Regional Meteorological Training Centre
(WMO RTC)
OSHODI – LAGOS, NIGERIA

Students' Information Handbook

2018 – 2021

REGIONAL TRAINING CENTRE,

NIGERIAN METEROLOGICAL AGENCY

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FOREWORD

This student handbook is developed to answer many of the common questions that students do ask. The handbook contains information about student rights and responsibilities. Each student is responsible for familiarizing with its contents and keeping the handbook available for future use. It is a valuable reference during the school year and a means to avoid confusion and misunderstanding when questions arise. The entire course curriculum is in line with the World Meteorological Organization Education and Training guidelines and standards. Should a provision of this handbook contradict the Board Policy of the Nigerian Meteorological Agency (NIMET), the Board Policy prevails. This handbook supersedes all other written documents on the same subject and changes to this handbook may be made at anytime without notices to students, but they will be duly informed of the changes. The most current version of the handbook will be available on the RTC website (www.nimet.gov.ng/rtc-lagos).

Professor Sani Abubakar Mashi
Director General/Chief Executive Officer
NiMets, Abuja, Nigeria.

KEY OFFICERS OF RTC OSHODI

PROF. SANI ABUBAKAR MASHI
Director General/CEO, NiMet &
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CHAPTER ONE

INTRODUCTION

BRIEF HISTORY

In the mid-1950s, the National Meteorological Training School was established at Oshodi, Lagos, Nigeria, to train Class IV Meteorologists. The School was part of the then Nigerian Department of Meteorological Services (presently NIMET).

In 1964, a Regional Meteorological Training Centre (RMTC) was established at Ikeja to train Class III and Class II Meteorologists. These two training centres (National Meteorological Training School/and Regional Meteorological Training Centre) were merged in 1975 and designated Meteorological Research and Training Institute (MRTI) at Oshodi, Lagos, Nigeria. In 1994, the Department of Meteorology (now Department of Meteorology and Climate Science) at the Federal University of Technology, Akure was also designated as the University component of the RTC in Nigeria. The WMO Regional Training Centre (RTC), under the auspices of Nigerian Meteorological Agency (a division under the Directorate of Research and Training, through which it is funded), is responsible for the training of Meteorological Personnel from Nigeria, English-speaking West African countries and other African countries.

The programmes of training are tailored to the needs of National Meteorological and Hydrological Services (NMHs) in the West African sub-region, Armed Forces, Para-Military, Ministries, Departments and Agencies (MDAs) of the Federal Government of Nigeria and the Media.

VISION STATEMENT

To ensure effective training and capacity building which are fundamental to the provision of high standard products and services and maintain the highest tenet in research activities.

MISSION STATEMENT

To ensure the provision of adequate training to all categories of staff as well as engage in tailored research with a view to continuously improving the quality of the National Meteorological and Hydrological Services of West Africa in particular and Africa in general.

OBJECTIVE

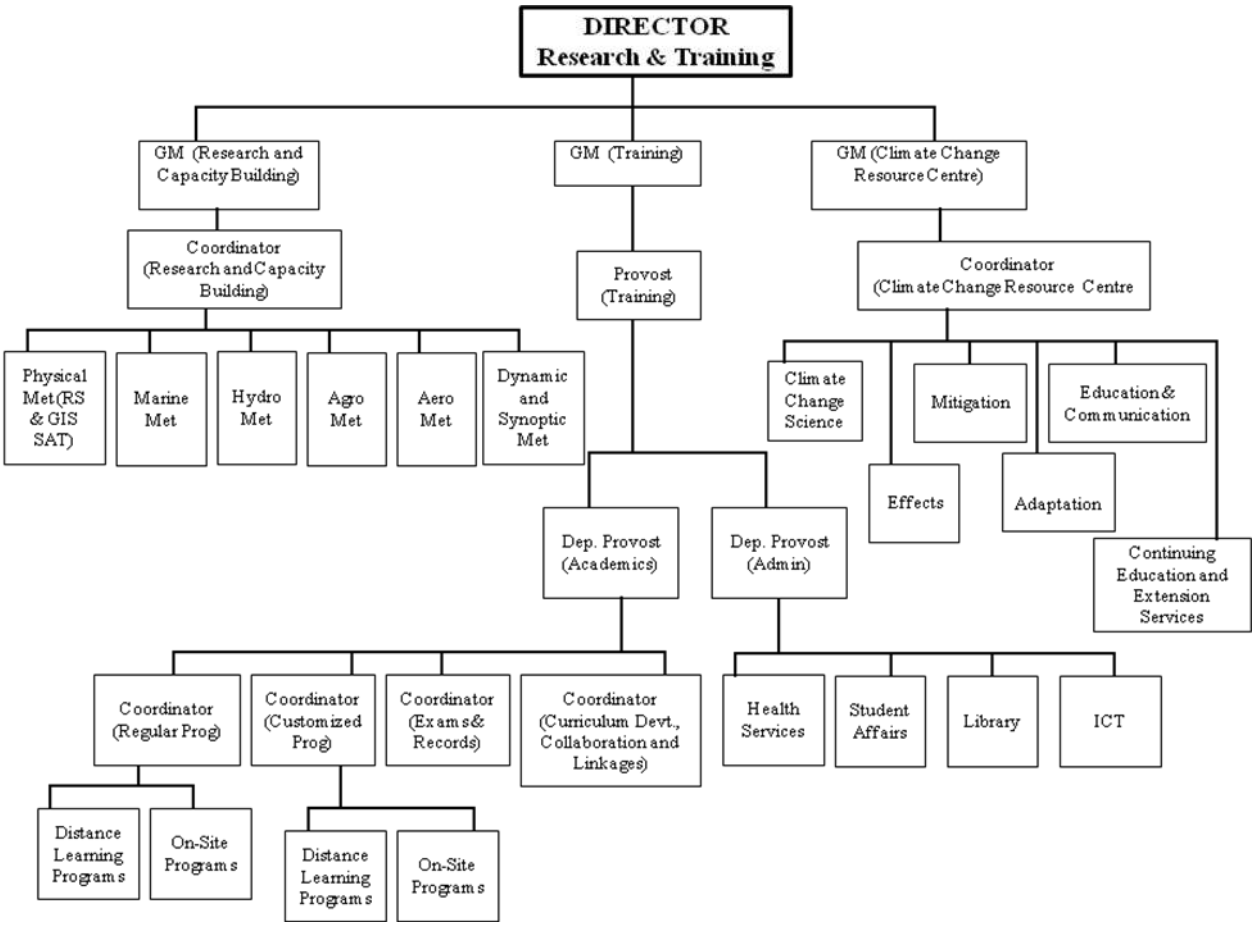
The main objective of the RTC is to train, retrain and monitor Basic Instruction Package for Meteorological Technicians (BIP-MT) in various aspects of meteorology in accordance with standards and guidelines of WMO prescribed in WMO-No. 1083 "Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology."

PROSPECTIVE CUSTOMERS OF THE RTC

- Agriculturists.
- Energy Institutions, e.g. hydropower generators, transmission and distribution.
- Water Resources (for hydrological forecasting and flash flood warning).
- River Basin Authorities (for River Basin Management).
- Policy Makers in Government.
- Industries.
- Research centres and institutes.
- World Ozone Data Centre in Canada.
- Various World Data Centres for Atmospheric Constituents (Greenhouse Gases, CFCs, Radiations, etc).
- Universities.
- State and National Libraries.

- Federal and State Ministries.
- NIMET.
- Military and Para-Military
- Countries within ECOWAS Sub-Region.
- Oil Companies
- Airline Representatives and Executives.
- Air Traffic Controllers.
- Pilots.
- Aerodrome Engineers.
- Extension Farmers/Workers.
- Federal Office of Statistics.
- Urban Designers.
- Tourists.
- Insurance Firms.
- Firms of soil, Civil and Structural Engineers.
- Shipping Industries.
- Fishing Industries.
- Coastal Engineering/Construction Workers.
- Mass Media.
- Students from Universities and other tertiary Institutions.
- The General Public.

RTC Organogram



COURSE PROGRAMMES AND ADDMISSION REQUIREMENTS

REGULAR TRAINING PROGRAMMES

This programme has the following long term courses

1. Basic Instructional Package for Meteorological Technicians (BIP-MT).

Duration: 24 Calendar Months

Qualification: WASCCE/NECO/GCE O- or A- Level, NABTEB, OND or its equivalent with credit in Physics, Mathematics, English Language and two other Science Subjects in at MOST two sittings .

The minimum years to complete this programme are Two years while the maximum years are Four years. Any student that failed at the end the fourth year will be withdrawn from programme. If the student is a NIMET staff, he/she will be dismissed from the services of NIMET Agency.

WEIVER: Any candidate who did not possess the qualification for the BIP-MT but meets the requirements for employment into NIMET will be considered but he or she must get the requirement before graduation, else, he/she forfeits the certificate even if he/she passes all the courses sat for in the programme. Thus such student will also be dismissed from NIMET Agency.

Certificate Award: Certificate to be awarded is equivalent to Ordinary National Diploma (OND)

Teaching Language: English

2. **FUNDAMENTAL METEOROLOGY COURSE FOR GRADUATES**

This programme is basically to provide training for the newly recruited **NIMET** personnel. Related Agencies and Ministries from Nigeria and other Countries can also apply.

Duration: 12 Calendar Months

Qualification: In addition to the BIP-MT qualification, the candidate must possess any of the followings: HND, B.Tech Meteorology or First Degree in any Physical, Life, Engineering, Education, Environmental, Medical, Agricultural and Social Sciences or in any related field.

The minimum year to complete this programme is one year while the maximum years are three years. Any student that failed at the end the third year will be withdrawn from the programme. If the student is a NIMET staff, he/she will be dismissed from the services of NIMET Agency.

WEIVER: Any candidate who did not possess the "minimum qualification for the BIP-MT (O-Level)" but meets the requirements for employment into NIMET Meteorologist Cadre will be considered but he or she Must get the "O-Level qualification" before graduation, else, he/she forfeits the certificate even if he/she passes all the courses sat for in the programme.

Certificate Award: Certificate to be awarded enables the staff of NIMET to practice at the Weather Stations and also qualifies them (in addition to their relevant first degree) for M.Sc degree in Meteorology or Climatology

Teaching Language: English

3. **Basic Instructional Package for Meteorological Technicians (BIP-MT: Senior level).**

   This programme is equivalent to the former WMO Class II. It is basically meant to provide training for NIMET Staff with former WMO Class III Certificate, other Sub-Africa regions and other interested parties that need such training.

   Duration: 12 Calendar Months

   Qualification: A pass in Basic Instructional Package for Meteorological Technicians (WMO Class III) Certificate and minimum of two years of

practical experience after a successful completion of the former WMO Class III and WASCCE/NECO/NABTED GCE A-Level or its equivalent with credit in English, Physics and Mathematics.

Teaching Language: English

NON-REGULAR TRAINING/SPECIALIZED/CUSTOMIZED PROGRAMMES

Under this programme there are short Term and Medium Term courses

Medium Term courses

1. Advance Weather Forecasting Course

   Duration: 3 Calendar Months

   Prerequisite: Meteorologists or WMO Basic Instructional Package for Meteorological Technicians (Senior Level) Certificate or its equivalent.

   Teaching Language: English
2. Meteorological Instrumentation Course

   Duration: 3 Calendar Months

   Qualification: Engineering Technician or WMO Basic Instruction Package for Meteorological Technicians (Medium Level) Certificate or its equivalent.

   Teaching Language: English

3. Basic Instructional Package for Meteorologists Certificate Course in Aviation Meteorology

   Duration: 4 Calendar Months

   Qualification: Qualified Meteorologists or First Degree in any Basic Physical Sciences or related field.

   Teaching Language: English

4. Basic Instructional Package for Meteorologists Certificate Course in AgroMeteorology

   Duration: 4 Calendar Months

   Qualification: B.Tech Meteorology or First Degree in any Basic Physical, Life, Social, Environmental, Engineering and Agricultural Sciences or related field.

   Teaching Language: English

5. Basic Instructional Package for Meteorologists Certificate Course in HydroMeteorology

   Duration: 4 Calendar Months

   Qualification: B.Tech Meteorology or First Degree in any Basic Physical Life, Social, Environmental, Engineering or Sciences or related field.

   Teaching Language: English

6. Basic Instructional Package for Meteorologists Certificate Course in

   Climatology

   Duration: 4 Calendar Months

   Prerequisite: B.Tech Meteorology or First Degree in any social, physical Life, Social, Engineering, Environmental Sciences.

   Teaching Language: English

7. Basic Instructional Package for Meteorologists Certificate Course in Data Processing

   Duration: 4 Calendar Months

Qualification: B.Tech Meteorology or First Degree computer or relevant Sciences.

Teaching Language: English

Short Term Courses.

1. Refresher Course for Aeronautical Meteorological Observers (AMO)
   Duration: Two weeks
   Qualification: Meteorologists or WMO Basic Instructional Package for Meteorological Technicians or its equivalent.
   Teaching Language: English
2. Refresher Course for Aeronautical Meteorological Forecasters (AMF)
   Duration: Two weeks.
   Prerequisite: Meteorologists or WMO Basic Instructional Package for Meteorological Technicians (Senior Level) or Advance Weather Forecasting Course.
   Teaching Language: English
3. Climate Change Studies.
   This course is specialized and customized basically for NIMET Staff, University, Polytechnic, College of Education and Secondary School Teachers' Staff, Media, Farmers, Aqua-culturists, herdsmen, Agricultural Extension Workers, Ministries of: Agriculture, Environment, water Resources, Energy, Transportation, Aviation, Industry and the General Public.
   Duration: 2 weeks -3 Calendar Months
   Qualification: (1) Non Formal Education, Primary, Secondary, NCE, OND, HND First Degree and Post Graduate Degrees in all Fields.
   Teaching Language: English Language (Where applicable, Pigin and some local Nigerian Languages will be used).

4. Basic Training Course in Meteorology for supporting staff.

This course is basically for NIMET Staff (Commercials Unit, Data Unit, Secretaries, Clerk, ICT, Library, etc), the Media and the General Public

Duration: One-Three weeks.

Qualification: Minimum of School Certificate

Teaching Language: English

5. Basic Observers' Course.

   This course is basically for NIMET Staff

   Duration: Three months.

   Qualification: Minimum WMO Class III Certificate

   Teaching Language: English.

6. Urban Meteorology

   This course is basically for NIMET staff, University, Polytechnic and College of Education Staff, Town/Urban Planners, Ministries of: Environment, Land and Survey, Agriculture, Water Resources, Energy and Power and the Media, Insurance Companies, Fire Services and the General Public.

   Duration: 2 weeks-3 months.

   Qualification: Minimum of School Certificate.

   Teaching Language: English

7. Marine Meteorology

   This course is basically for NIMET staff, Military, Navy, Police, oceanographers, Water resources, Oil Companies, Shipping Industry and Boatmen, Fishing Industry Coastal Engineering and Construction Companies and the General Public.

   Duration: 2 weeks-3 months.

   Qualification: Minimum of School Certificate.

   Teaching Language: English

8. HydroMeteorology

This course is designed for NIMET staff, River Basin Development Authority, Water resources, Power and Energy, Farmers, Aqua-culturists and herdsmen.

Duration: 2 weeks-3 months.

Qualification: Non Formal Education, School Certificate and other qualifications.

Teaching Language: English, (Where applicable Pigin and some Nigerian Languages)

9. Disaster and Risk Management.

This course is designed for NIMET staff, University, Polytechnic and College of Education, Secondary School Teachers' Staff, Ministries of: Agriculture, Environment, Water resource, Energy and Power, Transportation and Education, Town and Unban Planning, Air Force, Police, Road Safety, Civil Defence Corp, Farmers, Aqua-culturists, Media, herdsmen and the General Public.

Duration: 3 weeks-3 months.

Qualification: Non Formal Education, School Certificate and other qualifications.

Teaching Language: English (Where applicable Pigin and some Nigerian Languages)

10. CUSTOMISED COURSES ARE AVAILABLE ON REQUEST.

CHAPTER TWO

ACADEMIC POLICY OF THE REGIONAL METEOROLOGICAL TRAINING CENTRE

This policy has been formulated in a spirit of cooperation and responsibility. It is a living document and thus, is subject to change in every four years. The RTC does not discriminate or permit discrimination by any of the students. The student will be evaluated on knowledge, character and academic performance for purposes of granting academic award and not on the basis of personal sentiments or affiliations.

ASSESSMENT OF POLICIES AND PROCEDURES OF THE RTC

Grades will be used as evaluation of students. It is important that grades accurately and fairly reflect the quality and level of the student's knowledge of the course. Grading serves as an evaluation of students' work, thereby providing feedback to instructors on their students, and gives information that can inform teaching decisions. It is also a source of motivation to student to continue learning and improving in their studies. This will be tested throughout the duration of the course through progress tests, on the-job training assessment (with the supervision of RTC instructors) and oral interview that will be held at the end of the programme. The grading system of each course is as follows:

Class attendance: 10%
Assignments and Test: 30%
Examination: 60%

Course Grade: <50% =Fail; 50-59% =C; 60-69% =B and $\geq$70=A.

The overall assessment at the end of the session goes thus:

MARK	GRADING
0% - 49%	Fail
50% - 59%	Merit
60% - 64%	Lower credit
65%-69%	Upper credit
70% and above	Distinction

A candidate is declared to have passed creditably if he scores at least 50% in all his courses.

Course Repeats

BIP-MT

The only circumstance which justifies the repeat of a programme is failure.

The following rules apply:

1. At the end of the session, students that failed any course(s) will be allowed to re-sit the failed course(s). If he/she still fails more than three courses after the re-sit, he/she is allowed to repeat the academic session. However, at the end of re-sit, if he/she fails three courses or less, he/she will be promoted but allowed to carry over the failed courses.
2. On repeating a session, if a student fails to meet the requirements to pass the class, he will be given another opportunity to repeat that class again for the last time.
    a. However, on repeating for the second time, (that is, three years in the first year of the programme) and he/she is unable to meet the requirements for promotion to year two, the student will be withdrawn from the School. If the student is a NIMET staff, it means dismissal from NIMET services.
    b. If a student passes successfully upon repeating the first year twice, he/she will be allowed to proceed to the next class. However, he/she will not be allowed to repeat in the year two because, by then, he/she must have exhausted the maximum four years of the programme. However, such student will be allowed to re-sit the failed courses, if such student fails again, he/she would have exhausted all the opportunities available to remain in the programme and in the services of NIMET.

Staff members/students who have been awarded the *BIP-MT (Job entry) certificate (former WMO Class Four)* before 2018, due to their inability to pass *BIP-MT (Job course,)* such student will continue to appear after a minimum of two years on the field, (this is subject to DG/CEO's approval) in the programme starting from year II (Direct entry) until he/she is able to pass the programme. This is in line with WMO 1083. A student is not allowed to return more than three times.

THE STUDENTS CONDUCT

For the purpose of these regulations the term "Student" means any individual who has been formally admitted to study for the regular or short time course within the RTC, while "he" represents both males and females.

There shall be an organized orientation programmes for students at the beginning of every programme. It is a programme wherein students are

taken through the culture, practices, philosophy and standards of the RTC. It is compulsory for all students to participate.

Students are expected to conduct themselves in accordance with the highest standards of integrity, personal discipline and moral and in particular shall:

i. Respect and agreed to the administrative and academic proceedings and structure established by for the control, governance and operation of Centre.

ii. Respect the rights and privileges of the members of RTC at all times.

iii. Refrain from any conduct that might bring the RTC or any section or program thereof to dispute and carry themselves in all public places with such humility and dignity that befit their status as a responsible student.

It is expected that:

1. Every RTC student should ensure compliance with the principles, rules and regulations of the Training School. Learning must be done with professional discipline, dignity, integrity and courtesy, notably in his relations with his instructors, superiors, colleagues, as well as with the public.
2. His conduct shall be deemed to be appropriate only when he behaves in a manner that enhances public confidence and boosts the image of the Training School.
3. Students must be well disciplined. Rules and regulations should be adhered to and the interests of the institution must be paramount.
4. Students should keep the school and hostel, premises and offices tidy.
5. Students should also ensure that they are properly dressed during official hours. Casual wears or improper dressing will not be tolerated either in classes or within the RTC complex.
6. Any form of discrimination or unprofessional conduct as regards age, race, colour, sex, background, religion status and nationality is not allowed at all.

The following provisions describe unacceptable conduct and behaviours of RTC students. Engaging in these prohibited acts violates the standards of individual integrity, self respect; for the rights and property of others and the responsible behaviour which are expected in the RTC. Any infringement, Infraction or persistence disregard or contempt of this code of ethics shall constitute a disciplinary offence for which disciplinary action will be taken against a student in accordance with the rules in this handbook. Without

prejudice to the generality of the above provision, the following conduct shall constitute specific disciplinary offences:

1. Use, possession or distribution of alcoholic beverages, drunkenness, engaging in drinking activities or exhibition of potentially dangerous behaviour or encouraging others to do so and/or public intoxication are highly prohibited
2. Physical abuse, verbal abuse, threats, intimidation, harassment, coercion and conduct that threatens or endangers the health or safety of any person or persons are highly prohibited
3. Dishonesty – giving of false information, any form of forgery, alterations or interference with records
4. False claims against the Training School
5. Any form of assault on members of staff of the RTC.
6. Improper dressing especially during office hours
7. Habitual lateness to classes
8. Absence from class and school without authorised permission
9. Membership into any form of cult or illegal group or society.
10. Illegal Possession of official documents
11. Refusal to take/carry out lawful instructions from the Instructors or superior officers
12. Malicious statement detrimental to the Instructors or Training School
13. Any form of bribery
14. Any form of sexual harassment
15. Any form of sabotage or wilful damage of school property
16. Any form of theft
17. Vandalism or wilful damage to or loss of RTC property.
18. Falsification of credentials and certificates
19. Use, possession or carrying of firearms or other weapons concealed or not concealed with or without permit while on properties owned or controlled by the Institute or while on programmers or activities authorized or sponsored by the RTC.
20. Use, possession or distribution of narcotics and other controlled substances.
21. Admission of unauthorized person into the School Hostel.
22. Any attempt to convene or organize or any involvement or participation in demonstrations, gatherings or party for which permission has not been obtained from the RTC Management.

DISCIPLINARY PROCEDURES

Every disciplinary offence shall, in the first instance be officially reported to and dealt with by disciplinary committees constituted by RTC Management. The disciplinary committee is made up of:

The Principal/Rector - Chairman
Head of Guidance and Counselling unit
Two Senior Instructors
Student representative
Class Adviser

Student representative shall be exempted in any offences related to examination and other academic matters.

1. All disciplinary offences committed within the Hostel or all such offence as it relates essentially to the proper conduct of Hostel affairs shall be reported to the Hostel Disciplinary Committee for action.

2. If any matter reported to Hostel Disciplinary Committee is in its opinion essentially of an academic nature or involves issues not pertinent to the Hostel affair of the Hostel concerned, such a matter shall be transmitted at once to the appropriate RTC disciplinary committee for actions.

3. All other disciplinary offences whenever committed shall be reported to the appropriate RTC Disciplinary Committee for actions.

4. At all proceedings or a disciplinary committee before which he is summoned, the student shall be entitled to a fair hearing.

5. Disciplinary committee at RTC level shall have power to impose any one or more of the following penalties:

    I. A letter of query and warning or reprimand

    II. The payment of damages commensurate with the nature and gravity of the offence committed.

    III. Expulsion from Hostel for a specified period.

IV. Any other penalty which the committee in question may deem fit to impose or recommend to RTC Management.

6. Any penalty imposed by a disciplinary committee herein shall not take effect without the approval of the RTC Management

7. In arriving at an appropriate penalty or combination, committee shall be at liberty to consider the total conduct (past and present) of the student within or outside RTC and not merely the immediate circumstances furnishing the reason for disciplinary action against him/her.

8. Failure to appear before a panel of disciplinary committee; after being notified of a misconduct Meeting, the student is obligated to appear at the date, time, and location specified. If a student fails to appear (after a prior notice), a meeting may be conducted in the student's absence and a decision on charge(s) may be made.

9. The record and decision of any disciplinary action taken against a student shall be reported to the Director of Research and Training and DG/ CEO of NIMET and shall form part of the students' record.

EXAMINATION REGULATIONS AND CONDUCT

Examination is a very important component of a student's academic life. Students are expected to familiarize themselves with examination rules and regulations in each respective course. They should ensure that they have fulfilled all the examination requirements in each progress examination which are as follow:

Students should note that a minimum attendance of 70% will be required to qualify a candidate sit for any examination. In health related cases medical report is required. Attendance and continuous assessment form 30% of their course grading, while the examination is 70%.

1. Lateness to the examination venues will not be tolerated and no student will be allowed to enter an examination hall 20 minutes after the start of the examination.

2. Students are advised to ensure that at no time do they carry unauthorized materials such as notes, books, handbags, phones e.t.c into the examination hall. However, where a particular course requires the use of tables, graphs, charts etc., the School shall supply these

during examinations. Students are advised to search themselves before entering the examination halls.

3. Any student caught cheating in examination for example, by copying, having or making reference to unauthorized materials, any form of communication, will be awarded zero in that course. Students who need clarification are advised to raise their hands to draw the attention of the Invigilator.

4. If a student is caught twice (in two courses) in the same examination he shall not be eligible (based on examination committee recommendation) to sit for the remaining examination and he will be awarded zero in the affected courses.

5. Students are expected to go into examination halls with their Ball pens, erasers, rulers, pencils and any other materials that are permitted. No borrowing of any material is allowed during examinations.

6. All the eligible students are expected to put on their NIMET ID cards and also fill (their name, examination script number, their NIMET number and also append their signature) in the attendant register before and after each examination.

7. On no circumstance should answer booklet, used or unused, be removed from the examination hall, mutilated or tampered with by a candidate.

8. No Student is allowed to leave the examination hall without handing over the examination script to the Invigilator. On handing over the script, the student must ensure that he signs out on the attendance register. However, students are not permitted to leave the examination hall without the permission of the Invigilator, who may wish to reconcile the number of scripts with the number of students present in the hall.

9. No schedule will be made for any student who missed examinations due to ill health or other reasons e.g. bereavement. Such student will carry the course(s) over.

10. Examination results will be ready three weeks after each examination.

11. Academic transcripts will be available at the end of each academic programme and are issued on application to the Principal/Rector.

CHAPTER THREE

ACCOMMODATION AND HOUSING REGULATIONS

ACCOMMODATION

There are two types of accommodation;

Hostel **A**: for the regular students (NIMET recruited staff).

Hostel **B**: for the Foreigner/Classified students.

Students on a regular course and Foreigners are entitled to a 'bed space' in the RTC hostels within the duration of the period of study. Only those on a regular course sponsored by the Agency are expected to pay a very minimal monthly stipend to oversee minor repairs and exigencies of the hostel. On demend, the classified students could be given a room and he pays for the number of bed spaces in that room. This option is subject to availability of rooms in that section.

Occupying the RTC hostel and the use of its facilities is a privilege and not a right. This opportunity must therefore not be abused.

HOUSING REGULATIONS

All students shall conduct themselves with responsibility and maturity while in residence at RTC and in particular shall strictly observe the followings;

1. Adhere to the list of allocation of rooms as determined by the Hostel Warden. Change of rooms, or hall once allocated has been made will not be allowed without the permission of the Hostel Warden.

2. Share rooms in addition to other facilities of common use.

3. Admission or harbouring of non-occupants in the rooms will not be allowed.

4. No student should remove any furniture or RTC properties from their rooms or any other part of the hall or from the premises within the halls and common room except by permission from the Hostel Warden.

5. Report all absence from hostel to the Hostel Warden.

6. Use of sound producing electronic materials in the Hostel will be permitted only on one condition that the sound does not cause disturbances.

7. No student shall use any electrical appliances such electric cooker or boiling ring in the Hostel.

8. The TV in the common room is to furnish the student with the latest information. Therefore no student shall tune on the TV away from the station where news are broadcast without the consent of other students present in the common room.

9. In the event of pregnancy either before or after allocation of room in the Hostel, the student will report her condition early to the Hostel Warden. She will be allowed to remain in the hostel not longer than three month of her pregnancy. Female students that are nursing mother are not allowed to reside with their babies in the hostels.

10. Motor vehicles of students will not be allowed on the RTC premises without the written permission of the RTC Principal/Rector. Such permission will be issued only on proof of ownership. Such permission may be refused or withdrawn without assigning any reason thereof.

11. Students are to refrain from acts of hooliganism, unruly or rowdy behaviour (including fighting), mission of unreasonable or excessive noise, or conduct likely to cause annoyance or disturbance to others within or outside the hostel premises.

11. Desist from tampering with smoke detector fire fighting appliances wherever installed and shall use such appliance for fire- fighting purpose only.

12. Desist from misuse or wilful damage to or destruction of RTC properties, in default of which such students shall bear full responsibility thereof.

13. Avoid use of drugs, smoking, drunkenness or drunken behaviour as would constitute a disturbance to other students.
14. Unauthorised entry or use of RTC premises and failure to report lost or stolen keys of the Hostel.

15. Every occupant is expected to be within the hostel premises on or before 10 p.m.

16. No person shall create a safety or health hazard within and around any residential Hall. Examples of prohibited behaviour include opening outside doors, unlocking lounge windows, using windows or balconies to enter and exit building, using unauthorised doors for entering or leaving the buildings, accumulating excessive garbage or filth, changing electrical wiring,

throwing, pushing objects or liquids off windows or balconies, sitting or playing on the railings.

18. All electrical appliances/lights should be switched off when leaving the room.

19. The use of rugs in the rooms is prohibited. However, the use of carpets is allowed.

20. Cooking in the rooms or unauthorized places is highly prohibited.

21. No form of co-habitation between the opposite sex is permitted

22. Every student shall participate in the general cleaning and sanitation of the Hostel environment every last Saturday of the month.

23. All non- hostel residents and visitors entering the hostels, most check in at the security post or Hall Portal. Non- compliance shall lead to students being surcharged, ejected from hostels or banned from hostel accommodation for the remaining part of his/her studies.

Failure to abide by any of these rules and regulations will lead to automatic suspension, ejection or expulsion from the Hostel as decided by the Disciplinary Committee. All forms of complaints shall be addressed to the School Management through the Hostel Warden.

Room Changes

The Hostel Warden and the School Authorities have the right to change the location of any occupant at any time, as it is deemed fit. Any occupant affected by this change is expected to comply to this directive as soon as it is given. However, in case of damages the affected student is responsible for the replacement.

Keys

The key to the room of occupation by each occupant is not transferrable to another occupant, without adequate knowledge and permission of the School Authorities. No student shall duplicate any room key without adequate knowledge and permission of the School Authorities

CHAPTER FOUR

FACILITIES, RECORDS PROCEDURES AND OTHER POLICIES OF THE RTC

FACILITIES OF THE RTC

GUIDANCE AND COUNSELLING FACILITIES

STUDENT SERVICE SCHOOL GUIDANCE AND COUNSELLING UNITS

The guidance and counselling unit is an integral component of the education mission of the school.

In the school setting, School Counselling like all other staff has a set of professional responsibilities that define their scope of activities addressing the needs of;

1. Students.
2. Colleagues.
3. School and Community.

WORKING WITH STUDENTS

The School Counsellor's first responsibly goes to the students in term of education, academic, career, personal and social needs within the school setting to develop a comprehensive guidance and counselling program.

The diverse needs of students may require specific counselling expertise and the School Counsellor recognizes their boundaries of competence by proving only those services for which they are qualified by training or experience. When students require specialized, intensive or long-time counselling beyond what school may reasonable be expected to provide appropriate referrals are made.

WORKING WITH COLLEAGUES

Guidance and Counselling service are part of a broader delivery system designed to enhance the success of all learners. The School Counsellor establishes and maintains an ongoing professional, collaborative relationship with School Staff, Clinicians and other service providers who work with

students in the school. Colleagues and professional information related to the educational success and well-being of students who are also in their care. Information is shared with adherence to appropriate guidelines for confidentiality. School counselling must work within the limits of the law, within the policies and procedure of the school as well as the ethical requirements of the school.

WORKING WITH THE SCHOOL

School Counsellor's service plays a dual role of educator (through guidance education activities) and counsellor (through counselling services) merging when the counsellor is involved in prevention work. For instance by addressing student personal needs through counselling, the school counsellor simultaneously teaches resiliency skills and affect the student's readiness for educational challenges. As a result of such interrelationship, the school counsellors support the integration of guidance and counselling services to address school community needs. The school counselling develops a comprehensive, developmental guidance counselling program within the school team to meet the needs for their context and specific school population. This development process includes identifying needs, implementing and monitoring programs as well as adjusting plans based on the development needs of the students. Regular evaluation of the plan and its implementation are important to ensure that the school and communities are being served.

CONSULTATION SUPPORT PROVIDED

School Counsellor is a staff member who works together with other certified teachers and clinical professionals to increase opportunities for success in the lives of all learners. School Counsellors provide education, guidance, and counselling to all students in the school through activities such as;

1. Direct instruction
2. Guidance education

3. Team teaching
4. Group and individual counselling and
5. Student support team planning.

IMPORTANCE OF GUIDANCE AND COUNSELING

Guidance and counselling is needed to help the students for optimum achievement and adequate adjustment in their varied life situations. The analysis of the student's academic record in the school shows the need of guidance and counselling service in the academic, social, health, moral, personal and marital areas.

Guidance and counselling program needs to be introduced to newly employed students, due to the following reasons:

- To help in the total development of the student.
- To help the student adjust to his/her new environment.
- To develop a proper motivation and clarification of goals and ideals of students in conformity with their basic potentialities and social tendencies.
- A total development of the students necessitates that individual's differences among them are expected, accepted, understood, and planned for.
- All types of experiences in the training Centre is to be so organized as to contribute to the total development of students.
- To develop readiness for choices and change in facing new challenges
- To motivate and advice the students in their careers progression.
- To help the student in their period of confusion.
- To help the student in checking wastage and stagnation.
- To ensure the proper utilization of time spent outside the classrooms.
- The manners in which students spend their non-class hours clearly affect their success in achieving both academic competence and personal development of all types. So, it is the responsibility of the

guidance and councillor to tell the students the ills of excessive non-class hours in their academic success.

- Majority of the students lack a sense of direction, a sense of purpose and a sense of fulfilment, and indulge in destructive activities, which lead to social damage and loss. To minimize the incidence of indiscipline, adequate guidance and counselling is required to help the student to worthwhile channels and assist them realize the goals of optimum academic, personal and social development.

RTC LIBRARY

The RTC Library is an information age learning centre. It is the academic heart and research nerve centre of the Training School. Libraries form a vital part of the world's system of communication and education. The following study resources are available in the library:

- Reference materials
- Periodicals: Journals, Newspapers, Magazines
- E-Books
- Online databases
- Books
- Projects/dissertations/theses

The hours of operation of the RTC Library are:

Monday to Friday is 8:00am –10:00pm, Saturday is 9am-2pm while Sunday is from 2pm-6pm. Every library user is expected to sign in and sign out when using the library with his/her identity card.

Attempted theft or mutilation of any library material is a serious offence, which attracts heavy penalty from the School Management.

ICT FACILITIES

The ICT Centre has several dedicated systems networked for use by students. It is to provide ICT and internet services to students and staff members of the RTC, strictly for academic and research purposes

The hours of operation of the ICT Centre are:

Monday to Friday 8.00 am –6.00 pm. Every user of the ICT facilities is expected to sign in and sign out when using the ICT Centre with his/her identity card. Attempted theft or mutilation of any of the facilities of the ICT Centre is a serious offence, which attracts heavy penalty from the School Management.

EXTRA-CURRICULAR ACTIVITIES

The RTC organises extracurricular activities to enhance learning among her students. These include:

- Organisation of seminars, workshops, and symposia for students, staff and stakeholders of the RTC
- Provision of a Chapel and a Mosque for religious activities among staff and students (While religious activities are being encouraged in the Training School, the use of loud speakers that disturb or cause noise pollution is prohibited.
- Provisions for competitive and recreational sporting activities (both indoor and outdoor games) among students. Friendly competitions among the students are encouraged.
- School excursions are an important and effective means of motivating students and engaging them in active learning experiences. In view of this, the RTC Management gives opportunity to students from various schools of learning to visit RTC on Thursdays in order to develop or enhance their knowledge in the field of Meteorology. RTC Students see and enrich their knowledge of places and work they were taught in the classroom.

RECORDS , PROCEDURES AND OTHER POLICIES

CHECKING OF END OF SESSION RESULTS

After the approval of the Semester and the Session results by the RTC/NIMET Management, the result for each Semester will be pasted on the notice board for the students' information.

RIGHT TO FILE COMPLAINT

Students have the right to file a complaint with RTC academic committee whenever there is an academic grievances, that is, student's disagreement with his/her overall academic results. This will be done by submitting an official complaint through the Class Adviser.

DISCLOSURE OF EDUCATIONAL RECORDS

The RTC reserves the right to deny academic transcripts or copies of academic records to student in any of the following situations among others:

1. The student has an unpaid financial obligation to RTC.
2. There is an unresolved disciplinary action against the student.
3. There is an unresolved certificate issues especially entry qualification).

RIGHT TO REQUEST AMENDMENT OF EDUCATIONAL RECORDS

Students may request that their educational records be amended if they believe that they are inaccurate or misleading. A student who wishes to ask RTC to amend a record should do so by writing to the Training School official who is responsible for the records. The written request should clearly state which record(s) need to be amended and why. RTC will notify the student in writing of the decision on the issue.

TYPES, LOCATIONS, AND CUSTODIANS OF EDUCATIONAL RECORDS

The following is a list of the types of records that RTC maintains, their locations, and their custodians.

- Admission Records: held in the Central File, controlled by the Records Office/Admin.
- Cumulative Academic Records: current and former students' are held in the Principal's/Rector's Office.
- Disciplinary Records: held by the Disciplinary Committee Chairman.
- Financial Records: held in the RTC Secretariat by the Vice Principal.
- Occasional Records (Students' educational records not included above, such as minutes of committee meetings, minutes of RTC

meetings, copies of correspondence in offices not listed above, etc.): If such records are desired, the appropriate official will collect such records, or otherwise make them available for inspection and review.

- Transcript Records: all transcript records are controlled by the Principal's /Rector's Office.
- Guidance and Counselling Records: held by the Guidance and Counselling Chairman.
- Quality Management System (QMS) Records: held in the QMS Secretariat.

Filing Complaint or Informational Report

Any student of the RTC alleging a violation of the Code of Conduct may file a complaint to the Principal/Rector. Upon receipt of this report, an investigation will take place and, if deemed appropriate, referral will be made to the appropriate committee to commence the Conduct Process. Complaint reports (specific action reports) should be within 24 hours of the violation. Complaint reports must include a detailed description of the incident, date, time, and location of the alleged violation, the name of the accused student(s), if known, and the name of the person filing the report (complainant).

Committee report options:

1) No Action (2) Screening Meeting.

1. No Action

Upon investigation of the complainant's report, the Conduct Committee may determine that there is insufficient information about a violation of the Code of Conduct to warrant a conduct meeting. The Conduct committee may choose to keep the report on file for reference in future allegations of violations of the Code of Conduct.

2. Screening Meeting

Upon receipt of the complaint report, if the Conduct Committee investigation finds sufficient information about a violation of the Code of

Conduct, he will schedule a Screening Meeting where three (3) members of the Screening Committee along with an Advisor will meet with the individuals involved in the report to review the report. All individuals that may have been involved in the alleged commission of violation of the Code of Conduct or may have knowledge that is pertinent to the incident will be invited to appear at this meeting.

The purpose of this meeting is to give the accused student(s) an opportunity to read and review the report and respond in writing to any factual discrepancies they have with the report. Conduct committee members will be responsible for asking questions at this meeting to determine any other information that may be useful in reaching a decision about whether or not a violation of the Code of Conduct occurred.

The accused student has the right to admit responsibility for violating the Code of Conduct and have the case resolved at the Screening Meeting. For violations involving sexual harassment, assault, or other violations of a serious nature, a Review Board meeting may be required.

Note: If the incident of an alleged violation of the Code of Conduct involving more than one student is not able to be resolved with all of the involved students at the Screening Meeting, the Training School reserves the right to have a student who has admitted responsibility appear before the Conduct committee before their case is resolved.

Conduct Outcomes

Following the Conduct committee, the decision will be made by a simple majority whether or not a violation of the Code of Conduct occurred. The decision will be sent with a recommendation for sanctions (if violation occurred) to the RTC Management for approval.

ATTENDANCE OF STUDENTS

The RTC Management recognizes that attendance is a critical component and academic achievement and success. The RTC seeks to reduce the

amount of student absence by implementing a uniform policy promoting a joint effort among students and the instructors. The policy recognizes that student attendance is the responsibility of the student and supported by the instructors and administration. Therefore, the purpose of this policy is to encourage regular attendance and punctuality so that learning can take place. Students are expected to be in school and on time.

Attending lectures is compulsory and other activities should not be scheduled during lecture time. A student who does not make/attain at least 70% attendance is not eligible to sit for any examination.

LECTURE TIME

- Monday to Thursday: Lectures are held between the hours of 8:45am to 2:45pm.
- Break-time: An hour's break time between 11am to 12pm. on Monday to Thursday.
- Friday: All lectures terminate by 12pm. This is to allow students for religious activity (Jumat services).

USE OF MOBILE PHONES

All electronic gadgets should be switched off during lectures, and should not be brought to any examination hall.

ATTENDANCE RECORDING

It is the Instructor's responsibility to;

a. 2. Student arriving lecture room when the Instructor is already in the class will be marked late.
b. 3. Arriving the class late may, disrupt and interferes with learning. Therefore, such student may not be allowed to attend the lecture.

c. Take attendance during his/her lecture period and to maintain accurate attendance records in each assigned class and other instruction of activities.
d. Be familiar with all procedures governing attendance and to apply these procedures. Uniformly in class assignment and for all assigned students.
e. Provide any student who has been absent with any missed assignments upon request, particularly when the absence is based on health or bereavement.

CLASS ADVISER

Class Advisers are the member of RTC assigned to oversee the affair of the designated classes.

CLASS ADVISER 'S RESPONSIBILITIES

1. To give quality advice to the student.
2. To prepare the academic session calendar.
3. To prepare the semester time tables.
4. To keep records of the attendance of all students in each course.
5. To enlist the students who are eligible to sit for any examination.
6. Paste the list of the students who are not eligible to sit for examination on notice boards, at least a week before the examination.
7. To compute the examination results.
8. Any letter of absenteeism should submitted en-route the Class Adviser.

Room Check-in/Out Procedure

A student is expected to check in into his/her room and bed space as assigned by the School Authorities. No student is allowed to share his/her bed space with anyone else, and is expected to take responsibility of every item accorded to him/her. A check-in form will be provided and it must be filled by the students.

On checking out, either at the end of the session or at the end of the programme, a check -out form will be filled by the occupant, while he/she hands over the keys and every other hostel property to the Hostel Master. This

shall serve as part of the clearance required for the student to make before he is deemed to have completed his course of study. However, in case of damages the affected student(s) is responsible for the replacement.

CHAPTER FIVE

COURSE CONTENT AND CURRICULUM

CURRICULUM FOR BASIC INSRTUCTIONAL PACKAGE FOR METEOROLOGICAL TECHNICIAN (BIP-MT)

FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 111	Physics (Mechanics & Properties of Matter)	2	Required
2	BIP 112	Differential and Integral Calculus	2	Required
3	BIP 113	Physics (Heat)	2	Required
4	BIP 114	Computer Studies	2	Required
5	BIP 115	General Studies	2	Required

SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 121	Upper Air Observation	3	Core
2	BIP 122	Meteorological Instruments	3	Core
3	BIP 123	Codes And Observations	4	Core
4	BIP 124	Plotting	3	Core
5	BIP 125	General Meteorology	3	Core

THIRD SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 131	Algebra	2	Required
2	BIP 132	Agromeoteorology	3	Core
3	BIP 133	Statistics	3	Core
4	BIP 134	Aeronautical Meteorology	3	Core
5	BIP 135	On the Job Training (OJT)	4	Core

PHYSICS (MECHANICS & PROPERTIES OF MATTER): (BIP 111)

1. Units and dimensions of physical quantities.
2. Vector and scalar quantities.
3. Linear motion of a particle: equations of motion with uniform acceleration.
4. Newton's Laws of motion
5. Pressure.
6. Density.
7. Introduction to circular motion and Simple Harmonic Motion.
8. Oscillation and Waves.
9. Work and energy; momentum; Principles of conservation of energy;
10. Principle of conservation of momentum, coefficient of restitution
11. Dynamics of rigid bodies; moment of inertia; radius of gyration; Translational and Rotational energy; compound pendulum.
12. Motion of a body falling under gravity.
13. Friction.
14. Elasticity
15. Viscosity
16. Hydrostatics
17. Surface tension.
18. Simple harmonic motion: vibration of a spiral spring, elastic
19. string.

LEARNING OUTCOME ON PHYSICS (MECHANICS & PROPERTIES OF MATTER)

Understanding of the physical laws and its application to atmospheric science

DIFFERENTIAL AND INTEGRAL CALCULUS: (BIP 112)

1. Differentiation; The derivative of a function; its meaning and its determination from first principles in simple cases, e.g. x^2, 1/x; Differentiation of ax_n for integral and of sums and differences of such expressions; Gradient of a curve determined by differentiation; determination of greatest and least values; curve sketching turning points (Maxima and minima only); applications to problems involving small changes and rates of changes; Derivatives of sin x, tan x cot x, sec x and cosec x, Tangents Normals;

2. Introduction to Integration; Methods of Integration. The definite integral and its representation as an area; approximate evaluation of integrals; integration of ax_n for integral n and of sums and differences of such expressions.
3. Continuous function of a variable derived from a continuous Differential Function.
4. Differentiation of sum, difference, product and quotient of two functions; Implicit functions.
5. Differentiation of xn(n # o), trigonometric functions.
6. Compound angles.
7. Applications of Differentiation: Stationery values; maximum, Minimum and of a point of inflexion function of a variable; tangents and normal to a curve at a point; movement of a point on a straight line, velocity and acceleration.
8. Theories on circle.
9. Partial fractions.
10. Integration: xn ,(an +b) n ,trigonometric functions and Methods of Integration.
11. Applications of integration: area under a curve; the axis of the abscissae and ordinate of the end points of the arc; lateral area and volume of a body of revolution. Application to linear motion.
12. Conic Section: the Parabola, Ellipse and Hyperbola.
13. FUNCTIONS: Functions of a real variable, limts, continuity, differentiability, Rolle's Theorem, mean value theorem and leibnitz's formula.
14. Infinite series: Taylor series, Maclaurin series, convergence of power series.
15. Partial differentiation: First derivatives, function of a function, Higher order derivatives, Total derivatives and Exact differentials.
16. Line and multiple integrals: Properties of line integrals, line integrals around closed plane curves, connectivity, line integrals independent of path, properties of double integrals, properties of triple integrals, cylindrical coordinates, physical applications of triple integration.
17. Determinants: Definitions, properties of determinants, products of two determinants, Jacobians and wronskians.
18. Complex variable: Introduction, the exponential functions, circular functions and De moivre's theorem.

LEARNING OUTCOME FOR CALCULUS

To develop the calculative skill in relation to the scientific nature of the atmosphere

PHYSICS (HEAT): (BIP 113)

1. Concept of heat, heat sources, temperature and temperature scales
2. Thermometers: liquid-in-class, gas and electrical thermometers
3. Effect of heat on matter: solids, liquids and gases. Solids: thermal expansion – linear, area and volume. Liquids: apparent, real and absolute; expansion of water, Gases: adiabatic
4. Application: Bimetallic strips, Heat capacity, specific heat capacity and calorimetry, land and sea breezes, phase change, latent heat
5. Heat transfer: conduction, convection and radiation. Solar and terrestrial radiation.
6. Gas laws: Boyles, Charles, pressure and Dalton's law
7. Kinetic theory of gases. Boiling, evaporation, condensation, vapour pressure.

LEARNING OUTCOME FOR PHYSICS (HEAT)

Understanding of the physical laws and its application to atmospheric science.

COMPUTER STUDIES: (BIP 114)

1. Evaluation of the computer system: Definitions of computer; History of the computer(The beginning of computer age); Generation of computer; Types of computers; Classification of digital computers; Characteristics of computers; Application of computer in the society.
2. Functional parts of the digital computer. Hardware (Input units, output units, Processing units, storage units Communication units) and software (types of computer software, operating system, application software)
3. Computer safety and maintenance (Top computer mistakes beginners makes, Basic Troubleshooting Techniques, Maintaining your Computer).
4. Using the computer (Buttons and parts of on a computer, setting up a computer, computer safety and maintenance)
5. Application of computer in weather studies.
6. Introduction to software packages.
7. Programming. Creating and Publishing online material
8. Data Processing.

LEARNING OUTCOME FOR COMPUTER STUDIES

To improve the trainee's technical and operational skills in data management practice and its application at work

GENERAL STUDIES: (BIP 115)

1. Ethics of the Job/ documentation processes.
2. Accessing and obtaining information – Meteorological information via libraries, database and internet searching.
3. Historical context – The scientific and technological advances that have contributed to the development of meteorology and its application.
4. Written communications – Written communications within specified time limits in a concise, accurate and comprehensible way, including use of word processing and presentation programmes.
5. Oral presentations – Presentations within specified time limits, in which the context and style of delivery accurately conveys information in ways that can be understood by the audience.

LEARNING OUTCOME FOR GENERAL STUDIES

- To provide background knowledge of meteorology
- Application of civil service rules at work

UPPER AIR OBSERVATION (BIP 121)

1. General – Units of measurements. Meteorological balloons: There are three types of balloon colours in use for the measurement of upper wind:- Red, blue and white colour. The state of the sky determines the colour of balloon to be used. Gases for inflation of Meteorological balloon helium, or hydrogen gas. Hydrogen generators for Meteorological purposes. Theory of upper-wind measurement. Care and handling of Meteorological balloons. Sizes of Meteorological balloons. The Pilot – Balloon Theodolite. Ceiling measurement using pilot balloon (determination of cloud base). Optical Theodolite using pilot balloon
2. Pilot Balloon Codes PART A, B, C, D,
3. Temperature Message Identifier TTAA Radiosonde Transmitter
   The weather elements observed are: Pressure, Temperature, Wind direction and speed, humidity and dew point.
   3. Radio sounding of the upper atmosphere. General – units of measurement. The Principle of the radio sounding system: Principle of the radio sounding and ascent evaluation.

LEARNING OUTCOME FOR UPPER AIR

The students should be able to carry out sounding and the use of the instruments.

METEOROLOGICAL INSTRUMENTS: (BIP 122)

1. Direct and Indirect Meteorological measurement
   Measurement of meteorological variables
   Specific features of Meteorological Measurement
   Direct Reading Instruments: Thermometers, Barometer, Wind Vane, Cup-Counter Anemometer, Class A Pan, Gunn Bellani Radiation Integrator, Raingauge, Sunshine Recorder and Ordinary Anemometer.
   Autographic Instrument (Indirect Reading Instruments): Thermograph, Barograph, Hyetograph and Hygrograph. Desirable Characteristics of Meteorological Instruments (Accuracy, durability and reliability).
   General requirements for sitting and exposure of Meteorological Instruments.
2. Measurement of atmospheric pressure
   Nature of atmospheric pressure – Units of measurements; Principles underlying the operation of atmospheric pressure measuring
   Instruments; Mercury barometers; Kew Pattern Barometer and Fortins Barometer; Aneroid barometers; analogue and digital; The Principle of the barograph; Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature; Nature and units of measurement of air temperature, temperature scales used in Meteorology and conversion. Principles underlying the operation of air – temperature measuring; Instruments; Mercury-in-glass thermometers, spirit-In-glass thermometers; The bimetallic thermometers, station thermograph ; Exposure of air temperature measuring instruments (source of errors); Re-Setting of thermometers.
4. Measurement of atmospheric humidity; Nature and units of measurement of absolute humidity, relative humidity and dew point and other humidity parameters; General principles of hygrometers.
   Humidity measuring instruments based on change of dimension of Hygroscopic substances - the hair hygrometer, the psychrometer.
   Automated psychrometer and recording Psychrometer.
5. Measurement of surface wind direction and speed; Wind direction and wind speed – specific feature units of measurement; Principles of wind measuring instruments; The pressure plate anemometer; Cup counter

Anemometer- The rotation sensor cup – wheel – propeller; and Anemometers measuring run of wind.

6 Measurement of precipitation; General liquid and solid precipitation – units of measurement; Principles of the Point measurement of precipitation. Non – recording precipitation gauges – daily rain gauges of the unshielded and shaded types. Recording precipitation gauges – siphon (float type – tipping bucket and Weighing – balance type
Exposure requirements concerning precipitation point – measurement instruments. Routine care of precipitation measuring instruments; Factors affecting the accuracy of point – precipitation measurements (Evaporation Loss). Measurement of evaporation

7. General units of measurements, Principles of evaporation measuring Instruments, the evaporation pan: Class A Pan – (the hook gauge type). General requirements for the evaporation – measuring instruments' exposure, routine care of evaporation – measuring instrument.

8 Sunshine duration measurement
General principles of sunshine duration measurement
The Campbell Stokes sunshine duration recorders. Sitting and exposure requirements for sunshine duration measuring
Instruments, factors affecting the sunshine records (Cloud cover, Precipitation). Routine care of the Campbell Stokes sunshine recorder.

9 Automation of the measurement of Meteorological variables. Technical and economic aspects of automation objectives. Classification of automatic weather stations. Basic block diagram of an automatic weather station. Sensors used with automatic weather stations. Maintenance of automatic weather stations. Reliability of automatic equipment. Standard, quality control, calibration and inter comparison.

LEARNING OUTCOMES OF METEOROLOGICAL INSTRUMENTS

- The students should be able to know the factors of siting the instruments and spacing of instruments

- They should be able to understand the underlying principle of the instruments in relation to units and dimensions and their mode of operation

- They should be able to conduct necessary observations and understand the techniques

CODES AND OBSERVATIONS: (BIP 123)

1. Brief introduction to instrument used in taking meteorological observations.
2. Measurement of meteorological variables and procedure of observation, Specific features of Meteorological measurements; Direct and Indirect. Measurement of Temperatures; Air, Maximum, Minimum etc. Measurement of Humidity; Relative Humidity autographic instruments, derived values with the aid of Humidity slide rule, Measurement of Atmospheric Pressures (Barometers,) Barographs).
3. Measurement of Clouds; Types, Amount and Height (Ceilometers, ceiling Ascent, Cloud, Atlas and Pictures)
4. Measurement of surface Winds. Direction and speed; (Anemometers, and Beaufort scale for estimation).
5. Precipitation Measurements (Rates and Records of precipitation) Solid or Liquid, Gauges units. Precipitation (Amount and Duration). Automated weather station for intensity.
6. Measurement of Evaporation – Piche Evaporimeters
7. Visibility; General unit measurements, Definition of visibility (hydrometeor and lithometoes) and Visibility at night. Prevailing visibility/ directional visibility
8. Measurement of solar radiation (Sunshine recorders, Gunn Bellani radiation integrator and solarimeter).
9. Methods and procedures of observations Standard time, accuracy and measurement (UTC unit) Standard International Block and stations numbers e.g. Nigerian Stations.
10. Codes: Applications of SYNOP code for observation Section O -5
11. Present weather, Visibility and (Direction and speed), Application of METAR and SPECI Codes.
12. introduction to "9" special phenomenon groups i.e. 9spspspsp of synoptic message
13. Introduction to supplementary information groups of synoptic message e.g 5j1j2j3j4, 4ffff, 55408, 4esss etc.
14. section 5 555 of synoptic message e.g. 1sntxtxtx 2sntntntn 30uuu 40rrr
15. METAR modifications and corrections
16. SPECI modifications and corrections

LEARNING OUTCOME ON CODES & OBSERVATION

- To be able to identify and understand the principle behind the formation and associated weather events
- Ability to collate climatic data for research purposes

- To be able to identify hydrometeors and their method of observation
- To be able to code and transmit information
- Ability to collate climatic data for research purposes
- To be able to conduct necessary observations and understand the techniques
- To be able to identify clouds and their associated characteristics and formation

PLOTTING: (BIP 124)

1. Application of models and tables.
2. Locations of station on Charts
3. Data representation on charts. Data is represented on charts with international symbols.
4. Surface Plotting model, Ship message plotting model.

LEARNING OUTCOMES ON PLOTTING

- To be able to identify and interpret ICAO codes and symbols
- To be able to plot all meteorological information on weather charts

GENERAL METEOROLOGY: (BIP 125)

1. The composition and structure of the atmosphere: Saturated or unsaturated atmosphere ; atmospheric ozone; water Vapour; carbon dioxide; thermosphere; interplanetary gas; Vertical divisions of the atmosphere; Troposphere; Stratosphere; Mesosphere; Thermosphere; Ionosphere.
2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; mechanical, thermal, turbulence and clear air turbulence; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces(land and sea breeze).
3. Air temperature; basic principles of temperature measurements; Celsius, Fahrenheit and Kelvin temperature scales, Thermometers, physical processes used in thermometry, types; thermograph, measurement of air temperature; exposure; horizontal and vertical variations of air Temperature.
4. The effect of gravity on the atmosphere, air density, Atmospheric pressure, units; measurement; the hydrostatic equation; Horizontal and vertical variation of pressure; pressure to sea level; the ICAO Standard

atmosphere; the barometer used as an altimeter; Diurnal variation of pressure; Pressure gradient and its significance.

5. Moist air; the three states of water, solid, liquid and gaseous; density; Water vapour pressure; saturation vapour pressure; evaporation Condensation; freezing; sublimation; latent Heat
6. Moisture indicators; relative humidity; mixing ratio and dew point; water Vapour pressure
7. Elementary theory of the wet-bulb thermometer; principles of the Psychrometer and The hygrometer; rudiments of cloud, fog and precipitation. Formation and visibility. The effect of aerosols (fog and dust on visibility).
8. Expansion or compression of a rising or falling air parcel; variation of the parcel temperature with height; isobaric expansion and adiabatic expansion; the influence of condensation; basic knowledge of the vertical stability; non-saturated air and saturated air.
9. Forces that affect atmospheric motion e.g pressure gradient force, gravity force, Coriolis Effect and friction.
10. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the general circulation in the tropics and in non-tropical regions; local winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind; cyclones and Anticyclones; air masses and fronts; ITD and thunderstorms.

LEARNING OUTCOMES ON GENERAL METEOROLOGY

- to appreciate the physical structure of the atmosphere
- to enable the student to understand the physical processes of energy transfer from the sun to the earth surface and its application
- the principles of atmospheric pressure and its roles in the study of the atmosphere and aviation in specific/weather occurrence
- the principles of atmospheric temperature and its roles in the study of the atmosphere/climate variability
- to understand the importance of humidity in the study of the atmosphere
- to understand movement of air constituents

- to understand the concept of air flow and its effect to weather development

- to be able to understand the formation and effect of hazardous weather

ALGEBRA: (BIP 131)

1. Simultaneous equations: Linear and quadratic.
2. Indices.
3. Logarithms: Natural and any base.
4. Quadratics equations: Algebraic and graphical solutions, roots of quadratics.
5. Variations: Linear, Inverse, joint and partial.
6. Inequalities: Linear and quadratic.
7. Polynomials: Factor theorem; Remainder's Theorem; Pascal's Triangle.
8. Series and Progression.
9. Partial fraction.

LEARNING OUTCOME FOR ALGEBRA

To develop the calculative skill in relation to the scientific nature of the atmosphere

AGROMETEOROLOGY: (BIP 132)

1. Definition, scope and aims of Agrometeorology and other allied disciplines.
2. The relationship between weather, climate and agriculture as it affects soil, plants, farm animals, pests and diseases. Pest of crops and animals, farm building and equipment.
3. Artificial modifications of the Meteorological and Hydrological regimes namely; glass green houses, windbreaks, and shelter belts, irrigation, mulching.
4. The history of Agriculture and its relationship with association science. Agricultural Ecology and Ecosystem Distribution and Classification of Vegetation belts in Nigeria. Weather and climatic modification.
5. General production practice of field crops, crop production e.g. Maize Production factors for optimum yield of field crops. Factors affecting crop yield; Environmental factors – rainfall, CO_2, temperature, radiation, wind, light, evaporation water supply, nutrient, weed, pest and disease soil

physical condition. Plant population, field of individual plant and community.

6. Plant protection definition of pest, important of pest. Importance of plant protection. Types of Pests: Polyphagous pest, Locusts, Termites, Bihar hairy Caterpillar, Cutworm, Greasy Cutworm, Damage caused by locust phase. Theory of locust, life cycle of locusts and control. Observations on crop pests and diseases.
7. Factors affecting disease development and propagation(the role of the macro-climatic environment) namely, temp, humidity, soil pH, wind, soil texture.
8. Control of plant diseases
   Cultural methods
   - Proper selection of geographical area
   - Selection of field
   - Choice of time of sowing

   Exclusion method
   Eradication
   - Rogueing
   - Crop sanitation
   - Eradication of alternate and collateral hosts
   - Heat and Chemical treatments of diseased plants
   - Biological control
9. Pests of Crop plants
   Insect pests (the classification based on habits and parts of plants attached) barriers, sucking insects, leaf eating insects, fruit and seed eaters etc.
   Other Pests such as Birds, Rodents and Monkeys
10. Diseases of Crop Plants
    Fungal diseases
    Bacterial diseases
    Viral diseases
    Poultry diseases
    Symptoms and control

11. Phenology Definition of phenology Method of phonological observations. Different phases of phenological observations in different crop plants. Biological Observations (Phenological observations)
    Phonological phases in cereals
    Germination
    Emergence sprouting
    Tillering

flowering
earning
milky ripeness
waxy ripeness
Tasselling

Importance of phenological observations

12. Agrometeorological elements and their methods of observations.
13. Definition, climatic elements, Biological elements, conditions of observation, Agrometeorological station and Networks, Observation of physical elements, Observation of biological Character/Elements, Detail observation of high accuracy.
14. Prevention and mitigation of Agrometeorological calamities in Nigeria.
15. Evapotransition Studies .
16. Agrometeorological water balance

P + I =ET + R + D + S

Evaporation
Evapotranspiration (Actual and Potential)
Factors affecting evapotranspiration
Factors affecting evapotranspiration
Calculation and Measurements of evapotranspiration
Water balance: Lysimetry
Aerodynamic profile approach (Bowen into
Combination methods (Penman equation)
The use of evapotranspiration data.

17. Soil Water

Soil water availability
3 categories of soil water
Capillary
Hygroscopic
Gravitational
Field capacity
Wilting point
Soil water in relation to plant growth.
Plant response to water deficit and excess moisture
The need for soil Moisture

18. Agrometeorological stations

Classification
Principal
Ordinary
Auxiliary

Agromet station for specific purposes

19. Climatic normal for livestock's: poultry birds, Goat, Sheep, Pigs and Cattle. Meteorological equipment of crop plants for rice, sugar cane, cotton, maize, potatoes etc. Animal's production systems, uses of animals. Outdoor animals and Meteorological elements.
20. Water and the Hydrological Cycle in Agriculture moisture characteristics of soil water and vegetation. Determination of water loss from land surface fundamental of the evaporation process. Existing methods of determining evaporation Energy balance of estimating evaporation. Aerodynamic estimation of evaporation combination model methods of penman and others. Development of original penman equation. Evaporation formulae of priestle – Taylor and Penman – Monteith special forms of precipitation Dew, Snow, soil moisture Budgets – Irrigation needs

LEARNING OUTCOME FOR AGROMETEOROLOGY

- To understand the effect of meteorological and climatic data to crops and livestock
- To employ meteorological information to improve agricultural products

STATISTICS: (BIP 133)

1. Introduction: Definitions, meaning of statistics, examples with natural situations. Data collection and storage.
2. Data arrangement: Mean, median, mode; Mean of grouped and ungrouped data. Assumed Mean. Arithmetic and Geometric mean. Median and mode for grouped data Average mark.
3. Graphical representation of data: Pie chart, bar chart, Frequency table, cumulative frequency, Ogive.
4. Regression and Correlation

Scatter graphs, relationships between two variables and scatter graphs (construction, line of best fit, estimate from scatter graphs significance of the scatter graph, limitations of scatter graph). Regression lines (definition, equations of approximating curves i.e. exponential and polynomial curves); computing regression lines (equation of the line or straight line; method of least squares, measuring the deviations; the regression of y on x; the regression of x on y; graphing regression lines; the use of regression lines; choice of regression line and Regression coefficient). Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation r^2. Applications to time series graphing the

data; the equation of a least square line and fitting the data; estimates. Multiple linear regression and non–linear regression.

5. Probability

Introduction: Definitions of probability, events and various classes of events; trials and random variables and probability symbols. Conditional probability; independent and dependent event; mutually exclusive events; mathematical expectation; permutations and combination. Probability distributions, the binomial distribution (a short-cut i.e. P(X) =nCx Pxq (n-n), when can it be used, mean and standard deviation of Binomial distribution, some properties, the Poisson distribution (Poisson distribution, when it can be used, mean and standard deviation of the Poisson distribution and some properties and the Normal distribution some properties of the Normal distribution, the relationship between binomial and normal distribution.

6. Estimation

Tests of significance; testing a hypothesis (the null hypothesis, testing the Null hypothesis, rejection of the null hypothesis, non-rejection of the Null hypothesis, confidence level and the risk of rejecting a true hypothesis, Confidence level and the risk of not rejecting an incorrect hypothesis; type I and II errors; one-fact and two-tail tests. Testing the difference between means and properties (Distribution of the difference between properties).

7. Small Sampling Theory

Small Samples; "Student's" t-distribution, confidence intervals; Test of hypothesis and significance; the chi-square distribution; Confidence intervals for x^2 degree of freedom.

LEARNING OUTCOMES ON STATISTICS

- To analyse and interpret climatic data
- To understand the place of statistics in the use of weather and climate data

AERONAUTICAL METEOROLOGY: (BIP 134)

1. Forces that keep airplane in flight (Gravity, Upthrust, drag) and parts of the plane (fixed and rotary wings- helicopters).
2. General Aviation Services.
3. Brief history of aviation and aeronautical meteorology.
4. Observing techniques. Surface wind direction and speed, including changes and variations. Visibility and runway visual range, including

spatial and temporal variations in RVR OBSERVATIONS, Cloud amount, height and type and spatial and temporal variations; vertical visibility, observations using automatic instruments such as a ceilometers. Pressure measurements for the purpose of determining QFE and QNH.

5. Hazardous phenomena. Aircraft icing; elementary knowledge of icing types; formation, accretion rates and association of icing with clouds, turbulence, elementary knowledge of turbulence near the ground as related to topography, Elementary knowledge of high-level turbulence (Clear Air Turbulence) and its association with jet streams, wind shear, volcanic ash.
6. Aeronautical meteorological stations. Meteorological reports from aeronautical meteorological stations. Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SPECIAL and SPECI). Aerodrome forecasts. Forecasts for take-off. Landing forecasts (trend type).
7. Reporting, coding and dissemination of weather information. Complete Knowledge of international meteorological codes related to observations, Such as METAR, SPECI, SYNOP, PILOT, and TEMP. Knowledge of procedures for disseminating of weather information at the aerodrome, including the special needs of ATC units, Knowledge of the procedures for the preparation of the plain language forms of meteorological messages.
8. Definitions. Meteorological report, observation, visibility, runway visual. range. Altitude, elevation, height, aerodrome elevation, flight level, transition level. Aerodrome meteorological minima, instrument runway and landing area.
9. Procedures for meteorological services for international aviation, organization of the meteorological service and particularly the functions of the various types of meteorological offices. Aeronautical meteorological stations and their functions, local routine and special observations and reports, reports in METAR and SPECI code forms. Meteorological watch. Introduction to the responsibilities of ICAO and WMO in Aeronautical Meteorology.
10. Meteorological service for International Air Navigation Terminology. Area forecast centres. Aeronautical meteorological offices. Aeronautical meteorological stations. Observations made at
11. Wind shear and Aerodrome warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of meteorological messages. Information for search and rescue. Aeronautical climatological information.

12. Information for operations' local representatives. Information requires from operators. Information for pilots-in-command prior to departure. Information for pilots-in-command during flight. Debriefing. Definitions should include: Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level transitional level. Aerodrome minima, instrument runway, landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report, operator, operator's local representatives and pilot-in-command.
13. Air traffic services. Demands for meteorological services, including the types of meteorological information required by the various air traffic services units and the updating of this information by means of duplicate displays in ATS units or by prompt data transmission originated by the Meteorological Office or station.
14. Operation of aircraft. Flight planning, Duties of flight operations officers when exercising operational control. Navigation and landing aids. Effects of air density, icing, turbulence, wind, wind shear and volcanic ash on aircraft performance. Altimeter setting procedures, standard atmosphere. Performance characteristics, including fuel consumption of civil aviation. Aircraft; characteristic of propeller type, turbo-prop and turbo-jet and, where applicable, supersonic aircraft. Effects of various weather phenomena on aeronautical operations and on aerodrome ground services. Flight planning: Definition, flight planning services, sources of meteorological information, available meteorological information, flight planning requirements and significance of meteorological information. Duties of flight operation officers when exercising operational control. Principles of flight. Air density and aircraft performance. Standard atmosphere. Density altitude other factors affecting aircraft performance. Fuel consumption. Radio meteorology. Effects of meteorological phenomena on ground communications. General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and landing. Flight planning aspects. Aerodrome meteorological minima.
15. Aircraft Icing, fog, Turbulence, Volcanic ash: Their formation of icing, elementary knowledge of icing types, accretion rates and association of icing with cloud (stratiform and cumuliform clouds), freezing precipitation, orographic and frontal lifting.
16. Thunderstorms: Formation conditions, types of thunderstorm. The thunderstorm cell, aviation hazards, squall line thunderstorm hazards, hail hazards, hail formation, hail prediction and prevention lightning. Avoidance of thunderstorms.

17. Wind Shear: Low-level wind shear associated with marked inversion and/or low-level jet streams. Winds shear in the approach and landing phases of flight. Topographic winds shear.
18. Aeronautical telecommunications. Elementary knowledge of the general organization of aeronautical telecommunications, but they should have a good working knowledge of the operation of the aeronautical fixed service. Understanding the general organization of aeronautical telecommunication; Operation of the Aeronautical Fixed Service including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message headings, addressing of messages, priorities of messages, ICAO abbreviations used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should include: Meteorological Data Distribution (MDD), RETIM (SYNERGIE-PC), SATCOM, Primary Data User System (PDUS), MESSIR-VISION, MESSIR-COM, the Global Telecommunication System (GTS) and all latest available systems or facilities.
19. WMO and ICAO Documentation. Technical Regulations, (WMO-No. 49) Vol. 11 – Meteorological service for International Air Navigation. Manual on codes WMO-No 306). Guide to Meteorological Instruments and Methods of Observation (WMO-No 8). Weather Reporting (WMO-No 9).

LEARNING OUTCOMES ON AERONAUTICAL METEOROLOGY

- The students should be able to appreciate the different platforms available for dissemination of met information
- To be able to identify clouds and their associated characteristics and formation
- To be able to conduct necessary observations and understand the techniques
- To be able to determine the products and services that are generated and how to sell them to the public
- To familiarize the students with the functions of the national meteorological services

ON THE JOB TRAINING (OJT): (BIP 135)

The OJT will be carried out for three months.

1. The Student will be divided into groups.
2. Each group will be sent to each section including Ikeja (Forecast office).
3. The students are to be supervised by the RTC instructors.
4. At the end of the OJT they are to submit their logbooks dully signed by the head of the section. And also present a written report.

CURRICULUM FOR BASIC INSRTUCTIONAL PACKAGE METEOROLOGICAL TECHNICIAN

FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 211	Hydrometeorology	3	Core
2	BIP 212	Vector Analysis	2	Required
3	BIP 213	Climatological Returns	3	Core
4	BIP 214	Thermodynamics	3	Core
5	BIP 215	Differential Equations	2	Required
6	BIP 216	Climatology	3	Core

SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 221	Marine Meteorology	3	Core
2	BIP 222	Physics (Electricity)	2	Required
3	BIP 223	Meteorological Practical	3	Core
4	BIP 224	Satellite Meteorology	3	Core
5	BIP 225	Research Methodology	3	Core
6	BIP 226	Field Work	3	Core

THIRD SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 231	Physical Meteorology	3	Core
2	BIP 232	Dynamic Meteorology	3	Core
3	BIP 233	Synoptic Meteorology	3	Core
4	BIP 234	On the Job Training (OJT)	4	Core
5	BIP 235	Project	6	Core

HYDROMETEOROLOGY: (BIP 211)

1. Hydrology, Hydrometeorology; Definitions and Explanations. Water bodies of the world, Role of water in Economic Activities of nations.
2. Physical: properties of water cycle on the globe: physical properties of Water; the hydrological cycle on the earth; ground water; origin and Classification of ground water; physical properties of rocks in relationship to water; physical states and movement of ground water; ground water and its relationship to rivers; confined aquifer ground water and its role in the river feeding; Lakes and reservoirs; morphology of lakes; sources of inflow to lakes; water balance of lakes; dynamic phenomena on lakes (Waves and currents).
3. Heat regime of lakes; chemical composition of lake water; biological processes in Lakes; reservoirs, their regime and water balance; swamps; formation and classification of swamps; hydrological regime of swamps; formation and movement of glaciers, their influence on river inflow and regime.
4. River system; river basins; river valleys and channels; sources of river Flow; temperature regime of rivers; regime of river stages; movement of water in rivers; flow velocity; discharge in rivers, hydrograph analysis; sediment transport; chemical composition of river water; channel formation processes; water balance and runoff; units used to measure runoff and flow; water balance and runoff units used to measure run off and flow; water balance of bodies of water.
5. Calculation of evaporation from the surface of basin;
    a. Average long-term annual runoff: distribution of annual runoff in
    b. Months and seasons; flow duration curves, mass diagrams and
    c. Storage Behaviour diagrams; maximum discharge and its calculation;
    d. Minimum flow and its calculation; sediment discharge and its calculation.
6. General alter Balance equation
7. Hydrograph Analysis Knowledge of flood regime of a stream, intelligent design of a wide. Variety of hydraulic structures such as bridges and culvert openings. Reservoir spillways and flood control works of all sorts.

LEARNING OUTCOME ON HYDROMETEOROLOGY

To understand the components of the water cycle and its applications

VECTOR ANALYSIS – VECTOR ALGEBRA AND VECTOR CALCULUS: (BIP 212)

1. Introduction-definition and examples of scalar and vector quantities, Representation of a vector; vector fields, scalar fields.
2. Vector Algebra – addition, subtraction and multiplication of vectors, the null Vector, magnitude of a vector; unit vector; law of vector algebra.

3. Components of vectors – vectors in two and three dimensions, etc.
4. Cartesian system of reference direction in two and three dimensions- Magnitude of a vector in the Cartesian system.
5. Direction Cosines – definition of, angles between two angles in Cartesian components; etc.
6. Relative vectors – position vectors, velocity acceleration vectors, Division of a line in a given ratio, co linearity of points
7. Scalar or dot product of two vectors, properties of the scalar product; special cases of the scalar product, work and scalar product
8. Vector or cross product of vectors, properties of the vector product, Applications of the vector product, Cartesian form
9. Vector equation of a straight line, position vector of a point on a circle
10. Scalar triple products and vector triple products
11. Derivative of a vector function – definition, space curve, partial derivative of Vectors, velocity vector, application of vector in mechanics
12. Gradient field, Divergence of a vector and Curl of a vector – the vector Differential operator Del, the gradient, the divergence, the curl; some Formulae involving Del.
13. Application of vectors to geometry;
14. Vector identities (reciprocal set of vectors);
15. Vector Integration.

LEARNING OUTCOME ON VECTORS

To develop the calculative skill in relation to the scientific nature of the atmosphere

CLIMATOLOGICAL RETURNS: (BIP 213)

1. Climatological returns; its meaning; importance; qualities;
   Types of forms; Form Met.100; Form Met. 101, Form Met. 102; Form Met. 103, Form Met. 104; Form Met. 113; Form Met. 120; Form Met. 130; Form Met. 131; Form Met. 135; Form Met. 141l, Form Met. 143; Form Met. 145; Form Met. 146; Form Met. 147; Form Met. 509; Form Met. 4520; Form Met. 4521; Form Met.4522; Compilation; Computation;
2. Climatological returns forms and usage
   Autographic chart analysis and entries into appropriate form
   Extraction of meteorological data from climatological returns
   Checking of climatological returns.

LEARNING OUTCOME ON CLIMATOLOGICAL RETURNS

Ability to collate and archive climatic data for research purposes

THERMODYNAMICS: (BIP 214)

1. Introduction to thermodynamics System
2. Gas laws - Boyle's and Charles' Laws, Dalton's Law of partial pressures, Ideal gas law. Equation of state for dry and moist air, Mixture of gases. Kinetic theory of gases.
3. Adiabatic processes. Definitions, Dry, Moist and Pseudo – adiabatic processes. Equations for adiabatic processes, Dry, moist and saturated adiabatic lapse rates. Poisson equation and potential temperature. Latent heat of condensation. Comparison of magnitudes of different lapse rates. Methods of determining stability – parcel and slice methods. Hydrostatic balance, Potential energy, Geopotential meter and geopotential height.
4. Conservation of energy and the first law of thermodynamics. Change of phase and latent heat. Reversible and irreversible processes.
5. Hydrostatic stability and Convection.
6. Moisture variables. Definitions and meanings of Potential temperature, vapour pressure, mixing ratio, absolute humidity, equivalent potential temperature, saturation mixing ratio, absolute humidity, dew point temperature, specific humidity, virtual temperature etc.
7. Thermodynamic cycle. Carnot cycle, Isothermal and adiabatic expansion and compression.

LEARNING OUTCOME ON THERMODYNAMICS

- Understanding of the physical laws and its application to atmospheric science
- To be able to identify the various synoptic features meteorological charts and imageries and their effects
- To understand movement of air constituents

DIFFERENTIAL EQUATIONS: (BIP 215)

1. Differentiation and integration of simple functions, exponential functions, logarithmic functions and inverse trigonometric functions.
2. Partial derivatives; total differential and total derivatives.
3. Ordinary differential equations: equations of first order and degree; equation of higher degree; homogeneous and inhomogeneous equations.
4. Partial differential equations: linear partial differential equations of first and second order dent variables; the wave equation in one dimension; the vibrating string; normal modes of vibration and heat equation.

LEARNING OUTCOME FOR DIFFERENTIAL EQUATIONS

To develop the calculative skill in relation to the scientific nature of the atmosphere

CLIMATOLOGY: (BIP 216)

1. Definition of weather and climate. Techniques usually adopted in climatology.
   Climatic controls of a place and West Africa.
   Climatic Elements.
   Climatological elements. All elements of weather should be discussed, but emphasis on those which actually shape the climate of a place e.g. temperature (including radiation), winds, pressure, sky cover, radiation, precipitation, humidity (including rainfall and air mass structure in the area).

2. The climate of Nigeria
   The ITD-Definition and its seasonal movement. Its role in determining the climate of various places in Nigeria on a meridional axis.
   The seasons in Nigeria
   The length of the rainy and dry seasons in Nigeria
   The two seasons in Nigeria; the prevailing winds and principal air masses associated with each season. Relationship between winds and air masses.

3. Weather zones in Nigeria
   Climatological characteristics of each zone. Basis for the existence of the weather zones. Meridional movement of the ITD.

4. Regional climatology: geographical distribution of climates, Climatolography. Monsoon climate with definite seasonal pattern (wet and dry tropics). Climatic Classification
   Tropical climate
   Tropical arid and semi arid climates
   Temperate climate
   Polar climate
   Tundra, taiga
   topoclimate
5. Climatic statistics and Applications
6. Climate variability and Climate Change.

LEARNING OUTCOMES ON CLIMATOLOGY

- To be able to understand the elements involved in regional and local climates
- To be able to classify climates
- To be able to understand and appreciate the local climates to region of responsibility and their roles

- To be able to understand the importance of the global atmosphere and its spatio-temporal variability
- To appreciate the geographical characteristics of their area
- To be able to understand tropical disturbances and their roles in weather processes and the ITD
- To appreciate the physical processes of energy transfer from the sun to the earth surface and its application

MARINE METEOROLOGY: (BIP 221)

1. Introduction

   General introduction of marine meteorology and Definitions.
   Water coverage, Air-Sea interaction.
   Uses of marine meteorology information etc.

2. Marine Meteorology Service [MMS]

   Purpose and principles of MMS.
   Data acquisition, Voluntary Observing Ship (VOS) and
   Ship of Opportunity (SOO)
   Mobile and fixed Sea Stations.
   Components of MMS
   Services to high sea,
   Services to control and offshore areas;
   Services to Main ports and harbours; Port Meteorological Officer,
   Training in field of Marine meteorology Observation
   Importance of marine meteorological observation.
   Marine meteorological variables: Definition, general description of the variables and their importance.
   Visibility at sea.
   Dissemination of marine meteorological information.

3. The Ocean and Measurement of Current

   Oceans and their Dimensions
   Hydrostatic pressure, illumination and temperature of the Ocean, Thermoclines. Salinity and its measurements.
   Ocean Current; Definition and methods of measurement.

4. Sea Surface Temperature [SST] and its sub Surface Temperature. (S.S.T).

   Definition and uses of Sea Surface Temperature. (SST).
   Methods of measurement of SST.
   Diurnal and horizontal variation of SST.
   Influence of SST on weather
   Effects of temperature on marine life.
   Measurement of Sub Surface Temperature
   (Bathythermograph and reversing thermometer).

5. Marine Meteorological Codes and Ship messages

   Need for codes, marine meteorological log book.
   Ship messages: Selected, Supplementary and Auxiliary ship Messages.
   Marine Meteorological coding and decoding.

6. Ocean Waves

   Atmosphere Turbulence, Sea Waves, Swells and Waves Characteristics.
   Wave formation and growth.
   Relationship among wave characteristics in deep and shallow water
   Wave measurement [wave recorder].
   Measurement of sea state: Beaufort's scale and its limitations.
   Storm surges, tides, tidal waves etc.
   Coastal up welling.

7. El Nino/Southern Oscillation [ENSO]

   Description and causes of EL NINO, LA NINA and Southern Oscillation.
   Influence of EL NINO on global weather pattern.

8. Role of Marine Meteorological services in life saving, rescue operations and pollution monitoring. Sea level change.
   Relationship between climates and sea level change.
   Climate and tectonic factors responsible for global sea level rise.
   Temporal variability.
   Estimation of sea level change

LEARNING OUTCOMES ON MARINE METEOROLOGY

- To give background knowledge to understanding the marine environment

- To familiarize the students with the functions of the national meteorological services

ELECTRICITY: (BIP 222)

1. Electrostatics:
   Positive and negative charges, C onductors and insulators.Coulomb Law, Permittivity, Economic importance.
2. Electric fields:
   Equipotentials, Potential due to a point charge and conducting sphere. Field Strength, electric potential, potential gradient.
3. Chemical effect of current:
   Ohm's law, resistance in series and parallel, potential difference, internal resistance and loads. Primary and secondary cells; polarization. Kirchoffs law.
4. Heating effect of current:
   Electrical energy and power. Mechanism of heating effect. Theory of heat conduction; Power rating of resistors, high tension transmission.
5. Electromagnetism:
   Magnetic field – straight wire, circular coil and solenoid. Biot -savart law. Force on a conductor; Fleming's rule, cork screw rule. Moving coil instruments; couple in a magnetic field.
6. Electromagnetic induction:
   Lenz's law; magnitude of E.M.F.; flux linkages; induction coil. Applications of Induction – Dynamos, generators and the transformer. Eddy currents; Alternating currents; back E.M.F.

LEARNING OUTCOME ON ELECTRICITY

To enable the students understand the physical laws of the atmosphere and apply them to the study of meteorology

METEOROLOGICAL PRACTICALS (BIP 223)

1. Definition of various Isolines
2. Rules governing Analysis/Nature of Analysis
3. Types of Charts used in Analysis
4. Analysis of various elements (Surface and Upper Air)
5. -Temperature, Wind, Humidity, Dew point, Divergence, Vorticity etc
6. Introduction to Numerical weather Prediction
7. Tephigram: Analysis & Interpretation.

LEARNING OUTCOME ON METEOROLOGICAL PRACTICALS

- To be able to identify and understand the principle behind the formation and associated weather events

- To be able to understand the concept of weather developments at different scales over point location

- To be able to identify the various synoptic features, meteorological charts and imageries and their effects

- To be able to identify the various synoptic features meteorological charts and imageries and their effects

- To be able to evaluate the recent technology used for the display of weather systems, their benefits and shortcomings

SATELLITE METEOROLOGY: (BIP 224)

1. Basics in remote sensing Physics behind remote-sensing
2. Introduction to History of meteorology satellites
3. Satellites-data acquisition, processing and archiving
4. Satellite orbits, characteristics and radiometers
5. Satellite data acquisition, processing and data management.
6. Satellite image analysis, display and interpretation
7. Application of satellite imagery both in the visible and infrared
8. Regions for the analysis and interpretation of weather systems.
9. Case-studies, that is, a series of practical examples to examine a range of Meteorological events over the African continent, tropics and mid-latitude with emphasis on the application of satellite Meteorology to public weather forecast, Aeronautical Meteorology and Agro-meteorology.
10. Future of satellites meteorology

LEARNING OUTCOME ON SATELLITE METEOROLOGY

- To be able to identify hydrometeors and their method of observation

- To be able to conduct necessary observations and understand the techniques

- To be able to identify the various synoptic features of meteorological charts and imageries and their effects

- To be able to identify clouds and their associated characteristics and formation

RESEARCH METHODOLOGY: (BIP 225)

1. The concept of research, types of research, characteristics of research, ethical issues in research.
2. Research Agenda

2.1 Topic selection- Interest, Originality, Research ability, Significance, Feasible in Time and fund
2.2 Introduction, Problem definition, Background of study, Preamble etc
2.3 Objectives of study
2.4 Significance of Study
2.5 Research Questions
2.6 Hypothesis of Study
2.7 Scope of Study in time and space
2.8 Limitations /Problems of Study
2.9 Definition of terms
2.10 Theoretical framework and Literature review
2.11 Methodology: Instruments, Administration, Sources of Data, Questionnaires
2.12 Analysis, Discussions & Illustrations
2.13 Summary, Conclusion and Recommendations
2.14 References
2.15 Appendix

FIELDWORK; (226)

This is a week study of meteorological, hydrological and geographical phenomena that influence weather and climate. Impact of weather and climate on Agriculture, Water Resources, coastal areas, tourism and desertification are studied. While NIMET takes care of transportation and accommodation of Staff and Students, the Students will take care of their feeding. This study will take place in any part of the Country or West African Sub-region

PHYSICAL METEOROLOGY: (BIP 231)

1. Introduction to the subject
2. Definitions, Clouds, Fog and precipitation. Basic knowledge of their Formation. Fog classification and artificial rain, visibility, meteors.
3. Influence of the surface tension of rain drops and of the hygroscopicity of the nuclei on saturation pressure;
4. Process of raindrop formation.
5. Cooling of the air due to adiabatic and non-Adiabatic processes.

6. Cloud structure and evolution dynamics.
   i. Frontally generated cloud
   ii. Cumuliform clouds
   iii. Orographic clouds
   iv. International cloud classification
7. Static Electricity and Electrostatic phenomenon -
   i. Elements of Atmospheric Optics and Electricity, Refraction, rainbow, Halo, Corona Blue sky.
   ii. Transparency of the atmosphere. Types of atmosphere – Constant lapse rate, Homogenous, Isothermal and Adiabatic.
   iii. Relationship between static electricity and atmospheric phenomena.
   iv. Lightning discharge and thunderstorms.

LEARNING OUTCOMES ON PHYSICAL METEOROLOGY MEDIUM LEVEL

- To understand movement of air constituents
- To be able to identify clouds and their associated characteristics and formation
- To understand the processes leading to cloud formation and triggering processes/ propagation and regeneration
- To understand their formation and effect in the hazardous weather
- To appreciate the concept of atmospheric phenomenon
- To be able to identify hydrometeors and their method of observation

DYNAMIC METEOROLOGY: (BIP 232)

1. Concept of dynamic meteorology compared with synoptic and Physical Meteorology, physical dimensions and units.
2. Atmospheric scales; pressure gradient, gravitational, centrifugal, gravity and coriolis forces, equation of motion in a simple form, geostrophic wind, wind and pressure near the equator; gradient wind and comparison with geostrophic wind, trajectories and streamlines, cyclostrophic wind; flow within the planetary boundary layer (cross-isobaric flow)
3. Ageostrophic and Isallobaric winds. Hydrostatic equilibrium and Hypsometric equation and uses. Thermal wind, divergence, convergence and vertical motion. Intensification and deepening of pressure systems. Vorticity (relative and absolute). Formation of cyclones and anti cyclones. Turbulence and gustiness, eddies and vertical transport of matter, clear-air turbulence.

LEARNING OUTCOMES ON DYNAMIC METEOROLOGY

- To be able to identify the hazardous weather situations and their socio-economic importance to the area of consideration
- To be able to understand the concept of mesoscale systems in the tropics
- To understand the concept of air flow and its role of wind and its effect to weather development
- To be able to understand and explain the concept of airmasses and the modification.
- To be able to understand the connection between tropical and extra-tropical systems

SYNOPTIC METEOROLOGY: (BIP 233)

1. Introduction and Definition of Synoptic Meteorology.
2. ITD and the associated weather zones. Waves and jet streams, land and Sea breeze, anabatic and Katabatic winds. Evolution and Dynamics of west African line squall.
3. Tropical Weather systems. Trade inversions trade winds, Tropical/subtropical jet streams, and other broad wind systems. Rainfall, Tropical cyclones, monsoons. Characteristic patterns of cloud associated with easterly waves, seasonal evolution of the tropical wind systems, and the inter-tropical convergence zone; annual cycles.
4. Mid-latitude synoptic systems. Air-mass concept; source areas; formation processes for air-masses. Air-mass modification; thermodynamic and dynamic changes; boundary/interface between two adjacent air masses; the slope of steady-state frontal zones; frontal-wave depression.
5. General circulation

LEARNING OUTCOME ON SYNPOTIC METEOROLOGY MEDIUM LEVEL

- To Be Able To Identify Clouds And Their Associated Characteristics And Formation
- To Be Able To Understand The Importance Of The Global Atmosphere And Its Spatio-Temporal Variability
- To Be Able To Identify The Various Synoptic Features Meteorological Charts And Imageries And Their Effects

- To Be Able To Understand Tropical Disturbances And Their Roles In Weather Processes And The ITD
- To Be Able To Understand The Connection Between Tropical And Extra-Tropical Systems
- To Understand The Processes Leading To Cloud Formation And Triggering Processes/ Propagation And Regeneration

- To Be Able To Understand The Concept Of Mesoscale Systems In The Tropics
- To Be Able To Understand And Explain The Concept Of Airmasses And The Modification.
- To Be Able To Identify The Hazardous Weather Situations And Their Socio-Economic Importance To The Area Of Consideration

ON THE JOB TRAINING (OJT): (BIP 234)

The OJT will be carried out for three months.

1. The Student will be divided into groups.
2. Each group will be sent to each section including Ikeja (Forecast office).
3. The students are to be supervised by the RTC instructors.
4. At the end of the OJT they are to submit their logbooks dully signed by the head of the section. And also present a written report.

LEARNING OUTCOMES ON ON THE JOB TRAINING (OJT)
To have more practical knowledge of meteorology on the job

PROJECT: (BIP 235)

Students may choose a title of his/her project work with relevance to Meteorology/related field and to be supervised by RTC instructor. There is going to be an oral presentation defence of the project and to be graded alongside with the class work. Once the project is completed, students are to submit three bound finished copies to the office of program Director. The colour of the project cover is green.

LEARNING OUTCOMES ON PROJECT
To be able to explain and analyse specific weather phenomenon/ variables and produce findings, conclusions and recommendations

COURSE CONTENT AND CURRICULUM
FOR BASIC INSTRTUCTIONAL PACKAGE METEOROLOGICAL TECHNICIAN (BIP-MT SENIOR LEVEL).

FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 311	Hydrometeorology	3	Core
2	BIP 312	Physical Meteorology	3	Core
3	BIP 313	Research Methodology	3	Core
4	BIP 314	Calculus	3	Core
5	BIP 315	Satellite Meteorology	3	Core
6	BIP 316	Agrometeorology	3	Core

SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 321	Differential Equations	3	Core
2	BIP 322	Synoptic Meteorology	3	Core
3	BIP 323	Aeronautical Meteorology	3	Core
4	BIP 324	Synoptic Meteorological Practicals	3	Core
5	BIP 325	Statistics	3	Core
6	BIP 326	Field Work	3	Core

THIRD SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 331	Dynamic Meteorology	3	Core
2	BIP 332	Thermodynamics	3	Core
3	BIP 333	Climatology	3	Core
4	BIP 334	Vector Analysis	3	Core
5	BIP 335	Project	4	Core

HYDROMETEOROLOGY: (BIP 311)

1. Hydrology, Hydrometeorology; Definitions and Explanations
   Water bodies of the world, Role of water in Economic Activities of Nations:
2. Physical: properties of water cycle on the globe: physical properties of Water; the hydrological cycle on the earth; ground water; origin and Classification of ground water; physical properties of rocks in relationship to water; physical states and movement of ground water; ground water

and its relationship to rivers; confined aquifer ground water and its role in the river feeding; Lakes and reservoirs; morphology of lakes; sources of inflow to lakes; water balance of lakes; dynamic phenomena on lakes (Waves and currents).

3. Heat regime of lakes; chemical composition of lake water; biological processes in Lakes; reservoirs, their regime and water balance; swamps; formation and classification of swamps; hydrological regime of swamps; formation and movement of glaciers, their influence on river inflow and regime.
4. River system; river basins; river valleys and channels; sources of river Flow; temperature regime of rivers; regime of river stages; movement of water in rivers; flow velocity; discharge in rivers, hydrograph analysis; sediment transport; chemical composition of river water; channel formation processes; water balance and runoff; units used to measure runoff and flow; water balance and runoff units used to measure run off and flow; water balance of bodies of water.
5. Calculation of evaporation from the surface of basin;
   Average long-term annual runoff: distribution of annual runoff in
   Months and seasons; flow duration curves, mass diagrams and
   Storage Behaviour diagrams; maximum discharge and its calculation; Minimum flow and its calculation; sediment discharge and its calculation.
6. General alter Balance equation
7. Hydrograph Analysis Knowledge of flood regime of a stream, intelligent design of a wide. Variety of hydraulic structures such as bridges and culvert openings. Reservoir spillways and flood control works of all sorts.

LEARNING OUTCOME ON HYDROMETEOROLOGY

To understand the components of the water cycle and its applications

PHYSICAL METEOROLOGY: (BIP 312)

1. The sun, earth and electromagnetic radiation. Features of the Sun, motions of the Earth; seasons; duration and intensity of sunshine ; solar radiation; types of heat transfer radiant energy and light; blackbody radiation; emissivity, absorptivity and trasmissivity. Qualitative discussion of radiation laws Kirchhoff, Plank, Stetan-Bolzman, Wien; scattering; absorption of the radiant energy in the atmosphere; albedo of natural surfaces; upper surface of clouds, land surfaces, water greenhouse effect. The heat balance of the atmosphere; terrestrial radiation; the free atmosphere radiation; radiation flux; the earth heat balance.
2. Introductory atmospheric thermodynamics. Vertical structure of the atmosphere; Distribution of temperature and pressure; troposphere; stratosphere; tropopause; upper atmosphere; adiabatic process hydrostatics balance; geopotential; The laps rate; vertical stability.
3. Atmospheric moisture; condensation process. Water vapour; change of phase; vapour pressure; saturation; absolute and specific humidity;
   relative humidity; temperature of dew point. Change of phase;

adiabatic process at saturation; reversible adiabatic and pseudo adiabatic condensation process; formation of clouds and precipitation; wet-bulb temperature; thermodynamics diagrams; tephigram; conditional and convective instability.

4. Atmospheric motion; geostrophic flow. Atmospheric pressure; gravity; pressure gradient force; hydrostatic balance; carioles forces; geostrophic wind; variation of wind and temperature with height; upper winds; frictional force. Orographic effects; local winds; convection; elements of atmospheric turbulence.

5. Element of atmospheric optics and electricity. Atmospheric refraction, rainbow, halo, corona, blue of the sky; transparency of the atmosphere and visibility; air conductivity, lightning discharge and thunderstorms.

6. Energy balance of the upper atmosphere; photo ionization; photo dissociation of oxygen; ozone layer.

7. Cloud and precipitation; water cycle Evaporation; condensation and sublimation; saturation vapour pressures over liquid and solid; relative and specific humidity; suspended particles. Formation of fogs, mist and cloud; cloud condensation nuclei. Growth of a drop by condensation cloud droplets growth by collision and coalescence.

LEARNING OUTCOME ON PHYSICAL METEOROLOGY

To enable the students understand the physical processes of energy transfer from the sun to the earth surface

RESEARCH METHODOLOGY: (BIP 313)

1. Introduction to research method. What constitutes research? An overview of Methodologies and Methods. Definition of Research Methodology:

2.Types of Research: Qualitative research, Applied research, Theoretical research. Research ethics characteristics of research of researcher

3.Measurement and Scaling. Nature of measurement, Levels of Measurement, Validity, Reliability, Reasons for using scales.

4.Selecting and defining a research problem.

Why the need for problem formulation? Criteria for selecting a problem.

Choosing a Methodology. Evaluating problems. Hypothesis and its functions

5.Theoretical framework and Literature Review. What is literature review? Why the needs for literature review? How to carry out a literature review?

6. Sampling.Reasons, Problems and Principles of sampling. Types of Sampling. Sampling in Qualitative Research.

7.Data Collection.Methods of data collection – direct and indirect methods.

8.Data Analysis. Research.Data Presentation and analysis /interpretation abd discussion. Central Tendency and Dispersion, Associations,

Tests of Significance.

9.Summary of findings ,recommendation, conclusion.

Referencing.

LEARNING OUTCOME ON RESEARCH AND METHODOLOGY

To be able to apply research skills and methods in a research project work

CALCULUS: BIP 314

1. FUNCTIONS: Functions of a real variable, limits, continuity, differentiability, Rolle's theorem, mean value theorem and leibnitz's formula.
2. INFINITE SERIES: Taylor series, Maclaurin series, convergence of power series.
3. PARTIAL DIFFERENTIATION: First derivatives, function of a function, Higher order derivatives, Total derivatives and Exact differentials.
4. LINE AND MULTIPLE INTEGRALS: Properties of line integrals, line integrals around closed plane curves, connectivity, line integrals independent of path, properties of double integrals, properties of triple integrals, cylindrical coordinates, physical applications of triple integration.
5. DETERMINANTS: Definitions, properties of determinants, products of two determinants, Jacobians and wronskians.
6. COMPLEX VARIABLE: Introduction, the exponential functions, circular functions and De moivre's theorem.

LEARNING OUTCOME FOR CALCULUS

To develop the calculative skill in relation to the scientific nature of the atmosphere

SATELLITE METEOROLOGY: (BIP 315)

1. Basics in remote sensing Physics behind remote-sensing
2. Introduction to History of meteorology satellites
3. Satellites-data acquisition, processing and archiving
   Satellite orbits, characteristics and radiometers
   Satellite data acquisition, processing and data management.
4. Satellite image analysis and interpretation
   Satellite image analysis, display and interpretation
   Application of satellite imagery both in the visible and infrared
   Regions for the analysis and interpretation of weather systems.
5. Case-studies, that is, a series of practical examples to examine a range of Meteorological events over the African continent, tropics and mid-latitude With emphasis on the application of satellite Meteorology to
   Public weather forecast
   Aeronautical Meteorology and
   Agro-meteorology.
6. Future of satellites meteorology

LEARNING OUTCOME ON SATELLITE METEOROLOGY

- To be able to identify hydrometeors and their method of observation
- To be able to conduct necessary observations and understand the techniques
- To be able to identify the various synoptic features of meteorological charts and imageries and their effects
- To be able to identify clouds and their associated characteristics and formation

AGROMETEOROLOGY: (BIP 316)

1. Introduction, Definition, aims, Scope, Objective and relationship between Agricultural meteorology and other allied discipline.
2. The relationship between weather and agriculture, soil, plants, farm animals

(Livestock); diseases and pest of crops and animals, farm building and equipment. Artificial modification of meteorological and hydrological regimes.

3. The history of Agriculture and its relationship with association science. Agricultural Ecology and Ecosystem Distribution and Classification of Vegetation belts in Nigeria. Weather and climatic modification
4. General production practice of field crops, crop production e.g. Maize Production factors for optimum yield of field crops. Factors affecting crop yield; Environmental factors – rainfall, CO_2, temperature, radiation, wind, light, evaporation water supply, nutrient, weed, pest and disease soil physical condition. Plant population, field of individual plant and community.
5. Plant protection definition of pest, important of pest. Important of plant protection. Types of Pests: Polyphagous pest, Locusts, Termites, Bihar hairy Caterpillar, Cutworm, Greasy Cutworm, Damage caused by locust phase. Theory of locust, life cycle of locusts and control.
6. Phenology Definition of phenology Method of phonological observations. Different phases of phonological

   Observation in different crop plants.
7. Agrometeorological elements and their methods of observations.

Definition, climatic elements, Biological elements, conditions of observation, Agrometeorological station and Networks, Observation of physical elements, Observation of biological Character/Elements, Detail observation of high accuracy.

1. Climatic normal for livestock's: poultry birds, Goat, Sheep, Pigs and Cattle. Meteorological equipment of crop plants for rice, sugar cane, cotton, maize, potatoes etc. Animal's production systems, uses of animals. Outdoor animals and Meteorological elements.

9. Water and the Hydrological Cycle in Agriculture moisture characteristics of soil water and vegetation. Determination of water loss from land surface fundamental of the evaporation process.

   Existing methods of determining evaporation Energy balance of estimating evaporation. Aerodynamic estimation of evaporation combination model methods of penman and others. Development of original penman equation.

   Evaporation formulae of priestle – Taylor and Penman – Monteith special forms of precipitation Dew, Snow, soil moisture Budgets – Irrigation needs

LEARNING OUTCOME FOR AGROMETEOROLOGY

- To understand the effect of meteorological and climatic data to crops and livestock
- To employ meteorological information to improve agricultural products

DIFFERENTIAL EQUATIONS: (BIP 321)

1. Differentiation and integration of simple functions, exponential functions, logarithmic functions and inverse trigonometric functions.

2. Partial derivatives; total differential and total derivatives.

3. Ordinary differential equations: equations of first order and degree; equation of higher degree; homogeneous and inhomogeneous equations.

4. Partial differential equations: linear partial differential equations of first and second order dent variables; the wave equation in one dimension; the vibrating string; normal modes of vibration and heat equation.

SYNOPTIC METEOROLOGY: (BIP 322)

1. West African line squalls

Definitions, formation, structure, propagation and maintenance. In-situ development, deep mesoscale convection systems. Importance to national economy.

2. Harmattan dust haze

Definition, concept of plume, Mechanics of dust raising and transportation. Role of gravity in dust deposition, Clearance of dust haze, Frequency of dust spells. Behaviour of Saharan high pressure cell and mid- latitude trough, Dust particles as pollutants. Economic aspects in relation to human health, aviation and other sectors of the economy.

3. Monsoons

Theory of global monsoon circulations. West African Monsoons-onset, maintenance, cessation and failure, Baroclinicity, energetic and vertical wind profile. Consequences of late onset and failure.

4. Little Dry Season (LDS)

Definition, period of occurrence and area affected. Associated synoptic features, Aspects of divergence, vorticity and intensity. Critical temperature for onset and cessation.

5. Atmospheric general circulation

One and three cellular models, Hadley and Ferrell cells, Establishment of wind and pressure systems globally. Energy exchange, creation of solenoidal fields. Application of Monsoons tilts at troughs and
Redistribution of Meteorological quantities. Angular momentum balance.

6. African waves

Origin and formation, structure, dynamics and stability criteria. Evolution of weather types.

7. Forcing function in West African

Definition, concept of forcing functions. Influence of various forcing functions over West Africa. Location and structure of forcing functions e.g. African Easterly Jet (AEJ).

8. Frontal systems

Mid-latitude and polar fronts. Cold front, warm front and occlusion. Association weather and synoptic features, Linkage with tropical systems. Dynamics of frontal systems.

9. Inter-tropical Discontinuity (ITD)

Definition and characteristics. Dynamics, the three-dimensional structure, Association weather zones and concept of monsoon trough.

10. Wide-spread wet spells;

Low level convergence and upper level divergence. Condition for sustained vertical motion. Circulation in vertical planes and solenoidal field.

11. West African Jets;

African Easterly Jet – Location, existence period, structure, dynamics and influence on propagation storms. Tropical Easterly Jet – structure, dynamics, period of existence, location and influence on weather.

LEARNING OUTCOME ON SYNPOTIC METEOROLOGY SENIOR LEVEL

- To be able to understand and explain the concept of air masses and the modification.
- To be able to identify the various synoptic features meteorological charts and imageries and their effects

AERONAUTICAL METEOROLOGY: (BIP 323)

1. General Aviation Services.
2. Brief history of aviation and aeronautical meteorology. Operation aspects. Flight preparation. Flight plan. Meteorological service.
3. Hazardous Phenomena
4. Aircraft Icing, fog, Turbulence, Volcanic ash: Their formation of icing, elementary knowledge of icing types, accretion rates and association

of icing with cloud (stratiform and cumuliform clouds), freezing precipitation, orographic and frontal lifting.

5. Thunderstorms:Formation conditions, types of thunderstorm. The thunderstorm cell, aviation hazards, squall line thunderstorm hazards, hail hazards, hail formation, hail prediction and prevention lightning. Avoidance of thunderstorms.
6. Wind Shear: Low-level wind shear associated with marked inversion and/or low-level jet streams. Winds shear in the approach and landing phases of flight. Topographic winds shear.
7. Meteorological service for International Air Navigation
8. Terminology. Area forecast centres. Aeronautical meteorological offices. Aeronautical meteorological stations. Observations made at
9. Aeronautical meteorological stations. Meteorological reports from aeronautical meteorological stations. Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SPECIAL and SPECI). Aerodrome forecasts. Forecasts for take-off. Landing forecasts (trend type).
10. Wind shear and Aerodrome warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of meteorological messages. Information for search and rescue. Aeronautical climatological information.
11. Information for operations' local representatives. Information requires from operators. Information for pilots-in-command prior to departure. Information for pilots-in-command during flight. Debriefing.
12. Definitions should include:
    Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level transitional level. Aerodrome minima, instrument runway, landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report, operator, operator's local representatives and pilot-in-command.
13. Operation of Aircraft
    Flight planning: Definition, flight planning services, sources of meteorological information, available meteorological information, flight planning requirements and significance of meteorological information. Duties of flight operation officers when exercising operational control. Principles of flight. Air density and aircraft performance. Standard atmosphere. Density altitude other factors affecting aircraft performance. Fuel consumption. Radio meteorology. Effects of meteorological phenomena on ground communications. General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and landing. Flight planning aspects. Aerodrome meteorological minima.
14. Aeronautical telecommunications
    Understanding the general organization of aeronautical telecommunication; Operation of the Aeronautical Fixed Service

including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message headings, addressing of messages, priorities of messages, ICAO abbreviations used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should include: Meteorological Data Distribution (MDD), RETIM (SYNERGIE-PC), SATCOM, Primary Data User System (PDUS), MESSIR-VISION, MESSIR-COM, the Global Telecommunication System (GTS) and all latest available systems or facilities.

15. Air Traffic Services
    Definitions. Flight rules. The nature of air traffic services. Air traffic control service. Area control service. Approach control service. Aerodrome control service.
16. WMO and ICAO Documentation: Technical Regulations, (WMO-No.49), Vol.II – Meteorological service for International Air Navigation. Manual on codes (WMO-No.306). Guide on Meteorological Observation and Information Distribution System at Aerodrome (WMO-No.731). Guide to practices for Meteorological Offices Serving Aviation (WMO-No.732). Guide to .Meteorological instruments and Methods of observation (WMO-No.8). Weather Reporting (WMO-No.9).

LEARNING OUTCOME ON AERONAUTICAL METEOROLOGY

- To be able to determine the products and services that are generated and how to sell them to the public
- To familiarize the students with the functions of the national meteorological services

SYNOPTIC METEOROLOGICAL PRACTICALS: (BIP 324)

1. Definition of Analysis
2. Composition/Design of various Charts
3. Types of elements and the charts used
4. Rules governing Analysis/Nature of Analysis
5. Types of Analysis and available
   Surface
   Upper Air
   7. Frontal
6. Importance of the above to science of Meteorology
7. Practical Exercise
8. The use of PDUS, AFDOS, Messir vision and Radar in Meteorology and Global Model Charts
9. Synoptic Systems Theory
10. Dust Haze, Fog, Thunderstorms/Line Squall

LEARNING OUTCOME ON SYNOPTIC METEOROLOGICAL PRATICALS SENIOR LEVEL

- To Understand The Principles Behind The Formation And Associated Weather Events
- To Be Able To Appreciate The Concept Of Weather Developments At Differennt Scales Over Point Location
- To Be Able To Identify The Various Synoptic Features Meteorological Charts And Imageries And Their Effects
- To Be Able To Eveluate The Recent Technology Used For The Display Of Weather Systems, Their Benefits And Shortcomings
- To Be Able To Describe Processes And Principles Of Nwp As Well As Interpreting NWP Products

STATISTICS: (BIP 325)

1. Graphical representation of data; finding the mean, median and mode of grouped data; Quartiles, percentiles, deciles etc.
2. Regression and Correlation
3. Scatter graphs, Relationships between two variables and scatter graphs (construction, line of best fit, and estimate from scatter graphs significance of the scatter graph, limitations of scatter graph) computing regression lines equation; method of least squares, measuring the deviation; the regression of y on x; graphing regression lines; the use of regression lines; choice of regression line and regression coefficient.
4. Correlation (computation of r; interpretation of r; types of correlation; Rank correlation r^1; the equation of a least square line and fitting the data; Multiple linear regression and non-linear regression.
5. Probability

Conditional probability; independent and dependent evens; mutually exclusive events; Mathematical expectation; permutations and combinations. Probability distributions, the binomial distribution, the Poisson distribution, Properties of the Normal distribution. The relation between binomial and normal distribution.

6. Estimation

Tests of significance; testing a hypothesis; the null hypothesis, testing the null hypothesis, rejecting of the null hypothesis, non-rejection of the null hypothesis, confidence level. Venn diagrams.

LEARNING OUTCOME ON STATISTICS SENIOR LEVEL

To analyse and interpret climatic data

Fieldwork (BIP 326)

This is a week study of meteorological, hydrological and geographical phenomena that influence weather and climate. Impact of weather and climate on Agriculture, Water Resources, coastal areas, tourism and

desertification are studied. While NIMET takes care of transportation and accommodation of Staff and Students, the Students will take care of their feeding. This study will take place in any part of the Country or West African Sub-region

LEARNING OUTCOME ON FIELDWORK (BIP 326)

- To expose the students to the natural forces that influence weather and climate.
- To have a practical knowledge on how weather and climate impact on agriculture, water resources, urban dwellers, tourism, transportation, commerce and industry, energy and power, among others.

DYNAMIC METEOROLOGY: (BIP 331)

1. Atmospheric scales, Discussions on pressure gradient, gravitational, frictional, centrifugal, Gravity and carioles forces, total local derivatives, transformation from non-rotating co-ordinate system; equation of motion and vector form as derived from Newton's second law, Equation of motion in spherical co-ordinates (tangent plane approximation); scale analysis leading to simplified equations.

2. Introduction to hydrostatic approximation, justification for this approximation, equation of quasi-hydrostatic motion using pressure as vertical co-ordinate.

3. Horizontal balanced motions, motion with no tangential acceleration, geostrophic and gradient wind relations, comparison of geostrophic and gradient wind, geostrophic thermal wind, streamlines and trajectories, barotrophic and baroclinic atmosphere, thermodynamic energy equation, continuity equation, divergence of three dimensional and horizontal wind fields, vertical motion, vortices and circulation, Bjeknes' circulation theorem, introduction to stream friction and velocity potential, Rossby long waves, brief description of the baroclinic waves and baroclinic instability.

4. Angular momentum of the atmosphere about the earth's axis; relative and absolute momentum; balance of angular momentum; meridional transport by atmospheric disturbances; relation between this transport and zonal circulation; the balance of the atmospheres' kinetic energy internal energy; production, destruction and transport of energy; role of Baroclinicity; the energy circle of the general circulation; influence of oceans, continent and large scale orographic features on general circulation.

5. The nature of turbulent flow, flow near a boundary, the mixing length hypothesis; velocity profile near a boundary (smooth surface, rough surface); power-law profile; statistical theories of turbulence; eddy transport or momentum, heat and water vapour with planetary atmosphere boundary layer; the heat flux equation and the problem of convection; Richardson criteria; forced free convection.

LEARNING OUTCOME ON DYNAMIC METEOROLOGY SENIOR LEVEL

- To understand the processes leading to cloud formation and triggering processes/ propagation and regeneration
- To be able to describe processes and principles of nwp as well as interpreting nwp products

THERMODYNAMICS: (BIP 332)

1. Object of thermodynamics; thermodynamic system – definition, exchanges of energy and matter with the external world; closed and open systems; physical state of a system, variables of state, (p.v) systems, Clapeyron's diagram.

2. Temperature scales (Celsius, Fahrenheit, Kelvin); variables of state and the equation of state of a system; homogenous and non-homogenous system; thermal expansion of solids, liquids and gases – the laws of Boyle Mariotte, GayLussac, Avogadro and Dalton (gas mixtures); equation of state of a gas – perfect gas and van deer Waals' gas.

3. Definition of heat, quantity of heat, calorie, thermal conductivity, specific heat, case of gases, heat of change of phase, heat of reaction; calorimetric.

4. First law of thermodynamics; various forms of energy (work, heat, electricity, chemical, etc.); principle of conservation of energy; principle of the equivalency of heat and work (joule); internal energy, enthalpy; work accomplished by the expansion of an ideal fluid; reversible exchange of work and heat; adiabatic transformation, case of perfect gas.

5. Second law of thermodynamics

Entropy of a system, Entropy change as a function of potential temperature. Irreversibility –concept of statement of second law of thermodynamics.

LEARNING OUTCOME ON THERMODYNAMICS SENIOR LEVEL

- To Understand Movement Of Air Constituents
- To Be Able To Describe Processes And Principles Of Nwp As Well As Interpreting Nwp Products

CLIMATOLOGY: (BIP 333)

1. General climatology, notion of climate, definition of climate physical factors of climate, importance of heat, radiation and humidity in climatology.
2. Astronomical and geographical factors: notion of solar climates; influence of latitude environmental influence on climate; effects of distribution of sea and land; degree of continentality; effects of water masses
3. Climatic elements: mean climatic elements, classification, representation (mean, sum, frequency, normal, and variability), instruments and method of observation for various climatic elements.

4. Physical climatology: notion relating to the radiation, heat, energy and water balances, elementary notions on diffusion and turbulence; comparison of normal values and variability of climatic elements at the various latitude.
5. Dynamical climatology: general atmospheric circulation; centres of activity and types of climate associated with them; climatologically aspects of dynamical meteorology; representation of climatologically data.
6. Synoptic climatology: grouping of climatic elements according to the nature of the air masses; mean or frequency of climatic elements associated with types of weather; geographical distribution of fronts; frontal zones and air masses and climatological phenomenon associated with them. Regional meteorology: description of the climate of the globe; climatology of the region or country where the training is given qualitative description, numerical data, maps and atlases.
7. Meso and micro climatology: general principles, concepts and definitions; examples of microclimates.
8. Bioclimatology: general principles, concepts and definitions; bioclimatology related to the various human activities and associated fields.

9. Applied climatology: general notions on the application of climatology to the various human activities (agriculture, aeronautics, marine, public work, transport ,etc.), Climatic changes: basic notions
10. Special climatological methods: climatological statistics: emphasis is on the practical aspects.
11. Machine processing of climatological data: punched cards, magnets tapes, punched tapes; use of computer: programming (principles and simple application).

VECTOR ANALYSIS – VECTOR ALGEBRA AND VECTOR CALCULUS: (BIP 334)

1. Introduction-definition and examples of scalar and vector quantities, Representation of a vector; vector fields, scalar fields.
2. Vector Algebra – addition, subtraction and multiplication of vectors, the null Vector, magnitude of a vector; unit vector; law of vector algebra.
3. Components of vectors – vectors in two and three dimensions, etc.
4. Cartesian system of reference direction in two and three dimensions-Magnitude of a vector in the Cartesian system.
5. Direction Cosines – definition of, angles between two angles in Cartesian components; etc.
6. Relative vectors – position vectors, velocity acceleration vectors, Division of a line in a given ratio, co linearity of points
7. Scalar or dot product of two vectors, properties of the scalar product; special cases of the scalar product, work and scalar product
8. Vector or cross product of vectors, properties of the vector product, Applications of the vector product, Cartesian form

9. Vector equation of a straight line, position vector of a point on a circle
10. Scalar triple products and vector triple products
11. Derivative of a vector function – definition, space curve, partial derivative of Vectors, velocity vector, application of vector in mechanics
12. Gradient field, Divergence of a vector and Curl of a vector – the vector Differential operator Del, the gradient, the divergence, the curl; some Formulae involving Del.
13. Application of vectors to geometry;
14. Vector identities (reciprocal set of vectors);
15. Vector Integration.

LEARNING OUTCOME ON VECTOR SENIOR LEVEL

To Develop The Calculative Skill In Relation To The Scientific Nature Of The Atmosphere

PROJECT: (BIP 335)
Students may choose a title of his/her project work with relevance to Meteorology/related field and to be supervised by RTC instructor. There is going to be an oral presentation defence of the project and to be graded along side with the class work. Once the project is completed, students are to submit two bounded finished copies to the office of program Director. The colour of the bound copies is light green.

LEARNING OUTCOME ON PROJECT (BIP 335)
To develop the skills of analysing specific weather phenomenon/ variables and produce a **project report**

FUNDAMENTAL METEOROLOGY COURSE FOR GRADUATES

COURSE CONTENT

FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 411	Upper Air Observation	3	Core
2	BIP 412	Codes And Observations	4	Core
3	BIP 413	Meteorological Instruments	3	Core
4	BIP 414	Plotting	3	Core
5	BIP 415	Aeronautical Meteorology I	3	Core
6	BIP 416	Agrometeorollogy	3	Core
7	BIP 417	Marine Meteorology	3	Core
8	BIP 418	Field Work/Studies	4	Core

SECOND SEMESTER

S/N	COURSE CODE		UNITS	STATUS
1	BIP 421	Climatological Return	3	Core
2	BIP 422	Research Methodology	2	Core
3	BIP 423	Synoptic Meteorology	3	Core
4	BIP 424	Synoptic Meteorology Practicals	3	Core
5	BIP 425	Aeronautical Meteorology II	3	Core
6	BIP 426	Climatology	3	Core

THIRD SEMESTER

S/N	COURSE CODE	COURSE TITLE	UNITS	STATUS
1	BIP 431	Hydrometeorology	3	Core
2	BIP 432	Dynamic meteorology	3	Core
3	BIP 433	Thermodynamics	3	Core
4	BIP 434	Satellite Meteorology	3	Core
5	BIP 435	Project	6	Core
6	BIP 436	On the Job Training (OJT)	4	Core

UPPER AIR OBSERVATION (BIP 411)

1. General – Units of measurements.
   Meteorological balloons: There are three types of balloon colours in use for the measurement of upper wind:- Red, blue and white colour. The state of the sky determines the colour of balloon to be used. Gases for inflation of Meteorological balloon helium, or hydrogen gas. Hydrogen generators for Meteorological purposes. Theory of upper-wind measurement. Care and handling of Meteorological balloons. Sizes of Meteorological balloons. The Pilot – Balloon Theodolite. Ceiling measurement using pilot balloon (determination of cloud base). Optical Theodolite using pilot balloon
2. Pilot Balloon Codes PART A, B, C, D,
3. Temperature Message Identifier TTAA Radiosonde Transmitter
   The weather elements observed are: Pressure, Temperature, Wind direction and speed, humidity and dew point.
4. Radio sounding of the upper atmosphere
   General – units of measurement

The Principle of the radio sounding system: Principle of the radio sounding and ascent evaluation.

LEARNING OUTCOME FOR UPPER AIR

The students should be able to carry out sounding and the use of the instruments.

CODES AND OBSERVATIONS: (BIP 412)

1. Brief introduction to instrument used in taking meteorological observations.

2. Measurement of meteorological variables and procedure of observation, Specific features of Meteorological measurements; Direct and Indirect. Measurement of Temperatures; Air, Maximum, Minimum etc. Measurement of Humidity; Relative Humidity autographic instruments, derived values with the aid of Humidity slide rule, Measurement of Atmospheric Pressures (Barometers,) Barographs).

2. Measurement of Clouds; Types, Amount and Height (Ceilometers, ceiling Ascent, Cloud, Atlas and Pictures)
3. Measurement of surface Winds. Direction and speed; (Anemometers, and Beaufort scale for estimation).
4. Precipitation Measurements (Rates and Records of precipitation) Solid or Liquid, Gauges units. Precipitation (Amount and Duration). Automated weather station for intensity.
5. Measurement of Evaporation – Piche Evaporimeters
6. Visibility; General unit measurements, Definition of visibility (hydrometeor and lithometoes) and Visibility at night. Prevailing visibility/ directional visibility
7. Measurement of solar radiation (Sunshine recorders, gunn bellani radiation integrator and solarimeter).
8. Methods and procedures of observations Standard time, accuracy and measurement (UTC unit) Standard International Block and stations numbers e.g. Nigerian Stations.
9. Codes: Applications of SYNOP code for observation Section O -5
10. Present weather, Visibility and (Direction and speed), Application of METAR and SPECI Codes.
11. introduction to "9" special phenomenon groups i.e. 9spspspsp of synoptic message
12. Introduction to supplementary information groups of synoptic message e.g 5j1j2j3j4, 4ffff, 55408, 4esss etc.
13. section 5 555 of synoptic message e.g. 1sntxtxtx 2sntntntn 30uuu 40rrr
14. METAR modifications and corrections
15. SPECI modifications and corrections

LEARNING OUTCOME ON CODES & OBSERVATION

- To be able to identify and understand the principle behind the formation and associated weather events

- Ability to collate climatic data for research purposes
- To be able to identify hydrometeors and their method of observation
- To be able to code and transmit information
- Ability to collate climatic data for research purposes
- To be able to conduct necessary observations and understand the techniques
- To be able to identify clouds and their associated characteristics and formation

METEOROLOGICAL INSTRUMENTS: (BIP 413)

1. Direct and Indirect Meteorological measurement. Measurement of meteorological variables. Specific features of Meteorological Measurement. Direct Reading Instruments: Thermometers, Barometer, Wind Vane, Cup-Counter Anemometer, Class A Pan, Gunn Bellani Radiation Integrator, Raingauge, Sunshine Recorder and Ordinary Anemometer. Autographic Instrument (Indirect Reading Instruments): Thermograph, Barograph, Hyetograph and Hygrograph. Desirable Characteristics of Meteorological Instruments (Accuracy, durability and reliability). General requirements for sitting and exposure of Meteorological Instruments.
2. Measurement of atmospheric pressure. Nature of atmospheric pressure – Units of measurements. Principles underlying the operation of atmospheric pressure measuring. Instruments. Mercury barometers; Kew Pattern Barometer and Fortins Barometer. Aneroid barometers; analogue and digital; The Principle of the barograph. Exposure of atmospheric pressure measuring instruments.
3 Measurement of air temperature. Nature and units of measurement of air temperature, temperature scales used in Meteorology and conversion. Principles underlying the operation of air – temperature measuring Instruments; Mercury-in-glass thermometers, spirit-In-glass thermometers. The bimetallic thermometers, station thermograph. Exposure of air temperature measuring instruments (source of errors). Re-Setting of thermometers.
4 Measurement of atmospheric humidity. Nature and units of measurement of absolute humidity, relative humidity and dew point and other humidity

parameters. General principles of hygrometers. Humidity measuring instruments based on change of dimension of
Hygroscopic substances - the hair hygrometer, the psychrometer.
Automated psychrometer and recording Psychrometer.

5 Measurement of surface wind direction and speed. Wind direction and wind speed – specific feature units of measurement. Principles of wind measuring instruments; The pressure plate anemometer. Cup counter Anemometer- The rotation sensor cup – wheel – propeller and Anemometers measuring run of wind.

6 Measurement of precipitation. General liquid and solid precipitation – units of measurement. Principles of the Point measurement of precipitation. Non – recording precipitation gauges – daily rain gauges of the unshielded and shaded types. Recording precipitation gauges – siphon (float type – tipping bucket and Weighing – balance type Exposure requirements concerning precipitation point – measurement instruments. Routine care of precipitation measuring instruments. Factors affecting the accuracy of point – precipitation measurements. (Evaporation Loss).

7. Measurement of evaporation. General units of measurements, Principles of evaporation measuring Instruments, the evaporation pan: Class A Pan – (the hook gauge type). General requirements for the evaporation – measuring instruments' exposure, routine care of evaporation – measuring instrument.

8 Sunshine duration measurement. General principles of sunshine duration measurement. The Campbell Stokes sunshine duration recorders. Siting and exposure requirements for sunshine duration measuring Instruments, factors affecting the sunshine records (Cloud cover, Precipitation) Routine care of the Campbell Stokes sunshine recorder.

9. Automation of the measurement of Meteorological variables. Technical and economic aspects of automation objectives. Classification of automatic weather stations. Basic block diagram of an automatic weather station. Sensors used with automatic weather stations. Maintenance of automatic weather stations. Reliability of automatic equipment. 7 Standard, quality control, calibration and inter comparison.

LEARNING OUTCOMES METEOROLOGICAL INSTRUMENTS

- The students should be able to know the factors of siting the instruments and spacing of instruments

- They should be able to understand the underlying principle of the instruments in relation to units and dimensions and their mode of operation

- They should be able to conduct necessary observations and understand the techniques

PLOTTING: (BIP 414)

1. Application of models and tables.
2. Locations of station on Charts
3. Data representation on charts. Data is represented on charts with international symbols.
4. Surface Plotting model, Ship message plotting model.

LEARNING OUTCOMES ON PLOTTING

- To be able to identify and interpret ICAO codes and symbols
- To be able to plot all meteorological information on weather charts

AERONAUTICAL METEOROLOGY: (BIP 415)

1. Forces that keep airplane in flight (Gravity, Upthrust, drag) and parts of the plane (fixed and rotary wings- helicopters).
2. General Aviation Services.
3. Brief history of aviation and aeronautical meteorology.
4. Observing techniques. Surface wind direction and speed, including changes and variations. Visibility and runway visual range, including spatial and temporal variations in RVR OBSERVATIONS, Cloud amount, height and type and spatial and temporal variations; vertical visibility, observations using automatic instruments such as a ceilometers. Pressure measurements for the purpose of determining QFE and QNH.
5. Hazardous phenomena. Aircraft icing; elementary knowledge of icing types; formation, accretion rates and association of icing with clouds, turbulence, elementary knowledge of turbulence near the ground as related to topography, Elementary knowledge of high-level turbulence (Clear Air Turbulence) and its association with jet streams, wind shear, volcanic ash.
6. Aeronautical meteorological stations. Meteorological reports from aeronautical meteorological stations. Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SPECIAL and SPECI). Aerodrome forecasts. Forecasts for take-off. Landing forecasts (trend type).

7. Reporting, coding and dissemination of weather information. Complete Knowledge of international meteorological codes related to observations, Such as METAR, SPECI, SYNOP, PILOT, and TEMP. Knowledge of procedures for disseminating of weather information at the aerodrome, including the special needs of ATC units, Knowledge of the procedures for the preparation of the plain language forms of meteorological messages.
8. Definitions. Meteorological report, observation, visibility, runway visual. range. Altitude, elevation, height, aerodrome elevation, flight level, transition level. Aerodrome meteorological minima, instrument runway and landing area.
9. Procedures for meteorological services for international aviation, organization of the meteorological service and particularly the functions of the various types of meteorological offices. Aeronautical meteorological stations and their functions, local routine and special observations and reports, reports in METAR and SPECI code forms. Meteorological watch. Introduction to the responsibilities of ICAO and WMO in Aeronautical Meteorology.
10. Meteorological service for International Air Navigation Terminology. Area forecast centres. Aeronautical meteorological offices. Aeronautical meteorological stations. Observations made at
11. Wind shear and Aerodrome warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of meteorological messages. Information for search and rescue. Aeronautical climatological information.
12. Information for operations' local representatives. Information requires from operators. Information for pilots-in-command prior to departure. Information for pilots-in-command during flight. Debriefing. Definitions should include: Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level transitional level. Aerodrome minima, instrument runway, landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report, operator, operator's local representatives and pilot-in-command.
13. Air traffic services. Demands for meteorological services, including the types of meteorological information required by the various air traffic services units and the updating of this information by means of duplicate displays in ATS units or by prompt data transmission originated by the Meteorological Office or station.
14. Operation of aircraft. Flight planning, Duties of flight operations officers when exercising operational control. Navigation and landing aids. Effects

of air density, icing, turbulence, wind, wind shear and volcanic ash on aircraft performance. Altimeter setting procedures, standard atmosphere. Performance characteristics, including fuel consumption of civil aviation. Aircraft; characteristic of propeller type, turbo-prop and turbo-jet and, where applicable, supersonic aircraft. Effects of various weather phenomena on aeronautical operations and on aerodrome ground services. Flight planning: Definition, flight planning services, sources of meteorological information, available meteorological information, flight planning requirements and significance of meteorological information. Duties of flight operation officers when exercising operational control. Principles of flight. Air density and aircraft performance. Standard atmosphere. Density altitude other factors affecting aircraft performance. Fuel consumption. Radio meteorology. Effects of meteorological phenomena on ground communications. General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and landing. Flight planning aspects. Aerodrome meteorological minima.

15. Aircraft Icing, fog, Turbulence, Volcanic ash: Their formation of icing, elementary knowledge of icing types, accretion rates and association of icing with cloud (stratiform and cumuliform clouds), freezing precipitation, orographic and frontal lifting.
16. Thunderstorms: Formation conditions, types of thunderstorm. The thunderstorm cell, aviation hazards, squall line thunderstorm hazards, hail hazards, hail formation, hail prediction and prevention lightning. Avoidance of thunderstorms.
17. Wind Shear: Low-level wind shear associated with marked inversion and/or low-level jet streams. Winds shear in the approach and landing phases of flight. Topographic winds shear.
18. Aeronautical telecommunications. Elementary knowledge of the general organization of aeronautical telecommunications, but they should have a good working knowledge of the operation of the aeronautical fixed service. Understanding the general organization of aeronautical telecommunication; Operation of the Aeronautical Fixed Service including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message headings, addressing of messages, priorities of messages, ICAO abbreviations used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should include: Meteorological Data Distribution (MDD), RETIM (SYNERGIE-PC), SATCOM, Primary Data User System (PDUS),

MESSIR-VISION, MESSIR-COM, the Global Telecommunication System (GTS) and all latest available systems or facilities.

19. WMO and ICAO Documentation. Technical Regulations, (WMO-No. 49) Vol. 11 – Meteorological service for International Air Navigation. Manual on codes WMO-No 306). Guide to Meteorological Instruments and Methods of Observation (WMO-No 8). Weather Reporting (WMO-No 9).

LEARNING OUTCOMES ON AERONAUTICAL METEOROLOGY

- The students should be able to appreciate the different platforms available for dissemination of met information
- To be able to identify clouds and their associated characteristics and formation
- To be able to conduct necessary observations and understand the techniques
- To be able to determine the products and services that are generated and how to sell them to the public
- To familiarize the students with the functions of the national meteorological services

AGROMETEOROLOGY: (BIP 416)

21. Definition, scope and aims of Agrometeorology and other allied disciplines.
22. The relationship between weather, climate and agriculture as it affects soil, plants, farm animals, pests and diseases. Pest of crops and animals, farm building and equipment.
23. Artificial modifications of the Meteorological and Hydrological regimes namely; glass green houses, windbreaks, and shelter belts, irrigation, mulching.
24. The history of Agriculture and its relationship with association science. Agricultural Ecology and Ecosystem Distribution and Classification of Vegetation belts in Nigeria. Weather and climatic modification .
25. General production practice of field crops, crop production e.g. Maize Production factors for optimum yield of field crops. Factors affecting crop yield; Environmental factors – rainfall, CO_2, temperature, radiation, wind, light, evaporation water supply, nutrient, weed, pest and disease soil physical condition. Plant population, field of individual plant and community.

26. Plant protection definition of pest, important of pest. Importance of plant protection. Types of Pests: Polyphagous pest, Locusts, Termites, Bihar hairy Caterpillar, Cutworm, Greasy Cutworm, Damage caused by locust phase. Theory of locust, life cycle of locusts and control. Observations on crop pests and diseases.

27. Factors affecting disease development and propagation(the role of the macro-climatic environment) namely, temp, humidity, soil pH, wind, soil texture.

28. Control of plant diseases

Cultural methods

. Proper selection of geographical area
. Selection of field
. Choice of time of sowing

Exclusion method

Eradication

. Rogueing
. Crop sanitation
. Eradication of alternate and collateral hosts
. Heat and Chemical treatments of diseased plants
. Biological control

29. Pests of Crop plants

Insect pests (the classification based on habits and parts of plants attached) barriers, sucking insects, leaf eating insects, fruit and seed eaters etc.

Other Pests such as Birds, Rodents and Monkeys

30. Diseases of Crop Plants

Fungal diseases
Bacterial diseases
Viral diseases
Poultry diseases
Symptoms and control

31. Phenology Definition of phenology Method of phonological observations. Different phases of phenological observations in different crop plants. Biological Observations (Phenological observations)

Phonological phases in cereals
Germination
Emergence sprouting
Tillering
flowering
earning

milky ripeness
waxy ripeness
Tasselling
Importance of phenological observations

32. Agrometeorological elements and their methods of observations.
33. Definition, climatic elements, Biological elements, conditions of observation, Agrometeorological station and Networks, Observation of physical elements, Observation of biological Character/Elements, Detail observation of high accuracy.
34. Prevention and mitigation of Agrometeorological calamities in Nigeria.
35. Evapotransition Studies .
36. Agrometeorological water balance

P + I =ET + R + D + S

Evaporation
Evapotranspiration (Actual and Potential)
Factors affecting evapotranspiration
Factors affecting evapotranspiration
Calculation and Measurements of evapotranspiration
Water balance: Lysimetry
Aerodynamic profile approach (Bowen into
Combination methods (Penman equation)
The use of evapotranspiration data.

37. Soil Water

Soil water availability
3 categories of soil water
Capillary
Hygroscopic
Gravitational
Field capacity
Wilting point
Soil water in relation to plant growth.
Plant response to water deficit and excess moisture
The need for soil Moisture

38. Agrometeorological stations

Classification
Principal
Ordinary
Auxiliary
Agromet station for specific purposes

39. Climatic normal for livestock's: poultry birds, Goat, Sheep, Pigs and Cattle. Meteorological equipment of crop plants for rice, sugar cane, cotton, maize, potatoes etc. Animal's production systems, uses of animals. Outdoor animals and Meteorological elements.

40. Water and the Hydrological Cycle in Agriculture moisture characteristics of soil water and vegetation. Determination of water loss from land surface fundamental of the evaporation process. Existing methods of determining evaporation Energy balance of estimating evaporation. Aerodynamic estimation of evaporation combination model methods of penman and others. Development of original penman equation. Evaporation formulae of priestle – Taylor and Penman – Monteith special forms of precipitation Dew, Snow, soil moisture Budgets – Irrigation needs

LEARNING OUTCOME FOR AGROMETEOROLOGY

- To understand the effect of meteorological and climatic data to crops and livestock
- To employ meteorological information to improve agricultural products

MARINE METEOROLOGY: (BIP 417)

1. Introduction General introduction of marine meteorology and
2. Definitions. Water coverage, Air-Sea interaction. Uses of marine meteorology information etc.
3. Marine Meteorology Service [MMS]

Purpose and principles of MMS.
Data acquisition, Voluntary Observing Ship (VOS) and
Ship of Opportunity (SOO)
Mobile and fixed Sea Stations.
Components of MMS
Services to high sea,
Services to control and offshore areas;
Services to Main ports and harbours; Port Meteorological Officer,
Training in field of Marine meteorology Observation
Importance of marine meteorological observation.
Marine meteorological variables: Definition, general description of the variables and their importance.

Visibility at sea.
Dissemination of marine meteorological information.

4. The Ocean and Measurement of Current

Oceans and their Dimensions
Hydrostatic pressure, illumination and temperature of the Ocean, Thermoclines. Salinity and its measurements.
Ocean Current; Definition and methods of measurement.

5. Sea Surface Temperature [SST] and its sub Surface Temperature. (S.S.T).

Definition and uses of Sea Surface Temperature. (SST).
Methods of measurement of SST.
Diurnal and horizontal variation of SST.
Influence of SST on weather
Effects of temperature on marine life.
Measurement of Sub Surface Temperature (Bathythermograph and reversing thermometer).

6. Marine Meteorological Codes and Ship messages

Need for codes, marine meteorological log book.
Ship messages: Selected, Supplementary and Auxiliary ship Messages.
Marine Meteorological coding and decoding.

7. Ocean Waves

Atmosphere Turbulence, Sea Waves, Swells and Waves Characteristics.
Wave formation and growth.
Relationship among wave characteristics in deep and shallow water
Wave measurement [wave recorder].
Measurement of sea state: Beaufort's scale and its limitations.
Storm surges, tides, tidal waves etc.
Coastal up welling.

8. El Nino/Southern Oscillation [ENSO]

Description and causes of EL NINO, LA NINA and Southern Oscillation.
Influence of EL NINO on global weather pattern.

9. Role of Marine Meteorological services in life saving, rescue operations and pollution monitoring. Sea level change.
   Relationship between climates and sea level change.
   Climate and tectonic factors responsible for global sea level rise.
   Temporal variability.
   Estimation of sea level change

LEARNING OUTCOMES ON MARINE METEOROLOGY

- To give background knowledge to understanding the marine environment

- To familiarize the students with the functions of the national meteorological services

FIELDWORK/STUDIES: (418)

This is a comprehensive two weeks study of meteorological, hydrological and geographical phenomena that influence weather and climate. It will involve the interrelationship between weather and man. Special emphasis will be placed on Weather and: Urbanization, coastal and marine features, Agrometeorology and market gardening, Agroforestry, Water Resources, tourism, transportation and desertification among others. While NIMET takes care of transportation and accommodation of Staff and Students, the Students will take care of their feeding. This study will take place in any part of Nigeria or West African Sub-region.

LEARNING OUTCOME ON FIELDWORK (BIP 418)

- To expose the students to the natural forces that influence weather and climate.
- To have a practical knowledge on how weather and climate impact on agriculture, water resources, urban dwellers, tourism, transportation, commerce and industry, energy and power, among others.

CLIMATOLOGICAL RETURNS: (BIP 421)

1. Climatological returns; its meaning; importance; qualities;
   Types of forms; Form Met.100; Form Met. 101, Form Met. 102; Form Met. 103, Form Met. 104; Form Met. 113; Form Met. 120; Form Met. 130; Form Met. 131; Form Met. 135; Form Met. 141l, Form Met. 143; Form Met. 145; Form Met. 146; Form Met. 147; Form Met. 509; Form Met. 4520; Form Met. 4521; Form Met.4522; Compilation; Computation;
2. Climatological returns forms and usage

Autographic chart analysis and entries into appropriate form
Extraction of meteorological data from climatological returns
Checking of Climatological returns.

LEARNING OUTCOME ON CLIMATOLOGICAL RETURNS
Ability to collate and archive climatic data for research purposes

RESEARCH METHODOLOGY: (BIP422)

1. Introduction: The need for teaching the Methodology, Characteristic of research, ethical issues in research, etc
2. Research Agenda

2.1 Topic selection- Interest, Originality, Research ability, Significance, Feasible in Time and fund
2.2 Introduction, Problem definition, Background of study, Preamble etc
2.3 Objectives of study
2.4 Significance of Study
2.5 Research Questions
2.6 Hypothesis of Study
2.7 Scope of Study in time and space
2.8 Limitations /Problems of Study
2.9 Definition of terms
2.10 Theoretical framework and Literature review
2.11 Methodology: Instruments, Administration, Sources of Data, Questionnaires
2.12 Analysis, Discussions & Illustrations
2.13 Summary, Conclusion and Recommendations
2.14 References
2.15 Appendix

LEARNING OUTCOME ON RESEARCH - **METHODOLOGY:**
Ability to apply the knowledge of research methodology in their project work.

SYNOPTIC METEOROLOGY: (BIP 423)

1. Introduction and Definition of Synoptic Meteorology.
2. ITD and the associated weather zones. Waves and jet streams, land and Sea breeze, anabatic and Katabatic winds. Evolution and Dynamics of west African line squall.
3. Tropical Weather systems. Trade inversions trade winds, Tropical/subtropical jet streams, and other broad wind systems. Rainfall, Tropical cyclones, monsoons. Characteristic patterns of cloud associated with easterly waves, seasonal evolution of the tropical wind systems, and the inter-tropical convergence zone; annual cycles.

4. Mid-latitude synoptic systems. Air-mass concept; source areas; formation processes for air-masses. Air-mass modification; thermodynamic and dynamic changes; boundary/interface between two adjacent air masses; the slope of steady-state frontal zones; frontal-wave depression.
5. General circulation

LEARNING OUTCOME ON SYNPOTIC METEOROLOGY MEDIUM LEVEL

- To Be Able To Identify Clouds And Their Associated Characteristics And Formation
- To Be Able To Understand The Importance Of The Global Atmosphere And Its Spatio-Temporal Variability
- To Be Able To Identify The Various Synoptic Features Meteorological Charts And Imageries And Their Effects
- To Be Able To Understand Tropical Disturbances And Their Roles In Weather Processes And The ITD
- To Be Able To Understand The Connection Between Tropical And Extra-Tropical Systems
- To Understand The Processes Leading To Cloud Formation And Triggering Processes/ Propagation And Regeneration

- To Be Able To Understand The Concept Of Mesoscale Systems In The Tropics
- To Be Able To Understand And Explain The Concept Of Airmasses And The Modification.
- To Be Able To Identify The Hazardous Weather Situations And Their Socio-Economic Importance To The Area Of Consideration

SYNOPTIC METEOROLOGICAL PRACTICALS (BIP 424)

1. Definition of various Isolines
2. Rules governing Analysis/Nature of Analysis
3. Types of Charts used in Analysis
4. Analysis of various elements (Surface and Upper Air)
5. -Temperature, Wind, Humidity, Dew point, Divergence, Vorticity etc
6. Introduction to Numerical weather Prediction
7. Tephigram: Analysis & Interpretation.

LEARNING OUTCOME ON METEOROLOGICAL PRACTICALS

- To be able to identify and understand the principle behind the formation and associated weather events

- To be able to understand the concept of weather developments at differennt scales over point location

- To be able to identify the various synoptic features, meteorological charts and imageries and their effects

- To be able to identify the various synoptic features meteorological charts and imageries and their effects

- To be able to evaluate the recent technology used for the display of weather systems, their benefits and shortcomings

AERONAUTICAL METEOROLOGY: (BIP 425)

1. Forces that keep airplane in flight (Gravity, Upthrust, drag) and parts of the plane (fixed and rotary wings- helicopters).
2. General Aviation Services.
3. Brief history of aviation and aeronautical meteorology.
4. Observing techniques. Surface wind direction and speed, including changes and variations. Visibility and runway visual range, including spatial and temporal variations in RVR OBSERVATIONS, Cloud amount, height and type and spatial and temporal variations; vertical visibility, observations using automatic instruments such as a ceilometers. Pressure measurements for the purpose of determining QFE and QNH.
5. Hazardous phenomena. Aircraft icing; elementary knowledge of icing types; formation, accretion rates and association of icing with clouds, turbulence, elementary knowledge of turbulence near the ground as related to topography, Elementary knowledge of high-level turbulence (Clear Air Turbulence) and its association with jet streams, wind shear, volcanic ash.
6. Aeronautical meteorological stations. Meteorological reports from aeronautical meteorological stations. Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SPECIAL and SPECI). Aerodrome forecasts. Forecasts for take-off. Landing forecasts (trend type).
7. Reporting, coding and dissemination of weather information. Complete Knowledge of international meteorological codes related to observations, Such as METAR, SPECI, SYNOP, PILOT, and TEMP. Knowledge of procedures for disseminating of weather information at the aerodrome, including the

special needs of ATC units, Knowledge of the procedures for the preparation of the plain language forms of meteorological messages.

8. Definitions. Meteorological report, observation, visibility, runway visual. range. Altitude, elevation, height, aerodrome elevation, flight level, transition level. Aerodrome meteorological minima, instrument runway and landing area.
9. Procedures for meteorological services for international aviation, organization of the meteorological service and particularly the functions of the various types of meteorological offices. Aeronautical meteorological stations and their functions, local routine and special observations and reports, reports in METAR and SPECI code forms. Meteorological watch. Introduction to the responsibilities of ICAO and WMO in Aeronautical Meteorology.
10. Meteorological service for International Air Navigation Terminology. Area forecast centres. Aeronautical meteorological offices. Aeronautical meteorological stations. Observations made at
11. Wind shear and Aerodrome warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of meteorological messages. Information for search and rescue. Aeronautical climatological information.
12. Information for operations' local representatives. Information requires from operators. Information for pilots-in-command prior to departure. Information for pilots-in-command during flight. Debriefing. Definitions should include: Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level transitional level. Aerodrome minima, instrument runway, landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report, operator, operator's local representatives and pilot-in-command.
13. Air traffic services. Demands for meteorological services, including the types of meteorological information required by the various air traffic services units and the updating of this information by means of duplicate displays in ATS units or by prompt data transmission originated by the Meteorological Office or station.
14. Operation of aircraft. Flight planning, Duties of flight operations officers when exercising operational control. Navigation and landing aids. Effects of air density, icing, turbulence, wind, wind shear and volcanic ash on aircraft performance. Altimeter setting procedures, standard atmosphere. Performance characteristics, including fuel consumption of civil aviation. Aircraft; characteristic of propeller type, turbo-prop and turbo-jet and,

where applicable, supersonic aircraft. Effects of various weather phenomena on aeronautical operations and on aerodrome ground services. Flight planning: Definition, flight planning services, sources of meteorological information, available meteorological information, flight planning requirements and significance of meteorological information. Duties of flight operation officers when exercising operational control. Principles of flight. Air density and aircraft performance. Standard atmosphere. Density altitude other factors affecting aircraft performance. Fuel consumption. Radio meteorology. Effects of meteorological phenomena on ground communications. General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and landing. Flight planning aspects. Aerodrome meteorological minima.

15. Aircraft Icing, fog, Turbulence, Volcanic ash: Their formation of icing, elementary knowledge of icing types, accretion rates and association of icing with cloud (stratiform and cumuliform clouds), freezing precipitation, orographic and frontal lifting.
16. Thunderstorms: Formation conditions, types of thunderstorm. The thunderstorm cell, aviation hazards, squall line thunderstorm hazards, hail hazards, hail formation, hail prediction and prevention lightning. Avoidance of thunderstorms.
17. Wind Shear: Low-level wind shear associated with marked inversion and/or low-level jet streams. Winds shear in the approach and landing phases of flight. Topographic winds shear.
18. Aeronautical telecommunications. Elementary knowledge of the general organization of aeronautical telecommunications, but they should have a good working knowledge of the operation of the aeronautical fixed service. Understanding the general organization of aeronautical telecommunication; Operation of the Aeronautical Fixed Service including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message headings, addressing of messages, priorities of messages, ICAO abbreviations used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should include: Meteorological Data Distribution (MDD), RETIM (SYNERGIE-PC), SATCOM, Primary Data User System (PDUS), MESSIR-VISION, MESSIR-COM, the Global Telecommunication System (GTS) and all latest available systems or facilities.
19. WMO and ICAO Documentation. Technical Regulations, (WMO-No. 49) Vol. 11 – Meteorological service for International Air Navigation. Manual

on codes WMO-No 306). Guide to Meteorological Instruments and Methods of Observation (WMO-No 8). Weather Reporting (WMO-No 9).

LEARNING OUTCOMES ON AERONAUTICAL METEOROLOGY

- The students should be able to appreciate the different platforms available for dissemination of met information
- To be able to identify clouds and their associated characteristics and formation
- To be able to conduct necessary observations and understand the techniques
- To be able to determine the products and services that are generated and how to sell them to the public
- To familiarize the students with the functions of the national meteorological services

CLIMATOLOGY: (BIP 426)

4. Definition of weather and climate. Techniques usually adopted in climatology.
   Climatic controls of a place and West Africa.
   Climatic Elements.
   Climatological elements. All elements of weather should be discussed, but emphasis on those which actually shape the climate of a place e.g. temperature (including radiation), winds, pressure, sky cover, radiation, precipitation, humidity (including rainfall and air mass structure in the area).

5. The climate of Nigeria
   The ITD-Definition and its seasonal movement. Its role in determining the climate of various places in Nigeria on a meridional axis.
   The seasons in Nigeria
   The length of the rainy and dry seasons in Nigeria
   The two seasons in Nigeria; the prevailing winds and principal air masses associated with each season. Relationship between winds and air masses.

6. Weather zones in Nigeria
   Climatological characteristics of each zone. Basis for the existence of the weather zones. Meridional movement of the ITD.

4. Regional climatology: geographical distribution of climates, Climatolography. Monsoon climate with definite seasonal pattern (wet and dry tropics). Climatic Classification
   Tropical climate
   Tropical arid and semi arid climates
   Temperate climate
   Polar climate
   Tundra, taiga
   topoclimate
5. Climatic statistics and Applications
6. Climate variability and Climate Change.

LEARNING OUTCOMES ON CLIMATOLOGY

- To be able to understand the elements involved in regional and local climates
- To be able to classify climates
- To be able to understand and appreciate the local climates to region of responsibility and their roles
- To be able to understand the importance of the global atmosphere and its spatio-temporal variability
- To appreciate the geographical characteristics of their area
- To be able to understand tropical disturbances and their roles in weather processes and the ITD
- To appreciate the physical processes of energy transfer from the sun to the earth surface and its application

HYDROMETEOROLOGY: (BIP 431)

1. Hydrology, Hydrometeorology; Definitions and Explanations. Water bodies of the world, Role of water in Economic Activities of nations.
2. Physical: properties of water cycle on the globe: physical properties of Water; the hydrological cycle on the earth; ground water; origin and Classification of ground water; physical properties of rocks in relationship to water; physical states and movement of ground water; ground water and its relationship to rivers; confined aquifer ground water and its role in the river feeding; Lakes and reservoirs; morphology of lakes; sources of inflow to lakes; water balance of lakes; dynamic phenomena on lakes (Waves and currents).

3. Heat regime of lakes; chemical composition of lake water; biological processes in Lakes; reservoirs, their regime and water balance; swamps; formation and classification of swamps; hydrological regime of swamps; formation and movement of glaciers, their influence on river inflow and regime.
4. River system; river basins; river valleys and channels; sources of river Flow; temperature regime of rivers; regime of river stages; movement of water in rivers; flow velocity; discharge in rivers, hydrograph analysis; sediment transport; chemical composition of river water; channel formation processes; water balance and runoff; units used to measure runoff and flow; water balance and runoff units used to measure run off and flow; water balance of bodies of water.
5. Calculation of evaporation from the surface of basin;
    e. Average long-term annual runoff: distribution of annual runoff in
    f. Months and seasons; flow duration curves, mass diagrams and
    g. Storage Behaviour diagrams; maximum discharge and its calculation;
    h. Minimum flow and its calculation; sediment discharge and its calculation.
6. General alter Balance equation
7. Hydrograph Analysis Knowledge of flood regime of a stream, intelligent design of a wide. Variety of hydraulic structures such as bridges and culvert openings. Reservoir spillways and flood control works of all sorts.

LEARNING OUTCOME ON HYDROMETEOROLOGY

To understand the components of the water cycle and its applications.

DYNAMIC METEOROLOGY: (BIP 432)

1. Concept of dynamic meteorology compared with synoptic and Physical Meteorology, physical dimensions and units.
2. Atmospheric scales; pressure gradient, gravitational, centrifugal, gravity and coriolis forces, equation of motion in a simple form, geostrophic wind, wind and pressure near the equator; gradient wind and comparison with geostrophic wind, trajectories and streamlines, cyclostrophic wind; flow within the planetary boundary layer (cross-isobaric flow)
3. Ageostrophic and Isallobaric winds. Hydrostatic equilibrium and Hypsometric equation and uses. Thermal wind, divergence, convergence and vertical motion. Intensification and deepening of pressure systems. Vorticity (relative and absolute). Formation of cyclones and anti cyclones. Turbulence and gustiness, eddies and

vertical transport of matter, clear-air turbulence.

LEARNING OUTCOMES ON DYNAMIC METEOROLOGY

- To be able to identify the hazardous weather situations and their socio-economic importance to the area of consideration
- To be able to understand the concept of mesoscale systems in the tropics
- To understand the concept of air flow and its role of wind and its effect to weather development
- To be able to understand and explain the concept of airmasses and the modification.
- To be able to understand the connection between tropical and extra-tropical systems

THERMODYNAMICS: (BIP 433)

1. Introduction to thermodynamics System
2. Gas laws - Boyle's and Charles' Laws, Dalton's Law of partial pressures, Ideal gas law. Equation of state for dry and moist air, Mixture of gases. Kinetic theory of gases.
3. Adiabatic processes. Definitions, Dry, Moist and Pseudo – adiabatic processes. Equations for adiabatic processes, Dry, moist and saturated adiabatic lapse rates. Poisson equation and potential temperature. Latent heat of condensation. Comparison of magnitudes of different lapse rates. Methods of determining stability – parcel and slice methods. Hydrostatic balance, Potential energy, Geopotential meter and geopotential height.
4. Conservation of energy and the first law of thermodynamics. Change of phase and latent heat. Reversible and irreversible processes.
5. Hydrostatic stability and Convection.
6. Moisture variables. Definitions and meanings of Potential temperature, vapour pressure, mixing ratio, absolute humidity, equivalent potential temperature, saturation mixing ratio, absolute humidity, dew point temperature, specific humidity, virtual temperature etc.
7. Thermodynamic cycle. Carnot cycle, Isothermal and adiabatic expansion and compression.

LEARNING OUTCOME ON THERMODYNAMICS

- Understanding of the physical laws and its application to atmospheric science
- To be able to identify the various synoptic features meteorological charts and imageries and their effects

- To understand movement of air constituents

DIFFERENTIAL EQUATIONS: (BIP 433)

1. Differentiation and integration of simple functions, exponential functions, logarithmic functions and inverse trigonometric functions.
2. Partial derivatives; total differential and total derivatives.
3. Ordinary differential equations: equations of first order and degree; equation of higher degree; homogeneous and inhomogeneous equations.
4. Partial differential equations: linear partial differential equations of first and second order dent variables; the wave equation in one dimension; the vibrating string; normal modes of vibration and heat equation.

LEARNING OUTCOME FOR DIFFERENTIAL EQUATIONS

To develop the calculative skill in relation to the scientific nature of the atmosphere

SATELLITE METEOROLOGY: (BIP 434)

1. Basics in remote sensing Physics behind remote-sensing
2. Introduction to History of meteorology satellites
3. Satellites-data acquisition, processing and archiving
4. Satellite orbits, characteristics and radiometers
5. Satellite data acquisition, processing and data management.
6. Satellite image analysis, display and interpretation
7. Application of satellite imagery both in the visible and infrared
8. Regions for the analysis and interpretation of weather systems.
9. Case-studies, that is, a series of practical examples to examine a range of Meteorological events over the African continent, tropics and mid-latitude with emphasis on the application of satellite Meteorology to public weather forecast, Aeronautical Meteorology and Agro-meteorology.
10. Future of satellites meteorology

LEARNING OUTCOME ON SATELLITE METEOROLOGY

- To be able to identify hydrometeors and their method of observation
- To be able to conduct necessary observations and understand the techniques
- To be able to identify the various synoptic features of meteorological charts and imageries and their effects

- To be able to identify clouds and their associated characteristics and formation

PROJECT: (BIP 435)

Students may choose a title of his/her project work with relevance to Meteorology/related field and to be supervised by RTC instructor. There is going to be an oral presentation defence of the project and to be graded alongside with the class work. Once the project is completed, students are to submit three bound finished copies to the office of program Director. The colour of the project cover is green.

LEARNING OUTCOMES ON PROJECT

To be able to explain and analyse specific weather phenomenon/ variables and produce findings, conclusions and recommendations

ON THE JOB TRAINING (OJT): (BIP 436)

The OJT will be carried out for Two months.

1. The Student will be divided into groups.
2. Each group will be sent to each section including Ikeja (Forecast office).
3. The students are to be supervised by the RTC instructors.
4. At the end of the OJT they are to submit their logbooks dully signed by the head of the section. And also present a written report.

LEARNING OUTCOMES ON ON THE JOB TRAINING (OJT)

To have more practical knowledge of meteorology on the job

CURRICULUM FOR BASIC INSRTUCTIONAL PACKAGE FOR SPECIALIZED COURSES

CERTIFICATE COURSE IN CLIMATOLOGY

LEARNING OUTCOME FOR CLIMATOLOGY

Have the understanding of the physical climate system and climate change impacts

The Tailored Basic Instruction Packages for the Trainees will be satisfied through successful completion of the following curriculum for Applied Climatology:

1. Climatology – CLI 101
2. Computer Studies - CLI 102
3. Climate Change - CLI 103
4. General Meteorology - CLI 104
5. Physical Meteorology - CLI 105
6. Statistics - CLI 106
7. Synoptic Meteorology - CLI 107
8. Data Processing I - CLI 108
9. Dynamic Meteorology - CLI 109
10. Meteorological Instruments - CLI 110

Course outlines for each subject are as follows:

CLIMATOLOGY - CLI 101

1. Introduction, Clear distinction between weather and climate
2. Climatological elements, All elements of weather should be discussed, but emphasis on those which actually shape the climate of a pl ace e.g. temperature (including radiation), winds, humidity,precipitation (including rainfall and air mass structure in the area)
3. Factors which can affects or modify the Climate of a place
4. Climatological Maps
5. The climatic regions of the world. The role of air masses in determining the major climatic regions of the world
6. Diurnal Variations of Temperature, Pressure, Wind Speed, etc
7. Introduction to General Circulation (Types of motions; Pressure and Wind patterns)
8. Air Masses, The two seasons in Nigeria, The prevailing winds and principal air masses
9. The climate of Nigeria, The ITD and its seasonal movements, Its role in determining the climate of various places in Nigeria
10. Weather zones in Nigeria, Climatological characteristics of each zone, Basis for the existence of the Weather zones
11. The length of the rainy and dry seasons with Nigeria as illustration, Approximate on-set dates (months) for the two major seasons in

Nigeria (Rainy and dry seasons), Reasons for the variation of the on-set dates in Nigeria

12. Monsoon climate with definite seasonal pattern (wet and dry tropics), tropical climate, tropical arid and semi-arid climates, temperate climate, polar climate,
13. Climatic scales, macro-, meso-, micro-climates
14. Climatic Classification; Climatic Regions of the World; Tropical and Equatorial, Tropical and Mid – latitude, Polar and Artic, Mountain Climates, Local Climates, Desert Climates, Acclimatization
15. Applied Climatology; Climate and Transport, Climate and Construction Climate and Water Resources, Climate and Agriculture, Climate and Business, Climate and Sports
16. Processing of climatological data – application of statistical method
17. African climate, Climatology of basic meteorological systems for the African continent especially on a North – South axis in West and Central Africa
18. The monsoons of the world with specific reference to West Africa, East Africa and India.
19. Anthropogenic impact on the climate system in Nigeria

COMPUTER STUDIES - CLI 102

1. Evolution of the computer systems: Definitions of computer; History of the computer (The beginning of computer age); Generations of computers; Types of computers; Classifications of digital computers; Characteristics of computers; Application of computers in the society.
2. Functional parts of a digital computer: Hardware (Input units, Output units, Processing units, Storage units, Communication units) and software (types of computer software, operating system, application software).
3. Computer Safety and Maintenance (Top Computer Mistakes Beginners Make, Basic Troubleshooting Techniques, Maintaining Your Computer).
4. Using the computer (Buttons and parts on a computer, Setting up a computer, Computer safety and maintenance).
5. Introduction To Data Transmission And Computer Networking (Data Transmission, Data Transmission And Communication Facilities, Computer Network, Types Of Network, Network Configurations, The Internet And The Electronic Mail).
6. Introduction To Computer Programming (Flowchart And Algorithm, Introduction To The BASIC Programming Language)

CLIMATE CHANGE - CLI 103

1. Introduction**:** The concept of climate: Climate variation and Climate change.
2. The Climate System**:** How climate is generated, components of the climate system, i.e the atmosphere, the lithosphere, the oceans, the cryosphere and the biosphere.

3. History of climate change
4. Theories of possible causes of climate change**:** Terrestrial theories; Astronomical theories; Extra-terrestrial theories; the Global warming debate.
5. Potential impacts of global warming and climate change: Impacts on agriculture and land use; impacts on the ecosystems and biodiversity; impacts on human settlements; impacts on human settlements; impacts on diseases and health and impacts on hydrology an d water resources.
6. Vulnerability to climate change: The concept of vulnerability; assessing vulnerability to climate change and reducing vulnerability to climate change.
7. Response strategies to climate change: Climate change mitigation strategies; climate change adaptation strategies; climate change and coastal zone management; climate change – water management and agriculture.
8. The Climate prediction**:** Weather prediction and climate prediction methods and problems of climate prediction. Future weather and climate- the way forward.

GENERAL METEOROLOGY - CLI 104

1. The layers and composition of the atmosphere: water vapour; carbon dioxide; etc. Vertical divisions of the atmosphere – troposphere; stratosphere; mesosphere; thermosphere; ionosphere.
2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces.
3. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the General circulation in the tropics and in non-tropical regions; local Winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind; cyclones and Anticyclones; air masses and fronts; thunderstorms; synoptic chart analyses; Weather associated with synoptic systems.
4. Atmospheric temperature; horizontal and vertical variations of air Temperature, troposphere and stratosphere.
5. The effect of gravity on the atmosphere, air density, Atmospheric pressure, Variations in pressure; mean sea level pressure; horizontal and vertical pressures; significance of pressure gradient.
6. The three states of water; vapour pressure; saturation vapour pressure; evaporation, condensation; freezing; sublimation; isobaric and adiabatic processes; latent heat; Moisture indicators; relative humidity; mixing ratio and dew point.
7. Rudiments of cloud, fog and precipitation formation; visibility, the influence of water vapour, of water drops and dust (aerosols).

8. Basic knowledge of the vertical stability or instability; non-saturated air and saturated air; isobaric expansion and adiabatic expansion; the influence of condensation

PHYSICAL METEOROLOGY - CLI 105

1. Introduction to physical meteorology.
2. Transparency of the atmosphere and visibility.
3. Definitions, basic knowledge and formation of Clouds (International cloud classification, stratiform clouds, cumuliform clouds, orographic clouds), Fog (Fog Classification) and Precipitation (Process of raindrop formation, artificial rain).
4. Large- and small-scale cooling of the air due to adiabatic and non-adiabatic processes.
5. Elements of Atmospheric Optics and Electricity; Atmospheric ions and the Conductivity of the air; Refraction; Rainbow; Halo; Corona; Blueness of the sky; Lightning discharge and thunderstorms.

STATISTICS - CLI 106

1. Introduction: Definitions, meaning of statistics, examples with natural situations, Data collection and storage.
2. Data arrangement: Mean, median, mode, Mean of grouped and ungrouped data, Assumed Mean, Arithmetic and Geometric mean. Median and mode for grouped Data
3. Graphical representation of data: Graphs, Pie chart, bar chart, Frequency table, cumulative frequency.
4. Applications: Daily and monthly means of weather elements like temperature, pressure, Humidity, etc.
5. Regression and Correlation, Scatter graphs, Relationships between two variables and scatter graphs (construction of line of best fit, estimate from scatter graphs, significance of the scatter graph, limitations of scatter graph); computing regression lines (equation of straight line, measuring the Deviations; graphing Regression lines; the use of regression lines; choice of regression line and Regression coefficient; Multiple linear regression and non–linear regression); Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation).

SYNOPTIC METEOROLOGY - CLI 107

1. Tropical Weather systems; Tropical/subtropical jet streams, and other broad wind systems (AEJ, Trade winds, seasonal evolution of the tropical wind systems, and ITD / ITCZ; annual cycles); Tropical cyclones; Monsoons; Synoptic analysis of the disturbance patterns at the surface and their relation to high-altitude features.
2. ITD / ITCZ and the associated weather zones.
3. Waves and jet streams. Sea breeze, Anabatic and Katabatic winds.
4. Mid-latitude synoptic systems. Air-masses – source regions; formation processes of air-masses; Air-mass modification; frontal-wave depression.

5. Global observing system (Synoptic data for Surface, Upper-air and Special observations; coding and decoding, representation and analysis of meteorological data; quality control); World Weather Watch Program; Global Meteorological Telecommunications Network.
6. General circulation and the pressure systems.
7. West –African line squall.
8. Harmattan dust haze
9. Monsoons
10. Little dry season
11. African waves
12. Forcing functions.
13. Frontal systems
14. West African Jets.

DATA PROCESSING I - CLI 108

1. Introduction to Data Processing; Definitions, Types, Categories and Method of Data Processing, Basic Data processing, etc.
2. The Concept of Data and Information; Data processing system and Information System and their classification, Development of Information Management.
3. Data processing cycle; Areas and Stages of Data processing, Data Input, Storage , Output and Processing Techniques.
4. Data processing operations; Data Collection, Data Review, Data Entry, Data validation and types, Data processing Jobs and activities, Data types and Structures, Centralized and Decentralized Data processing Centres etc.

DYNAMIC METEOROLOGY - CLI 109

1. Concept of dynamic meteorology compared with synoptic and physical meteorology, physical dimensions and units.
2. Atmospheric scales, discussions on pressure gradient, gravitational, frictional, centrifugal, Gravity and carioles forces, total local derivatives, transformation from non-rotating co-ordinate system; equation of motion in vector form as derived from Newton's second law, Equation of motion in spherical co-ordinates (tangent plane approximation); scale analysis leading to simplified equations.
3. Ageostrophic and isallobaric winds, hydrostatic equilibrium and Hypsometric equation and uses, thermal wind, divergence, convergence and vertical motion, intensification and deepening of pressure systems, vorticity(relative and absolute), formation of cyclones and anti cyclones; turbulence and gustiness, eddies and vertical transport of matter, clear-air turbulence.
4. Horizontal balanced motions, motion with no tangential acceleration, geostrophic and gradient wind relations, comparism of geostrophic and gradient wind, geostrophic thermal wind, streamlines and trajectories, barotrophic and baroclinic atmosphere, thermodynamic energy

equation, continuity equation, divergence of three dimensional and horizontal wind fields, vertical motion, vortices and circulation, Bjeknes' circulation theorem, introduction to stream friction and velocity potential, Rossby long waves, brief description of the baroclinic waves and baroclinic instability.

5. Introduction to hydrostatic approximation, justification for this approximation, equation of quasi-hydrostatic motion using pressure as vertical co-ordinate.
6. The nature of turbulent flow, flow near a boundary, the mixing length hypothesis; velocity profile near a boundary (smooth surface, rough surface); ower-law profile; statistical theories of turbulence; eddy transport or momentum, heat and water vapour with planetary atmosphere boundary layer; the heat flux equation and the problem of convection; Richardson criteria; forced and free convection.

METEOROLOGICAL INSTRUMENTS - CLI 110

1. Measurement of meteorological variables, Specific features of Meteorological Measurement, Direct and indirect Meteorological measurement, Direct Reading Instruments, Indirect Reading Instruments, Desirable Characteristics of Meteorological Instruments, General requirements for sitting and exposure of Meteorological Instruments.
2. Measurement of atmospheric pressure, Units of measurements of atmospheric pressure, Principles underlying the operation of atmospheric pressure measuring Instruments (Mercury barometers, Kew Pattern Barometer and Fortin Barometer, Aneroid barometers, barographs), Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature, units of measurement of air temperature, temperature scales used in Meteorology and conversion, Principles underlying the operation of air – temperature measuring Instruments (Mercury-in-glass thermometers, spirit-In-glass thermometers, The bimetallic thermometers, thermographs), Exposure of air temperature measuring instruments – radiation errors, Setting time of thermometers.
4. Measurement of atmospheric humidity, units of measurement of absolute humidity, relative humidity, dew point and other humidity parameters. General principles of hygrometers. Humidity measuring instruments based on change of dimension of hygroscopic substances (the hair hygrometer, the psychrometer).
5. Measurement of surface wind direction and speed, units of measurements of wind direction and wind speed, Principles of wind measuring instruments (The pressure plate anemometer, The rotation sensor cup – wheel – propeller, Anemometers measuring run of wind).
6. Measurement of precipitation (liquid and solid precipitation), units of measurement, Principles of the Point measurement of precipitation, Non – recording precipitation gauges (daily rain gauges of the unshielded and shielded types), Recording precipitation gauges (siphon, float type, tipping bucket, Weighing balance type), Exposure requirements

concerning precipitation point – measurement instruments, Routine care of precipitation measuring instruments, Factors affecting the accuracy of point – precipitation measurements.

7. Measurement of evaporation, General units of measurements, Principles of evaporation measuring Instruments (evaporation pan: Class A Pan, the hooked – gauge type, etc.), General requirements for the evaporation measuring instruments' Exposure, routine care of evaporation – measuring instruments.
8. Sunshine duration measurement, General principles of sunshine duration measurement, The Campbell Stokes sunshine duration recorders, Sitting and exposure requirements for sunshine duration measuring instruments; factors affecting the sunshine records of the Campbell Stokes instrument, Routine care of the Campbell Stokes sunshine recorder, measurement of burnt trace on the cards.
9. Automation of the measurement of Meteorological variables, Technical and economic aspects of automation objectives, Classification of automatic weather stations, Basic block diagram of an automatic weather station, Sensors used with automatic weather stations, Maintenance of automatic weather stations, Reliability of automatic equipment.

METEOROLOGIST CERTIFICATE COURSE IN DATA PROCESSING

LEARNING OUTCOME FOR DATA PROCESSING

Improve trainee's technical and operational skills in data management practice, and its application at work

The Tailored Basic Instruction Packages for the Trainees will be satisfied through successful completion of the following curricula for Data Processing and Management:

1. Computer Studies - DAT 101
2. Computer Operations - DAT 102
3. Data Processing I - DAT 103
4. Data Processing II - DAT 104
5. Computer Programming - DAT 105
6. General Meteorology - DAT 106
7. Statistics - DAT 107
8. Climatology - DAT 108

Course outlines for each subject are as follows:

COMPUTER STUDIES - DAT 101

1. Evolution of the computer systems: Definitions of computer; History of the computer (The beginning of computer age); Generations of computers; Types of computers; Classifications of digital computers; Characteristics of computers; Application of computers in the society.
2. Functional parts of a digital computer: Hardware (Input units, Output units, Processing units, Storage units, Communication units) and software (types of computer software, operating system, application software).
3. Computer Safety and Maintenance (Top Computer Mistakes Beginners Make, Basic Troubleshooting Techniques, Maintaining Your Computer).
4. Using the computer (Buttons and parts on a computer, setting up a computer, Computer safety and maintenance).
5. Introduction To Data Transmission And Computer Networking (Data Transmission, Data Transmission And Communication Facilities, Computer Network, Types Of Network, Network Configurations, The Internet And The Electronic Mail).
6. Introduction To Computer Programming (Flowchart And Algorithm, Introduction To The BASIC Programming Language)

DATA PROCESSING I - DAT 102

1. Introduction to Data Processing; Definitions, Types, Categories and Method of Data Processing, Basic Data processing, etc.
2. The Concept of Data and Information; Data processing system and Information System and their classification, Development of Information Management.
3. Data processing cycle; Areas and Stages of Data processing, Data Input, Storage, Output and Processing Techniques.
4. Data processing operations; Data Collection, Data Review, Data Entry, Data validation and types, Data processing Jobs and activities, Data types and Structures, Centralized and Decentralized Data processing Centres etc.

DATA PROCESSING II - DAT 103

1. Database Management; Definitions; Database, Database Management, Database Management System (DBMS).
2. DBMS Building Blocks.
3. DBMS Staff and their functions.
4. Data Tabulation and Presentation.
5. Data control and retrieval.
6. Batch Processing
7. Introduction to Database Design; Steps in Database Designing, Examples of Database Design, Methodology and Tables of Database Design, Logical database Design, Relational Database Design, Access Database Design, Hierarchical Database Design, Normalization, primary Key, Entity Relational Diagram, etc.
8. Data Analysis and Interpretation; Definition, Data Analysis Techniques, Steps and Examples in Data Analysis, Simple Data Analysis and Types,

Methods of Data Analysis ,Data Analysis Reports, Working with Ms Excel, Basic Analysis with SPSS, etc.

COMPUTER OPERATIONS - DAT 104

1. Computer System; History and Classification, Computer Peripherals, Computer Hardwares and Softwares, workstations, etc.
2. Computer Networking.
3. Programming Languages.
4. Open and Closed Systems
5. Decision Support Systems and Decision making.
6. Information Technology.
7. Internet Concepts, etc.

COMPUTER PROGRAMMING - DAT 105

1. Introduction to Programming
2. Primitive Types and Variables
3. Operators and Expressions
4. Console Input and Output
5. Conditional Statements
6. Loops
7. Arrays
8. Methods
9. Recursion
10. Creating and Using Objects
11. Exception Handling
12. Strings and Text Processing
13. Defining Classes
14. Text Files

GENERAL METEOROLOGY - DAT 106

1. The layers and composition of the atmosphere: water vapour; carbon dioxide; etc. Vertical divisions of the atmosphere – troposphere; stratosphere; mesosphere; thermosphere; ionosphere.
2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces.

3. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the General circulation in the tropics and in non-tropical regions; local Winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind; cyclones and

Anticyclones; air masses and fronts; thunderstorms; synoptic chart analyses; Weather associated with synoptic systems.
4. Atmospheric temperature; horizontal and vertical variations of air Temperature, troposphere and stratosphere.
5. The effect of gravity on the atmosphere, air density, Atmospheric pressure, Variations in pressure; mean sea level pressure; horizontal and vertical pressures; significance of pressure gradient.
6. The three states of water; vapour pressure; saturation vapour pressure; evaporation, condensation; freezing; sublimation; isobaric and adiabatic processes; latent heat; Moisture indicators; relative humidity; mixing ratio and dew point.
7. Rudiments of cloud, fog and precipitation formation; visibility, the influence of water vapour, of water drops and dust (aerosols).
8. Basic knowledge of the vertical stability or instability; non-saturated air and saturated air; isobaric expansion and adiabatic expansion; the influence of condensation

STATISTICS - DAT 107

1. Data arrangement: Mean, median, mode, Mean of grouped and ungrouped data, Assumed Mean, Arithmetic and Geometric mean. Median and mode for grouped Data.
2. Graphical representation of data: Graphs, Pie chart, bar chart, Frequency table, cumulative frequency.
3. Applications: Daily and monthly means of weather elements like temperature, pressure, Humidity, etc.
4. Regression and Correlation, Scatter graphs, Relationships between two variables and scatter graphs (construction of line of best fit, estimate from scatter graphs, significance of the scatter graph, limitations of scatter graph); computing regression lines (equation of straight line, measuring the Deviations; graphing Regression lines; the use of regression lines; choice of regression line and Regression coefficient; Multiple linear regression and non–linear regression); Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation).

CLIMATOLOGY - DAT 108

1. Introduction, Clear distinction between weather and climate
2. Climatological elements, All elements of weather should be discussed, but emphasis on those which actually shape the climate of a place e.g. temperature (including radiation), winds, humidity (including rainfall and air mass structure in the area)
3. Factors which can affects or modify the Climate of a place
4. Climatological Maps
5. The climatic regions of the world. The role of air masses in determining the major climatic regions of the world

6. Diurnal Variations of Temperature, Pressure, Wind Speed, etc
7. Introduction to General Circulation (Types of motions; Pressure and Wind patterns)
8. Air Masses, The two seasons in Nigeria, The prevailing winds and principal air masses
9. The climate of Nigeria, The ITD and its seasonal movements, Its role in determining the climate of various places in Nigeria
10. Weather zones in Nigeria, Climatological characteristics of each zone, Basis for the existence of the Weather zones
11. The length of the rainy and dry seasons with Nigeria as illustration, Approximate on-set dates (months) for the two major seasons in Nigeria (Rainy and dry seasons), Reasons for the variation of the on-set dates in Nigeria
12. Monsoon climate with definite seasonal pattern (wet and dry tropics), tropical climate, tropical arid and semi arid climates, temperate climate, polar climate,
13. Climatic scales, macro-, meso-, micro-climates
14. Climatic Classification; Climatic Regions of the World; Tropical and Equatorial, Tropical and Mid – latitude, Polar and Arctic, Mountain Climates, Local Climates, Desert Climates, Acclimatization
15. Applied Climatology; Climate and Transport, Climate and Construction Climate and Water Resources, Climate and Agriculture, Climate and Business, Climate and Sports, climate and tourism
16. Processing of climatological data – application of statistical method
17. African climate, Climatology of basic meteorological systems for the African continent especially on a North – South axis in West and Central Africa
18. The monsoons of the world with specific reference to West Africa, East Africa and India.
19. Anthropogenic impact on the climate system in Nigeria.

CERTIFICATE COURSE IN AGROMETEOROLOGY

LEARNING OUTCOME FOR AGROMETEOROLOGY

To fully understand agricultural practices and its interaction with the atmosphere for sustainable food production and security

The Tailored Basic Instruction Packages for the Trainees will be satisfied through successful completion of the following curricula for Applied Agro-Meteorology:

1. Agro-Meteorology I - AGR 101
2. Agro-Meteorology II - AGR 102
3. Climatology - AGR 103
4. Computer Studies - AGR 104

5. General Meteorology - AGR 105
6. Meteorological Instruments - AGR 106
7. Hydrometeorology - AGR 107
8. Statistics - AGR 108
9. Satellite Meteorology - AGR 109

Course outlines for each subject are as follows:

AGRO-METEOROLOGY I - AGR 101

1. Introduction to Agricultural Meteorology; Definition, Scope and aims of Agro-meteorology. The relationship between weather / climate and agriculture as it affects soil, plants, farm animals, pests and diseases
2. Artificial modifications of the Meteorological and Hydrological regimes namely; glass / green houses, windbreaks and shelter belts, irrigation, mulching, etc
3. Biological Observations (Phenological observations), Phonological phases in cereals, Germination, Emergence, sprouting, Tillering, flowering, earing, milky ripeness, waxy ripeness, Tasselling, Importance of phenological observations
4. Agronomic Concepts of the Physically-defined Growing Season
5. Agrometeorological stations (Classifications – Principal, Ordinary, Auxiliary, Agromet Station for specific purposes)
6. Calculation of Potential Evapo-Transpiration (PET) and Evaporation over Water Surface using Penman method. Practical comparison of actual Potential Evapo-Transpiration and Evaporation in the observatory to the calculated values using Penman method, The use of evapotranspiration data
7. Practical evaluation of soil Moisture values using the direct and indirect Methods
8. Soil Water, Soil water availability, 3 categories of soil water (Capillary, Hygroscopic and Gravitational), Field capacity, Wilting point, Soil water in relation to plant growth, Plant response to water deficit and excess moisture, The need for soil Moisture
9. Agro-meteorological water balance (P + I = ET + R + D + S), Evaporation, Factors affecting evaporation, Water balance
10. Crop Forecasting Methods (The Crop forecasting method based on Agro Meteorological Information; The Crop forecasting method based on statistical analysis)
11. Practical effects of weather elements on Crop yields (e.g. Maize, Cassava, Tomatoes, Cabbage, Peanuts, water Melon etc.), Effect of spacing on Maize Crop yield, Effect of controlled environment on Crop yield, Analysis of Crop yield variation to different weather elements.

AGRO-METEOROLOGY II - AGR 102

1. The History of Agriculture and its relationship with associated science. The relationship between Agriculture and weather elements. Weather and climatic modification for sustainable and affordable agriculture.
2. General production practice of field crops, crop production e. g Maize; Production factors for optimum yield of field crops. Factors affecting crop yield; Environment factors – rainfall, co2, temperature, Radiation, wind, light, evaporation water supply, nutrient, weed, pest and Disease soil physical condition. Plant population, Field of individual plant and community.
3. Phenology. Definition of phenology. Method of phonological observations. Different phases of phonological observation in different crop plants.
4. Agro-meteorological elements and their methods of observations. Definition, climatic elements, Biological elements, condition of observation, Agro-meteorological station and Networks, Observation of physical elements, Observation of biological Character/ Elements, Detail observation of high accuracy.
5. Climatic normal for livestock:- Poultry birds, Goat, sheep, pigs and cattle. Meteorological equivalent of crop plants for rice, sugar cane, cotton, maize, Potatoes etc. Animal production systems. Uses of animals. Outdoor animals and Meteorological elements.
6. Water and the Hydrological Cycle in Agriculture moisture characteristics of Soils water and vegetation. Determination of water loss land surface Fundamental of the evaporation process. Existing methods of determining evaporation Energy balances of estimating Evaporation Aerodynamic estimation of evaporation combination model methods of Penman and others. Development of original Penman equation. Evaporation formulae of Priestle – Taylor and Penman- Monteith special forms of precipitation Dew, snow, soil moisture Budgets – Irrigation needs.
7. Observations of crop pests and diseases, Factors affecting disease development and propagation (the role of the Macro-climatic environment namely temperature, humidity, soil pH, wind, soil Texture, etc.), Control of plant diseases (Cultural methods, Exclusion method, Eradication method, Heat and Chemical treatments of diseased plants, Biological control), Identification of Crop / plant pests and diseases. Diseases of Crop Plants (Fungal diseases, Bacterial diseases, Viral diseases), Poultry diseases (Symptoms and control)

CLIMATOLOGY - AGR 103

1. Introduction, Clear distinction between weather and climate
2. Climatological elements, All elements of weather should be discussed, but emphasis on those which actually shape the climate of a place e.g. temperature (including radiation), winds, humidity (including rainfall and air mass structure in the area)
3. Factors which can affects or modify the Climate of a place
4. Climatological Maps

5. The climatic regions of the world. The role of air masses in determining the major climatic regions of the world
6. Diurnal Variations of Temperature, Pressure, Wind Speed, etc
7. Introduction to General Circulation (Types of motions; Pressure and Wind patterns)
8. Air Masses, The two seasons in Nigeria, The prevailing winds and principal air masses. The climate of Nigeria, The ITD and its seasonal movements, Its role in determining the climate of various places in Nigeria
9. Weather zones in Nigeria, Climatological characteristics of each zone, Basis for the existence of the Weather zones
10. The length of the rainy and dry seasons with Nigeria as illustration, Approximate on-set dates (months) for the two major seasons in Nigeria (Rainy and dry seasons), Reasons for the variation of the on-set dates in Nigeria
11. Monsoon climate with definite seasonal pattern (wet and dry tropics), tropical climate, tropical arid and semi arid climates, temperate climate, polar climate,
12. Climatic scales, macro-, meso-, micro-climates
13. Climatic Classification; Climatic Regions of the World; Tropical and Equatorial, Tropical and Mid – latitude, Polar and Artic, Mountain Climates, Local Climates, Desert Climates, Acclimatization.
14. Applied Climatology; Climate and Transport, Climate and Construction Climate and Water Resources, Climate and Agriculture, Climate and Business, Climate and Sports, climate and tourism
15. Processing of climatological data – application of statistical method
16. African climate, Climatology of basic meteorological systems for the African continent especially on a North – South axis in West and Central Africa
17. The monsoons of the world with specific reference to West Africa, East Africa and India.
18. Anthropogenic impact on the climate system in Nigeria

COMPUTER STUDIES - AGR 104

1. Evolution of the computer systems: Definitions of computer; History of the computer (The beginning of computer age); Generations of computers; Types of computers; Classifications of digital computers; Characteristics of computers; Application of computers in the society.
2. Functional parts of a digital computer: Hardware (Input units, Output units, Processing units, Storage units, Communication units) and software (types of computer software, operating system, application software).
3. Computer Safety And Maintenance (Top Computer Mistakes Beginners Make, Basic Troubleshooting Techniques, Maintaining Your Computer).
4. Using the computer (Buttons and parts on a computer, Setting up a computer, Computer safety and maintenance).

5. Introduction To Data Transmission And Computer Networking (Data Transmission, Data Transmission And Communication Facilities, Computer Network, Types Of Network, Network Configurations, The Internet And The Electronic Mail).
6. Introduction To Computer Programming (Flowchart And Algorithm, Introduction To The BASIC Programming Language)

GENERAL METEOROLOGY - AGR 105

1. The layers and composition of the atmosphere: water vapour; carbon dioxide; etc. Vertical divisions of the atmosphere – troposphere; stratosphere; mesosphere; thermosphere; ionosphere.
2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces.
3. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the General circulation in the tropics and in non-tropical regions; local Winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind; cyclones and Anticyclones; air masses and fronts; thunderstorms; synoptic chart analyses; Weather associated with synoptic systems.
4. Atmospheric temperature; horizontal and vertical variations of air Temperature, troposphere and stratosphere.
5. The effect of gravity on the atmosphere, air density, Atmospheric pressure, Variations in pressure; mean sea level pressure; horizontal and vertical pressures; significance of pressure gradient.
6. The three states of water; vapour pressure; saturation vapour pressure; evaporation, condensation; freezing; sublimation; isobaric and adiabatic processes; latent heat; Moisture indicators; relative humidity; mixing ratio and dew point.
7. Rudiments of cloud, fog and precipitation formation; visibility, the influence of water vapour, of water drops and dust (aerosols).
8. Basic knowledge of the vertical stability or instability; non-saturated air and saturated air; isobaric expansion and adiabatic expansion; the influence of condensation

METEOROLOGICAL INSTRUMENTS - AGR 106

1. Measurement of meteorological variables, Specific features of Meteorological Measurement, Direct and indirect Meteorological measurement, Direct Reading Instruments, Indirect Reading Instruments, Desirable Characteristics of Meteorological Instruments, General requirements for sitting and exposure of Meteorological Instruments.

2. Measurement of atmospheric pressure, Units of measurements of atmospheric pressure, Principles underlying the operation of atmospheric pressure measuring Instruments (Mercury barometers, Kew Pattern Barometer and Fortin Barometer, Aneroid barometers, barographs), Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature, units of measurement of air temperature, temperature scales used in Meteorology and conversion, Principles underlying the operation of air – temperature measuring Instruments (Mercury-in-glass thermometers, spirit-In-glass thermometers, The bimetallic thermometers, thermographs), Exposure of air temperature measuring instruments – radiation errors, Setting time of thermometers.
4. Measurement of atmospheric humidity, units of measurement of absolute humidity, relative humidity, dew point and other humidity parameters. General principles of hygrometers. Humidity measuring instruments based on change of dimension of hygroscopic substances (the hair hygrometer, the psychrsometer).
5. Measurement of surface wind direction and speed, units of measurements of wind direction and wind speed, Principles of wind measuring instruments (The pressure plate anemometer, The rotation sensor cup – wheel – propeller, Anemometers measuring run of wind).
6. Measurement of precipitation (liquid and solid precipitation), units of measurement, Principles of the Point measurement of precipitation, Non – recording precipitation gauges (daily rain gauges of the unshielded and shielded types), Recording precipitation gauges (siphon, float type, tipping bucket, Weighing balance type), Exposure requirements concerning precipitation point – measurement instruments, Routine care of precipitation measuring instruments, Factors affecting the accuracy of point – precipitation measurements.
7. Measurement of evaporation, General units of measurements, Principles of evaporation measuring Instruments (evaporation pan: Class A Pan, the hooked – gauge type, etc.), General requirements for the evaporation measuring instruments' Exposure, routine care of evaporation – measuring instruments.
8. Sunshine duration measurement, General principles of sunshine duration measurement, The Campbell Stokes sunshine duration recorders, Sitting and exposure requirements for sunshine duration measuring instruments; factors affecting the sunshine records of the Campbell Stokes instrument, Routine care of the Campbell Stokes sunshine recorder, measurement of burnt trace on the cards.
9. Automation of the measurement of Meteorological variables, Technical and economic aspects of automation objectives, Classification of automatic weather stations, Basic block diagram of an automatic weather station, Sensors used with automatic weather stations, Maintenance of automatic weather stations, Reliability of automatic equipment.

STATISTICS - AGR 107

1. Introduction: Definitions, meaning of statistics, examples with natural situations, Data collection and storage.

2. Data arrangement: Mean, median, mode, Mean of grouped and ungrouped data, Assumed Mean, Arithmetic and Geometric mean. Median and mode for grouped Data
3. Graphical representation of data: Graphs, Pie chart, bar chart, Frequency table, cumulative frequency.
4. Applications: Daily and monthly means of weather elements like temperature, pressure, Humidity, etc.
5. Regression and Correlation, Scatter graphs, Relationships between two variables and scatter graphs (construction of line of best fit, estimate from scatter graphs, significance of the scatter graph, limitations of scatter graph); computing regression lines (equation of straight line, measuring the Deviations; graphing Regression lines; the use of regression lines; choice of regression line and Regression coefficient; Multiple linear regression and non–linear regression); Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation).

SYNOPTIC METEOROLOGY - AGR 108

1. Tropical Weather systems; Tropical/subtropical jet streams, and other broad wind systems (AEJ, Trade winds, seasonal evolution of the tropical wind systems, and ITD / ITCZ; annual cycles); Tropical cyclones; Monsoons; Synoptic analysis of the disturbance patterns at the surface and their relation to high-altitude features.
2. ITD / ITCZ and the associated weather zones.
3. Waves and jet streams. Sea breeze, Anabatic and Katabatic winds.
4. Mid-latitude synoptic systems. Air-masses – source regions; formation processes of air-masses; Air-mass modification; frontal-wave depression.
5. Global observing system (Synoptic data for Surface, Upper-air and Special observations; coding and decoding, representation and analysis of meteorological data; quality control); World Weather Watch Program; Global Meteorological Telecommunications Network.
6. General circulation and the pressure systems.
7. West –African line squall.
8. Harmattan dust haze
9. Monsoons
10. Little dry season
11. African waves
12. Forcing functions.
13. Frontal systems
14. West African Jets.

CERTIFICATE COURSE IN AVIATION METEOROLOGY

LEARNING OUTCOME FOR AVIATION METEOROLOGY

To be able to analyse and monitor the weather situation, forecast aeronautical and meteorological phenomena, ensure quality of meteorological information and communicate meteorological information to users

The Tailored Basic Instruction Packages for the Trainees will be satisfied through successful completion of the following curricula for Aviation Meteorology:

1. Aeronautical Meteorology (1 & 2) - AER 101 & AER 102
2. Codes and Observation - AER 103
3. Computer Studies - AER 104
4. General Meteorology - AER 105
5. Satellite Meteorology - AER 106
6. Meteorological Instrument - AER 107
7. Plotting - AER 108
8. Statistics - AER 109
9. Upper Air Observation - AER 110
10. Synoptic Meteorology - AER 110

Course outlines for each subject are as follows:

AERONAUTICAL METEOROLOGY I - AER 101

1. Observing techniques. Surface wind direction and speed, including changes and variations. Visibility and runway visual range, including spatial and temporal variations in RVR observations, cloud amount, height and type and spatial and temporal variations. Vertical visibility, observations using automatic instruments such as a ceilometer. Pressure measurements for the purpose of determining QFE and QNH.
2. Hazardous phenomena. Aircraft icing. Elementary knowledge of icing types; formation, accretion rates and association of icing with clouds; turbulence, elementary knowledge of turbulence near the ground as related to topography; elementary knowledge of high level turbulence (CAT) and its association with jet streams. Wind shear and volcanic ash.
3. Reporting, coding and dissemination of weather information. Complete knowledge of international meteorological codes related to observations such as METAR, SPECI, SYNOP, PILOT and TEMP. Knowledge of procedure for dissemination of weather information at the aerodrome, including the special needs of ATC units. Knowledge of the procedures for the preparation of the plain language forms of meteorological messages.

4. Definitions. Meteorological report, observation, visibility, runway visual range. Altitude, elevation height, aerodrome elevation, flight level, transition level, aerodrome meteorological minima, instrument runway, landing area.
5. Procedures for meteorological services for international aviation. Organization of the meteorological service and particularly the functions of the various types of meteorological offices. Aeronautical meteorological stations and their functions. Local routine and special observations and reports, reports in METAR and SPECI code forms. Meteorological watch. Introduction to the responsibilities of ICAO and WMO in aeronautical meteorology.
6. Air traffic services. Demands for meteorological services including the types of meteorological information required by the various air traffic service units and the updating of information by means of duplicate displays in ATC units or by prompt data transmission originated by the meteorological office or station.
7. Operation of aircraft. Flight planning. Duties if flight operations officers when exercising operation control. Navigation and landing aids. Effects of air density, icing, turbulence, wind, wind shear and volcanic ash on aircraft performance. Altimeter setting procedures, standard atmosphere. Performance characteristics, including fuel consumption of civil aviation aircraft; characteristics of propeller type, turbo-prop and turbo-jet and where applicable, supersonic aircraft. Effects of various weather phenomena on aeronautical operations and on-ground services.
8. Aeronautical telecommunications. Elementary understanding of the general organization of aeronautical telecommunications, but they should have a good working knowledge of the operation of the aeronautical fixed service.
9. WMO documents. Technical regulations, (WMO-No 49) Vol II – Meteorological service for International Air Navigation. Manual on codes (WMO-No 306). Guide to Meteorological Instruments and methods of observation (WMO-No 8). Weather reporting (WMO-No 9).

AERONAUTICAL METEOROLOGY II - AER 102

1. Meteorological Service for International Air Navigation.
Terminology. Area forecast centres. Aeronautical meteorological offices.
Aeronautical meteorological stations. Observation made at aeronautical meteorological Stations. Meteorological reports from aeronautical meteorological stations Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SECIAL and SPECT). Aerodrome forecasts . Forecasts for take-off. Landing forecasts (trend type).
Wind shear and Aerodrome Warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of

meteorological messages. Information for search and rescue. Aeronautical climatological information. Information for operator's local representatives. Information required from operators. Information for pilots-in-command prior to departure.

Information for pilots-in-command during flight. Debriefing.

Definitions should include:

Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level, and transitional level Aerodrome minima, instrument runway, landing area. Landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report. Operator, Operator's local representative and pilot-in-command.

2. Operation Aircraft

Flight planning : Definitions, flight planning services, sources of meteorological Information, available meteorological information, flight planning requirements and Significance of meteorological information.

Duties of flight operation officers when exercising operational control. Principle of flight. Air density and aircraft performance. Standard atmosphere. Density

Altitude other factors affecting aircraft performance.

Fuel consumption. Radio meteorology. Effects of meteorological phenomena on

Ground communications General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and land. Flight planning aspects. Aerodrome meteorological minima.

3. Aeronautical Telecommunications

Understanding the general organization of aeronautical telecommunication; a thorough knowledge of the procedures applicable to the preparation of meteorological messages, which they or their assistants will normally originate. Operation of the Aeronautical Fixed Service including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message heading, addressing of message, priorities of messages, ICAO abbreviations. Used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should Include: Meteorological Data Distribution (MDD), RETIM (SYNWRGIE-PC), SATCOM, Primary Data User System (PDUS), MESSIR-VISION,MESSIR,-COM, the Global Telecommunication System (GTS) and all latest available systems Or facilities.

4. Air Traffic Services

Definitions. Flight rules. The nature of air traffic services. Air traffic control service. Area control service. Approach control service. Aerodrome control service. Responsibility for air traffic services. Demand for meteorological services,

Including the types of meteorological information required by the various air traffic Services units and the updating of the information.

5. Organization for International Aviation Service
   WMO Global Telecommunication System. Aeronautical telecommunication Facilities. Meteorological telecommunication facilities. International co-ordination Of procedures Regulatory documents and related publications.
6. Meteorological aspects of flight planning
   Meteorological basis for pressure-pattern flying, meteorological requirements For en-route winds and temperatures, weather and aerodrome forecasts. Significance of operational meteorological information (OPMET) in flight operations and planning. Interpretation of area, route and terminal forecast and preparation of material for briefing of flight crews. Use of flight documentation from the World Area Forecast System.
7. ICAO Documentation: Annex 3. Meteorological Services for International Air Navigation Regional Supplementary procedures** (Doc.7030). Procedures for Air Navigation Services – ICAO Abbreviations and Codes (PANS-ABC, Doc. 8400) Location Indicators (Doc.7910). Manual of Aeronautical Meteorological Practice (Doc.8896). Manual of Co-ordination between Air Traffic Services and Aeronautical Meteorological Services(Doc. 9377). Manual of Runway Visual Range Oberving and Reporting Practices (Doc.9328). ICAO/WMO manual on the Provision of Meteorological Services for International Helicopter Operations (Doc.9680). Relevant Air Navigation Plans (ANPs and FASID)**.

CODES AND OBSERVATION - AER 103

1. Procedures for observing meteorological parameters: Standard time, accuracy and measurement (UTC unit), Standard International Block and stations numbers e.g. Nigerian Stations.
2. Direct and Indirect Measurement of Temperatures (Air, Soil, Maximum, Minimum, etc.), Measurement of Humidity (Relative Humidity autographic instruments, Derived values with aid of Humidity slide rule), Measurement of Atmospheric Pressures (Barometers, Barographs).
3. Observation of Clouds (Forms, Types, Amount, Height of base, the use of Cloud Atlas and Pictures).
4. Observation of surface Winds (Direction and speed, use of Anemometers and Beaufort scale for estimation of wind speed).
5. Measurements of Precipitation and Evaporation.
6. Visibility: General unit measurements, Definition of visibility parameters, Visibility at night.
7. Measurement of radiation and sunshine duration.
8. Coding of observation: Applications of SYNOP code for observation (Section 0-5), Cloud (Type, form, height of base), Present and past weather, Visibility, Wind (Direction and speed), Precipitation (Amount and Duration). Application of METAR and SPECI Codes.

COMPUTER STUDIES - AER 104

1. Evolution of the computer systems: Definitions of computer; History of the computer (The beginning of computer age); Generations of computers; Types of computers; Classifications of digital computers; Characteristics of computers; Application of computers in the society.
2. Functional parts of a digital computer: Hardware (Input units, Output units, Processing units, Storage units, Communication units) and software (types of computer software, operating system, application software).
3. Computer Safety and Maintenance (Top Computer Mistakes Beginners Make, Basic Troubleshooting Techniques, Maintaining Your Computer).
4. Using the computer (Buttons and parts on a computer, setting up a computer, Computer safety and maintenance).
5. Introduction To Data Transmission And Computer Networking (Data Transmission, Data Transmission And Communication Facilities, Computer Network, Types Of Network, Network Configurations, The Internet And The Electronic Mail).
6. Introduction To Computer Programming (Flowchart And Algorithm, Introduction To The BASIC Programming Language)

SATELLITE METEOROLOGY - AER 105

1. Introduction: history of meteorological satellites.
2. Basics in remote sensing; Physics behind remote-sensing; Remote-sensing techniques – merits and applications.
3. Satellite data acquisition, processing and archiving.
4. Satellite imagery analysis and interpretation; application of satellite imagery both in visible and infrared spectral regions for the analysis and interpretation of weather systems.
5. Series of practical examples to examine – a range of meteorological events over the African continent, tropics and mid-latitude; Public weather forecast; Aeronautical meteorology.

GENERAL METEOROLOGY - AER 106

1. The layers and composition of the atmosphere: water vapour; carbon dioxide; etc Vertical divisions of the atmosphere – troposphere; stratosphere; mesosphere; thermosphere; ionosphere.
2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces.
3. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the General circulation in the tropics and in non-tropical regions; local Winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind;

cyclones and Anticyclones; air masses and fronts; thunderstorms; synoptic chart analyses; Weather associated with synoptic systems.

4. Atmospheric temperature; horizontal and vertical variations of air Temperature, troposphere and stratosphere. The effect of gravity on the atmosphere, air density, Atmospheric pressure, Variations in pressure; mean sea level pressure; horizontal and vertical pressures; significance of pressure gradient.
5. The three states of water; vapour pressure; saturation vapour pressure; evaporation, condensation; freezing; sublimation; isobaric and adiabatic processes; latent heat; Moisture indicators; relative humidity; mixing ratio and dew point.
6. Rudiments of cloud, fog and precipitation formation; visibility, the influence of water vapour, of water drops and dust (aerosols).
7. Basic knowledge of the vertical stability or instability; non-saturated air and saturated air; isobaric expansion and adiabatic expansion; the influence of condensation.

METEOROLOGICAL INSTRUMENTS - AER 107

1. Measurement of meteorological variables, Specific features of Meteorological Measurement, Direct and indirect Meteorological measurement, Direct Reading Instruments, Indirect Reading Instruments, Desirable Characteristics of Meteorological Instruments, General requirements for sitting and exposure of Meteorological Instruments.
2. Measurement of atmospheric pressure, Units of measurements of atmospheric pressure, Principles underlying the operation of atmospheric pressure measuring Instruments (Mercury barometers, Kew Pattern Barometer and Fortin Barometer, Aneroid barometers, barographs), Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature, units of measurement of air temperature, temperature scales used in Meteorology and conversion, Principles underlying the operation of air – temperature measuring Instruments (Mercury-in-glass thermometers, spirit-In-glass thermometers, The bimetallic thermometers, thermographs), Exposure of air temperature measuring instruments – radiation errors, Setting time of thermometers.
4. Measurement of atmospheric humidity, units of measurement of absolute humidity, relative humidity, dew point and other humidity parameters. General principles of hygrometers. Humidity measuring instruments based on change of dimension of hygroscopic substances (the hair hygrometer, the psychrometer).
5. Measurement of surface wind direction and speed, units of measurements of wind direction and wind speed, Principles of wind measuring instruments (The pressure plate anemometer, The rotation

sensor cup – wheel – propeller, Anemometers measuring run of wind).

6. Measurement of precipitation (liquid and solid precipitation), units of measurement, Principles of the Point measurement of precipitation, Non – recording precipitation gauges (daily rain gauges of the unshielded and shielded types), Recording precipitation gauges (siphon, float type, tipping bucket, Weighing balance type), Exposure requirements concerning precipitation point – measurement instruments, Routine care of precipitation measuring instruments, Factors affecting the accuracy of point – precipitation measurements.
7. Measurement of evaporation, General units of measurements, Principles of evaporation measuring Instruments (evaporation pan: Class A Pan, the hooked – gauge type, etc.), General requirements for the evaporation measuring instruments' Exposure, routine care of evaporation – measuring instruments.
8. Sunshine duration measurement, General principles of sunshine duration measurement, The Campbell Stokes sunshine duration recorders, Sitting and exposure requirements for sunshine duration measuring instruments; factors affecting the sunshine records of the Campbell Stokes instrument, Routine care of the Campbell Stokes sunshine recorder, measurement of burnt trace on the cards.
9. Automation of the measurement of Meteorological variables, Technical and economic aspects of automation objectives, Classification of automatic weather stations, Basic block diagram of an automatic weather station, Sensors used with automatic weather stations, Maintenance of automatic weather stations, Reliability of automatic equipment.

PLOTTING - AER 108

1. Locations of station on Charts.
2. Data representation on chart with international symbols (Surface Plotting model, Ship message plotting model, etc.).
3. Tables (Table I - Wind direction and speed, Table II - Clouds and pressure tendencies, Table III - Present weather symbols).
4. Application of models and tables.

STATISTICS - AER 109

1. Introduction: Definitions, meaning of statistics, examples with natural situations, Data collection and storage.
2. Data arrangement: Mean, median, mode, Mean of grouped and ungrouped data, Assumed Mean, Arithmetic and Geometric mean. Median and mode for grouped Data
3. Graphical representation of data: Graphs, Pie chart, bar chart, Frequency table, cumulative frequency.

4. Applications: Daily and monthly means of weather elements like temperature, pressure, Humidity, etc.
5. Regression and Correlation, Scatter graphs, Relationships between two variables and scatter graphs (construction of line of best fit, estimate from scatter graphs, significance of the scatter graph, limitations of scatter graph); computing regression lines (equation of straight line, measuring the Deviations; graphing Regression lines; the use of regression lines; choice of regression line and Regression coefficient; Multiple linear regression and non–linear regression); Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation).

UPPER AIR OBSERVATION - AER 112

1. Theory of upper-wind measurement.
2. Meteorological balloons and the state of the sky that determines the colour of the balloon to be used; Inflation of meteorological balloons; hydrogen generators for meteorological purposes; Care and handling of Meteorological balloons; Sizes of Meteorological balloons. Pilot – balloon ceiling measurement for the determination of cloud – base (Height).
3. The Pilot – Balloon theodolite.
4. Pilot Balloon Codes PART A, B, C, and D.
5. Radio sounding of the upper atmosphere (Radio-Sonde Transmitter; weather elements observed in radio sounding – Pressure, Temperature, Wind direction and speed, humidity and dew point). Temp Messages (Message Identifier TTAA).

SYNOPTIC METEOROLOGY - AER 111

1. Tropical Weather systems; Tropical/subtropical jet streams, and other broad wind systems (AEJ, Trade winds, seasonal evolution of the tropical wind systems, and ITD / ITCZ; annual cycles); Tropical cyclones; Monsoons; Synoptic analysis of the disturbance patterns at the surface and their relation to high-altitude features.
2. ITD / ITCZ and the associated weather zones.
3. Waves and jet streams. Sea breeze, Anabatic and Katabatic winds.
4. Mid-latitude synoptic systems. Air-masses – source regions; formation processes of air-masses; Air-mass modification; frontal-wave depression.
5. Global observing system (Synoptic data for Surface, Upper-air and Special observations; coding and decoding, representation and analysis of meteorological data; quality control); World Weather Watch Program; Global Meteorological Telecommunications Network.
6. General circulation and the pressure systems.
7. West –African line squall.
8. Harmattan dust haze
9. Monsoons
10. Little dry season

11. African waves
12. Forcing functions.
13. Frontal systems
14. West African Jets.

CERTIFICATE COURSE IN CONVENTIONAL METEOROLOCAL INSTRUMENT

LEARNING OUTCOME FOR METEOROLOCAL INSTRUMENT COURSE

Get better understanding in the calibration, structure, operation and maintenance of meteorological instruments.

The Tailored Basic Instruction Packages for the Trainees will be satisfied through successful completion of the following curricula for Conventional Meteorological Instrument Course:

1. Computer Studies – MIC 101
2. Fault Finding — MIC 102
3. General Meteorology – MIC 103
4. Meteorological Instrument Installation — MIC 104
5. Meteorological Instrument – MIC 105
6. Meteorological Instrument Calibration & Quality Control – MIC 106
7. Meteorological Instrument Maintenance — MIC 107
8. Statistics – MIC 108

Course outlines for each subject are as follows:

COMPUTER STUDIES – MIC 101

1. Evolution of the computer systems: Definitions of computer; History of the computer (The beginning of computer age); Generations of computers; Types of computers; Classifications of digital computers; Characteristics of computers; Application of computers in the society.
2. Functional parts of a digital computer: Hardware (Input units, Output units, Processing units, Storage units, Communication units) and software (types of computer software, operating system, application software).
3. Computer Safety And Maintenance (Top Computer Mistakes Beginners Make, Basic Troubleshooting Techniques, Maintaining Your Computer).
4. Using the computer (Buttons and parts on a computer, setting up a computer, Computer safety and maintenance).
5. Introduction to Data Transmission And Computer Networking (Data Transmission, Data Transmission And Communication Facilities, Computer Network, Types Of Network, Network Configurations, The Internet And The Electronic Mail).
6. Introduction To Computer Programming (Flowchart And Algorithm, Introduction To The BASIC Programming Language)

GENERAL METEOROLOGY – MIC 102

1. The layers and composition of the atmosphere: water vapour; carbon dioxide; etc. Vertical divisions of the atmosphere – troposphere; stratosphere; mesosphere; thermosphere; ionosphere.

2. Heat exchange processes in the atmosphere; solar and terrestrial radiation; Conduction and convection; advection; energy budget of the atmosphere; effect of radiation at the earth's surface; temperature difference between land and sea surfaces.
3. Elementary knowledge of synoptic and dynamic meteorology; air motion; Significance of scale; the winds and their causes; rudiments of the General circulation in the tropics and in non-tropical regions; local Winds; diurnal wind variation (breezes) and annual wind variations (monsoons); relation between the horizontal pressure gradient and the Winds; Buys-Ballot's law and the geostrophic wind; cyclones and Anticyclones; air masses and fronts; thunderstorms; synoptic chart analyses; Weather associated with synoptic systems.
4. Atmospheric temperature; horizontal and vertical variations of air Temperature, troposphere and stratosphere.
5. The effect of gravity on the atmosphere, air density, Atmospheric pressure, Variations in pressure; mean sea level pressure; horizontal and vertical pressures; significance of pressure gradient.
6. The three states of water; vapour pressure; saturation vapour pressure; evaporation, condensation; freezing; sublimation; isobaric and adiabatic processes; latent heat; Moisture indicators; relative humidity; mixing ratio and dew point.
7. Rudiments of cloud, fog and precipitation formation; visibility, the influence of water vapour, of water drops and dust (aerosols).
8. Basic knowledge of the vertical stability or instability; non-saturated air and saturated air; isobaric expansion and adiabatic expansion; the influence of condensation

METEOROLOGICAL INSTRUMENTS – MIC 103

1. Measurement of meteorological variables, Specific features of Meteorological Measurement, Direct and indirect Meteorological measurement, Direct Reading Instruments, Indirect Reading Instruments, Desirable Characteristics of Meteorological Instruments, General requirements for sitting and exposure of Meteorological Instruments.
2. Measurement of atmospheric pressure, Units of measurements of atmospheric pressure, Principles underlying the operation of atmospheric pressure measuring Instruments (Mercury barometers, Kew Pattern Barometer and Fortin Barometer, Aneroid barometers, barographs), Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature, units of measurement of air temperature, temperature scales used in Meteorology and conversion, Principles underlying the operation of air – temperature measuring Instruments (Mercury-in-glass thermometers, spirit-In-glass thermometers, The

bimetallic thermometers, thermographs), Exposure of air temperature measuring instruments – radiation errors, Setting time of thermometers.

4. Measurement of atmospheric humidity, units of measurement of absolute humidity, relative humidity, dew point and other humidity parameters. General principles of hygrometers. Humidity measuring instruments based on change of dimension of hygroscopic substances (the hair hygrometer, the psychrometer).
5. Measurement of surface wind direction and speed, units of measurements of wind direction and wind speed, Principles of wind measuring instruments (The pressure plate anemometer, The rotation sensor cup – wheel – propeller, Anemometers measuring run of wind).
6. Measurement of precipitation (liquid and solid precipitation), units of measurement, Principles of the Point measurement of precipitation, Non – recording precipitation gauges (daily rain gauges of the unshielded and shielded types), Recording precipitation gauges (siphon, float type, tipping bucket, Weighing balance type), Exposure requirements concerning precipitation point – measurement instruments, Routine care of precipitation measuring instruments, Factors affecting the accuracy of point – precipitation measurements.
7. Measurement of evaporation, General units of measurements, Principles of evaporation measuring Instruments (evaporation pan: Class A Pan, the hooked – gauge type, etc.), General requirements for the evaporation measuring instruments' Exposure, routine care of evaporation – measuring instruments.
8. Sunshine duration measurement, General principles of sunshine duration measurement, The Campbell Stokes sunshine duration recorders, Sitting and exposure requirements for sunshine duration measuring instruments; factors affecting the sunshine records of the Campbell Stokes instrument, Routine care of the Campbell Stokes sunshine recorder, measurement of burnt trace on the cards.
9. Automation of the measurement of Meteorological variables, Technical and economic aspects of automation objectives, Classification of automatic weather stations, Basic block diagram of an automatic weather station, Sensors used with automatic weather stations, Maintenance of automatic weather stations, Reliability of automatic equipment.

STATISTICS – MIC 104

1. Data arrangement: Mean, median, mode, Mean of grouped and ungrouped data, Assumed Mean, Arithmetic and Geometric mean. Median and mode for grouped Data.
2. Graphical representation of data: Graphs, Pie chart, bar chart, Frequency table, cumulative frequency.

3. Applications: Daily and monthly means of weather elements like temperature, pressure, Humidity, etc.

4. Regression and Correlation, Scatter graphs, Relationships between two variables and scatter graphs (construction of line of best fit, estimate from scatter graphs, significance of the scatter graph, limitations of scatter graph); computing regression lines (equation of straight line, measuring the Deviations; graphing Regression lines; the use of regression lines; choice of regression line and Regression coefficient; Multiple linear regression and non–linear regression); Correlation (computation of r; interpretation of r; types of correlation; Spurious correlation; Rank correlation).

FAULT FINDING – MIC 105

1. Introduction
2. Maintenance and the user
3. Preparation prior failure
4. fault-finding fundamentals
5. Health and safety essentials
6. Fault-finding techniques
7. Component replacement
8. Test equipment
9. Out on your own
10. Further reading.

INDUCTION COURSE FOR METEOROLIGIST

Meteorological Instruments

1. Measurement of meteorological variables, Specific features of Meteorological Measurement, Direct and indirect Meteorological measurement, Direct Reading Instruments, Indirect Reading Instruments, Desirable Characteristics of Meteorological Instruments, General requirements for sitting and exposure of Meteorological Instruments.

2. Measurement of atmospheric pressure, Units of measurements of atmospheric pressure, Principles underlying the operation of atmospheric pressure measuring Instruments (Mercury barometers, Kew Pattern Barometer and Fortin Barometer, Aneroid barometers, barographs), Exposure of atmospheric pressure measuring instruments.
3. Measurement of air temperature, units of measurement of air temperature, temperature scales used in Meteorology and conversion, Principles underlying the operation of air – temperature measuring Instruments (Mercury-in-glass thermometers, spirit-In-glass thermometers, The bimetallic thermometers, thermographs), Exposure of air temperature measuring instruments – radiation errors, Setting time of thermometers.
4. Measurement of atmospheric humidity, units of measurement of absolute humidity, relative humidity, dew point and other humidity parameters. General principles of hygrometers. Humidity measuring instruments based

on change of dimension of hygroscopic substances (the hair hygrometer, the psychrometer).

5. Measurement of surface wind direction and speed, units of measurements of wind direction and wind speed, Principles of wind measuring instruments (The pressure plate anemometer, The rotation sensor cup – wheel – propeller, Anemometers measuring run of wind).
6. Measurement of precipitation (liquid and solid precipitation), units of measurement, Principles of the Point measurement of precipitation, Non – recording precipitation gauges (daily rain gauges of the unshielded and shielded types), Recording precipitation gauges (siphon, float type, tipping bucket, Weighing balance type), Exposure requirements concerning precipitation point – measurement instruments, Routine care of precipitation measuring instruments, Factors affecting the accuracy of point – precipitation measurements.
7. Measurement of evaporation, General units of measurements, Principles of evaporation measuring Instruments (evaporation pan: Class A Pan, the hooked – gauge type, etc.), General requirements for the evaporation measuring instruments' Exposure, routine care of evaporation – measuring instruments.
8. Sunshine duration measurement, General principles of sunshine duration measurement, The Campbell Stokes sunshine duration recorders, Sitting and exposure requirements for sunshine duration measuring instruments; factors affecting the sunshine records of the Campbell Stokes instrument, Routine care of the Campbell Stokes sunshine recorder, measurement of burnt trace on the cards.
9. Automation of the measurement of Meteorological variables, Technical and economic aspects of automation objectives, Classification of automatic weather stations, Basic block diagram of an automatic weather station, Sensors used with automatic weather stations, Maintenance of automatic weather stations, Reliability of automatic equipment.

Codes and Observation

1. Measurement of meteorological variables and procedure of observation. Specific features of Meteorological measurements. Direct and Indirect Measurement of Temperatures (Air, Soil, Maximum, Minimum, etc.), Measurement of Humidity (Relative Humidity autographic instruments, Derived values with aid of Humidity slide rule), Measurement of Atmospheric Pressures (Barometers, Barographs).
2. Measurement / Observation of Clouds - Forms, Types, Amount, Height of base (ceilometers, ceiling ascent, the use of Cloud Atlas and Pictures).
3. Measurement / Observation of surface Winds (Direction and speed, use of Anemometers and Beaufort scale for estimation of wind speed).
4. Measurements of Precipitation (rates and records of precipitation). Solid or liquid gauge units.
5. Measurements of Evaporation.

6. Visibility: General unit measurements, Definition of visibility parameters, Visibility at night.
7. Measurement of Solar radiation and sunshine duration.
8. Methods and Procedures for observing meteorological parameters: Standard time, accuracy and measurement (UTC unit), Standard International Block and stations numbers e.g. Nigerian Stations.
9. Coding of observation: Applications of SYNOP code for observation (Section 0-9), Cloud (Type, form, height of base), Present and past weather, Visibility, Wind (Direction and speed), Precipitation (Amount and Duration). Application of METAR and SPECI Codes. Application of Question codes.

Plotting

1. Locations of station on Charts.
2. Data representation on chart with international symbols (Surface Plotting model).
3. Tables (Table I - Wind direction and speed, Table II - Clouds and pressure tendencies, Table III - Present weather symbols).
4. Application of models and tables

AERONAUTICAL METEOROLOGY

AERONAUTICAL METEOROLOGY I

1. Observing techniques. Surface wind direction and speed, including changes and variations. Visibility and runway visual range, including spatial and temporal variations in RVR observations, cloud amount, height and type and spatial and temporal variations. Vertical visibility, observations using automatic instruments such as a ceilometer. Pressure measurements for the purpose of determining QFE and QNH.
2. Hazardous phenomena. Aircraft icing. Elementary knowledge of icing types; formation, accretion rates and association of icing with clouds; turbulence, elementary knowledge of turbulence near the ground as related to topography; elementary knowledge of high level turbulence (CAT) and its association with jet streams. Wind shear and volcanic ash.
3. Reporting, coding and dissemination of weather information. Complete knowledge of international meteorological codes related to observations such as METAR, SPECI, SYNOP, PILOT and TEMP. Knowledge of procedure for dissemination of weather information at the aerodrome, including the special needs of ATC units. Knowledge of the procedures for the preparation of the plain language forms of meteorological messages.

4. Definitions. Meteorological report, observation, visibility, runway visual range. Altitude, elevation height, aerodrome elevation, flight level, transition level, aerodrome meteorological minima, instrument runway, landing area.
5. Procedures for meteorological services for international aviation. Organization of the meteorological service and particularly the functions of the various types of meteorological offices. Aeronautical meteorological stations and their functions. Local routine and special observations and reports, reports in METAR and SPECI code forms. Meteorological watch. Introduction to the responsibilities of ICAO and WMO in aeronautical meteorology.
6. Air traffic services. Demands for meteorological services including the types of meteorological information required by the various air traffic service units and the updating of information by means of duplicate displays in ATC units or by prompt data transmission originated by the meteorological office or station.
7. Operation of aircraft. Flight planning. Duties if flight operations officers when exercising operation control. Navigation and landing aids. Effects of air density, icing, turbulence, wind, wind shear and volcanic ash on aircraft performance. Altimeter setting procedures, standard atmosphere. Performance characteristics, including fuel consumption of civil aviation aircraft; characteristics of propeller type, turbo-prop and turbo-jet and where applicable, supersonic aircraft. Effects of various weather phenomena on aeronautical operations and on-ground services.
8. Aeronautical telecommunications. Elementary understanding of the general organization of aeronautical telecommunications, but they should have a good working knowledge of the operation of the aeronautical fixed service.
9. WMO documents. Technical regulations, (WMO-No 49) Vol II – Meteorological service for International Air Navigation. Manual on codes (WMO-No 306). Guide to Meteorological Instruments and methods of observation (WMO-No 8). Weather reporting (WMO-No 9).

AERONAUTICAL METEOROLOGY II

1. Meteorological Service for International Air Navigation.

Terminology. Area forecast centres. Aeronautical meteorological offices. Aeronautical meteorological stations. Observation made at aeronautical meteorological Stations. Meteorological reports from aeronautical meteorological stations Aviation routine weather report (MET Report and METAR). Aviation selected special weather report (SECIAL and SPECT). Aerodrome forecasts . Forecasts for take-off. Landing forecasts (trend type).
Wind shear and Aerodrome Warnings. GAMET area forecast, SIGMET and AIRMET (information). Route forecast. Dissemination of meteorological information. Information for and from air traffic services. Forms of

meteorological messages. Information for search and rescue. Aeronautical climatological information. Information for operator's local representatives. Information required from operators. Information for pilots-in-command prior to departure.
Information for pilots-in-command during flight. Debriefing.
Definitions should include:
Meteorological report, observation. Visibility, runway visual ranges. Altitude, elevation, height, aerodrome, flight-level, and transitional level Aerodrome minima, instrument runway, landing area. Landing forecast, aerodrome forecast, GAMET area forecast, SIGMET and AIRMET (information). Briefing route and special air-report. Operator, Operator's local representative and pilot-in-command.

2. Operation Aircraft

Flight planning : Definitions, flight planning services, sources of meteorological Information, available meteorological information, flight planning requirements and Significance of meteorological information.
Duties of flight operation officers when exercising operational control. Principle of flight. Air density and aircraft performance. Standard atmosphere. Density
Altitude other factors affecting aircraft performance.
Fuel consumption. Radio meteorology. Effects of meteorological phenomena on
Ground communications General flight navigation. Air pilotage. Electronic navigation. Celestial navigation. Aids to approach and land. Flight planning aspects. Aerodrome meteorological minima.

3. Aeronautical Telecommunications

Understanding the general organization of aeronautical telecommunication; a
thorough knowledge of the procedures applicable to the preparation of meteorological messages, which they or their assistants will normally originate. Operation of the Aeronautical Fixed Service including particularly the Aeronautical Fixed Telecommunication Network (AFTN), Aeronautical Telecommunication Network (ATN); message heading, addressing of message, priorities of messages, ICAO abbreviations. Used in messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX); satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS). Other systems should Include: Meteorological Data Distribution (MDD), RETIM (SYNWRGIE-PC), SATCOM, Primary Data User System (PDUS), MESSIR-VISION,MESSIR,-COM, the Global Telecommunication System (GTS) and all latest available systems Or facilities.

4. Air Traffic Services

Definitions. Flight rules. The nature of air traffic services. Air traffic control service. Area control service. Approach control service. Aerodrome control service. Responsibility for air traffic services. Demand for meteorological services,

Including the types of meteorological information required by the various air traffic Services units and the updating of the information.

5. Organization for International Aviation Service
   WMO Global Telecommunication System. Aeronautical telecommunication Facilities. Meteorological telecommunication facilities. International co-ordination of procedures Regulatory documents and related publications.
6. Meteorological aspects of flight planning
   Meteorological basis for pressure-pattern flying, meteorological requirements For en-route winds and temperatures, weather and aerodrome forecasts. Significance of operational meteorological information (OPMET) in flight operations and planning. Interpretation of area, route and terminal forecast and preparation of material for briefing of flight crews. Use of flight documentation from the World Area Forecast System.
7. ICAO Documentation: Annex 3. Meteorological Services for
   International Air Navigation Regional Supplementary procedures**
   (Doc.7030). Procedures for Air Navigation Services – ICAO Abbreviations and Codes (PANS-ABC, Doc. 8400) Location Indicators (Doc.7910). Manual of Aeronautical Meteorological Practice (Doc.8896). Manual of Co-ordination between Air Traffic Services and Aeronautical Meteorological Services(Doc. 9377). Manual of Runway Visual Range Observing and Reporting Practices (Doc.9328). ICAO/WMO manual on the Provision of Meteorological Services for International Helicopter Operations (Doc.9680). Relevant Air Navigation Plans (ANPs and FASID).

SATELLITE METEOROLOGY

1. Basics in remote sensing. Physics behind remote-sensing. Remote sensing techniques, merits and application
2. Introduction and History of Meteorological Satellites.
3. Satellite-data acquisition, processing and archiving. Satellite orbits, characteristics and radiometers. Satellite data acquisition, processing and data management.
4. Satellite image analysis and interpretation. Satellite image analysis, display and interpretation. Application of satellite imagery both in the visible and infrared spectral regions for the analysis and interpretation of weather systems.
5. Case studies, that is, a series of practical examine a range of Meteorological Events over the African continent, tropics and mid-latitude with emphasis
   In the application of Satellite Meteorology to Public weather forecast Aeronautical Meteorology and Agro-meteorology.
6. Future Satellites.

SYNOPTIC METEOROLOGY

1. West African line squalls
   Definitions, formation, structure, propagation and maintenance. In-situ development, deep mesoscale convective systems. Importance to national economy.
2. Harmattan dust haze
   Definitions, concept of plume, Mechanics of dust raising and transportation. Role of gravity in dust deposition, Clearance of dust haze, Frequency of dust spells. Behaviours of Saharan high pressure cell and mid-latitude trough, Dust particles as Pollutants . Economic aspects in relation to human health, aviation and other sectors of the economy.
3. Monsoons
   Theory of global monsoon circulations. West African Monsoon – onset, maintenance, cessation and failure, Baroclinicty, energetic and vertical wind profile. Consequence of late onset and failure.
4. Little Dry Season (LDS)
   Definition, period of occurrence and area affected. Associated synoptic Feature, Aspects of divergence, vorticity and intensity. Critical temperature for
   onset and cessation.
5. Atmospheric general circulation.
   One and three cellular models. Hadley and Ferrel cells. Establishment of wind and
   Pressure systems globally. Energy exchanges. Creation of solenoidal field.
   Application of Monsoons tilt at troughs and Redistribution of Meteorological quantities. Angular momentum balance.
6. African waves
   Origin and formation, Structure, Dynamics and stability criteria evolution of weather type.
7. Forcing function in West Africa
   Definitions, concept of forcing functions. Influence of various forcing functions Over West Africa. Locations and structure of forcing functions e.g African Easterly Jet (AEJ)
8. Frontal systems
   Mid-latitude and Polar fronts. Cold front, warm front and occlusion. Associated
   Weather and synoptic features, Linkage with tropical systems.
   Dynamics of frontal systems.
9. Inter-tropical Discontinuity (ITD);
   Definition and characteristics. Dynamics, the three-dimensional structure, Associated weather zones and concept of monsoon trough.
10. Wide-spread wet spells;
    Low level convergence and upper level divergence. Condition for sustained Vertical motion. Circulation in vertical planes and solenoidal field.
11. West African jets;

African Easterly jet – Location, existence period, structure, dynamics and influence on Propagating storms. Tropical Easterly Jet – structure, dynamics, period of existence, Location and influence on weather.

PYHSICAL METEOROLOGY

1. Introduction to physical meteorology.
2. Transparency of the atmosphere and visibility.
3. Definitions, basic knowledge and formation of Clouds (International cloud classification, stratiform clouds, cumuliform clouds, orographic clouds), Fog (Fog Classification) and Precipitation (Process of raindrop formation, artificial rain).
4. Large- and small-scale cooling of the air due to adiabatic and non-adiabatic processes.
5. Elements of Atmospheric Optics and Electricity; Atmospheric ions and the Conductivity of the air; Refraction; Rainbow; Halo; Corona; Blueness of the sky; Lightning discharge and thunderstorms.

SYNOPTIC METEOROLOGICAL PRACTICALS/FORECASTING PROCEDURES

1. Definition of Analysis
   Composition/Design of Various Charts

2. Types of elements and the Charts used
   Rules governing Analysis/Nature of Analysis
   Types of Analysis and available
   - Surface
   - Upper Air
   - Frontal
3. Importance of the above to Science of Meteorology

4. Practical Exercise
   The use of PDUS, AFDOS, Messir vision and Radar in Meteorology and Global Model Charts.

5. Synoptic Systems Theory
   Dust Haze
   Fog
   Thunderstorms/Line Squall

STATISTICS

1. Graphical representation of data; Finding the means, median and mode of grouped data; Quartiles; percentiles, deciles etc.

2. Regression and Correlation
   Scatter graphs, relationships, between two variables and scatter graphs (construction, line of best fit, estimate from scatter graphs significance of the scatter graph, limitations of scatter graph) computing regression lines equation; method of least squares, measuring the deviations; the regression of y on x ; the regression of x on y; graphing regression lines; the use of regression lines; choice of regression line and regression coefficient.
   Correlation (computation of r; interpretation of r; types of correlation;
   Rank correlation r^1; the equation of a least square line and fitting the data; Multiple linear Regression and non-linear regression.
3. Probability
   Conditional probability; Independent and dependent events; mutually exclusive events;
   Mathematical expectation; permutations and combinations. Probability distributions, the Binomial distribution the poisson distribution. Properties the Normal distribution. The relation between Binomial and normal distribution.
4. Estimation
   Tests of significance; test a hypothesis; the null hypothesis, testing the null hypothesis, Rejection of the null hypothesis, non-rejection of the null hypothesis, confidence level.
5. Venn Diagrams.

Data Processing

1. Introduction to Data Processing; Definitions, Types, Categories and Method of Data Processing, Basic Data processing, etc.
2. The Concept of Data and Information; Data processing system and Information System and their classification, Development of Information Management.
3. Data processing cycle; Areas and Stages of Data processing, Data Input, Storage, Output and Processing Techniques.
4. Data processing operations; Data Collection, Data Review, Data Entry, Data validation and types, Data processing Jobs and activities, Data types and Structures, Centralized and Decentralized Data processing Centres etc.
5. Database Management; Definitions; Database, Database Management, Database Management System (DBMS).
6. DBMS Building Blocks.
7. DBMS Staff and their functions.
8. Data Tabulation and Presentation.

9. Data control and retrieval.
10. Batch Processing
11. Introduction to Database Design; Steps in Database Designing, Examples of Database Design, Methodology and Tables of Database Design, Logical database Design, Relational Database Design, Access Database Design, Hierarchical Database Design, Normalization, primary Key, Entity Relational Diagram, etc.
12. Data Analysis and Interpretation; Definition, Data Analysis Techniques, Steps and Examples in Data Analysis, Simple Data Analysis and Types, Methods of Data Analysis ,Data Analysis Reports, Working with Ms Excel, Basic Analysis with SPSS, etc.

STAFF PROFILE OF REGIONAL TRAINING CENTRE (RTC)

Research and Training Centre Staff list and Qualifications

S/N	Name	Areas of Specialization	Qualification	Rank
1	Prof. Odjugo, Peter. A. Ovuyovwiroye	Applied Climatology	B.Sc(Ed) Geography Sci.),M.Sc Geography (Climatology), PhD Geography (Climatology).	Director (Research & Training)
2	Matazu, M. B. (Dr.)	Applied Met.	B.Sc (Geography), Mtech. (Met), Ph.D(Applied Met), PGD (Education), PGD (Urban Mgt tools for Climate change)	General Manager (Research)
3	Akinyemi, Abel Olatunji	Aeronautical Meteorology	W.M.O Class III Cert., B.Sc(Agric. Met. & Water Mgt), M.Sc(Geography: (Climatology Option)	Principal /Assistant General Manager
4	Bankole, Julius Ayodele	General Meteorology	W.M.O Class III Cert., B.Tech(Met), PGD(Geo-Informatics), M.Tech(Met)	Vice Principal/ Assistant General Manager
5	Aremu,Olusegun Amos	Climatology	W.M.O Class III Cert., B.Tech(Met), M. Tech(Met)	Instructor/Chief Meteorologist
6	Oluwatosin,Helen Ifepade (Mrs)	Physical Meteorology	W.M.O Class III & II Cert., B.Tech(Met), MSc (Geography in view)	Instructor/Asst. Chief Meteorologist
7	Sanwoolu,Adedeji Oluwafemi	Aeromet, Hydromet & Agric. Met.	W.M.O Class III Cert., BSc(Water Res. Mgt & Agric. Met), MSc(Geography: Hydrology Option). Radar Met Cert., WMO/ICAO Aeromet Competency Assessment Cert.	Instructor/ Chief Meteorologist
8	Iheme,Patricia Nnenna (Mrs.)	Dynamic Met & Met. Statistics	W.M.O Class III & II Cert., B.Tech(Met), M. Tech(Met)	Instructor/ Asst. Chief Meteorologist
9	Popoola,Temidayo	Synoptic Met	W.M.O Class III & II Cert.,	Instructor/ Asst. Chief Meteorologist

			B.Tech(Met), M. Tech(Met)	
10	Oyegoke, Joyce Olusola (Mrs.)	Synoptic Met	WMO Class III & Class II, B. Tech (Met)	Instructor/ Chief Meteorological Technologist
11	Williams,Agnes Inyang (Mrs)	General Meteorology/Research	W.M.O Class III & II Cert., B.Tech(Met), M. Tech(Met)	Instructor/ Asst. Chief Meteorological Technologist
12	Orisakwe,Chinomnso Grace (Miss)	Met. Observation	W.M.O Class III Cert., B.Sc(Computer Science)	Instructor/ Principal Meteorological Technologist II
13	Aweda,Emmnuel Damilola	Satellite Met.	B.Tech(Met), M. Tech(Met)	Instructor/ Meteorologist I
14	Rasaq-Balogun Saidat Opeyemi	Atmospheric Physics	B.Tech(Met), M. Tech(Met)	Instructor/ Meteorologist I
15	Kolade,Olanrewaju Odunayo	IT Support/ Network Administrator	BSc Computer Science, Oracle Certified Associate & Expert (OCA/OCE)	Support / ICT Officer II
16	Adelakun,Sarafadeen Ayinde	IT Support	B.Sc Computer Science	Support / ICT Officer II
17	Orji, Bernard N	Weather forecasting	W.M.O Class III Cert., BSc(Met). NWP Product Interpretation Cert., Aeromet Cert.	Instructor/ Chief Meteorologist
18	Ajaezi,Godwin Obiayor	Agric. Met.	B.Tech(Met), MSc Applied & Agric. Met.	Instructor /Deputy General Manager
19	Ikekhua,Felix O.	Satellite Met & Aeromet	B.Tech(Met), MSc (Geography: Climatology option)	Instructor / Deputy General Manager
20	Kemakolam,Jasper Uche	Agric. Met.	B.Agric(Tech) PGD(Agric. Met.)	Instructor / Asst. General Manager
21	Obi, Godwin Ekunke (Dr.)	Agric. Met.	DVM, W.M.O Class I Cert,. PGD Met., EUMESAT Application in Agric. Met Cert.,	Instructor/ Chief Meteorologist
22	Sholademi,Mutiat Olaide (Mrs.)	Marine Met	W.M.O Class III Cert., Bsc(Water Res Mgt & Agric. Met), MSc(Agric. Met.) Cert.,(Marine Obs), Cert., (Wave Forecasting)	Instructor/ Asst. General Manager
23	Sholademi,Ajiboye Bamidele	Agric. Met	W.M.O Class III Cert., Bsc(Water Res Mgt & Agric.	Instructor/ Asst. Chief Meteorologist

			Met), MSc(Agric. Met. In View)	
24	Eboh,Chinyere Clara (Mrs.)	Computer Science & Engineering	W.M.O Class III Cert., B Eng (Computer Science & Engr.)., Upper Air Sounding Cert.,	Instructor / Asst. Chief Engineer
25	Chukwuma,Jude Uchenna	Upper Air Observation	W.M.O Class III Cert., B.Sc(Computer Science)	Instructor / Asst. Chief Meteorological Technologist
26	Ojediran,Dele Isaac	Met. Instrument	W.M.O Class IV Cert.,	Associate Instructor/ Asst. Chief Meteorological Technologist
27	Nwanacho,Christian Kelechi	Upper Air Observation	W.M.O Class III Cert.	Associate Instructor/ Principal Meteorological Technologist II
28	Adewole,Oluwaseun Adebayo	Met. Observation	W.M.O Class III Cert.	Associate Instructor/ Meteorological Technician
29	Olatunji,Omodolapo Monsurudeen	Met. Observation	W.M.O Class III Cert.	Associate Instructor/ Meteorologist II
30	Ajobiewe,Kayode Moses	Met. Observation	W.M.O Class III Cert.	Associate Instructor/Asst. Chief Meteorological Technologist
31	Akpojivi,Taniru (Mrs.)	Secretarial Support	Advanced Diploma (Sec. Studies)	Principal Confidential Secretary II
32	Eze, Friday	Administrative Support	S.S.C.E	Senior Clerical Officer
33	Olatoke, Ramat Omotayo (Mrs)	Administration/ Librarian	HND(Sec Admin), PGD(Mgt Sci.), MPA	Support / Principal Administrative Officer
34	Badia Nasir Anas (Miss)	Librarian	BA (Library and Information Science B. Sc Sociology	Librarian/Administrative Officer
35	Itseuma P (Miss)	Nurse	Nursing and Midwifery	Nurse
36	Itseuma H. (Mrs)	Nurse Assistant	Auxiliary Nurse	Nurse Assistant
37	Ikeotuonye Christiana(Miss)	Hostel Manager	B.Sc. (Mass communication)	Administrative Officer
38	Elugbaju Wande Kasope	Hostel manager	B. Sc Sociology and Anthropology	Administrative Officer
39	Bakare Olalekan Kazeem	Hostel Manager	HND Mass Communication	Administrative Officer

40	Gidado Abubakar	Hostel Manager	B. Sc Economics	Administrative Officer

External Examiners and Adjunct Lecturers for RTC Oshodi

S/N	NAME	AREA OF SPECIALIZATION/ INSTITUTION	NEEDED FOR	TENURE
1	Prof. Enete Ifeayi Christian	Climatology. Dept of Geography and Meteorology, NAU, Awka	External Examiner	1st
2	Prof. HASSAN SHUAIB, MUSA	Climatology. Dept. of Geography, UNIABUJA, Abuja	External Examiner	1st
3	Prof. Abdul Dahiru Ardo Buba	Physics. Dept. of Physics, UNIABUJA, Abuja	External Examiner	1st
4	Prof. Oyeyemi Elijah Oyedola	Physics Dept of Physics, University of Lagos. ,	Adjunct Lecturer	1st
5	Prof. Osemwenkhae Joseph Erunmwosa	Mathematics Dept of Mathematics, UNIBEN, Benin City	Adjunct Lecturer	1st
6	Prof. Adegbie, Kolawole Sunday	Mathematics Dept of Mathematics, FUT, Akure	Adjunct Lecturer	1st
7	Dr. Atedhor Godwin Oghenebrozie	Climatology Dept of Geography and Regional Planning, UNIBEN, Benin City	Adjunct Lecturer	1st
8	Dr. Weli, Vincent	Climatology	Adjunct	1st

	Ezikornwor	Dept. of Geography and Environmental Management, UNIPORT	Lecturer	
9	Prof. Okogbue Emmanuel Chilekwu	Meteorology. Dept of Meteorology and Climate Science FUT, Akure	Adjunct Lecturer	1st
10	Dr. Akinbobola A. A.	Meteorology Dept of Meteorology and Climate Science FUT, Akure	Adjunct Lecturer	1st
11	Dr. Oluwamisere, K. O.	Depart. Of Agronomy, Faculty of Agriculture, University of Ibadan, Ibadan, Oyo State	Adjunct Lecturer	1st