FEDERAL UNIVERSITY OF KASHERE

FACULTY OF SCIENCE

Department of Mathematics and Computer Science

B.Sc. Mathematics Programme

UNDERGRADUATE STUDENTS' HANDBOOK
2021-2023

FORWARD

I am delighted to put in the second edition of the *Students' Handbook* of the Department of Mathematics and Computer Science. I am equally happy to welcome our dear students, fresh and returning to our department. There are many reasons why Mathematics is worth study, none surpassed that of its applications in real-life situations.

The objective of the publication of this Handbook is to disseminate information to students in the department on the history of the programmes offered in the department, its organizational structure, philosophy, mission, vision, aim and objectives, admission requirements, workload per level, grading system, graduation requirements, results computation as well as its course structures (Curricula).

Students are therefore strongly advised to read this Handbook carefully so that they will be conversant with the dos and don't of the department and other relevant information that will lead to their itch-free study and also achieve their study objectives. There may be other rules and academic regulations of specific nature not covered by this Handbook. Such rules are important as those contained in the *University Student Handbook*, 2013.

I wish to add that any comment for improvement of this Handbook will always be welcomed.

I also wish you God's blessing and protection throughout your study period in this department and the University at large.

Prof. P. B. Zirra
Head of Department

(A) LIST OF STAFF, QUALIFICATION, RANK AND STATUS

S/N	Name of Staff	Rank/Designation	Status	Qualification, dates obtained and specialization, membership of professional association
1	Prof. P. B. Zirra (HOD)	Professor	F/T	NCE Math/Phy (Hong,1987); B. Tech. Comp. Sc. (ATBU,1994); MBA Finance (Unimaid, 2001); M.Tech. Comp. Sc. (ATBU, 2006); Diploma Theology (KBC,2010);PhD Comp. Sc. (MAUTECH, 2012). CPN, NCS, TRCN, ITSSP, NIM.
2	Prof. G.M. Wajiga	Professor	S	B.Sc. Maths (Zaria,1979);M.Sc. OR (Aston, 1983);PhD Comp. Sc. (ATBU, 2000). NCS,MAN,ORS(UK)
3	Prof. M..I. Bello	Professor	S	B.Sc. Maths (Unimaid, 1990); M.Sc. Maths (ATBU 1994); PhD. Maths (ATBU 2003). MAN, NMS.
4	Prof. M. N. Haggai	Professor	S	B.Sc. Maths (Unimaid, 1989); M.Sc. Maths (ATBU 1994); PhD. Maths (ATBU 2006). MAN, NMS.
5	Dr. J. Abah	Reader	S	B.Tech. Comp.Sc. (ATBU, 2005), MSc Comp. Sc. (BUK,

				2011), PhD Comp. Sc. (FUTM, 2016) IEEE, MAN, CPN, NCS
6	Dr B. Y. Baha	Reader	S	B.Tech. CS (ATBU, 2000); M.Sc. CS (ABU, 2008);PhD. CS (MAUTech.,2012) CPN, NCS, AITP
7	Dr A. Y. Gital	Reader	S	PhD CS (UTM, 2015), MSC. CS (ATBU, 2010), BTech. CS (ATBU, 2003) ACM, NCS, CPN, IEEE, IAENG
8	Dr. I. Asabe	Senior Lecturer	F/T	B.Sc. Statistics (Unimaid, 2004); M.Sc. Statistics (ABU 2010); PhD. (BHU, 2016).
9	Dr. Joel John Taura	Senior Lecturer	F/T	B.Sc. Maths (ABU,2000);PGDE (Gashua,2007);M.Sc. Maths (ABU, 2011). PhD. Maths (ABU,2016)
10	Dr. J. A. Kwanamu	Senior Lecturer	F/T	B.Sc. Maths (MAUTECH, 1995); M.Sc.. Maths (MAUTECH 2006); PhD. Maths (MAUTECH, 2016).
11	Dr. E. J. Garba	Senior Lecturer	F/T	PhD CS (MAUTech,2012), MSc CS (PSIPMO Uni, 2004), BSc. CS (PSIPMO, Uni, 2002) NSC, CPN, IEEE
12	Dr M. A. Mahdi	Senior Lecturer	F/T	PhD Comp. Info. Sys. (UTM, 2016)

				MSc. Info. Tech. (UTM, 2012) B. Eng. E/lec (BUK, 2006) NCS, ISMI, CPN
13	Dr. A.M. Mabu	Senior Lecturer	F/T	PhD CS (SHAUTS, India, 2018) MSC. CS (BUK, 2015) BSc. CS (BUK, 2007) ND Stat (FPD, 1998)
14	Dr. M. Mohammed	Senior Lecturer	F/T	PhD Comp. Tel. Network (2018) MSc Computer Networking (Uni of Greenwich, 2012) BTech CS (MAUTech, 2009) IEEE
15	Dr. B. Modi	Senior Lecturer	S	PhD CS (Uni of Kent, 2015), MSc. CS BUK, 2009), BTech. CS (ATBU, 2003), ND Stat. (Kaduna Poly., 1991)
16	Dr A.U Abdullahi	Senior Lectuer	F/T	BSc. C S (ATBU, 2003), MSc. CS (BUK, 2011) PhD Info Tech. (UTPM, 2018) FNCS,, CPN, TRCN
17	Dr. S.S. Jauro	Senior Lecturer	F/T	PhD CS (SHUATS India, 2020), MSc. CS (BUK, 2015), BSc. CS. (BUK, 2008)
18	Dr. A.U. Terang	Lecturer I	F/T	NCE(Coll., of Edu., Hong, 1993); B.Sc. Maths (ADSU,2008); M.Sc. Maths (ADSU, 2013). PhD

				Maths(MAUTEC, 2019)
19	Dr. Y.M. Malgwi	Lecturer I	F/T	PhD Comp. Sc. (Mautech. 2019), MSc. Comp. Sc. (ADSU, 2014),B.Tech. Comp. Sc. (FUT, 2006) NCE, (1995), ND Comp. Sc. (FPM, 1999) NCS, TRCN
20	Dr. S.Y. Enoch	Lecturer I	F/T	B.Sc. Comp. Sci. (ADSU, 2007); M.Sc. Comp. Sc. (UI, 2011); P.hD. Comp. Sc.(UC New Zealand, 2018). IEEE, ACM, NCS, SDIWC,NIM
21	Dr. M.L. Jibrin	Lecturer I	F/T	B.Sc. Comp. Sc. (UOP, 2010) MBA (UOW, 2011) M.Sc. Comp. Sci. (BUK, 2015), PhD. Comp. Sci. (MAUTECH, 2019)
22	Dr. M.K. Ahmed	Lecturer I	F/T	PhD CS (MAUTECH, 2019), MSc CS (UDU, 2016), BSc. CS (GSU, 2010)
23	Dr. M.A. Usman	Lecturer I	F/T	PhD Cs (USM, 2020) MSc. CS (ADSU, 2014) BSc. CS (ATBU, 2005) IEEE, MIAENG, NCS, TRCN
24	Y. Atomsa	Lecturer I	F/T	B.Sc. Comp. Sci. (ADSU, 2006), M.Sc. Comp. Sci. (Uni. Hong Kong, 2011)

25	Dr. O. David	Lecturer II	F/T	B.Sc. Maths (UNAD,2007); M.Sc. Maths (UniAbuja, 2013). PhD. Maths (FUTMinna,2017) Publication - 18
26	A. Nuraini	Lecturer II	F/T	B. Tech. Comp. Sc. (ATBU, 2010) MSc. Software Engr.(UTHM,2015)
27	A. M. Umar	Lecturer II	F/T	NCE. Maths/Geo (2001); B.Sc. Maths (BUK, 2010). M.Sc. Maths (BUK,2017)
28	M.B. Jibrin	Assistant Lecturer	F/T	B.Sc. Comp. Sc. (KSU 2008) MSc. Comp. Sci. (Uni.Ilorin, 2018)
29	Dr. A. Auwal	Assistant Lecturer	F/T	B.Sc. Maths (Unijos,2011); M.Sc. Maths (Unimaid, 2007), PhD Maths (UPM,2020)
30	A.J. Ibrahim	Assistant Lecturer	F/T	B.Tech. Software Engr.(UTM, 2013) MSc. Comp. Sci. (UTM, 2015)
31	U.A. Jauro	Assistant Lecturer	F/T	B.Sc. Info. Tech (MU 2012) M.Sc. Info. Tech (MU 2013).
32	N.A. Muhammad	Assistant Lecturer	F/T	BSc. Comp. Sci. (ABU, 2014) MSc. Comp. Sci. (India, 2019)
33	D.O. Silas	Assistant Lecturer	F/T	BSc. Comp. Sci. (FUT Minna, 2013),MSc. Comp. Sci. (ABU, 2017)
34	A.D. Azi	Assistant Lecturer		B.Tech. Maths (FUTY,2012) MSc. Maths (FUTY,2018)

35	A. Bernard	Assistant Lecturer	F/T	B.Sc Maths (BSU,2006) MSc Maths (NSU,2010)
36	U. Umar	GA	F/T	BSc. Comp Sc. (BUK, 2013)
37	S.Y. Danjuma	GA	F/T	BSc. Comp Sc. (Bingham uni, 2016)
38	U.I. Ismail	GA	F/T	BSc. Comp Sc. (GSU, 2015)
39	Z.D. Babantakko	GA	F/T	BSc. CS (2015)
40	S.M. Shehu	GA	F/T	BSc. Comp Sc. (SUM, 2015)
41	A. Umar	GA	F/T	BSc. Comp Sc. (NIMS Uni India, 2015)
42	M.B.A Aisha	GA	F/T	BSc. Comp Sc (2013)
43	B.M. Ali	GA	F/T	BSc. Maths (FUK, 2016)
44	H.J. Ankale	GA	F/T	BSc. Maths (ATBU, 2017)
45	H.S. Abdullah	GA	F/T	BTech. Maths (ATBU, 2015)
46	A.S. Joseph	GA	F/T	BSc. Maths (FUK, 2015)
47	S.S. Kada	GA	F/T	BSc. Maths (GSU, 2016)
48	A.S. Yayangida	GA	F/T	BSc. Maths (FUD, 2016)

(B) LABORATORY STAFF

i. Computer Laboratory I

Name	***Rank/Designation Date of First Appointment***	***Qualifications, Dates Obtained Membership of Professional Association***
Aliyu abdullahi	Data Processing Officer, 2019	HND CS (2016), ND CS (2013)
Adamu Mohammed Mangadu	Lab Computer Assistant,, 2012	Advance Cert. (2012),

		ND CS (2005)

ii. Computer Laboratory II

Name	***Rank/Designation Date of First Appointment***	***Qualifications, Dates Obtained Membership of Professional Association***
Yakubu Abubakar Maidu	System Analyst II, 2019	B.Tech. CS (2013)
Ibrahim Abubakar	Senior Science Lab. Assistant I, 2018	OND Computer Operation, 2010

iii. Computer Laboratory III

Name	***Rank/Designation Date of First Appointment***	***Qualifications, Dates Obtained Membership of Professional Association***
Fada Maikano	System Analyst II, 2019	B.Sc. CS (2018)
Ahmed Abubakar	Senior Computer Operator, 2019	Internal Adavance Diploma in Computing (2007) Diploma Diploma in Computing (2007)

iv. Computer Hardware Maintennce Laboratory

Name	***Rank/Designation Date of First Appointment***	***Qualifications, Dates Obtained Membership of Professional Association***
Abdullahi Yerima Abubakar	Senior system Analst, 2018	B,Eng (Computer Engeering)

Bashir Abubakar	Senior Computer Techncians, 2015	Diploma in Computer Studies, 2005, Cert in Computer Studies, 2004

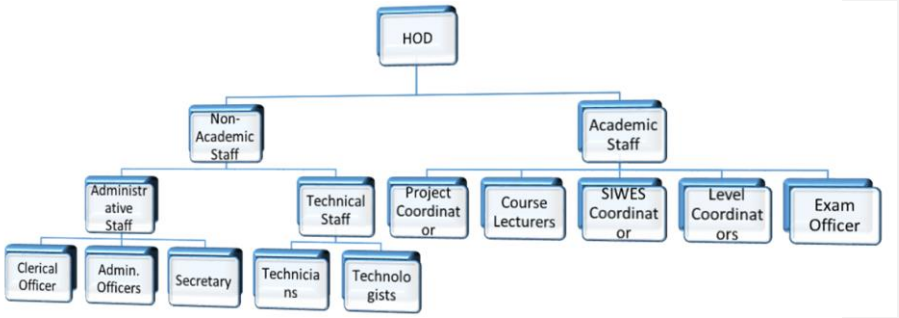
(C) **ADMINISTRATIVE NON-TEACHING STAFF**

Name of Staff	***Rank/Designation Salary Scale and Date of First Appointment***	***Qualification and Dates Obtained***	***Post Qualificatin Work Experience***	***Remarks***
Caroline Idajor Samuel	*Senior Confidential Secretary, 2018*	*HND Secretarial Studies, (2010), ND Secretarial Studies*	*FUK, 2015to Date*	*Departmental Secretary*
Abdulrahman Tijjani	*Administrative Officer,* *CONTISS 8, 28/8/2017*	*B.A.(Ed) Islamic Studies (2012)*	FUK, 2017 to Date	AO incharge of general administration
Theophilus Albert	*Administrative Assistant,* *CONTISS 7/2, 20/5/2019*	*B.Sc. Sociology & Anthropology (2014)*	*FUK, 2019 to Date*	AO in charge of student matters
Nuhu Muhammad Abubakar	*Administrative Assistant,* *CONTISS 7/2, 24/5/2019*	*B.A.(Ed) Islamic Studies (2015)*	*FUK, 2019 to Date*	AO incharge of senior staff matters
Dauda Abubakar	*Administrative Assistant,* *CONTISS 7/3, 16/1/2018*	*B.Sc. Business Administration (2011)*	*FUK, 2018 to Date*	AO incharge of junior staff matters

Sule A. Uba	*Clerical Officer,CONTISS 3/3, 5/7/2016*	*Basic Cert. ICT (2016)* *SSCE (2014)*	*FUK, 2016 to Date*	*Inchage of file and memo movement*

ORGANIZATIONAL STRUCTURE OF THE DEPARTMENT

The Department is headed by the Head of Department (HOD) who assigns duty and responsibilities to staff. The departmental activities are guided by the regulations approved by the University Senate and supervised by the Dean of School. The Organization Structure is shown in the Figure below. The Department uses a committee system with the Departmental board as its highest decision-making body after the committees. The HOD chairs all the meetings of the Departmental Board while the secretary who is appointed from the members of academic staff takes the minute, prepares, and circulates it in readiness for the next meeting. He/she is assisted by an other staff.



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1.0 HISTORICAL BACKGROUND OF THE DEPARTMENT

Bachelor of Science (B.Sc.) in Mathematics was started in the Department of Mathematics and Computer Science in August 2012. Mathematics and Computer Science in August 2012. The Department of Mathematics and Computer Science is one of the departments in the Faculty of Science established in August 2012 with four (4) academic staff and seventeen (17) students at the takeoff side. Since then, the Department enjoys a very solid backing and support of the Vice-Chancellor and the University Management, currently, the Department has a total of thirty five academic staff on permanent and pensionable status excluding Graduate Assistants and those on study fellowship, six administrative staff, and three Technologists.

The Departments has computer laboratories, lecture rooms, lecture theaters and staff offices. Currently, the Department offers Bachelor of Science (B.Sc.) degree programmes in Computer Science, Mathematics and Statistics with a total enrollment of five hundred and fifty five (555) students.

The pioneer Acting Head of Department was Mr. Yusuf Enoch Simon an Assistant Lecturer who served from 2012 to 2014. Dr. P.B. Zirra a Senior Lecturer succeeded him from 2014 to 2018. Between 2018 and 2020, Dr. Asabe Ibrahim a Senior Lecturer became the third Head of Department. Professor P.B. Zirra took over again from Dr. Asabe Ibrahin as Head of Department on 1st November, 2020 till date.

2.0 VISION

The Department of Mathematics aspires to be globally recognized as a centre of excellence for interdisciplinary - research and teaching. The Programme will promote a comprehensive, innovative and dynamic learning environment that meets the changing needs of the student population.

3.0 MISSION

The Programme mission is to provide students with rigorous training that enables them to develop reasoning and analytical skills and pursue graduate degrees for service to the communities and the world at large.

4.0 PHILOSOPHY

The training of Mathematics should involve a broad strategy of human resource development with its broader goals of social and political modernization. Rigorous training and research in mathematics are what makes the acquisition of solid foundation knowledge of the application of mathematics to society. That is the knowledge that nurtures confidence, zeal and capacity for analytical problem solving and potential for research in the modern scientific age

5.0 AIM AND OBJECTIVES

The aim of this programme is to produce graduates with the abilities to tackle mathematical and computational problems of the society and the world community at large, through the acquisition of a solid foundation knowledge of the mathematical sciences.

The objectives are:

i. To develop in the students the enabling capacity to develop mathematical models to solutions to various scientific and socioeconomic problems.
ii. To produce mathematics graduates that will compete favourably with their contemporaries in the labour market in Nigeria and the world at large.
iii. To widen the knowledge base and enhance the capacity of students to address the general mathematical problems of the pure and applied sciences.
iv. To prepare students intellectually to pursue postgraduate research studies in all areas of mathematics and related fields.
v. To produce graduates that are self-reliant and job creators.

6.0 COURSE ASSESSMENT

Each course is assessed by a continuous assessment which includes assignments, tests, practical and end of semester examination.

(a) The practically based courses are assessed according to the following distribution:
- Practical: 20%
- Assignment and Test: 20%
- End of Semester Examination: 60%
- Total Weighting for the course: 100%

(b) The non- practically based courses are assessed according to the following distribution:
- Assignment and Continuous Assessment Test: 40%
- End of Semester Examination: 60%
- Total Weighting for the course: 100%

7.0 ADMISSION / ENTRY REQUIREMENT

a) U.T.M.E. Applicants: Five ordinary level passes at credit level in English, Mathematics, Physics and any other two relevant science subjects from ICT/Computer Studies, Chemistry and Biology/Agricultural Science, Geography and Further Mathematics in not more than two (2) sittings. In addition, applicants are expected to

sit for the relevant **U.T.M.E.** subjects (Mathematics, Physics and any of Biology/Agricultural Science, Chemistry or Geography) obtain the minimum cut off points as may be specified from time to time by the Joint Admission and Matriculation Board (JAMB).

b) Direct Entry (D.E.) Applicants: The D.E. applicants are expected to have the following:

i. Five ordinary level passes at credit level in English, Mathematics, Physics and any other two relevant science subjects from ICT/Computer Studies, Chemistry and Biology/Agricultural Science, Geography and Further Mathematics in not more than two (2) sittings.

ii. National Diploma/NCE (not professional) in Mathematics/Computer Science with Upper Credit or I.J.M.B. in relevant subjects (Mathematics and Physics as core and any other one from Chemistry, Biology or Geography) with a minimum of ten (10) points.

8.0 GRADING SYSTEM

Students' academic work shall be graded at the end of every semester using the following letter grades

Letter	Grade	Marking Scale (%)	Grade Points
A	70 –100	Excellent	5 Points
B	60 – 69	Very Good	4 Points
C	50 – 59	Good	3 Points
D	45 – 49	Average	2 Points
E	40 – 44	Pass	1 Point
F	0 – 39	Fail	0 Point

9.0 EXAMINATION

Course Credit System: The department has adopted the Course Credit System in computing results of students' performance. It is a quantitative system of organization of the curriculum in which the subject areas are split into examinable unit courses that are assigned weights or Credit Units (e.g. 1 Unit, 2 Units, 3 Units, etc) and for which credits are earned after passing them. The course (Core, general and elective) are arranged in progressive order of difficulty or in levels of academic progress e.g. Level 1 or 100 Level or Year 1 donated as 1201, 1301, 1402, etc; Level 2 or 200 Level or Year 2 designated as 2301, 2301, 2202, etc. the first digit represents the level, the second digit represents the credit unit, the third and fourth digits represent the serialization of the course.

Credit: Is generally a 'Value' used to measure students workload in terms of learning time required to complete course units, resulting in learning outcomes. The number of credits awarded to a learner is determined by Credit Value or Credit Points assigned to a particular course.

Course: A course is essentially a constituent of a 'Program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. A 'Course' in simple terms corresponds to the word 'subject' used in many Universities.

Core Courses: These are compulsory courses that each student must register for and pass before graduating.

General Courses: These are compulsory Courses offered by all students at a particular level and must pass them before graduating.

Elective Courses: These are optional (not compulsory) courses designed for the student to make up the minimum credit units for registration.

Credit Unit (CU): This is a measure of the 'Workload' of a learner and is an index of student-teacher contact hours per week per semester e.g. 1 credit unit means one hour of lecture or tutorial etc per week per semester.

Grade Point (GP): The grade point derives from the actual percentage, the raw score for a given course; the raw score is converted into a letter grade and hence the grade point. Each grade, except 'Inc' and 'Pnd' is assigned a Grade Point as follows:

Raw score	70-100	60-69	50-49	45-49	40-44	0-39
Letter Grade	A	B	C	D	E	F
Grade Point	5	4	3	2	1	0

Credit Point (CP): The credit point is the product of the credit units of the course and the grade point. For example, if a student obtains a C in a 2 credit unit course then his/her credit point is *2 x 3 = 6.*

Total Credit Unit Registered (TCUR): This represents the total number of credit units registered by a student in any given semester.

Total Credit Unit Earned (TCUE): This represents the number of credit units for which a student has sat for in examination and passed in a semester.

Weight Grade Point (WGP): The sum of Grades Points of courses offered in a semester (i.e.$WGP = \sum GP$).

Grade Point Average (GPA): Performance in any semester is reported in Grade Point Average. This is the average of weighted grade points earned in the courses offered in a semester. The grade point average is obtained in each semester by summing the grade point of courses offered in the semester and then divide it by the total number of credit units registered for the semester.

$$GPA = \frac{Weighted\ Grade\ Point\ (WGP)}{Sum\ of\ Credit\ units\ Registered\ (CUR)}$$

Suppose a 100-Level student in Mathematics has the following results for a session.

FIRST SEMESTER

Course	MTH1201	MTH1203	MTH1205	CSC1201	STA1201	GST 1201
Credit Units (CU)	2	2	2	2	2	2
Raw Score	50	60	70	45	38	40
Grade	C	B	A	D	F	E
GP	3	4	5	2	0	1
GP x CU	6	8	10	4	0	2

$$GPA = \frac{Weighted\ Grade\ Point\ (WGP)}{Sum\ of\ Credit\ units\ Registered\ (CUR)} = \frac{(6+8+10+4+0+2)}{12} = \frac{30}{12} = 2.5$$

Cumulative Grade Point Average (CGPA): This is the up to date average of the grade points earned by the student in a program of study. It is an indication of the student's overall performance at any point in the training program. To compute the CGPA, the total weighted grade points gained in the semesters attended is divided by the total number of credit units for all courses registered by the students.

i.e. **CGPA** $= \frac{Total\ Weighted\ Grade\ Points\ Earned\ for\ the\ session}{Total\ Credit\ Units\ Registered\ for\ the\ session} = \frac{TWGP}{TCUR} = \frac{WGP_1 + WGP_2}{CUR_1 + CUR_2}$

Where WGP_1 and WGP_2 are weighted grade points Earned for first and second semesters, CUR_1 and CUR_2 are credit units registered for first and second semesters respectively. This calculation is carried out up to the final year from which the final CGPAs will determine the class of degree.

Since the minimum pass mark of a course is 40% corresponding to a GP of 1.00, the minimum CGPA of 1.00 is required for graduation. An example of how the above mentioned terms are used in calculating CGPA is given in the tables below for a 100 Level Mathematics as an illustration.

Computation of CGPA (example)

- **a.** Total Credit Units Registered (TCUR)
- **b.** Total Credit Units Earned (TCUE)
- **c.** Total Weight Grade Point (TWGP)

SECOND SEMESTER

Course	MTH1202	MTH120 4	MTH1206	STA120 2	GST1202	GST1204
Credit Units (CU)	2	2	2	2	2	2
Raw Score	55	60	63	45	56	60
Grade	C	B	B	D	C	B
GP	3	4	4	2	3	4
GP x CU	6	8	8	4	6	8

$$GPA = \frac{(6+8+8+4+6+8)}{12} = \frac{40}{12} = 3.33$$

$$The\ CGPA = \frac{WGP_1 + WGP_2}{CUR_1 + CUR_2} = \frac{(6+8+10+4+0+2)+(6+8+8+4+6+8)}{12 \quad + \quad 12} = \frac{30+40}{12+12} = \frac{70}{24} = 2.92$$

Cumulative

TCUR	TCUE	TWGP	CGPA
12+12=24	10+12=22	30+40=70	70/24=2.92

Therefore the CGPA for that level = 2.92

Instructions to Candidates on Examination

a) A candidate must arrive at the examination hall 30 minutes before the commencement of the examination.

b) A candidate who arrives late for any examination shall not be allowed extra time.

c) No candidate shall remove a question paper from the examination room without the consent of the Chief Invigilator.

d) In case a candidate has to leave the examination room temporarily he/she shall be accompanied by an invigilator or security personnel.

e) No candidate shall be allowed to enter an examination room later than 30 minutes after the start of an examination session. However, any candidate who seeks entry into the examination room after the first 30 minutes may be allowed to do so by the Chief Invigilator but such cases shall be reported in writing to the Examination Committee.

f) No candidate is allowed to leave the examination Hall 30 minutes to the end of the examination.

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

i) A candidate shall not directly or indirectly;

   i. Give assistance to any candidate.
   ii. Accept any assistance from any other candidate during the examination.

j) A candidate shall not remove from an examination room any papers used or unused, except the question paper and such books or papers, if any, as he/she was authorized by the invigilator to take into the examination room. The invigilator will indicate occasions when question papers may not be taken out of the examination room.

k) A candidate shall not be allowed during an examination to communicate in any way with any other candidate, nor shall he/she leave his/her seat except with the consent of an invigilator. Should the candidate act in such a way as to disturb or inconvenience other candidates he/she shall be warned and if he/she persists he/she may, at the directive of the chief invigilator, be expelled from that examination room.

l) A candidate shall comply with all instructions to candidates set out on the examination answer booklet or other examination materials supplied to him/her, and shall comply with directives given by the invigilator.

m) A candidate shall not write on any paper other than the answer booklet of the examination except when indicated. All rough work must be done in the answer

booklet and crossed out neatly. Supplementary answer sheets, even if they contain only rough work, must be tied inside the main answer booklets and handed in.

n) When leaving the examination room, a candidate shall not leave his/her written work on the desk but he/she shall hand it over to the invigilator. Candidates are responsible for the proper return of their written work.

o) Smoking, chewing and eating shall not be permitted in examination rooms during examination sessions.

p) Any candidate involved in examination misconduct must complete the misconduct form or write a statement as demanded by the invigilator stating clearly his/her level of involvement. Such a report should be signed by the candidate and dated.

q) Candidates who have been requested by an invigilator to change their seats must comply with the directive.

r) All candidates must ensure that they have signed in and out on the Attendance list when their scripts are submitted to the invigilator at the end of each examination.

10.0 STUDENT ACADEMIC WORKLOAD

All full-time students shall take a minimum of 15 credit units and a maximum of 24 credit units per semester. A student may apply to take less or more than the limit through the Faculty Board for Senate's consideration.

11.0 ACADEMIC PROBATION

A student shall be placed on Academic Probation if he/she fails to maintain a minimum CGPA of 1.00 at the end of the session. The probationary status of a student shall be reversed if the student maintains a CGPA of at least 1.00 in any subsequent semester after the first year.

The responsibility to reverse the probationary status rests with the student.

A preliminary notice of poor academic standing shall be given to a student in writing by the University.

Commented [1]: Have we being doing this?

12.0 TEACHING AND LEARNING

We use a wide range of teaching methods to suit the content and aims of each course unit:

a. **Fieldwork**: Students undertake directed work and independent research projects to develop observation, experimental design and data collection skills.
b. **Tutorials**: regular sessions with an advisor and small group of students develop your oral and written communication, team working and problem-solving skills whilst exploring topics related to your degree discipline.
c. **Lectures**: delivered to audiences ranging from 20 to 500 students using technology such as PowerPoint.
d. **E-learning**: our virtual learning environment provides learning resources on-demand (discussion boards, quizzes) to enhance and support lecture-based units.
e. **Practical**: undertake modern experimental techniques to develop laboratory, experimental design, and data analysis skills.
f. **Seminars**: examine and debate topical areas of research to develop the students' critical thinking and communication skills.
g. **Projects**: carry out an independent research project which could be lab-based or in a number of other formats for example planning a new bioscience enterprise or an education project.

13.0 WITHDRAWAL FOR ACADEMIC FAILURE (WAF)

A student shall be required to withdraw for academic failure if he/she at the end of any session fails to maintain a CGPA of at least 1.00. However, this rule shall not apply to the first year students.

However, a student in his/her final year of study who fails to make a minimum CGPA of 1.00 may be allowed to register for courses in the final year. Such students who fail to make a minimum CGPA of 1.00 in the concession year shall be asked to withdraw from the University.

Commented [2]: is it from the university or course of study? Please, verify.

14.0 DURATION OF PROGRAMME

The expected duration for UTME candidates shall be four years, while that of DE shall be three years.

15.0 RESIDENCY PERIOD

The residency period for a UTME candidate to graduate in six years, while it is five years for DE candidates.

Commented [3]: is it five years or four and half years? Please, verify.

16.0 GRADUATION REQUIREMENTS FOR BACHELOR'S DEGREE

In order to qualify for the Bachelor's Degree in Mathematics of this Department, students must attain:

i. A passing grade in supervised Student Industrial Work Experience Scheme, (SIWES) where applicable;
ii. A minimum of CGPA of 1.00;
i. A minimum of 1159 (B.Sc. Mathematics) and 115 (B.Sc. Mathematics) units including SIWES for UTME and DE admission respectively. A transfer student must earn a minimum of 112 units.
iv. A passing grade is required in all compulsory courses. A student may take some Elective courses to meet graduation requirements.

17.0 FINAL CLASSIFICATION OF DEGREE

For the purpose of the final classification of degree, a student should have achieved the following CGPA at the end of 159 or more units.

CGPA		CLASS OF DEGREE
4.50 – 5.00	-	First Class
3.50 – 4.49	-	Second Class (Upper Division)
2.40 – 3-49	-	Second Class (Lower Division)
1.50 – 2.39	-	Third Class
1.00 – 1.49	-	Pass

18.0 PROGRAMME STRUCTURE

18.1 Structure:

The duration for B.Sc. Mathematics programme is four academic sessions and every academic session comprises two semesters. At 300L, a student is required to go for a six(6) months Student Industrial Work Experience Scheme (SIWES) after finishing the first semester courses. At the end of the SIWES, a student has to write, present and defend a technical report on what he/she learnt in the industry. A student with more than 10 cumulative units backload (carry over and dropped courses) is not eligible to proceed to SIWES. At 400 Level, each student undertakes a one year project in any field of interest besides the normal stipulated courses. A report on the project will also be presented and defended by the student.

18.2 SUMMARY OF CREDIT LOAD DISTRIBUTION BY SEMESTER AND LEVEL

LEVEL	SEMESTER		TOTAL
	FIRST	SECOND	CREDIT
100	24	20	44
200	23	20	43
300	24	6	30
400	21	21	42
TOTAL	**U.T.M.E**		**159**
	D.E		**115**

19.0 COURSE CODING/NUMBERING/DESCRIPTION

Each course offered in Mathematics has as its prefix the letter MTH which indicates a Mathematics Course. The letter MTH is followed by a four digit numbers; the first digit indicates the level to which the course belongs, second, the credit unit(s) and the last two digits indicates the serialization of the course in any given semester – an odd number indicates a first semester course whereas an even number indicates a second semester course.

100 LEVEL: First Semester

Code	Course Title	CU	P/req	L	T	P
MTH1301	General Mathematics I: Algebra and Trigonometry	3		3	1	
MTH1303	General Mathematics III: Vectors, Geometry and Dynamics	3		3	1	
CSC1301	Introduction to Computer Science	3				
CSC 1203	IT Essentials: PC Hardware & Software	2				
PHY 1311	General Physics I (Mechanics, Thermal Physics and Waves)	3				
PHY 1171	General Physics Laboratory I	1				
CHM 1301	General Chemistry I	3				
STA 1301	Descriptive Statistics	3		**3**	**1**	
GST 1201	Communication in English I	2				
GST 1105	Introduction to Service – Learning I	1				
Total		24				

100 LEVEL: Second Semester

Code	Course Title	CU	P/req	L	T	P
CSC 1302	Introduction to Problem Solving	3				
MTH1302	General Mathematics II: Calculus	3		3	1	
STA 1304	Statistical Inference	3		3	1	
PHY 1322	Gen. Physics II (Electricity, Magnetism and Modern Phy.)	3				
PHY 1172	General Physics Laboratory II	1				

GST 1202	Communication in English II	2				
GST 1204	Use of library, Studies skills and ICT	2				
GST 1106	Introduction to Service – Learning II	1				
Total		**18**				

200 LEVEL: First Semester

Core courses

Code	Course Title	CU	Prerequisite	L	T	P
MTH2301	Mathematical Methods I	3	MTH1302	3	1	
MTH2303	Sets Logic and Algebra	3	MTH 1301	3	1	
MTH2205	Linear Algebra I	2		2	1	
MTH2307	Real Analysis I	3	MTH1301	3	1	
MTH 2309	Vector and Tensor Analysis	3		3	1	
CSC2301	Computer Programming I: Java	3				
STA2201	Probability I	2	STA1202	2	1	
GST 2201	Nigerian People and Culture	2				
GST2203	Entrepreneurship and Innovation I	2				
Total		**23**				

200 LEVEL: Second Semester

Core courses

Code	Course Title	CU	Prerequisite	L	T	P
MTH2302	Ordinary Differential Equations I	3	MTH1302	3	1	
MTH2204	Linear Algebra II	2		2	1	
MTH2306	Real Analysis II	3	MTH1301	2	1	
MTH2308	Introduction to Numerical Analysis I	3		3	1	3
CSC2302	Computer Programming II: C++	3				
STA 2202	Probability II	2	STA1202	2	1	
GST 2202	Logic, Philosophy and Human Existence	2				
GST 2208	Peace Studies and Conflict Resolution	2				
Total		**20**				

300 LEVEL: First Semester

- **Core courses**

Code	Course Title	CU	Prerequisite	L	T	P
MTH3301	Mathematical Methods II	3	MTH2301	3	1	
MTH3303	Metric Space and Topology	3	MTH2307	3	1	
MTH3305	Abstract Algebra I	3	MTH2303	3	1	
MTH3307	Complex Analysis I	3	MTH1304	3	1	
MTH3209	Ordinary Differential Equation II	2	MTH2301	3	1	
MTH3211	Introduction to Mathematical Modeling	2	MTH1303	2	1	2
MTH3313	Numerical Analysis II	3	MTH2310	3	1	
MTH 3315	Discrete Mathematics	3		3	1	
GST 3201	Enterprise Business Creation and Growth II	2				

Total	**24**				

300 LEVEL: Second Semester

Code	Course Title	CU
MTH3699	Students Industrial Work Experience Scheme	6
Total		**6**

400 LEVEL: First Semester

Core courses

Code	Course Title	CU	Prerequisite	L	T	P
MTH4301	Theory of Ordinary Differential Equations	3	MTH3309	3	1	
MTH4303	General Topology	3	MTH3303	3	1	
MTH4305	Theory of Finite Groups	3	MTH3305	3	1	
MTH4307	Functional Analysis	3	MTH2306	3	1	
MTH4309	Hydrodynamics I	3	MTH2301, MTH3301	3	1	
MTH4311	Number Theory	3	MTH 2303	3	1	
MTH4317	Abstract Algebra II	3	MTH 3305	3	1	
Total		**21**				

400 LEVEL: Second Semester

Core Courses

Code	Course Title	CU	Prerequisite	L	T	P
MTH4699	Project	6	MTH3699			
MTH4302	Theory Partial Differential Equations	3	MTH2302, MTH3309	3	1	
MTH4304	Lebesgue Measure and Integration	3	MTH2306, MTH2307	3	1	
MTH 4306	Representation of finite groups	3	MTH 3305	3	1	
MTH 4312	Complex Analysis II	3	MTH 3307	3	1	
Total		**18**				

Elective courses: a minimum of 3 credit units should be selected from the first semester or second semester

400 LEVEL: ***First Semester***

Code	Course Title	CU	Prerequisite
MTH4313	Analytical Dynamics	3	MTH 2308/ MTH 3301
MTH4315	Quantum Mechanics	3	MTH 2308/ MTH 3301

400 LEVEL: ***Second Semester***

Code	Course Title	CU	Prerequisite
MTH4308	Fluid Dynamics	3	MTH2308/ MTH3301
MTH4310	Mathematical Methods III		MTH3301
MTH4314	Measure Theory	3	MTH2306
MTH4316	Abstract Algebra III	3	MTH3305
MTH4318	Introduction to Operations Research	3	MTH 2301

COURSE DESCRIPTIONS

MTH 1301: **General Mathematics I: Algebra and Trigonometry (3 Units)**
Status: *Core*
Prerequisite: *O/Level Mathematics*

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers; integers, rational and irrational numbers, mathematic I, induction real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand Diagram. Re Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 1302: **General Mathematics II: Calculus (3 Units)**
Status: *Core*

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

MTH 1303: General Mathematics III: Vectors, Geometry and Dynamics (3 Units)

Status: *Core*
Prerequisite: *O/Level Mathematics*

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-

dimensional coordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Elementary Mathematics IV. Impact of two smooth spheres, and of a sphere on a smooth sphere.

STA 1202: Introductory Statistics (2 Units)
Prerequisite: O/*Level Mathematics*

Nature of statistics, its definition, importance and limitations, types of statistical data, the primary and secondary data, methods of collecting primary data, graphical and diagrammatic representations of data, the frequency distribution, nature of frequency curves, characteristics of a frequency distribution, central tendency, dispersion, skewness and kurtosis along with their measures, essential requisites of an ideal measure, simple motions of probability, theory of attributes.

STA 1304: Statistical Inference (3 Units)
Prerequisite: *O/Level Mathematics*

Population and samples. Random sampling Distribution, estimation (Point and interval) and Tests of hypotheses concerning population mean and proportion (one and two large sample cases). Regression and Correlation. Elementary time series analysis.

200 LEVEL

MTH 2301: Mathematical Methods I (3 Units)
Prerequisite: *MTH 1302*

Applications of Calculus: Revision of different techniques of differentiation, successive differentiation, Leibniz's theorem, Taylor and Maclaurin series Curvature, definite integrals. Methods of integration, reduction formulae.
Differential Equations: Concept of differential equations. First order ordinary differential equations of the forms; variable separable, homogeneous, exact and linear. Second order ordinary linear differential equations with constant coefficients, auxiliary equations, and cases of auxiliary equations having distinct, equal, and complex roots, complementary functions and particular integrals in connection with non-homogeneous equations. Uses of the operator D = d/dx and the method of undetermined coefficients for calculating particular integrals, differential equations of Euler's type of second order.

MTH 2302: Ordinary Differential Equation I (3 Units)
Status: *Core*
Prerequisite: *MTH 1302*

Derivation of differential equations from primitive, geometry, physics etc. order and degree of differential equation. Techniques for solving first and second order linear and non – linear equations. Solutions of systems of first order linear equations. Finite linear difference equations. Application to geometry and physics.

Solutions of systems of two linear differential equations, Second order Ordinary Linear Differential Equations with variable coefficients; reduction of order, variation of parameters.

MTH 2303: Sets Logic and Algebra (3 Units)
Prerequisite: *MTH 1301/ MTH 1304*

Introduction to the language and concepts of modern Mathematics. Topics include; Basic set theory: mappings, relations, equivalence and other relations, Cartesian products. Binary logic, methods of proof. Binary operations. Algebraic structures, semigroups, rings, integral domains fields. Homeomorphic. Number systems; properties of integers, rationals, real and complex numbers.

MTH 2204: Linear Algebra II (2 Units)
Prerequisite: *MTH 1301/MTH 1304*

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

MTH 2205: Linear Algebra I (2 Units)
Status: *Core*
Prerequisite: *MTH 1301*

Vector Spaces: Basic definitions and examples of vector spaces. Subspaces, linear dependence and independence. Bases, dimension of a vector space. Homomorphism and quotient space. Direct sum, Dual spaces.
Matrices: Definition, types of matrices, algebra of matrices, matrix as a sum of symmetric and skew symmetric matrices. Elementary operations of matrices and echelon form, equivalent matrices. Inverse of a matrix.
Systems of linear equations and matrices: Systems of m linear equations in n unknowns and their solutions. Gaussian elimination by pivot method and matrix representation. Solution of the system using Gaussian elimination and Gauss-Jordan reduction.
Determinants: Definition, evaluation of determinants, cofactor expansion, inverse of a non-singular matrix, solution of systems of linear equations using Cramer's rule.

MTH 2306: Real Analysis II (3 Units)
Status: *Core*
Prerequisites: *MTH 1301*

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

Derivatives: derivative of functions derivative of composition of functions. Higher order derivatives. Algebraic operations on derivatives of functions. Differentiability and some related results. Rolle's and Mean value theorems, Taylor's formula, L'Hospital's rule, local and global extrema, saddle points, monotonicity, geometrical interpretations.
Riemann Integration: Partition of an interval, refinement, Riemann sums, Riemann integrals, uniqueness of Riemann integral, Darboux Integral of a real valued function, relation between Riemann and Darboux integrals.

MTH 2307: Real Analysis I (3 Units)
Status: *Core*
Prerequisites: *MTH 1301*

Preliminaries: Properties of real numbers, algebraic and topological properties, identity theorem, density theorem for Q and R Ordering and properties.
Boundedness: Boundedness and related simple results.
Relations and Functions: Cartesian products of sets.
Relations: equivalence relations, equivalence classes.
Functions: injective, surjective, bijective, inverse, composition of functions, monotone functions, graph of functions, algebraic operations on functions.
Sequences and series of Real Numbers: Sequences of real numbers, subsequences, bounded and unbounded sequences.
Limit of a sequence; limit superior and limit inferior, improper limits. Algebraic operations on sequences and their limits; Monotone sequences and properties.Cauchy sequences and related results.
Series of real numbers: partial sums, convergence, absolute and conditional convergences.
Convergence tests: comparison, ratio, Ra'abe, De-Morgan and Bertrand, logarithmic, Cauchy root test. Cauchy condition for the convergence of series, rearrangement of series.

MTH 2308: Introduction to Numerical Analysis I (3 Units)

Status: *Core*
Prerequisite: *MTH 1302*

Accuracy in Numerical Calculations: Types of errors and their sources, error accumulation in different operations.
Solution of Equations: Numerical solutions of algebraic and transcendental equations.
Finite Differences: Difference operators and Difference table, separation of symbols.
Interpolation: Interpolation formulae for equal and unequal intervals, Central Difference Formulae, Numerical Differentiation, Numerical Integration, Summation of Series.

MTH 2309: Vector and Tensor Analysis (2 Units)
Prerequisite: *O/Level Mathematics*

Vectors: Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar multiplication, linear independence and dependence of vectors.

Scalar and vector products of vectors. Differentiation and integration of vectors w.r.t a scalar variable.
Tensor products of vector spaces. Tensor algebra.Symmetry. Gartesiantensers.

STA 2201: Probability I (2 Units)
Prerequisites: *STA 1202*
Status: *Core*

Various definitions of probability, Baye's theorem, and concepts of probability function, probability density function, cumulative probability density function and moment generating function, univariate probability distributions such as Bernoulli distribution, Binomial and Poisson distribution, geometric distributions, negative binomial distribution, hypergeometric distribution, Poisson and geometric distributions.

STA 2202: **Probability II (2 Units)**
Prerequisites: *STA 2201*

Univariate continuous probability distributions such as Normal, Uniform, exponential, beta and gamma distributions, various properties of these distributions, fitting of normal distribution. Concept of Bi-variate probability distribution, joint, marginal and conditional probability distribution. The multiple and partial regression and correlation (for 3 variables case only).

300 LEVEL
MTH 3301: Mathematical Methods II (3 Units)
Status: *Core*
Prerequisites: *MTH 2301*

Vector Fields: Revision of definitions and elementary results related to vectors; gradient, divergence and curl in different coordinate systems. Multiple integrals; areas and volumes, Surface and Line integrals; Stokes theorem, Divergence theorem.Green's theorem.

Fourier Series: Definition, computation of Fourier coefficients, expansions of evenand odd functions, change of period, half period expansion, Fourier transform.

Laplace Transform: Definition, elementary formulae, convolution theorem, application of solutions of ordinary differential equations.

MTH 3303: Metric Space and Topology (3 Units)
Prerequisite: *MTH 2307*

Sets, matrics, and examples. Open spheres (or balls). Open sets and neighbourhoods. Closed sets. Interior, exterior, frontier, limit points and closure of a set. Dense subsets and separable space. Convergence in metric space homeomorphisms. Continuity and compactness, connectedness. Baire's category theorem.

MTH 3305: Abstract Algebra I (3 Units)
Status: *Core*

Prerequisite: *MTH 2303*

Group: definition, examples including permutation grounds. Subgroups, cosets. Lagrange's theorem and applications.Cyclic groups. Rings: definition examples including Z, Zn, rings of polynomials and matrices. Integral domains, fields. Polynomial rings, factorization. Euclidean algorithm for polynomials H.C.F. and L.C.M. of polynomials. Groups, Algorithms and Programming.

MTH 3307: Complex Analysis I (3 Units)
Status: *Core*
Prerequisite: *MTH1304*

Sequences and Series of Complex Numbers: Definition of sequences and series of complex numbers, properties of convergence, uniform and absolute convergence of sequences of complex numbers. Algebraic operations on limits of sequences.
Limit, Continuity and Differentiability of Complex Functions: Definition of Complex function. Properties of continuous complex functions. Limit of a complex function and its properties. Continuity of a complex function. Differentiation of a complex function. Analytic and entire functions. Laplace and Cauchy-Riemann equations. Elementary functions (exponential, trigonometric, logarithmic, rational, power and hyperbolic functions) Harmonic functions.
Complex Integration: Definition and properties of complex integration. Cauchy integral theorem, Cauchy formula. Contour integration: Integration of complex functions along a continuously differentiable arc, along a piecewise, differentiable arc and along a rectifiable arc. Cauchy-Goursat theorem

MTH 3209: Ordinary Differential Equation II (2 Units)
Status: *Core*
Prerequisite: *MTH 2301*

Ordinary differential equations: linear dependence, wronskian, reduction order, variation of parameters, series solution about ordinary and regular points. Special functions: Gamma, Beta, Bessel, Legendre's and Hyper-geometric functions.
Partial Differentiation: Real valued functions of two and three variables. Partial derivatives, chain rule, Jacobian, Extrema, Lagrange's multipliers.

MTH 3211: Introduction to Mathematical Modelling (2 Units)
Status: *Core*
Prerequisite: *MTH 1303*

The methodology of model building; identification, formulation and solution of problems, cause-effect diagrams. Equation types: Algebraic, ordinary differential, partial differential, difference, integral and functional equations. Application of mathematical models to pluprical, biological, social and behavioural sciences.

MTH 3313: Numerical Analysis II (3 Units)
Status: Core

Prerequisite: *MTH 2310*

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

MTH 3315: Discrete Mathematics (3 Units)
Status: *Elective*
Prerequisite: *MTH 2303*

Group and subgroups; Group Axioms, permutation Group, Cosets, Graph; directed and undirected graphs, subgroups, cycles, connectivity, Application (flow Charts) and state transition graphs; lattices and Boolean Algebra, Finite fields: Mini polynomials. Irreducible polynomials, polynomial roots, Application (error correction codes, sequences generators).

MTH 3319: Real Analysis III (3 Units)
Status: *Elective*
Prerequisite: *MTH 2306*

Uniform Convergence of Sequences and Series of Functions: Pointwise and uniform convergences, Cauchy's general principle of uniform convergence, test for uniform convergence; Mn -test, Weierstrass M-test, Abel's test, Dirichlet's test. Uniform convergence and continuity, Dini's theorem. Integrability of uniform limit of a uniformly convergent series of integrable functions, term by term integration. Uniform convergence and differentiability.Weierstrass's continuous non-differentiable function.Uniform convergence of power series.
Functions of Bounded Variation and their Properties: Variation function of a function of bounded variation, Jordan's theorem.
Riemann – Stieltjes Integral: Stieltjes integral and its various generalizations, conditions of integrability, integration by parts. First, mean value theorem, second mean value theorem. Differentiation under the integral sign.

MTH 3699 : **Students Industrial Work Experience Scheme (SIWES) – (6 Units)**
Status: *Core*

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

A student with more than 10 cumulative units backload (carry over and dropped courses) is not eligible to proceed on industrial training.

400 LEVEL

MTH 4301: Theory of Ordinary Differential Equations (3 Units)
Status: *Core*
Prerequisite: *MTH 3309*

Differential equations: existence and uniqueness theorems dependence of the solution on initial data and parameters. Properties of solutions. Sturm comparison and Sonin – Polya theorems. Linear and non – linear systems. Floguet's theorem and stability theory, integral equations: classification, Volterra and Fredholm types Neumann series. Fredholm alternative for degenerate Hilbert – Schmidt kernels. Reduction of ordinary differential equations to integral equations. Symmetric kernels, eigenfunction expansion with the application.

MTH 4302: Partial Differential Equations (3 Units)
Status: *Core*
Prerequisite: *MTH 2302/MTH 3309*

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

MTH 4303: General Topology I (3 Units)
Status: *Core*
Prerequisite: *MTH 3303*

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

MTH 4304: Lebesgue Measure and Integration (3 Units)
Status: *Core*
Prerequisite: *MTH 2307/MTH 2306*

Lebesgue measure; measurable and non-measurable sets. Measurable functions. Lebesgue integral: Integration of non-negative functions, the general integral convergence theorems.

MTH 4305: Theory of Finite Groups (3 Units)
Status: *Core*
Prerequisite: *MTH 3305*

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

MTH 4306: Representation Theory of Finite Groups (3 Units)
Status: *Core*
Prerequisite: *MTH 3305*

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

MTH 4307: **Functional Analysis (3 Units)**
Status: *Core*
Prerequisite: *MTH 2306*

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

MTH 4308: Fluid Dynamics (3 Units)
Status: *Elective*
Prerequisite: *MTH 2308/ MTH 3301*

Real and Ideal fluids.Differentiation following the motion of fluid particles. Equations of motion and continuity for incompressible inviscid fluids. Velocity potentials and Stoke's Stream functions. Berboulli's equation with application to flow along curved paths. Kinetic energy. Sources, links, double in 2-and-3-dimensions, limiting streamlines. Images and rigid planes.

MTH 4309: **Hydrodynamics (3 Units)**
Status: *Core*
Prerequisite: *MTH 2301/ MTH 3301*

Kinematics of Fluids: Lagrangian and Eulerian methods of treating the motion of fluids. Steady and unsteady flows. Streamlines. Resolution of fluid motion into translation, rotation and deformation. Irrotational motion. Velocity potential. Fluid acceleration in the Eulerian method. Acceleration components in Cartesian cylindrical and spherical polar coordinates. The significance of the operator D/Dt. V. condition for a boundary surface.
Conservation of Mass: Principle of conservation of mass of a fluid element. Equation of continuity in Cartesian, cylindrical and spherical polar coordinates. The Laplacian equation $V^2 = 0$ for steady, irrotational and incompressible flows. The concepts of stream function for steady two-dimensional, incompressible flows. Cauchy-Riemann relations and the complex potential $w = \ + i$. Equation of streamlines as $=$ constant. Circulation.
Equations of Motion: Euler's dynamical equations. Lagrange's integration of Euler's equations (so-called Bernoulli's equation) Bernoulli's equation for (I) steady incompressible flows, and (ii) steady, compressible adiabatic flows.
Irrotational Motion in Two Dimensions: Introduction. Boundary conditions for a moving cylinder. Flow due to translation motion of a right circular cylinder.

MTH 4310: **Mathematical Methods III (3 Units)**
Status: *Elective*
Prerequisite: *MTH 3301*

Calculus of variation: Lagrange's functional and associated density. A necessary condition for a weak relative extremum. Hamilton's principles. Lagrange's equations and geodesic problems. The Du Bois-Raymond equation and corner conditions. Variable end-points and related theorems. Sufficiency conditions for a minimum. Isoperimetric problems variational integral transforms. Laplace, Fourier and Hankel transform. Complex variable methods convolution theorems.Application to solution of differential equations.

MTH 4311: Number Theory (3 Units)
Status: *Core*
Prerequisite: *MTH 3303*

Division and Factorization properties for positive integer multiplicative arithmetical functions, Euler's φ-function, Themobius function μ. Linear congruences, residue sets (mod m). Euler's theorem.Fermat's theorem. Chinese Remainder theorem. The ring Z_m of residue classes (mod m). Mobius function.
Algebraic congruences, primitive roots, indices with respect to a primitive root.
Quadratic and high power residues.The Legendre and Jacobi symbols. Gauss Law of quadratic reciprocity. A representative of integers by binary quadratic forms.
Diophantine equations like $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$, e.t.c.

MTH 4312: Complex Analysis II (3 Units)
Status: *Elective*
Prerequisite: *MTH 3307*

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

MTH 4313: Analytical Dynamics (3 Units)
Status: *Elective*
Prerequisite: *MTH 3308/ MTH 3301*

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

MTH 4314 – Measure Theory (3 Units)
Status: *Elective*
Prerequisite: *MTH 2306*

Differentiation and Integration: Derivatives, Weierstrass's non-differentiable function. Vitali's theorem, Differentiability of monotone functions and functions of bounded variation. A general version of the fundamental theorem of calculus.Absolute continuity.Jordan decomposition theorem, Random – Nikodym theorem.
L^PSpace: The inequalities of Schwartz, Holder and Minkowski, The completeness of L^P space. Abstract integration, L^P spaces.
Multiple Integral (With an emphasis on double Integral): Generalization of Lebesgue measure and integral on R^n. Fubini's theorem.Tonelli's theorem.

MTH 4315 – Quantum Mechanics (3 Units)
Status: *Elective*

Prerequisite: *MTH 2301/ MTH 3301*

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

MTH 4316: **Abstract Algebra III (3 Units)**
Status: *Elective*
Prerequisite: *MTH 3305*

Theory of ideals in commutative rings. Noetherian rings. Principal ideal domains, Euclidean Rings. Product and Quotient of ideals. Prime ideals. Factorization of ideals. Theory of polynomial ideals. Algebra manifolds, zeros of a prime ideal dimension. Modules over a commutative unitary ring. Submodules, factor modules, Homomorphism, kernel. cokernel. Factorization of homomorphism. Jordan-Holder theorem, length of a module, Exact sequences. Generators, free modules, projective and injective modules, tensor products, flat modules.

MTH 4317: Abstract Algebra II (3 Units)
Status: *Elective*
Prerequisite: *MTH 3305*

Normal subgroups and quotient groups. Monomorphic isomorphism theorems. Cayley's theorems. Direct products. Groups of small order Group acting on sets. Sylow theorems. Ideal and quotient rings. P.I.D. 8, U.F.D ' Seuclides rings. Irreducibility; Field extensions, degree of an extension, minimum polynomial. Algebraic and transcendental extensions. Straight edged and compass constructions.

MTH 4318 – Introduction to Operation Research (3 Units)
Status: *Elective*
Prerequisite: *MTH 2301*

Phases of an operations research study. Classification of operations research models, linear; Dynamic and integer programming. Decision Theory. Inventory Models, Critical Path Analysis and project Controls.

MTH 4699: Project (6 Units)
Status: *Core*

Students should embark on substantial projects under the supervision of a member of staff in the field of Mathematics. It will spread over both semesters.