programme.

(c) Where a student transfers from a science based Faculty to another, the computation of is result in the new Faculty shall take cognizance of his previous CGPA in the new Department. The duration of they stay in the university will be what remains of the 1½ times the number of semesters required to complete the programme as approved by Senate.

(d) Where a student is transferring from a science-based to a Humanities/Arts-based Faculty or vice-versa, the transfer should be treated as if the student is just being admitted into the University. The GPA of the student will not be transferred to the new Department. He/She will however be required to take all the foundation/compulsory courses in the new Department.

2.0 BACHELOR OF SCIENCE DEGREE IN MATHEMATICS

2.1 Objective:

The undergraduate programme is designed to equip students with the tools for mathematical techniques and thinking. At the early stages students are exposed to the fundamentals of mathematical processes and principles in both pure and Applied Mathematics which will satisfy both the needs of mathematicians and users of mathematics. The Department offer candidates potentially capable of undertaking further study the opportunity to concentrate as necessary in a theoretical and / or applied area. In the process it exposes students to real life problems with a view to assisting them in seeing the connection between theory and practice.

Although, mathematics as a subject is basically in the Faculty of Science, the programme is such that students outside the Faculty of Science, e.g. Faculties of Technology and Social Sciences, can pursue it, combining it with subjects of their choice and thus culminating in either combined Honours or even as an Honour degree in Mathematics. For students in this category appropriate subjects in consultation with the Dean of the Faculty concerned can usually replace the Physics, Chemistry and Biological science based courses in the foundation programmes.

2.2 Degree Offered:

Bachelor of Science (B.Sc. (Hon)) Honour Degree in Mathematics.

2.3 Entry Requirements:

UTME candidates who wish to enroll for courses leading to a degree in mathematics must satisfy the University and Faculty of Science requirements for admission. Indeed such candidates must normally possess the Senior Secondary School Certificate or its equivalent, with credit in at least

five subjects, which must include English Language, Mathematics, Physics and Chemistry or Biology. Candidates who wish to enter by direct entry must in addition to the above requirements have good passes in Mathematics and any other science subject at the G.C.E. Advanced Level or its equivalent. Such candidate if admitted may be exempted from the appropriate courses.

2.4. Requirements for the Award of Degree:

To be eligible of the award of a degree candidate must satisfactorily complete the minimum number of unit prescribed of the degree. He must in addition complete successfully all the compulsory courses as well as the special and general elective for the degree as prescribed. The same course cannot be counted twice (e.g. from repeat) in the computation of the minimum number of units. A candidate will normally spend a period of four academic sessions in order to fulfill the above requirements.

2.5. Graduation Requirements:

(a) Foundation Programme Option

		Harmattan L-T-P	Rain L-T-P	Units
MTH 101	Elementary Mathematics I	4-1-0		5
MTH 102	Elementary Mathematics II	-	4-1-0	5
MTH 201	Mathematical Methods I	3-1-0	-	4
MTH 202	Mathematical Method II	-	3-1-0	4
PHY 101	General Physics I	3-1-0	-	4
PHY 102	General Physics II	-	3-1-0	4
PHY 107	Experimental Physics 1A	0-0-3	-	1
PHY 108	Experimental Physics 1B	-	0-0-3	1
PHY 205	Introductory Modern Physics	-	2-1-0	3
PHY 208	Experimental Physics IIB	-	0-0-3	1
CHM 101	Introductory Chemistry I	3-1-0	-	4
CHM 102	Introductory Chemistry II	-	3-1-0	4
CHM 103	Introductory Exp. Chemistry	0-0-3	-	1
CHM 104	Introductory Exp. Chemistry	-	0-0-3	1
BIO 101	Biology for Physical Sciences	2-1-0	-	3
		Sub-total	**=**	**45**

(b) Special Electives

	Units
Total Special Electives	**12**

(c) Departmental Requirements

		Harmattan L-T-P	Rain L-T-P	Units
MTH 104	Vectors	-	2-0-0	2
MTH 205	Introduction to Algebra	2-1-0	-	3
MTH 206	Introduction to Numerical Analysis	-	2-1-0	3
MTH 207	Logic, Sets and the Real Number System	2-1-0	-	3
MTH 208	Introduction to Real Analysis	-	2-1-0	3
MTH 211	Introduction to Mechanics	2-0-0	-	2
MTH 212	Mechanics	-	2-1-0	3
MTH 301	Functions of a Complex variable	2-0-0	-	2
MTH 302	Differential Equations	-	2-1-0	3
MTH 303	Advanced Calculus	2-0-0	-	2
MTH 305	Vectorial Mechanics	2-1-0	-	3
MTH 306	Groups and Ring	-	2-1-0	3
MTH 307	Introduction to Topology	2-1-0	-	3
MTH 309	Electromagnetic Theory	2-0-0	-	2
MTH 310	Hydromechanics	-	2-1-0	3
MTH 311	Linear Algebra	2-1-0	-	3
MTH 314	Real Analysis	-	2-1-0	3
MTH 321	Tensor Analysis	2-1-0	-	3
MTH 322	Introduction to Mathematics Modelling	-	2-1-0	3
MTH 401	General Topology	2-1-0	-	3
MTH 403	Measure Theory and Integration	2-1-0	-	3
MTH 404	Normed Linear spaces	-	2-1-0	3
STT 201	Introduction to Statistics	2-1-0	-	3
STT 202	Probability Distributions I	-	2-1-0	3
CSC 201	Computer programming I	2-0-3	-	3
CSC 208	Computer Technology	-	1-0-3	2
MTH 499	Honours Project in Mathematics	-	-	3
		Sub-total	=	**75**

(d) Restricted Electives: This may include courses the Head of Department may recommend

(i.) Register at least two (2) units from this section

		Harmattan L-T-P	Rain L-T-P	Units
MTH 213	History of Mathematics	2-0-0	-	2
MTH 312	Electromagnetic Theory II	-	2-1-0	3
MTH 316	Waves	-	2-0-0	2
MTH 318	Theory of Numbers	-	2-1-0	3
MTH 320	Introduction to Differential Geometry	-	2-1-0	3
STT 301	Probability Distributions II	2-1-0	-	3

Minimum Sub-total = 2

(ii.) Register at least 3 units from each of the following groups

GROUP 1

		Harmattan L-T-P	Rain L-T-P	Units
MTH 405	Galois Theory	2-1-0	-	3
MTH 407	Complex Analysis I	2-1-0	-	3
MTH 409	Ordinary Differential Equations	2-1-0	-	3
MTH 411	Homology Theory	2-1-0	-	3
MTH 413	Differential Geometry I	2-1-0	-	3
MTH 425	Non Associative Binary Systems	2-1-0	-	3
MTH 427	Group Representation	2-1-0	-	3

GROUP 2

		Harmattan L-T-P	Rain L-T-P	Units
MTH 415	Quantum Mechanics I	2-1-0	-	3
MTH 417	Fluid Dynamics I	2-1-0	-	3
MTH 419	Elasticity I	2-1-0	-	3
MTH 421	Electromagnetic Theory III	2-1-0	-	3
MTH 423	Numerical Analysis I	2-1-0	-	3

GROUP 3

		Harmattan L-T-P	Rain L-T-P	Units
MTH 402	Algebraic Topology	-	2-1-0	3

MTH 406	Commutative Algebra	-	2-1-0 3
MTH 408	Complex Analysis II	-	2-1-0 3
MTH 410	Ordinary Differential Equations II	-	2-1-0 3
MTH 412	Homotopy Theory	-	2-1-0 3
MTH 414	Differential Geometry II	-	2-1-0 3
MTH 426	Non Associative Binary Systems II	-	2-1-0 3
MTH 428	Introduction to group Rings	-	2-1-0 3

GROUP 4

		Harmattan L-T-P	**Rain L-T-P**	**Units**
MTH 416	Quantum Mechanics II	-	2-1-0	3
MTH 418	Fluid Dynamics II	-	2-1-0	3
MTH 420	Elasticity II	-	2-1-0	3
MTH 422	Electromagnetic Theory IV	-	2-1-0	3
MTH 424	Numerical Analysis II	-	2-1-0	3

Sub Total = 12

(e) Free Electives

6 Units of Courses outside those listed above

Sub-total = 6

Grand Total (a + b + c + d + e) = **155 Units**

2.6 Outline of Programme for PARTS I – IV Mathematics

PART I HARMATTAN SEMESTER

Course Code	**Course Title**	**L**	**T**	**P**	**U**
MTH 101	Elementary Mathematics I	4	1	0	5
PHY 101	General Physics I	3	1	0	4
PHY 107	Experimental Physics 1A	0	0	3	1
CHM 101	Introductory Chemistry I	3	1	0	4
CHM 103	Introductory Exp. Chemistry	0	0	3	1
BIO 101	Biology for Physical Sciences	2	1	0	3
	Special Electives	2	0	0	2
	Total Units				**20**

PART I RAIN SEMESTER

Course Code	Course Title	L	T	P	U
MTH 102	Elementary Mathematics II	4	1	0	5
MTH 104	Vectors	2	0	0	2
PHY 102	General Physics II	3	1	0	4
PHY 108	Experimental Physics 1B	0	0	3	1
CHM 102	Introductory Chemistry II	3	1	0	4
CHM 104	Introductory Exp. Chemistry	0	0	3	1
	Special Electives	2	0	0	2
	Total Units				**19**

PART II HARMATTAN

Course Code	Course Title	L	T	P	U
MTH 201	Mathematical Methods I	3	1	0	4
MTH 205	Introduction to Algebra	2	1	0	3
MTH 207	Logic, sets and the Real Number System	2	1	0	3
MTH 211	Introduction to Mechanics	2	1	0	2
STT 201	Introduction to Statistics	2	1	0	3
PHY 205	Introduction to Modern Physics	3	0	0	3
CSC 201	Introduction to Computing	3	0	0	3
	Special Electives	2	0	0	2
	Total Units				**23**

PART II RAIN

Course Code	Course Title	L	T	P	U
MTH 202	Mathematical Methods II	3	1	0	4
MTH 206	Introduction to Numerical Analysis	2	1	0	3
MTH 208	Introduction to Real Analysis	2	1	0	3
MTH 212	Mechanics	2	1	0	3
STT 202	Probability Distribution I	2	1	0	3
PHY 208	Experimental Physics IIB	0	0	3	1
CSC 208	Computer Technology	2	0	0	2
	Special Electives	2	0	0	2
	Total Units				**21**

PART III HARMATTAN

Course Code	Course Title	L	T	P	U
MTH 301	Function of a Complex variable	2	0	0	2
MTH 303	Advanced Calculus	2	0	0	2
MTH 305	Vectorial Mechanics	2	1	0	3
MTH 307	Introduction to Topology	2	1	0	3
MTH 309	Electromagnetic Theory I	2	0	0	2
MTH 311	Linear Algebra	2	1	0	3
MTH 321	Tensor Analysis	2	1	0	3
	Restricted elective				2/3
	Special Electives	2	0	0	2
	Total Units				**22/23**

PART III RAIN

Course Code	Course Title	L	T	P	U
MTH 302	Differential Equations	2	1	0	3
MTH 306	Groups and Rings	2	1	0	3
MTH 310	Hydromechanics	2	1	0	3
MTH 314	Real Analysis	2	1	0	3
MTH 322	Introduction to Mathematical Modelling	2	1	0	3
	Restricted Elective				3/2
	Special Electives	2	0	0	2
	Total Units				**19/20**

PART IV HARMATTAN

6 Units from:

Course Code	Course Title	L	T	P	U
MTH 401	General Topology	2	1	0	3
MTH 403	Measure Theory and Integration	2	1	0	3
MTH 405	Galois Theory	2	1	0	3
MTH 407	Complex Analysis I	2	1	0	3
MTH 409	Ordinary Differential Equations	2	1	0	3
MTH 411	Homology Theory	2	1	0	3
MTH 413	Differential Geometry I	2	1	0	3
MTH 425	Non Associative Binary System	2	1	0	3
MTH 427	Group Representation	2	1	0	3
	Sub Total				**6**

6 Units from:

Course Code	Course Title	L	T	P	U
MTH 415	Quantum Mechanics I	2	1	0	3
MTH 417	Fluid Dynamics I	2	1	0	3
MTH 419	Elasticity I	2	1	0	3
MTH 421	Electromagnetic Theory III	2	1	0	3
MTH 423	Numerical Analysis I	2	1	0	3
	Sub Total				**6**
	Free Elective Outside the Department				3
	Total				**15**

PART IV RAIN

6 units from:

Course Code	Course Title	L	T	P	U
MTH 402	Algebraic Topology	2	1	0	3
MTH 404	Normed Linear Spaces	2	1	0	3
MTH 406	Commutative Algebra	2	1	0	3
MTH 408	Complex Analysis II	2	1	0	3
MTH 410	Ordinary Differential Equation II	2	1	0	3
MTH 412	Homotopy Theory	2	1	0	3
MTH 414	Differential Geometry II	2	1	0	3
MTH 426	Non Associative Binary system II	2	1	0	3
MTH 428	Introduction to Group rings	2	1	0	3
	Sub Total				**6**

6 units from:

Course Code	Course Title	L	T	P	U
MTH 416	Quantum Mechanics II	2	1	0	3
MTH 418	Fluid Dynamics II	2	1	0	3
MTH 420	Elasticity II	2	1	0	3
MTH 422	Electromagnetic Theory IV	2	1	0	3
MTH 424	Numerical Analysis II	2	1	0	3
	Sub Total				**6**
MTH 499	Project in Mathematics				3
	Special Electives	2	0	0	2
	Total				**17**

2.7 Course Content (Mathematics)

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

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

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

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

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

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

Matrices: Definition of m x n matrices $1 \leq m, n \leq 3$; addition of matrices, matrix multiplication and inversion. Determinant of a matrix. Applications to simple linear equations, consistence and linear dependence.

MTH 102- Elementary Mathematics II

4-1-0 (5 Units) Rain Semester

Trigonometry: Circular measure, small angles, definition and properties of sine, consine, tangent, etc. Fomulae for sin (A + B), cos (A+B), Tan (A+B), sin A/2, cos A/2, tan A/2 etcetera. Sine and cosine formulae, Factor formulae, inverse trigonometric functions. General solution of trigonometric equations such as $\cos \theta + b \sin \theta = c$ etc.

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

Coordinate Geometry: Coordinates, equations of lines, circles ellipse, hyperbola and parabola.

Statistics: Finite sample spaces, definition of probability on finite sample spaces and examples. Probability as proportion of areas, conditional probability of event. Independence, tree diagrams, variables and cumulative frequency distribution, mean median variance and co- variance conditional expectation and linear correlation, using scatter diagram.

MTH 104 Vectors

2-0-0 (2 Units) Rain Semester

Introduction to vectors, vector addition components of a vector, unit vectors I, j, k, magnitude of a vector. Vector multiplication (Scalar vector, scalar triple and vector triple products). Applications to geometry and kinematics, (including relative velocity). Solutions of simple vector equations. Differentiation and integration of vectors.

MTH 105 Elementary Mathematics of Biological Sciences I

3-1-0 (4 units) Harmattan Semester

Elementary set theory, Quadratic function and equations. Solution of linear equations in three unknowns. Simple properties of determinants. Indices and logarithms; surds, permutation and combination; binomial theorem for positive and negative integral and fractional indices. Factor and Remainder theorems, inequalities.

Circular measurer, compound angles, trigonometric functions of angles between 00 and 360^0. Graphs of trigonometric function Limits; Differentiation of algebraic trigonometric, exponential logarithms, product and quotient functions.

(Not for students offering MTH 101).

MTH 106 Elementary Mathematics for Biological Sciences II

3-1-0 (4 units) Rain Semester

Applications of differentiation to gradient of curves and to maxima and minima of functions and physical quantities. Definite and indefinite integrals and their application to areas and volumes. Simple integration by substitution and by parts. Equations of the straight line and the circle in Cartesian coordinates.

First order ordinary differential equations with separable variables and application to first and second order chemical reactions, radioactivity and Clausus Clapeyrron equation.

Collection, tabulation and representation of data. Frequency distribution, histogram, Ogive, mean, mode and median. Measure of dispersion. Sample spaces and examples. Probability and proportion of area, conditional probability of events. Applications.

MTH 201 Mathematical Method I

3-1-0 (4 Units) Harmattan Semester

Sequence and Series: Limits, Continuity, Differentiability, Implicit functions, sequences, series, tests, of convergence. Sequences and series of functions.

Calculus: Partial differentiation, total derivatives, implicit functions change of variables, Taylor's theorem and maxima and minima of function of two variable. Lagangian multiplier.

Numerical Methods: Introduction to iterative methods, Newton's method applied to finding roots. Trapezium and Simpson's rules of integration.

Differential equations: Introduction, equation of first order and fist degree, separable equations, homogenous equations, exact equation, linear equation, Bernoulli's and Riccati equations.

Applications to mechanics and electricity. Orthogonal and oblique trajectories'. Second order equations with constant coefficients.

Pre – requisites: MTH 102.

MTH 202 Mathematical Methods II

3-1-0 (4 Units) Rain Semester

Vector Theory: Vector and Scalar field functions. Gad, div, curl, directional derivatives, Orthogonal curvilinear coordinates.

Complex Numbers: The algebra and geometry of complex numbers; De'Moive's theorem. Elementary transcendental functions. The nth root of unity and of a general complex number.

Linear Algebra: Vector spaces. Linear independence. Basis, chance of basis and dimension. Linear equations and matrices. Linear maps. The diagonal, permutation, triangle matrices.

Elementary Matrix: The inverse matrix. Rank and nullity. Determinants. Adjoint rule, canonical forms, similar matrices. Eigenvalues and eigenvectors, quadratic forms.

Pre – requisite: MTH 102.

MTH 205 Introduction to Algebra

2-1-0 (3 Units)

Set: Binary operations, mappings, equivalence relations.

Integers: Fundamental theorem of arithmetic, congruence's, linear congruence equations. Euler's function 0 (n)
Group theory: Definition and examples of groups. Sub – groups, coset decomposition, Lagrange's theorem. Cyclic groups, Homomorphism, isomorphism, odd and even permutations, Cayley's theorem.
Rings: Definition and examples of rings. Commutative rings. Integral domain. Order, well-ordering principle. Mathematical induction. Zn, division rings, field construction of the field of factions of an integral domain and the embedding theorem.
Pre- requisite: MTH 102

MTH 206 - Introduction to Numerical Analysis
2-1-0 (3 Units) Rain Semester
Solutions of Equations: Graphical method, simple iterative methods, graeffe's method, Bernoulli's method, Bairostow's method. Iterative methods for systems of linear equations. Gauss elimination method, Gauss – Jordan method. Jacobi iterative method. Gauss field iterative method.
Interpolation: Lagrange's and hemite interpolation formulae, divided differences and difference schemes.
Approximation: Least square polynomial approximation, Chebyshev's polynomials, continued fraction and rational faction. Orthogonal polynomials.
Numerical: integration Newton – Cote's formulae, Gaussian quadrature.
Matrices and Related Topics: Eigenvalues and eigenvectors Algebraic eigenvalue problems. Power method and Jacobi method.
Pre – requisite: MTH 201

MTH 207 Logic, Sets and the Real Number System.
2-1-0 (3 Units) Hamattan Semester
Logic: Statements, symbols of the three simplest connectives; truth tables, tautology and equivalence. Law of the algebra of statements, viz commutative, associative, distributive, idempotent, identity, the complement and De- Morgan's laws.

Sets and functions: Cartesian products of sets; family of sets. A function as a triple (F, x, Y). Direct and inverse images, subjective functions. Injective functions and one - one correspondence. Unipotent sets. Finite sets. Countable sets. Existence of uncountable sets.

The Real Number System R = R, +, <)

R as an ordered field. Axioms for addition and axioms of multiplication (the distributive laws). Mathematical induction. Definition of the natural numbers, the rational number. Upper bounds, lower bounds, supreme and infimum. The Completeness Axiom. Open intervals, open sets. Density of the rational in the real number system.

Every open set is a countable union of disjoint open intervals.

Pre – requisite: MTH 101 and MTH 102

MTH 208 Introduction to Real Analysis

2-1-0 (3 Units) Harmattan Semester

Sequences and Series: Functions and sequences. Elementary properties of limits, convergence of sequences, Cauchy convergence principle, convergence, conditional convergence, uniform convergence. Power series.

Continuity and Differentiability: Real values functions, periodic functions, bounded functions, continuity of functions using neighourhood. Elementary properties of continuous functions. Differentiability of functions, partial differentiation, total derivatives, implicit functions, change of variables. Derivative of higher orders, Rolle's Theorem, mean value Theorem, Taylor's Theorem and maxima and minima of functions of two variables, Lagrange Multiplier method.

Pre – requisite: MTH 207

MTH 211 Introduction to Mechanics

2-0-0 (2 Units) Harmattan Semester

Static: Moments and couples. Equilibrium of a particle and a rigid body under the action of a system of coplanar forces. Centre of mass of simple bodies. Moment of inertia of simple bodies.

Dynamics: Newton's laws. Forces, wok, power, energy and momentum.

Rectilinear Motion: Constant acceleration, force as a function of time, distance and velocity.
Impulsive Motion: Elastic and inelastic collisions.
Pre – requisite: MTH 104.

MTH 212 Mechanics
2-1-0 (3 Units) Rain Semester
Statics: System of line vectors. Couples and wrenches. Principles of virtual work. Stability of equilibrium.
Dynamics of System of Particles: Elastic strings. Hooke's Law motion in existing media. Changing mass. Motion along a curve. Frenet's formulae.
Coplanar Motion: Energy equation. Motion in a vertical circles simple pendulum. The cycloid and cycloidal motion. Orbital motion disturbed orbits and stability.
Pre- requisite: MTH 211

MTH 213- History of Mathematics
2-0-0 (2 Units) Hamattan Semester
Topics in the history of Mathematics, with emphasis on the development of modern mathematics

MTH 301 Functions of a Complex Variable
2-0-0 (2 Units) Hamattan Semester
The Cauchy Riemann equations. Conditions of functions to be analytic. Conformal transformations. Particular examples of one-to-one mappings including the bilinear transformation. Integration on the complex plane. Cauchy's theorem. Cauchy's inequality, Liouville's theorem. Morera's theorem. Taylor's and Laurent's series, singularities and zero. The residue theorem and the evaluation of integrals.

MTH 302 Differential Equations
2-1-0 (3 Units) Rain Semester
Ordinary Differential Equations: The concepts of existence and uniqueness of solutions. Operational methods of solution of leaned equations. Sturm- Liouville theory, Green's functions and some of their elementary properties. Gamma and Beta functions.

Legendary and Bessel functions. Expansions in orthogonal functions; Fourier series.

Partial Differential Equations: Solution of boundary and eigen value problems of partial differential equations by various methods which include separation of variables, transform techniques. Stum – Liouville theory; Green's functions, method of characteristics.

Prerequisite: MTH 201

MTH 303 Advanced Calculus

2-0-0 (2 Units) Harmattan Semester

Functions of Several Variables: Jacobian, functional dependence and independence, multiple integrals, line integrals. Improper integrals.

Integral Transforms: Fourier Series and Fourier and Laplace transforms; convolution properties and their applications which include linear integral equations with displacement kernel.

Per- requisite: MTH 201

MTH 305 Vectorial Mechanics

2-1-0 (3 Units) Harmattan Semester

Rotating Axes: Motion relative to the earth, Foucault's pendulum.

Rigid Body Dynamics: Moments and product of inertia. Principals axes – momental ellipsoid. Energy and angular momentum. Two dimensional problems. Three dimensional problems – Euler's equations. Pholhode cone. Eulerian angels. Processional Motion.

Analytical Mechanics: Lagrange's equation for holonomic and non holonomic systems. Ignorable coordinates, impulses, small oscillation, expressions for kinetic and potential energies. Normal coordinates. Principal modes of oscillation.

Prerequisite: MTH 212

MTH 306 - Groups and Rings

2-1-0 (3 Units) Rain Semester

Groups: Normal subgroup and quotient groups. The isomorphism theorems. Symmetric groups, automorrphism, conjugate classes, Normalizes. The Sylow theorem. Normal and composition series. The Jordan Holder theorem. Direct product. Solvable groups.

Rings: Isomorphism theorem for rings. Ideals and quotient rings. Euclidean rings. Principals Ideal Domain and Unique Factorization Domain.

Prerequisite: MTH 205

MTH 307 Introduction to Topology

2-1-0 (3 Units) Rain Semester

Definition and examples, Open sets, closed sets, Convergence, completeness, Vaire's theorems; continuous mapping of metric spaces. Spaces of continuous function C (X, R) as a Banach space Euclidean and unitary spaces, Cauchy's inequality, Minkowski's inequality. Compact metric spaces sequential compactness, the Bolzano–Weierstrass property. Lebesque covering lemma; total boundedness. Ascoli's theorem.

Prerequisite: MTH 208

MTH 309 Electromagnetic Theory I

2-0-0 (2 Units) Harmattan Semester

The electrostatic field of force conductors and condensers.

Continuous distributions. Method of images. Dielectrics, Electrostatic stress and energy.

Magnetism: The energy and interactions between two dipoles induced magnetism, Steady electric current in linear conductors and in a continuous media.

Prerequisite: MTH 202

MTH 310 Hydromechanics:

2-1-0 (3 Units) Rain Semester

Historical introduction, Physical Properties

Kinematics: Differentiation following the motion. Equation of continuity streamlines and path lines. Momentum equations, Euler's and Bernoulli's equations.

Inviscid Fluids: Kelvin's circulation theorem. Rotational motions and velocity potentials. Stream functions, two-dimensional flows complex potentials, three-dimension flows with axial symmetry. Flow past a circular cylinder. Circle and Blasius's theorem. Conformal mapping. Schwarz-Christoffel theory. Joukowski theory and aerofoils. Theory of flight; vortex motion.
Limitation of Inviscid Theory: D'Alembert's paradox. Boundary Layer Theory (introduction). Hele-Shaw cell.
Prerequisite: MTH 305

MTH 311 - Linear Algebra
2-1-0 (3 Units) Rain Semester
Vector Spaces: Definition and Examples. Elementary Basic concepts. Linear independence, Dual Spaces, Linear product spaces.
Modules: The algebra of linear transformations, characteristics vectors. Matrices canonical forms, triangle forms, Nilpotent transformations and Jordan form. Rational canonical form. Trace and transpose. Determinants, Hemitian, Unitary and normal transformation. Real quadratic forms.
Prerequisite: MTH 202

MTH 312 Electromagnetic Theory II
2-1-0 (3 Units) Rain Semester
Curent sheets. Magnetic interaction of currents. The potential Biot Savart Law. Solenoids, Magnetic field of current sheets. Energy of, and force acting on, a circuit in a magnetic field. Electromagnetic induction in one of two circuits involving condensers. Maxwell equations. Electromagnetic waves.
The Electromagnetic potential. Guides Relativistic formulation motion of electric charges in a magnetic and Electric fields.
Prerequisite MTH 309

MTH 314 Real Analysis
2-1-0 (3 Units)
Integration: The integral as the area of the ordinate set of a function.

Definition of the Riemann integral of bounded functions conditions for intergrability. Properties of the integral. Relations between the integrals and their derivatives. Approximation to integrals by sums.

Function of bounded variations, Reimann-Stieltjes integral. Integration with respect to functions of bounded variation. Rectifiable curve.

Sequences and Series of functions: Convergence of sequences and series of functions. Uniform convergence. Tests of convergence and uniform convergence. Continuity of sum of a uniform convergent series of continuous functions terms by term integration and differentiation of a series of continuous function. Applications to power series.

Prerequisite MTH 208

MTH 316 Waves

2-0-0 (2 Units) Rain Semester

Nature of waves. Equation of wave motion. Waves on strings, finite and infinite strings. Waves in membrane, longitudinal waves. Sound waves. Water waves-tidal waves, surface waves.

MTH 318 Theory of Numbers

2-1-0 (3 Units) Rain Semester

Divisibility, congruence and residues, Linea congruencies, Diophantine analysis, selected topics in the theory of primes, algebraic number theory Diophantine equations.

$X^2+Y^2 =Z^2$ and $x^4+y^4 = z^4$. Partition function P (n).

Prerequisite: MTH 205

MTH 320 Introduction to Differential Geometry

2-1-0 (3 Units) Rain Semester

Curves in 3-dimensional spaces. Frenet formulae in 3 spaces, normal curvature congruence of curves and of surfaces. Intrinsic geometry. Gauss-Bonnet theorems.

Prerequisite MTH 302

MTH 322 Introduction to Mathematical Modelling

2-1-0 (3 Units) Rain Semester

Methodology of model building; identifications, formulation and solution of problems cause effect diagrams. Equation types Algebraic, ordinary and partial differential, difference, integral and functional equations. Applications of Mathematical models to plural, biological, social and behavioural sciences.

MTH 321 Tensor Analysis

2-1-0 (3 Units) Harmattan Semester

Manifold of points. Tensors. Summation convention. Contravariant and covariant vectors; Scalars; tensors of higher rank. Knonecker delta; contraction. Determinants of tensors of second rank; integrals and tensor densities. Riemannian spaces; line elements; metric tensor; signature of metric.

Prerequisite MTH 201

MTH 401 General Topology

2-1-0 (3 Units) Harmattan Semester

Topological spaces. Definition and examples. Open bases, Open sub bases. Topologising of sets, G, F sets. Continuous maps, open maps and closed maps. Homeomorphisms. Weak topologies. Functions algebras C(X,R), C(X,C). Compact spaces. Products of spaces. Tychonoff's theorem. Locally compact spaces. The separation axioms. Connectedness. The Weierstrass's approximation theorem.

Prerequisite: MTH 307.

MTH 402 Algebraic Topology

2-1-0 (3 Units) Rain Semester

Fundamental Groups: Definition of the fundamental group of a space. Continuous mapping and fundamental groups. The fundamental group of a circle is infinite cyclic. Applications. The Brower fixed point theorem in 2 dimensions. The fundamental groups of a product space.

Covering Spaces: Definitions and Examples. Lifting of paths to a covering space. The fundamental group of a covering space homomorphism and automophism of covering spaces.

MTH 403 Measure Theory and Integration

2-1-0 (3 Units) Harmattan Semester

Measure Theory: Measure of open, closed sets. Outer and inner measure. Measurable sets. Properties of measure, non measurable sets. Measurable functions. Simple function algebra.

The Lebesgue Integral: Lebesgue measure. Integral of nonnegative function. Integral as measure of ordinate set, as a limit of approximate sums. Integral of an unbounded function integral over an infinite range.

Simple properties of the integral.

Sequences of integral (Positive functions; functions with positive and negative values). Lebesgue monotone convergence theorem. Fatou's Lemma. Dominated convergence theorem. Bepo Lemma. Bounded Convergence. Sets of measure zero.

Integration by parts. Fubini's theorem and application to multiple integrals

Prerequisite: MTH 314

MTH 404 Normed Linear Spaces

2-1-0 (3 Units) Rain Semester

Normed Linear Spaces: Definition and examples. Convex sets nomed. Holder's and Minkowski's inequalities. Riesz -Fisher theorem.

Linear operators on finite dimensional spaces. Linear functional space.

Banach spaces; examples. Quotient spaces. Inner product spaces. Topological linear spaces.

Hilbert spaces, examples. Linea operator in Hilbet's spaces Adjoint operators. Hermitian operators. Othogonality orthogonal complement and projections in Hilbert spaces.

Prerequisite: MTH 314 and MTH 403

MTH 405 Galois Theory

2-1-0 (3 Units) Harmattan Semester

Polynomials over field. Irreducibility criterion especially over Q the rational number fields. Field extensions. Finitely generated

finite and simple extensions. Algebraic extensions. Splitting fields derivatives and Separability, Normal extensions.
Automorphism of field. F-automorophisms, and normal extensions. Fundamental theorem of Galois theory. Applications.
Prerequisite: MTH 205 and MTH 306

MTH 406 Commutative Algebra

2-1-0 (3 Units) Rain Semester

Rings and ideals. Extension and contraction of ideals. The mildradical and the Jacobson radical, Modules and their properties. Restriction and extension of scalars. Exact sequences and additive functions. Multiplicatively closed subsets, rings of factions, local rings and localization contracted ideals in rings of fractions. Primary decomposition. Noetherian and Artinian rings.
Prerequisite: MTH 306.

MTH 407 Complex Analysis I

2-1-0 (3 Units) Harmattan Semester

Topological index and properties: Some topological properties of the index. Chains and Cycles. Simple connectivity. Local and conformal mapping theory: The Argument principle. Maximum Modulus theorem. Schwartz Lemma. Normal families. Riemann-Mapping Theorem.
Analytical Continuation: General Theory Singularities.
Riemann – Surface. Function defined by integrals. The Gamma function. The Zeta- function. The principle of reflection. Function with natural boundaries. Power series: Uniform convergence.
Prerequisite: MTH 301

MTH 408 Complex Analysis II

2-1-0 (3 Units) Rain Semester

Integral functions: Factorization of integral functions. Construction of different kinds of integral function. Maximum modulus of an integral function. The order of an integral function. Integral function of finite orders. Canonical products. Borel's theorems of canonical products. The Phagmen-Lindelof principle. The proximate order of an integral function.

Elliptic Function: Definitions. The irreducible poles and zeros of an elliptic function. Weistrass's elliptic function. Meromophic functions.
Prerequisite: MTH 407

MTH 409 Ordinary Differential Equations I
2-1-0 (3 Units) Hamattan Semester
Existence of solutions. Uniqueness of solutions. Method of successive approximation. Continuation of solutions. Systems of differential equations. The nth order equation. Extension of the idea of a solution, maximum and minimum solutions. Elementary differential inequalities. Dependence of solution on initial condition and parameters. Variation of solution on initial condition and parameters. Variation of solutions with respect to initial condition and parameters.
Prerequisite: MTH 302 and MTH 314

MTH 410 Ordinary Differential Equations II
2-1-0 (3 Units) Rain Semester
Linear homogenous and non-homogenous systems. Linear systems with constant coefficient. Linear systems with periodic coefficients. Linear differential equation of order n, n natural. Linear systems with isolated singularities of the first and second order: Formal solutions, Asymptotic series. Self adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems for second-order ode linear equations. Asymptotic behaviours of nonlinear systems; stability. Lyapunov's methods
Prerequisite: MTH 409.

MTH 411 Homology Theory
2-1-0 (3 Units) Hamattan Semester
Basic definition of homology. Equivalence ideas of category theory and functions. Axiomatic approach to cohomology. Homology theory. Chain complexes and singular homology. Applications to (1) Euclidean spaces; (2) degree of a map; and (3) local homology. Filtration and C.W. complexes. Calculation of the homology groups. Simplified homology.

Singular homology and cohomology with general coefficients.
Prerequisite: MTH 205, MTH 306 and enrollment in MTH 401

MTH 412 Homotopy Theory

2-1-0 (3 Units) Rain Semester

Homotopy and homotopy equivalence; Construction of the fundamental group; role of base point. Calculation of higher homotopy group;- the exact sequences of the pair and the fibration sequences.

Application to cell complexes. Killing homotopy classes. Construction of space with given homotopy group and the likes.

Prerequisite: MTH 205, MTH 306 and MTH 401

MTH 413 Differential Geometry I

2-1-0 (3 Units) Harrmattan Semester

Curve in Frenet Seret Formulae; Manifolds, Vectors fields and 1 forms, tensor algebra, Grassmann algebra, Exterior differentiation interpretation of the Jacobian, transformation of vector fields. Effect on Differential forms.

Affine connections, parallelism, the exponential mapping, covariant differentiation, structural equations, Riemannian connection.

Prerequisite: MTH 301, MTH 306

MTH 414 - Differential Geometry II

2-1-0 (3 Units) Rain Semester

Complete Riemannian manifolds, Isometrics, Sectional Curvature, Riemannian manifolds of negative curvature, totally geodesics sub manifold, Affine locally symmetric spaces, almost complex manifolds, complex Tensor fields, the Ricci curvature, bounded domains, the kennel functions.

Prerequisite: MTH 413

MTH 415 Quantum Mechanics I

2-1-0 (3 Units) Harrmattan Semester

Classical Dynamics in Hamiltonian form and its application to atomics problems. The Bohr Theory.

The ideal of Heisenbeg and Schrrodinger. Dynamical variables as operators and the states of a system. Examples of energy eigenfunctions. The representation of state in function space.
Prerequisite: MTH 302 and MTH 305.

MTH 416 Quantum Mechanics II

2-1-0 (3 Units) Rain Semester

Transformation of representations. Elements of linear operator theory. The Schrodinger and Heisenberg representations. The motion of a particle in three dimensions. Angular momentum relations. The hydrogen atom. The element of perturbation theory Ritz variation method of bounded states.

MTH 417 Fluid Dynamics I

2-1-0 (3 Units) Harrmattan Semester

Stresses and stains. Navier-Stokes Equation. Energy equation. Simple exact solutions. Dynamical similarity. Slow flows: Stoke's and Oseen's. Lubrication theory. Laminar boundary layer: Thickness, skin friction and heat transfer. Blasius solution for the flat plate and similar solutions. Laminar boundary layer separation.
Prerequisite: MTH 302, MTH 310

MTH 418 Fluid Dynamics II

2-1-0 (3 Units) Rain Semester

Thermodynamics, Compressibility effects, equations of continuity and motion. Energy equation. One-dimensional unsteady flow. Small disturbance theory. Normal and oblique's shock waves. Flow produced in a tube by a moving piston. Differential equations satisfied by velocity potential in steady rotational motion. Linearized form of the equation in subsonic and supersonic flows small disturbance treatment for 2 dimensional flows:
Prerequisite: MTH 302 and MTH 310

MTH 419 Elasticity I

2-1-0 (3 Units) Harmattan Semester

Tensor:- Introduction to the elements of tensor calculus.

Elasticity:- Stain, stress, Finite deformation of an elastic solid. Infinitesimal theory. Isotropic and non isotropic elastic media.
Solution of simple problems. Elementary concept of heterogeneous media.
Pre – requisite: MTH 321 and MTH 305

MTH 420 Elasticity II

2-1-0 (3 Units) Rain Semester

Two dimensional problems of elasticity. Plane strain, plane stress generalized plane problem. Theory of membranes and torsion problems; bending of flat plates.
The Airy's stress functions and displacement function. The complex stress function and complex stress potential. Simple solutions of a circular boundary.
Pre-requisite: MTH 419 and MTH 305

MTH 421 - Electromagnetic Theory III

2-1-0 (3 Units) Harmattan Semester

Maxwell's equations within matter, refraction and reflection of plane waves including total reflection. Transmission lines. Transmission of waves in (i) Waves Guides; and (ii) Homogeneous conductors.
Pre – requisite: MTH 302 and MTH 309.

MTH 422 - Electromagnetic Theory IV

2-1-0 (3 Units) Rain Semester

Special Theory of relativity with applications to the electromagnetic field and motion of charged particles.
Maxwell's tensor: Electromagnetic momentum; Pressure of radiation.
Pre-requisite: MTH 421.

MTH 423 - Numerical Analysis I

2-1-0 (3 Units) Harmattan Semester

The Approximation of the Solution of Ordinary Differential Equations:
Solutions of first order ordinary differential equations Taylors expansion approach, Euler's Methods, Runge – Kutta methods

predictor – corrector methods, and other integration formulae. Boundary value problems.

Eigenvalue and Eigenvectors: Cayley-Hamilton theorem. Characteristics equations. Krylor's methods fundamental properties of eth characteristics polynomial. Newton's formal of the coefficient of the characteristics equation. Calculation of eigenvalues and eigenvector. Matrix iteration method. Method of finding largest and smallest eigenvalues. The Mises theorem. The Rayleigh Quotient. Matrix deflation; similarity and equivalence of matrices.

Interpolation: General problem of the finite systems possessing the interpolation property. General remainder theorems for interpolation in linear spaces. Best real error estimates. Convergence theorems.

Pre-requisite: MTH 206

MTH 424 Numerical Analysis II

2-1-0 (3 Units) Rain Semester

Difference Equations: Notations and definitions. Formation of difference equations. The solution concept of a difference equation. Linear homogeneous difference equations. Formation of difference equations. Bernoullis Method . Partial differential equations.

Approximation of the Solution of Partial Differential Equations:

Classification of partial differential equations. The approximation of derivatives by finite difference. Simple parabolic differential equations. The explicit form of the difference equations and its convergence. The implicit form of the difference equation and its convergence. Stability and consistence. The Crank-Nicolson method.

Introduction to the Finite Elements Method:

Variation formulation, Engineers point of view of finite elements methods. Boundary condition. Weighted Residual methods. The Gelerkin methods.

Pre-requisite: MTH 423

MTH 425 Non- Associative Binary Systems I

2-1-0 (3 Units) Harmattan Semester

Quasigroups and loops. Basic properties of Extra, Moufang and Bol loops. Normal Subloops. Homomorphism theorems. Orthogonality. Latin square and other applications.

Pre-requisite: MTH 306

MTH 426 Non Associative Binary System II

2-1-0 (3 Units) Rain Semester

Commutative Moufang Loops. Hamiltonian Loops. Isotopy. Nilpotency. Holomorphy. Universal Alebra. Centrality Quasigroup Modules.

Pre-requisite: MTH 425

MTH 427 Group Representation

2-1-0 (3 Units) Harmattan Semester

General Theory: Definition. Reducibility. Complete reducibility. Schur's Lemma.

Finite Groups: Character relation. Regular representations. Character table. Finite abelian groups. Factor groups. Linear characters. Induced representation. Computation of character tables

Pre – requisite: MTH 306

MTH 428 Introduction to Group Rings

2-1-0 (3 Units) Rain Semester

The fundamental theorem of finitely generated abelian groups.

Torsion groups. Torsion free groups divisible groups. Presentation of groups. Free groups. Free products of groups. Definition of group rings. Examples. Group rings of finitely – generated torsion free rings. Ideals of group Rings. Twisted Group Rings. Tensor products. The trace map.

Pre – requisite: MTH 306

MTH 499 Project in Mathematics

(3 units) Harmattan Semester

The Honours Project in Mathematics will consist of a typewritten report on some approved and supervised topic(s) in the field of

Mathematics. The students are expected to either give a short seminar to be examined orally on the approved report.

3.0 BACHELOR OF SCIENCE DEGREE IN STATISTICS

3.1 Objective:

The B.Sc programme in Statistics offer the undergraduate a good grounding in Mathematics, the theory of probability and Statistics, their extension in several direction such as Stochastic processes and Sampling surveys, and some of their application in general and in special fields such as social sciences (Economics, Demography etc.) Agriculture, Engineering and Industry.

Basic Training in Computer programming and Data processing techniques useful in applied statistical work is incorporated into this programme. This programme is therefore flexible enough to offer.

(a) Candidates potentially capable of undertaking further study an opportunity to concentrate as necessary in a theoretical and / or applied area; and

(b) Candidates aiming at various jobs in specific field of application an opportunity to train in a number of these applied areas.

It is our hope that the programme will go a long way to meet the increasing national man power demand of statisticians in the following:

(i) Government Ministries, Research Institute and industries who can advice on the problems of data collection and analysis.

(ii) Introduction of statistics as a school subject from 1974

(iii) Increased statistical activities in the University for (a) efficient statistical consulting services in the University; organization of short term refresher courses for research workers and teachers; (c) postgraduate programme in statistics.

3.2 Degree Offered:

Bachelor of Science (B.Sc. (Hon)) Honour Degree in Statistics.

3.3 Entry Requirements:

UTME candidates who wish to enroll for courses leading to a degree in statistics must satisfy the University and Faculty of Science requirements for admission. Indeed such candidates must normally possess the Senior Secondary School Certificate or its equivalent, with credit in at least five subjects, which must include English Language, Mathematics, Physics and Chemistry or Biology. Candidates who wish to enter by direct entry must in addition to the above requirements have good passes in Mathematics and any other science subject at the G.C.E. Advanced Level or its equivalent. Such candidate if admitted may be exempted from the appropriate courses.

3.4. Requirements for the Award of Degree:

To be eligible of the award of a degree candidate must satisfactorily complete the minimum number of unit prescribed of the degree. He must in addition complete successfully all the compulsory courses as well as the special and general elective for the degree as prescribed. The same course cannot be counted twice (e.g. from repeat) in the computation of the minimum number of units. A candidate will normally spend a period of four academic sessions in order to fulfill the above requirements.

3.5. Graduation Requirements:

(a) Foundation Programme Option

		Harmattan L-T-P	Rain L-T-P	Units
MTH 101	Elementary Mathematics I	4-1-0		5
MTH 102	Elementary Mathematics II	-	4-1-0	5
MTH 201	Mathematical Methods I	3-1-0	-	4
MTH 202	Mathematical Method II	-	3-1-0	4
PHY 101	General Physics I	3-1-0	-	4
PHY 102	General Physics II	-	3-1-0	4
PHY 107	Experimental Physics 1A	0-0-3	-	1
PHY 108	Experimental Physics 1B	-	0-0-3	1

PHY 205	Introductory Modern Physics	-	2-1-0	3
PHY 208	Experimental Physics IIB	-	0-0-3	1
CHM 101	Introductory Chemistry I	3-1-0	-	4
CHM 102	Introductory Chemistry II	-	3-1-0	4
CHM 103	Introductory Exp. Chemistry	0-0-3	-	1
CHM 104	Introductory Exp. Chemistry	-	0-0-3	1
BIO 101	Biology for Physical Sciences	2-1-0	-	3
		Sub-total	**=**	**45**

(b) Special Electives **Units**

Total Special Electives outside Faculty of Science **12**

(c) Departmental Requirements

		Harmattan L-T-P	**Rain L-T-P**	**Units**
MTH 104	Vectors	-	2-0-0	2
MTH 205	Introduction to Algebra	2-1-0	-	3
MTH 206	Introduction to Numerical Analysis	-	2-1-0	3
MTH 207	Logic, Sets and the Real Number System	2-1-0	-	3
MTH 208	Introduction to Real Analysis	-	2-1-0	3
MTH 301	Functions of a complex variable	2-0-0	-	2
MTH 303	Advanced Calculus	2-0-0	-	2
MTH 314	Real Analysis	-	2-1-0	3
CSC 201	Introduction to computing	2-1-0	-	3
CSC 208	Computer Technology	-	2-0-0	2
CSC 307	Numerical Computation I	2-0-0	-	2
STT 201	Introduction to Statistics	2-1-0	-	3
STT 202	Probability Distributions I	-	2-1-0	3
STT 204	Practical Course I	-	1-0-3	2
STT 301	Probability Distributions II	2-1-0	-	3
STT 302	Sample Survey Design	-	2-1-0	3
STT 303	Stochastic Processes I	2-1-0	-	3
STT 304	Practical Course II	-	1-0-3	2
STT 305	Statistical Inference	2-2-0	-	4
STT 306	Multivariate analysis and Applications	-	2-1-0	3
STT 309	Regression Analysis	2-1-0	-	3
STT 402	Probability Theory	-	3-1-0	4
STT 403	Design of Experiments	2-1-0	-	3
STT 406	Non parametric Inference & Sequential methods	-	2-1-0	3
STT 407	Stationary Time Series Analysis	2-1-0	-	3

STT 415	Sample Survey Design II	2-1-0	-	3
STT 499	Honours Project in Statistics	-	-	3
			Sub-total	**= 76**

(d) Restricted Electives:

Register at least twelve (12) units from any of the following groups

GROUP I

		Harmattan L-T-P	**Rain L-T-P**	**Units**
AEC 503A	Statistics and Biometrics	2-1-0	-	3
AEC 515	Agricultural Sampling Techniques and Survey Design	2-1-0	-	3
BOT 102	Introductory Ecology	-	2-0-0	2
BOT 305	Autocology	2-1-0	-	3

GROUP 2

		Harmattan L-T-P	**Rain L-T-P**	**Units**
CSC 308	Numerical Computation II	-	2-0-0	2
CSC 522	Information Storage and Retrieval	-	2-0-0	2
CSC 524	Techniques in Data Analysis	-	2-0-0	2
CSC 501	Introduction to Operation Research	-	2-0-0	2
CSC 505	Standard Software Packages	2-0-0	-	2
CSC 515	Database	2-0-0	-	2
CSC 521	Modeling and Simulation	2-0-0	-	2
CSC 523	Mathematical Modelling	2-0-0	-	2
EEG 407	Communication Principles I	2-1-0	-	3
EEG 502	Statistics and Stochastic Processes in Electronics	-	2-1-0	3
EEG 504	Communications Principles I	-	2-1-0	3

GROUP 3

		Harmattan L-T-P	**Rain L-T-P**	**Units**
DSS 201	Introduction to Population Studies Population Characteristics	2-1-0	-	3
DSS 401	Demographic Data Evaluation	2-1-0	-	3
DSS 402	Demographic Estimation	-	2-1-0	3

ECN 201	Principles of Economics I	2-1-0	-	3
ECN 420	Operations Research	-	2-1-0	3
ECN 422	Econometric Methods IV	-	2-1-0	3

GROUP 4

	Harmattan L-T-P	Rain L-T-P	Units
MTH 302 Differential Equations	-	2-1-0	3
MTH 307 Introduction to Topology	2-1-0	-	3
STT 307 Statistical Quality Control	2-1-0	-	3
STT 308 Operations Research I	-	2-1-0	3
STT 401 Stochastic processes II	2-1-0	-	3
STT 404 Statistical Decision Theory	-	2-1-0	3
STT 405 Further Inference	2-1-0	-	3
STT 410 Operation Research II	-	2-1-0	3
STT 411 Information Theory	2-1-0	-	3
STT 412 Coding Theory	-	2-1-1	3
STT 413 game Theory	2-1-3	-	3
	Sub Total	=	**12**

(e) Free Electives

3 Units of Courses outside those listed above

Sub-total = 3

Grand Total (a + b + c + d + e) = **148 Units**

3.6 Outline of Programme for PARTS I – IV Statistics

PART I HARMATTAN SEMESTER

Course Code	Course Title	L	T	P	U
MTH 101	Elementary Mathematics I	4	1	0	5
PHY 101	General Physics I	3	1	0	4
PHY 107	Experimental Physics 1A	0	0	3	1
CHM 101	Introductory Chemistry I	3	1	0	4
CHM 103	Introductory Exp. Chemistry	0	0	3	1
BIO 101	Biology for Physical Sciences	2	1	0	3
	Special Electives	2	0	0	2
	Total Units				**20**

PART I RAIN SEMESTER

Course Code	Course Title	L	T	P	U
MTH 102	Elementary Mathematics II	4	1	0	5
MTH 104	Vectors	2	0	0	2
PHY 102	General Physics II	3	1	0	4

PHY 108	Experimental Physics 1B	0	0	3	1
CHM 102	Introductory Chemistry II	3	1	0	4
CHM 104	Introductory Exp. Chemistry	0	0	3	1
	Special Electives	2	0	0	2
	Total Units				**19**

PART II HARMATTAN

Course Code	**Course Title**	**L**	**T**	**P**	**U**
MTH 201	Mathematical Methods I	3	1	0	4
MTH 205	Introduction to Algebra	2	1	0	3
MTH 207	Logic, sets and the Real Number System	2	1	0	3
MTH 211	Introduction to Mechanics	2	1	0	2
STT 201	Introduction to Statistics	2	1	0	3
PHY 205	Introduction to Modern Physics	3	0	0	3
CSC 201	Introduction to Computing	3	0	0	3
	Special Electives	2	0	0	2
	Total Units				**23**

PART II RAIN

Course Code	**Course Title**	**L**	**T**	**P**	**U**
MTH 202	Mathematical Methods II	3	1	0	4
MTH 206	Introduction to Numerical Analysis	2	1	0	3
STT 202	Probability Distribution I	2	1	0	3
MTH 212	Mechanics	2	1	0	3
STT 204	Practical Course I	1	0	3	2
PHY 208	Experimental Physics IIB	0	0	3	1
CSC 208	Computer Technology	2	0	0	2
	Special Electives	2	0	0	2
	Total Units				**21**

PART III HARMATTAN

Course Code	**Course Title**	**L**	**T**	**P**	**U**
MTH 301	Functions of a complex variable	2	0	0	2
MTH 303	Advanced Calculus	2	0	0	2
STT 301	Probability Distribution II	2	1	0	3
STT 303	Stochastic Processes I	2	1	2	3
STT 305	Statistical Inference	3	1	0	3
STT 309	Regression Analysis	2	1	0	3
	Special Electives	2	0	0	2
	Total Units				**18**

PART III RAIN

Course Code	Course Title	L	T	P	U
MTH 314	Real Analysis	2	1	0	2
STT 302	Sample survey Design	2	1	0	3
STT 304	Practical Course II	1	0	3	2
STT 306	Multivariate Analysis	2	1	0	3

6 units from at most two groups:

Group I

Course Code	Course Title	L	T	P	U
BOT 102	Introductory Ecology	2	0	0	2

Group II

Course Code	Course Title	L	T	P	U
EEG 502	Statistics and Stochastic Processes In Electronics	2	1	0	3
EEG 504	Communications Principles II	2	1	0	3

Group III

Course Code	Course Title	L	T	P	U
DSS 202	Introduction to Population Characteristics	2	1	0	3
DSS 402	Demographic Estimation	2	1	0	3
ECN 420	Operation Research	2	1	0	3
ECN 422	Econometric Method IV	2	1	0	3

Group IV

Course Code	Course Title	L	T	P	U
MTH 302	Differential Equations	2	1	0	3
STT 308	Operation Research I	2	1	0	3
STT 404	Statistical Decision Theory	2	1	0	3
STT 410	Operation Research II	2	1	0	3
STT 412	Coding Theory	2	1	1	3
	Special Electives	2	0	0	2
	Total (Units)				**19**

PART IV HARMATTAN

Course Code	Course Title	L	T	P	U
STT 403	Design of Experiments	2	1	0	3
STT 415	Sample Survey Design II	2	1	0	3
STT 407	Stationary Time series Analysis	2	1	0	3

6 Units from the two groups of which courses were selected in Rain of part III

Group I

Course Code	Course Title	L	T	P	U
AEC 503	Statistics and Biometrics	2	1	0	3
AEC 515	Agricultural Sampling Techniques and Survey design	2	1	0	3
BOT 305	Ecology I	2	1	0	3

Group II

Course Code	Course Title	L	T	P	U
CSC 307	Numerical computation I	2	1	0	3
CSC 515	Database Analysis Techniques	2	0	0	2
CSC 501	Introduction to Operations Research	2	1	0	3
CSC 505	Standard Software Packages	2	0	0	2
CSC 523	Mathematical Modelling	2	0	0	2
EEG 407	Communication Principle I	2	1	0	3

Group III

Course Code	Course Title	L	T	P	U
DSS 201	Introduction to Population Studies, Data Theory and Patterns	2	1	0	3
DSS 401	Demographic Data Evaluation	2	1	0	3
ECN 201	Principles of Economics I	2	1	0	3

Group IV

Course Code	Course Title	L	T	P	U
MTH 307	Introduction to Topology	2	1	0	3
STT 307	Statistical Quality Control	2	1	0	3
STT 401	Stochastic Processes II	2	1	0	3
STT 405	Further Inference	2	1	0	3
STT 411	Information Theory	2	1	0	3
STT 413	Game Theory	2	1	3	3
	Special Electives	2	0	0	2
	Total Units				**17**

PART IV RAIN

Course Code	Course Title	L	T	P	U
STT 402	Probability Theory	3	1	0	4

STT 406	Non- parametric Inference and Sequential Methods	2	1	0	3
STT 404	Statistical Decision Theory	2	1	0	3
CSC 308	Numerical Computation II	2	1	0	3
	Free Electives				3
STT 499	Project in Statistics				3
	Special Electives	2	0	0	2
	Sub Total				**21**

3.7 COURSE CONTENTS (STATISTICS)

STT 201 Introduction to Statistics

2-1-0 (3 Units) Harrmattan Semester

Nature and scope of Statistics. Populations, samples and inductive processes. Tabular and diagrammatic representation of data. Combinatorial analysis. Discrete and continuous distributions; Poisson, Normal, t, and F distributions.

Measures of location and dispersion. Inference about population means, proportion and variances. Estimation. Tests of significance. Comparison of two means. Analysis of variance. Correlation and regression. Time series, Demographic measures and index numbers.

Pre- requisites: MTH 101, 102 or equivalent.

STT 202- Probability Distributions I

2-1-0 (3 Units) Rain Semester

Discrete Sample spaces. Algebra and probability of events combinatorial analysis. Sampling with and without replacement.

Conditional probability, Baye's theorem and Stochastic independence, Discrete distributions: Binomial, Poisson, negative binomial and Poisson. Poisson approximation to Binomial. Random variables and expectation: means, variance, covariance. Probability generating function and moment generating function. Chebychev's inequality. Continuous joint distributions: marginal and conditional density; stochastic independence. Expectations: moments, moment generating functions. Uniform, normal, gamma, beta, Cauchy and log-normal distributions.

Pre-requisites: MTH 201, STT 201.

STT 204 Practical Course I

1-0-3 (2 Units) Rain Semester

Descriptive Methods- Tabulation. Condensation of Data- Univaiate, Bivariate.

Summary Measures: Averages and other Statistics moments and Cummulants. Beta Coefficients. Problems of specification and estimation:

a. Standard Discrete Distribution: Binomial, Poisson, Negative Binomial, Hypergeometric.
b. Standard Continuous Distributions: Curve fitting; Normal Binomial, Poisson.
c. Regression and Correlation: Computation of regression and correlation from a bivariate frequency table.

Construction of Questionnaires.

Pre- requisites: STT 201

STT 301 Probability Distributions II

2-1-0 (3 Units) Harmattan Semester

Distribution of functions of random variables. Sampling distributions (including the distributions of sample mean and variance from the normal population); distribution function techniques, moment generating function techniques and change of variable techniques. Derivations and properties of t and F distributions. Distributions of ode statistics and their functions. Law of large numbers. Central limit theorem. Bivariate and multivariate normal distributions.

Pre- requisites: STT 202

STT 302 Sample Survey Design I

2-1-0 (3 Units) Rain Semester

The role of Sampling. Principal steps in sampling surveys sampling strategies. Desirable properties of sampling proportion and percentages. Stratified random sampling. Cluster sampling of equal and unequal sizes. Single stage cluster sampling with equal and unequal probabilities. Determination of sample sizes. Sources of error in sample surveys. Effect and types of non- response and their treatments. Call backs and the mode of effects.

Pre-requisites: STT 305

STT 303 Stochastic Pocessess I

2-1-2 (3 Units) Harmattan Semester

Random walk and ruin problems, fluctuations in coin tossing, Markov chains: classification of states; ergodic properties; applications. Generating functions. Convolutions; first passage times; partial fractions, expansions; bivariate generating functions. Recurrent events.

Pre- requisites: STT 202

STT 304 Practical Course II

1-0-3 (2 Units) Rain Semester

Probability: Calculus; combination of events, univariate, bivariate and p- variant distributions.

Sampling: use of random sampling numbers, sampling distributions.

Estimation: Criteria for a good estimate. Testing of hypotheses. Method of moments, maximum likelihood, minimum chi-square. General methods for testing parameters. Tests of parameters of Discrete distributions. Test of parameters of Normal populations. Analysis of variance.

Pre-requisites: STT 204 (o consent of Head of Department)

STT 305 - Statistical Inference

3-1-0 (4 Units) Harmattan Semester

Point Estimation; Properties of point estimates; sufficiency unbiassedness, consistence, efficiency and completeness. Maximum likelihood methods and the method of moments. Large sample; properties of Least Square Estimates, Bayes estimates.

Confidence intervals, regions for mean variance of binomial and normal distributions.

Tests of Hypothesis. Neyman-Pearson Theory. Composite hypotheses. Most powerful tests and UMP test. Generalized likelihood ratio tests. Tests of means and variance of a normal distribution. Tests of goodness of fit and independence in contingence tables. Elements of sequential analysis. Nonparametric tests.

Pre-requisite: STT 202

STT 306 Multivariate Analysis and Applications

2-1-0 (3 Units) rain Semester

Vector random variables: Expectations of random vectors and matrices. Multivariate Normal distribution and distribution of quadratic forms. Application to linear models: Tests of general linear hypothesizes and estimation.

Least Square Theory: Gausss-Markoff and general linear hypothesis with application to regression and experimental design models.

Estimation: Partial and multiple correlation coefficient, mean vector and co-variance matrix. Hotelling's T^2 and Wishart distribution: Multivariate ANOVA.

Pre- requisites: STT 305

STT 307 Statistical Quality Control

2-1-0 (3 Units) Harmattan Semester

Objectives of Statistical Quality control. Specification and tolerance limits, control Charts - X, R. Control Charts for attributes, Process control Procedure, acceptance sampling.

Dodge Roming System for Lot by lot acceptance sampling, Plan AQL/AOOL citera for acceptance sampling, one sage. Two stage, multi stage sampling, inspection plan – acceptance inspection of continuous production economics aspects of quality decisions case studies of representative cases.

Pre- requisite: STT 202

STT 308 Operations Research I

2-1-0 (3 Units) Rain Semester

Formulation of linear optimization models, product mix selection, feed mix selection, fluid blending scheduled. Graphical methods, simplex algorithm, sensitivity testing and duality. Classical transportation problems, Mathematical programming, method of Lagrange multipliers, Kuhn-Tucker conditions. Network algorithms shortest route algorithm, critical path analysis.

Pre- requisite: STT 301, MTH 302.

STT 309 Regression Analysis

2-1-0 (3 Units) Harmattan Semester

Multiple linear regression models, polynomial regression. Tests of independence and goodness of fit. Use of dummy variables. Non linearity in parameters requiring simple transformation.

STT 401 Stochastic Processes II

2-1-0 (3 Units) Hamattan Semester

Markov processes and processes with independent increments. Poisson process. Birth and death processes. Kolmogorov equations. Purely discontinuous and purely continuous processes. The Wiener process. Stationary processes. Martingales.

Pre- requisite: STT 303

STT 402 Probability Theory

3-1-0 (4 Units) Rain Semester

Axioms of probability. Random variables, expectation and independence. Convergence concepts. Laws of large numbers central limit theorem and its ramifications. Conditioning and Makov property.

Pre- requisite: STT 201, MTH 403

STT 403 Design of Experiments

2-1-0 (3 Units) Rain Semester

Basic principles of experimentation: Randomization, Replication and control. Uniformity trials. Completely randomized, randomized block and Latin square designs. Missing plot techniques. Factorial experimental confounding and partial confounding the experiments with factors at two levels each. Split plot designs. Balanced incomplete block design and lattice designs. Concepts of efficiency. Applications to agriculture, biology and industry.

Pre- requisite: STT 305

STT 404 Statistical Decision Theory

2-1-0 (3 Units) Rain Semester

Principles used in decision making.

Utility functions and their properties. Role of uncertainty, Bayes' strategies. Problems of prior and posterior distribution. Value of prior information. Minima strategies. Statistical preferences. Aspects of game theory.
Pre- requisite: STT 305

STT 405 Further Statistical Inference

2-1-0 (3 Units) Harmattan Semester

Conjugate families. Bayesian inference in binomial, Poisson and Normal models. Bayesian interpretation of the chi-square test of association and of the F test of the general linear hypothesis. Principle of invariance.
Pre-requisite: STT 305

STT 406 Non-parametric Inference and Sequential methods

2-1-0 (3 Units) Rain Semester

Non-parametric inference. Order statistics and their distributions. Kolmogorov type of test statistics, common non-parametric tests including us, sign, rank order and rank correlation. Null distributions and their approximation.
Efficiency properties. Estimates based on the test statistics. Sequential methods: Wald's sequential probability ratio tests (SPRT). Operating characteristics, fundamental identity, and the two stage procedure. Sequential estimation, confidence intervals. Applications.
Pre-requisite: STT 305

STT 407 Stationary Time Series Analysis

2-1-0 (3 Units) Harmattan Semester

Elementary treatment of time series. Stationary processes. Ergodicity, Autocorrelation function. Spectral density function and its representation. Linear filters, elements of prediction theory, estimation of correlation function and spectral density. Applications.
Pre- requisite: STT 301 and STT 305

STT 410 Operation Research II

2-1-0 (3 Units) Rain Semester

Stochastic System: The functions of a model problem of optimization, analytic and summation models; the role of the Makov chain concept;

Validation. Models for social land occupational mobility. Manpower systems. Replacement systems inventory and storage systems.

Queuing system: Single and multiple channels, finite capacity system. Queue network, machine interference problems, priority discipline, Application and queuing theory.

Pre-requisite: STT 306 and STT 401

STT 411 Information Theory

2-1-0 (3 Units) Harmattan Semester

A Measure of Information; Axioms of uncertainty; properties of the uncertainty function; Joint and conditional uncertainty; the measure of information.

The discrete memory-less channel: models for communication channels, channels capacity classification of channels; Decoding schemes; the fundamental theory; the weak converse to the fundamental theorem. Channels with memory; Finite state channels: The capacity of a general Discrete Channel. Continuous channels; the time discrete Gaussian channels; uncertainty in the continuous case; the time continuous Gaussian channels.

Optional: Comparison of the weak and strong converses for channels with memory. The converse to the coding theorem for the time discrete Gaussian channels. Band limited channels.

Pre- requisite: MTH 301 and MTH 424

STT 412 Coding Theory

2-1-1 (3 Units) Rain Semester

The problems of unique Decipherability. Necessary and sufficient conditions for the Existence of instantaneous codes. Extension of the condition

$$\sum_{1}^{n} D_1^{-1} < I$$ to Decipherable codes

I=1

The Noiseless coding theorem. Construction of optional codes. Error correcting codes: Minimum distance principle; relation between Distance and error correcting properties of codes; the Hamming Bound; Parity check coding.

Application of group theory to parity check coding; upper and lower bounds on the error-correcting ability of parity checks codes; the strong converse of the binary symmetric channels.

Further theory of error correcting codes; feedback shift registers and Cyclic codes; Bose-Chaudhuri-Hocquenghem (BCH) codes.

Per-requisites: MTH 306 and STT 411 Ash R. Information Theory. Gallager R. Information Theory and Communications.

STT 413 Game Theory:

2-1-0 (3 Units) Harmattan Semester

General theory of zero- sum two person games, illustrated by detailed study of examples.

Pre – requisite: STT 403

STT 415 Sample Survey Design II

2-1-0 (3 Units) Harmattan Semester

Further aspects of stratified sampling. Double sampling with equal and unequal probabilities. Multistage cluster sampling. Two stage and thee stage sampling clusters of unequal sizes.

Sub sampling with units of equal sizes. Area sampling. The economics design of Surveys. Sampling with imperfect frames.

STT 499 Project in Statistics

(3 Units) Beginning (Hamattan Semester)

Statistical project will be arranged within the Department. This requirement may also be satisfied by taking a course in a substantive area of application approved by the Department.

4.0 POSTGRADUATE PROGRAMME

4.1 Introduction

The main objectives of the graduate programme in the Department are to equip the prospective research student with the essential tools he would need in discovering and solving mathematical problems. To this end, the course is designed to expose him to as much literature as possible in his chosen field, and to enable him to learn the techniques of problems solving through numerous academic interaction with more experienced members of the Department.

The graduate programme in Statistics aims at meeting the increasing demands for experts in Statistics in Government, Commercial, industrial, teaching and research institutions. The programme is divided into two options, A and B. Option A (Mathematical Statistics) is designed for students with strong Mathematical background while Option B (Applied Statistics) is for those with less Mathematical preparation, especially from fields other than Mathematics and Statistics such as Economics, Demography and Agriculture. The theoretical aspects (Option A) are designed for those candidates who may wish to pursue a career in teaching and research, while the applied aspect of the Statistics programme will seek to develop competence in data analysis by emphasizing the use of both exploratory and confirmatory methods as well as the use of the computer for data handling and analysis. Students are urged to acquire some familiarity with a basic programming language such as FORTRAN as soon as possible. Students will be taught to analyze data from the Biological, Physical and Social Science.

4.2 Degree Awarded

M.Sc. and Ph.D. in the fields mentioned above.

4.3 General Requirements

General entrance and course requirements are as set forth by University and Faculty regulations.

4.4 General Departmental Requirements

A candidate with a minimum of Second Class Honours degree in Mathematics from the Obafemi Awolowo University or a recognized University may be admitted into the programme. A candidate with a good honour degree in Physics or Engineering or Mathematics/ Education may also be admitted. A candidate may, on the advice of the Chairman Graduate programme Committee (Mathematics Department), have to take some 400 level courses if he or she is deficient in those courses.

4.5 Course Work

(a) *General Plan*

The programme of study for the Master of Science degree is of minimum of twelve months continuous residence. Approximately the first eight months are spent in course work research, while the four months are devoted to intensive research, analysis and the preparation of a dissertation.

The course load required of all candidates is from 24 units. Of these, at least 15 units must be taken from the Department. Courses equaling 9 units may be selected from courses outside the Department or Faculty, always upon the recommendation of the supervisor and approval of the Postgraduate college. The thesis (6 units) is required of all candidates and Seminar is also required.

(b) *Course Requirements*

The courses are divided into three pats: Pure Mathematics, Applied Mathematics and Statistics.

M.Sc. in Pure Mathematics

(i) 16 units of relevant course work.
(ii) A comprehensive (written or oral) examination on the candidate's specialty;
(iv) Thesis;
(v) Oral defense

M.Sc. in Applied Mathematics

(i) 20 Units of Course work which must include
MTH 631 Mathematical Methods I;
MTH 632 Mathematical Methods II;
and
MTH 424 Numerical Analysis II
or
MTH 642 Boundary -value and Eigenvalue problems I

(ii) A comprehensive (written or oral) examination on the candidate's specialty;

(iii) A satisfactory seminar;

(iv) Thesis; and

(v) Oral defense.

M.Sc. in Statistics

(i) Option A course work consists of four core courses STT 601, STT 603, STT 605, STT 609 and one of the following special courses: STT 608, STT 612, STT 613, STT 614, STT 615, STT 616, STT 617, and STT 618. Option B course work consist of five core courses STT 404, STT 405, STT 605, STT 607, STT 608 and one of the following special courses: STT 612, STT 613, STT 614, STT 615, STT 616, STT 617, STT 618;

(ii) A comprehensive (written or oral) examination on the candidate's specialty;

(iii) A satisfactory seminar;

(iv) Thesis; and

(v) Oral defense.

Ph.D. in Mathematics

The Ph.D. course is a three year full time programme (or five year part-time programme) consisting of:

(i) Oral or written examination on the candidate's specialty;

(ii) Thesis;

(iii) One satisfactory seminar;

(iv) Oral defense; and

(v) A foreign language examination in French, German or Russian.

Every Ph.D. candidate must have a relevant M.Sc. of the University of Ife or equivalent.

c. Courses

Course Code	Course Tile	Units
MTH 601	Homological Algebra	4
MTH 602	Associative Rings	4
MTH 603	Commutative Algebra	4
MTH 604	Characters of Finite Group	4
MTH 605	Non associative Algebraic Systems	4
MTH 611	Topology	4
MTH 612	Differentiable Manifolds	4
MTH 613	Homolopy Theory	4
MTH 614	Homology	4
MTH 615	Theory of Graphs	4
MTH 616	Commutative Banach Algebras	4
MTH 617	Operator Algebras in Hilbert Space	4
MTH 618	Topological Groups and heir representation	4
MTH 621	Topological Vector Spaces	4
MTH 622	Normed Spaces and Algebras	4
MTH 623	Spectral Theory	4
MTH 624	Topological Groups	4
MTH 625	Lie Groups	4
MTH 626	Special Functions	4
MTH 627	Ordinary Differential Equations	4
MTH 631	Mathematical Methods I	4
MTH 632	Mathematical Methods II	4
MTH 633	Viscous Flow Theory	4
MTH 634	Compressible Flow Theory	4
MTH 635	Hydrodynamic Stability	4
MTH 636	Hypersonic Flow Theory	4
MTH 637	Hydromagnetics	4
MTH 638	Elasticity	4
MTH 639	Theory of Thin Shells	4
MTH 640	Initial Value Problems I	4
MTH 641	Initial Value Problems II	4
MTH 642	Boundary value and Eigenvalue problems	4
MTH 643	Boundary value and Eigenvalue problems	4

	(Advanced)	
MTH 644	Approximation Theory	4
MTH 645	Atmospheric Dynamics	4
MTH 646	Atmospheric Diffusion	4
STT 601	Probability Theory	4
STT 603	Statistical Inference	4
STT 605	Linear Statistical Models	4
STT 607	Applied Statistics	4
STT 608	Sampling Techniques and Design of Exp.	4
STT 609	Multivariate analysis and Sampling Dist.	4
STT 612	Theory of Games	4
STT 613	Non- Parametric Methods	4
STT 614	Robust inference	4
STT 615	Sequential Analysis	4
STT 616	Information Theory	4
STT 617	Time Series Analysis	4
STT 618	Applied Stochastic Processes	4

4.6 Examinations

(a) M.Sc.

Each course will be examined at the completion of the course and all such examinations will be completed within two semesters from the time the candidate came into residence. A thesis based on original research work and written in accordance to the regulations stipulated by the postgraduate college of the Obafemi Awolowo University must be presented by the candidate before the end of the fourth semester from the time the candidate came into residence. The thesis will be assessed in accordance with University and Faculty regulations.

(b) Ph.D.

The Ph.D. degree shall require not less than 6 semesters of full-time study and will be subject to general and special regulations laid down by the University and Faculty. The candidate will be expected to devote most of his time to research, at the end of which he shall present a thesis; the thesis shall be examined according to the regulations prescribed by University and the Faculty.

4.7 Staff for Graduate Programmes

See the list of staff for the undergraduate programme. All lecturers from the grade of Lecturer I can teach post-graduate courses. While Senior Lecturers and above can supervise both M.Sc. and Ph.D programmes, a Lecturer I can only supervise M.Sc.

4.8 Course syllabus

Mathematics Option

Algebra

MTH 601 Homological Algebra (4+0+0-4 Units)

Categories and functors. The category of modules and homomorphisms. Exact sequences of modules. Projective and injective modules. The tensor product and groups of homomorphism. The derived functors. The Torsion and extension functions. Applications.

Pre-requisites: MTH 306

MTH 602 Associative Rings (4 +0+0-4 Units)

Nill and nilpotent ideals. The nilradical and the Jacobson radical semi- simple rings. The density theorem. The Ascending Chain Condition (A. C. C) and Descending Chain Condition (D.C.C.)

Pre-Requisites: MTH 306

MTH 603 Commutative Algebra (4+0+0-4 Units)

Rings and modules of fractions. Primary decompositions. Noetherian and Artinian rings. Integral dependence. Valuations. Discrete valuation rings. Prufer Domains and Dedekind domains. Dimension theory and completions; Special topics.

Pre-requisites: MTH 406

MTH 604 Character of Finite Group (4+0+0-4 Units)

Representations Character. Complex representations. Centers of group algebras. Some properties of characters. Induced characters. The Schur index. F-elementary groups. Equation in groups. Criteria for solvability. Non-simplicity criteria. Normal complements. Characters of relativity; small Frobenius groups.

Pre- requisites MTH 306

MTH 605 Non-Associative Algebraic Systems (4+0+0-4Units)
Quasigroups and loops. Isotopy and homomorphism theorems. Normal sub loops and subquasi-group. Moufang and Bol loops. Arbitrary non-associative algebra. Malcev algebra.
Pre-requisites: MTH 306

Topology and Geometry

MTH 611 Topology (4+0+0-4Units)
Topological spaces; Compactness; Separation axioms; Connectedness; Approximations:
The Weierstrass approximation theorem. The Stone-Weierstrass theorem. Real complex forms for compact and locally compact.
Pre-requisites: MTH 402

MTH 612 Differentiable Manifolds (4+0+0-4 Units)
Topological manifolds; smooth manifolds; fundamental groups and covering spaces; manifolds and their tangent bundles; vector bundles; vector fields; differential forms.
Pre-requisites: MTH 402

MTH 613 Homotopy Theory (4+0+0-4Units)
Fibration, cofibration, push out, pull and homotopy properties, construction of homotopy method for calculation of homotopy groups of cell complexes e.g whitehead theorem, Freudental theorem etc. Eilenberg MacLane spaces. Obstruction theory extension and lifting problems. Special topics.

MTH 614 Homology Theory (4+0+0-4 Units)
Construction of various sorts of homology and cohomology theories operations on these, such as Steenod squares, cup products, cap products etc spectral sequences and some applications. Basic properties of manifolds and duality. Special topics.

Combinatories

MTH 615 Theory of Graphs (4+0+0-4 Units)
Introduction and basic concepts such as connectedness, trees, blocks, paths, and circuits. Eulerian and Hamiltonian graphs. Reconstruction problems. Planar graphs. Chromatic number and genus. Extremal and Ramsey type problems. Some applications.

Analysis

MTH 616 Commutative Banach Algebra (4+0+0-4 Units)
The Gelfand theory of commutative Banach algebras. Groups algebras of holomorphic functions. Special Topics. Text: Gelfand, Raikov, Shilov, commutative Normed rings.

MTH 621 Topological Vector Spaces (4+0+0-4 Units)
Definition and basic properties of Topological vector spaces. Duality and the Hahn-Banach theorem. Topology in dual spaces. Mackey-Arens theorems. Barreled spaces. Banach-Steinhaus theorem. Ascoli's theorem. Representation of duals. Applications.

MTH 622 Normed Spaces and Algebras (4+0+0-4 units)
Banach spaces and their duals. Examples. Commutative algebras. Algebras with involution. Dual algebras. H*-algebras. Algebras of operators. Algebras of functions.

MTH 623 Spectral Theory (4+0+0-4 Units)
Spectral analysis of linear operator. Compact operator. Spectral analysis in Hilbert spaces. Symmetric operators. Normal and self adjoint operator. Unitary operators.
Pre – requisites MTH 404

MTH 624 Topological Groups (4+0+0-4 Units)
Definition and basic properties of topological groups, subgroups and quotient groups. Locally compact groups. The Haar integral. Group representations. Character group. Compact abelain groups.
Pre-requisites MTH 402 and MTH 403.

MTH 625 Lie Groups (4+0+0-4 Units)
Lie Theory: Local Lie groups and examples. Local transformation groups with examples representation and realization of Lie Algebras. Generalized Lie derivatives.
Pre-requisites MTH 612

MTH 626 Special Functions (Application to Lie Groups) (4+0+0-4 Units)
Treatment by methods of classical analysis as well as application of lie Theory to the following:
Legendre Function, Bessel functions; Jacobi, Laguerre and Hermite Polynomial. The Hypergeometric functions of several variables (including the confluent hyperggeometric functions). The E- and the G – functions. Methods of obtaining generating functions of the above functions.
Pre-requisites: MTH 302 and MTH 625

MTH 627 Ordinary Differential Equations (4+0+0-4 Units)
Topics to be chosen from the following:- Existence and Uniqueness of solutions; Linear systems; Non singular boundary value problem;
Theory of periodic solution; stability of asymptotic expansions, perturbation theory; Poincare-Bendixson theorem. Integrals.
Pre-requisites: MTH 409 and MTH 410

MATHEMATICAL Methods

MTH 631 Mathematical Methods I (4+0+0-4 Units)
Analysis: Many-valued functions Riemann surfaces. Analytic continuation. Asymptotic expansions; method of steepest descent; method of stationary phase. Asymptotic expansion of Fourier integrals.
Partial Differential Equations: Differential equations. Method of characteristics. Second order linear equations. General first order equations.
Pre-requisites MTH 302

MTH 632 Mathematical Method II (4+0+0-4 Units)

Integral Equations: Fredholm's equation of the first and second kind. Iterated kernels and resolvent. Liouville-Neumann series for Volterra integral equation of the second kind. Eigenvalues and functions. Congugate and degenerated kernels. The Hilbert Schmidt theory of Hermitian kernel. Solution of inhomogeneous equations. Integral transforms for singular equations of the first and second kind. Green's functions and the connection between differential and integral. Flow theory equations.

Calculus of Variations: Functionals, fermets principles of Optics, Geodesic Curves, Isoperimetric problems. Euler's equations and extension to higher derivatives and several dependent and independence variables. Relaxing of conditions on class of admissible functions.

Pre-requisites MTH 631

Fluid Mechanics

MTH 633 Viscous flow Theory (4+0+0-4 Units)

Physical properties and simple kinetic theory of gases. Navier stokes equations and exact solutions. Flow at small Reynolds number swimming of microscopic organism. Stokes flow and Oseens Improvement. Lubricantion theory and approximator, boundary Layer theory – two dimensional boundary layers. Approximate methods of solutions. Unsteady boundary layers. Boundary layer separation and control.

Pre-requisites MTH 417

MTH 634 Compressible Fluid Flow (4+0+0-4 Units)

Thermodynamics – thermodynamics laws. Perfect gas mixture. Dissociation and ionization, Real gases. One dimensional flow of an inviscid compressible fluid. Shock waves. Method of small perturbations and linearized theory. Two dimensional subsonic and supersonic flows. Method of characteristics. Linear theories of wings and slender bodies. Cavitation and explosion theory. Boundary layer flow of a viscous compressible fluids.

Pre-requisites MTH 418

MTH 635 Hydrodynamics Stability (4+0+0-4Units)
Introduction. Surface phenomena. Centrifugal instability. Thermal instability such as that due to gravity acting on a horizontal layer of fluid which is heated from below. Instability of 2 dimensional parallel flow as illustrated by Poiseuille flow between parallel plates in which viscosity itself may play a destabilizing role. Kelvin Helmholtz instabilities. The instability of wakes, gets and luminary mixing regions. The development of turbulence from instability waves in boundary layer.
Pre- requisites MTH 633.

MTH 636 Hypersonic Flow Theory (4+0+0-4 units)
Introduction and general features. Centred expansion of homentropic flow. Oblique shock wave hypersonic small disturbance theory. Hypersonic analogy and blast wave solutions Sedov similar solutions. Sedons solution for intense explosions.
Pre-Requisites MTH 634

MTH 637 Hydromagnetics (4+0+0-4 Units)
Fundamental equations and general consequences. Hartman flow. Alfven waves. Aligned flow past aerofoils. Chester's flow motion solution. Boundary Layer flow. Magnetohydrostatic stability of pinches discharged. Mathematical discussion of magnetohydrostatic stability of pinched discharge. Mathematical discussion of magnetohydrostatic instability. Hydromagnetic shock waves. History and character of MHD. Introduction to solar MHD.
Pre-requisites MTH 312 and MTH 634

MTH 638 Elasticity (4+0+0-4 Units)
Stress-strain Analysis, Field equations and boundary value problems. Variation method of the theory of elasticity bending, buckling and torsion. Complex variable methods. Three dimensional problems. Elastic waves. Vibrations. Introduction to plasticity. Stress spaces, loading path yield surfaces. Various deformations and incremental theories. Boundary value problems of plasticity.
Pre- requisites MTH 419 and MTH 420

MTH 639 Theory of thin Shells (4+0+0-4 Units)
Shallow shells and shells of revolution. Nonlinear elasticity asymptotic integration of equations. Bucking and post bucking behavior of rings and shells. Tensor calculus and theory of surface, general linear and non linear shell theories, various simplified theories. Selected problems from recent literature.
Pre-requisites MTH 638

Numerical Analysis

MTH 640 Initial value problems I (By Numerical Methods) (4+0+0-4 Units)
Ordinary Differential Equations:
Linear Multistep Methods, difference equations. Consistency, algebraic stability conditions, truncation error. Dahlquist convergence theorem, strong and weak stability. Particular methods, error analysis, optimal difference methods, predictor-methods. Practical problems.
Partial Differential Equation:
The heat flow equation: methods for its numerical solution and their convergence and stability analysed by Fourier and energy methods. Simple hyperbolic equations characteristics and the Courant-Freidrich-Levy conditions. Convergence and stability for general linear problem the Lax equivalence theorem. Particular cases, choice of norms. Symbol of difference operator, amplification factors, the von-Neumann condition
Pre – Requisites MTH 424

MTH 641 Initial Value problems II (By Numerical Methods) (4 +0+0-4 Units)
Ordinary Differential Equations:
Dahlquist theorem on Multistep methods asymptotic behavior or error; Runge- Kutta and general one step methods, hybrid method; choice of methods, strong and weak stability, stiff equations; error estimation, choice and change of steplength.
Partial Differential Equations:
Algebraic stability conditions for constant coefficient difference schemes, Kreiss matrix theorem evergy methods, application to

variable coefficient and mixed initial boundary value problems; linear hyperbolic systems of equations; choice of anxillary boundary conditions and the Godunov-Ryabenkii criterion; Practical difference schemes, dissipative schemes.
Pre-requisites MTH 640

MTH 642 Boundary value and Eigenvalue Problems I (By Numerical Methods) (4+0+0-4 Units)
Classification of partial equation – boundary value problems are elliptic type, i.e equilibrium problems. Finite difference methods; difference equation for ordinary differential equation and Laplace's equation on a rectangle. Solution of equations with a tri-diagonal matrix. Reducible and irreducible matrices, directed graphs. Matrix theory linked to difference equations. The maximum principle. Bound on the discretixation error. Effect of round off in computation. Eigenvalue problems. Eigenvalues and eigenvectors for Laplace operator on a rectangle. Methods of solving difference equations. Further matrix algebra necessary for the study of iterative methods; Jacobi, Gauss- Seidel. Introduction to Finite Element Methods; variational form of the problem; essential and natural boundary conditions; admissible functions.
Pre- Requisites MTH 424

MTH 634 Boundary Value and Eigenvalue problem (Advanced) (4+0+0-4 Units)
Further study Of finite difference methods, block iterative methods alternating Direction Implicit methods. Further study of finite element methods for equilibrium problems with general self adjoint difference operators. Convergence, approximation, calenkin's method, estimation of eigenvalues,
Pre-requisites MTH 642

MTH 644 Approximation Theory (4+0+0-4 Units)
Uniform approximation by Polynomials. Convergence theorems; best approximations. Chebychev Polynomials, Chebychev series for functions. Expansion and collocation methods for ordinary differential equations. Spline functions for interpretation and

quadrature. Application to intial value and boundary value problems. Rational approximations in the complex plane; Pade approximants and their connections with continued fractions and orthogonal polynomials.

Dynamic Meterology

MTH 645 Atmospheric Dynamics (4 +0+0-4 Units)
This is concerned with (A) Formulation of mathematical models of large scale atmospheric dynamics; (B) Solution of the associated non linear time dependent, partial differential equations by numerical methods. The development is traced of the relatively simple early atmospheric models to the complex modern prediction models; with particular reference to the tropical situation.

MTH 646 Atmospheric Diffusion (4+0+0-4 Units)
The problem of predicting atmospheric turbulence is studied. The classical work of Taylor and Richardson are first considered, and then the subsequent development of theory based on the Lagrangian correlation and spectrum method and eddy diffusivity method.

MTH 699 Reading course 2 to 4 Units

Statistics Option

STT 601 Probability Theory (4 +0+0-4 Units)
Random variables. Expectation, independence. Convergence concepts. Laws of large number. Characteristics functions. Central Limit Theorem. Conditioning.
Markov chains. Martingales; Gambling System and stopping time and rules. Renewal theorem and local time theorem. Stochastic processes and Brownian motion. Stochastic processes with stationary independent increments.
Pre- requisites MTH 403

STT 603 Statistical Inference (4+0+0-4 Units)
Formation of the principles of statistical decisions as an aspect of the theory of games. Bayes' Minimax and admissible decision rules. The main theorems of statistical decision theory. Invariant and equivariant. Decision rules. Methods of solving for minimax, admissible admissible minimax and invariant and equivariant rules. Particular application to location parameter problems.
Decision theoretic approach to the theory of hypothesis testing Bayes tests. Neyman-Pearson and the Generalized Newman-Pearson lemmas. Uniformity most powerful, unbiased, invariant and locally most powerful tests. Invariant and minimax tests. Maximum likelihood estimation and asymptotic theory.
Pre- requisites STT 401

STT 605 Linear Statistical Models (4+0+0-4 Units)
Matrices and Quadratic forms. Multivariate, Normal Distribution. Linear models classification and analysis. General linear hypothesis of full rank. Computing methods. Polynomial and curvilinear models.
Regression models. Experimental design models. Incomplete block models. Mixed models two way classification model with interaction and with fixed and random effects. Balanced incomplete block design models. Linear Assays.
Pre-requisite STT 403

STT 607 Applied Statistics (4+0+0-4 Units)
Introduction to various Statistical packages for programming. Use of charts. Graphs and displays. Linearizing and normalizing transforms. Practical problems requiring the use of various sampling techniques from finite and infinite population. Analysis of discrete data by contingency table. Chi-squared goodness of fit of association. Use of multiple linear and polynomial regression. Analysis of multivariate data, use of discriminate and factor analysis. Non – parametric and robust data analytic techniques.
Pre requisites STT 304, 305, 306.

STT 608 Sampling Techniques and Design of Experiments (4+0+0-4 Units)

Sampling Techniques:

Sampling designs, probabilistic and inferential problems of finite populations sampling with varying probabilities stratified single stage, multistage, multiphase and cluster sampling. Ratio and Regression estimates.

Design of Experiments:

Basic ideas and assumptions; Randomization. Design of factorial experiments. Randomized block and Latin squares. Balanced incomplete block designs. Confounding and fractional replication in 2m theory of optimum designs.

Pre-requisites STT 301, 306

STT 609 Multivariate Analysis and sampling distribution (4+0+0-4 Units)

Multivariate Analysis:

Multivariate Analysis of variance. Multivariate normal distribution and its properties. Wishart and Hotelling's distributions. Applications of estimation of parameters and tests on means and covariance matrix. Multiple regression analysis, component, discriminate, canonical factor and cluster analysis. Multidimensional scaling.

Sampling Distribution:

Characteristics of sampling distributions. Unbiased estimates. Asymptotic properties of sampling distributions. The quartiles. Fisher's lemma on degrees of freedom. Exact sampling distribution. The generalized variance. Regression coefficients. Partial and multiple correlation coefficients.

Pre-requisites STT 301, 306

STT 612 Theory of Games (4+0+0-4 Units)

Two-person zero-sum games and their geometric interpretation. Linear programming methods. The minimax Theorem. Theories of n-person games and their applications.

Pre-requisites STT 301, 302

STT 613 Non Parametric Methods (4+0+0-4 Units)
Statistical procedures based on ranked, order statistics, signs permutation and runs. Testing for randomness, symmetry and independence. Invariance and insufficiency reductions. Treatment of ties. Asymptotics, U-statistics, Chernoff- Savage theorem. Efficiencies of rank tests by Pitman's and Bahadur's.
Pre – requisites STT 405

STT 614 Robust Inference (4+0+0-4 Units)
Heuristic description of the concept and reasons for robust methods. Development of basic tools such as the Prohorov model, minimax theory for robust estimates. Finite sample minimax theory for robust tests and estimates.
Pre-requisites STT 405

STT 615 Sequential Analysis (4+0+0-4 Units)
The Wald sequential probability ratio tests and various generalizations including tests of composite hypothesis. Non parametric sequential procedures. Sequential estimation and confidence intervals. Bayes sequential procedures. Stochastic approximations. Optimal stopping rules.
Pre-requisites STT 405

STT 616 Information Theory (4+0+0-4 Units)
Measures of information. Noiseless coding. Discrete memoryless channel. Channel capacity. Channels with memory models. Multi way channels.
Information sources. Source coding with Fidelity criterion.
Pre – requisites STT 401

STT 617 Times series Analysis (4+0+0-4 Units)
Discrete Time series Trends. The classical Model AR, MA, ARMA and ARIMA. Stationary Processes. Harmonic analysis and estimation linear stochastic models. Time series specified for

continuous time. Periodogram analysis. Estimation of continuous spectral.
Pre-requisites STT 407

STT 618 Applied Stochastic Processes (4+0+0-4 Units)
Stochastic convergence, Law of large Numbers, Markov chains. Basic concepts of Queueing models. Birth and death processes. Fundamental concepts of Renewal processes with emphasis on applications. Applications and extensions of the Martingale convergence theorems. Branching processes in discrete and continuous time.

STT 699: Reading Course 2 -4 Units

5.0 AREAS OF ACTIVE RESEARCH

Areas of active research in Mathematics and Statistics include, Special Function Theory, Functional Analysis, Fixed point theory, Theory of Loops, Banach algebras, Probability theory, Logistics theory, Distribution theory, Information theory, Fluid Mechanics, Solid Mechanics, Applied Statistics, Mathematical Analysis, Group representations and C*-algebras, Commutative algebras, Computational Mathematics, Stochastic processes, Numerical Analysis, and Differential equations.