NIGERIAN INSTITUTE OF SCIENCE LABORATORY TECHNOLOGY

Federal Ministry of Science and Technology

HANDBOOK ON MANDATORY PROFESSIONAL EXAMINATION (MPE) CURRICULUM

(A statutory Professional Body of Laboratory Technologists/Scientists Chartered by Act No. 12 of 2003 of the National Assembly)

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1. INTRODUCTION

1.1 BRIEF ON THE INSTITUTE

The Nigerian Institute of Science Laboratory Technology was established by Act 12 of 2003 of the National Assembly and made a parastatal of the Federal Ministry of Science and Technology. The Institute was before then known as the Nigerian Institute of Science Technology (NIST) founded in 1971.

1.2 VISION/MISSION OF THE INSTITUTE

The vision of the Institute is "To cause rapid development of the nation through science laboratory technology".

The mission statements of the Institute are

i) To advance Science Laboratory Technology profession in Nigeria.

ii) To maintain high ethical standards in science laboratory technology practice.

iii) To manage efficiently and effectively science laboratories in the context of the National Science Technology and Innovation system

1.3 MANDATE OF THE INSTITUTE

The core mandate of the Nigerian Institute of Science Laboratory Technology is to *"**advance science laboratory technology profession and ensure through its registered members effective and efficient management and administration of science laboratories in Nigeria**"*

The core mandate is broken down into the following activities as contained in the official gazette of the Federal Republic of Nigeria No. 47 Volume 90 of 23rd July, 2003.

a) Advancing science laboratory technology profession in Nigeria;

b) Determining the standard of knowledge, exposure to equipment, practical and skills, to be attained by person seeking to become registered members of the profession and reviewing those standards, from time to time, as circumstances may require;

c) Promoting the highest standards of competence, practice and conduct among the members of the profession;

d) Securing in accordance with the provisions of the Act, the establishment and maintenance of a register of members of the profession and the publication from time to time of the lists of those persons;

e) Serving as an agency to secure, safeguard and advance the professional knowledge, standing, efficiency and interests of science laboratory technologists through the Council;

f) Conducting examinations and granting certificates and diplomas and advising on, assisting in examinations relating to science laboratory technology in Nigeria;

g) Conducting research in all the areas of science laboratory technology;

h) Serving as a certifying agency through its registered members;

i) Ensuring safety standards and necessary facilities in science laboratories and workshops in Nigeria;

j) Ensuring, through its registered members, effective and efficient management and administration of all science laboratories in Nigeria;

k) Arranging appropriate on-the-job training for members of the profession;

l) Conducting inspection of science laboratories in schools, post-secondary institutions, industries and research institutes in order to improve the professional standards;

m) Doing such things as may advance and promote the advancement of the profession in both the public and private sectors of the economy;

n) Performing, through the Council established under Section 4 of this Act, the functions conferred on it by this Act.

2. TRAINING JUSTIFICATION

The Nigerian Institute of Science Laboratory Technology as a Professional Institute regulates the practice of science laboratory technology profession in Nigeria. As a professional regulatory agency of Government, the Institute ensures that all persons practising or aspiring to become practitioners of science laboratory technology profession are certified, registered and licensed by the Institute. In accordance with the Act, such persons must have gone through appropriate levels of exposure to knowledge and skills in science laboratory technology as prescribed by the Act establishing the Institute.

The increasing demand for professionals in institutional, industrial and private laboratories in Nigeria has necessitated the need to have properly trained and certified laboratory professionals competent in laboratory management and administration competent in laboratory. Also, the profession of science laboratory technology in recent years has undergone rapid growth and development with defined professional career prospects, which has elicited the interest and desire of graduates in other fields of specializations to become science laboratory technology professionals.

The Institute in fulfilling its mandate is therefore saddled with the responsibility of ensuring that standard professional practice is maintained in all the laboratories in Nigeria by providing adequate professional training and enforcing good laboratory practice to all those aspiring to become science laboratory technology professionals.

3. OBJECTIVES

The Nigerian Institute of Science Laboratory Technology has the primary responsibility as part of its mandate to determine the standard of knowledge, exposure to equipment and practical skills of persons seeking to become registered members of the profession. In pursuance of this, the Institute aims at:

(a) developing laboratory management skills.

(b) developing practical skills in the operations, use and maintenance of analytical instruments and equipment.

(c) developing general good laboratory practices and safety

(d) developing skills and competences in laboratory equipment maintenance protocols.

(e) enhancing professionalism in science laboratory technology profession and professional ethics.

(f) fostering inter-disciplinary relationship among members of the SLT profession and other science-based disciplines.

4. THE TRAINING PROGRAMME

4.1 SCOPE

The training programme covers core aspects of SLT profession which includes, laboratory management and administration, laboratory instrument application, equipment maintenance, general laboratory techniques and procedures, professional ethics, glass blowing and project.

4.2 DURATION

Minimum duration of this will be two academic sessions. The programme is divided into 2 modules to cover the following areas of the professional training

(i) General Laboratory techniques and management

(ii) Practical applications, instrumentation and analytical techniques in the different options and areas of specialization.

4.3 ELIGIBILITY

The examinations are open to Students studying or holders of Final Diploma/HND/B,Tech/B.Sc. in SLT (ONLY) from Polytechnic or University will be eligible for the PE I, II, III and IV examinations which will be coordinated by the Institute through the Department of Education, Training and Inspectorate, (ETI).

NOTE: MSc SLT NOT Eligible.

4.4 MODE OF TRAINING

The NISLT professional examination is designed to run concurrently with academic SLT programme in various Institutions offering SLT. At the commencement of each stage the specific programme, materials data sheets, periodic assessment tests and attendance record forms would be forwarded to the candidate through the institutional based coordinators. The professional Examination is Institutional based/problem-based learning. Hence the candidates must be student of SLT. External /International candidates (that is, SLT graduate) will register and have their examinations at the NISLT headquarters or other designated centres.

The Examination coordinators will be appointed and act as facilitators of learning and to make sure the candidates meet the requirements of training outlined in this schedule.

The programme coordinator would ensure that the candidate provides for all consumables and materials required for the training programme within the particular stage.

A committee would be constituted from the pool of members and the staff of the Institute which would meet regularly to oversee the smooth running of the programme

4.5 TRAINING CENTRES

Centres for the training programme shall be institutions where SLT is being offered. External /International candidates (that is, SLT graduate) will register and have their examinations at the NISLT headquarters or other designated centres.

4.6 REGISTRATION

All candidates for the professional examination are expected to complete registration formalities online with the institute.

4.7 PROFESSIONAL EXAMINATION

There shall be a professional examination conducted to cover;

1. General Laboratory Techniques and Management.
2. Different options and speciality areas of the core techniques.
3. Practical in different areas of specialization.

Success in the examinations qualifies the candidate to be registered as Associate Member of the Institute. Candidates who fail only one paper of the examination shall be allowed to have a re-sit of the paper at the next available opportunity. Candidates who fail more than two papers shall repeat the examination at the next available opportunity. Success in the professional examination qualifies the candidate to be licensed to practice the profession of Science Laboratory Technology in Nigeria. The Institute shall organize an induction programme and orientation ceremony for successful candidates.

4.8 PROGRAMME COORDINATOR/SUPERVISOR

Participating institution in the professional examination shall appoint a coordinator/supervisor. The appointed coordinator/supervisor shall be a Fellow or Associate member of the Institute with proven integrity and not below the rank of a Chief Technologist/Scientist or a Senior Lecture holding a current annual practicing license (APL) of the NISLT. The appointed coordinator/supervisor shall be in charge to coordinate the training programme in each identified institution. Where there is no available registered member of the NISLT holding a current annual practicing license (APL) of the institute, the NISLT shall be contacted to recommend a member in a sister institution closer to the centre for this purpose.

The coordinator is to –

(a) guide the candidates throughout the Professional Examinations;
(b) receives the time-table from the Institute;
(c) oversee the smooth conduct of all the stages to be covered throughout the duration of the programme;
(d) ensure the candidates are acquitted with SLT professional ethics;
(e) ensure strict exposure of the candidates to laboratory skills.

CURRICULUM

GENERAL LABORATORY TECHNIQUES AND ADMINISTRATION

INTRODUCTION

General laboratory technique and administration is the core course in science laboratory technology profession and is therefore compulsory for candidates in all areas of specialization. Candidates must therefore take and pass all courses in general Laboratory Technique and Administration as outline in the curriculum.

Areas of coverage in each module are outlined as follows:

PE III

(i) General Laboratory Procedures.
(ii) Instrument Maintenance
(iii) Laboratory Services Units.

PE IV

(i) Laboratory Organisation and Management.
(ii) Application of Information and Communication Technology (ICT) in the Laboratory.

PE III COURSE CONTENT

1. **General Laboratory Procedures**

On completion of the course, the candidate should be able to understand and apply -

1.1 Definition of Laboratory, types and basic outlook
1.2 Laboratory designs (including essential facilities& services)
1.3 Identification of laboratory wares and their uses
1.4 General safety rules and regulations in the workshop
1.5 Identification of workshop tools, uses, care and maintenance
1.6 Laboratory glassware; classification, care and maintenance
1.7 Laboratory fittings; benches, electrical fittings, water and gas
1.8 Measuring instruments in the laboratory, identification, uses, care and maintenance.
1.9 Application, structures, uses and simple maintenance of vacuum systems.
1.10 Equipment specification and identification.
1.11 Care, maintenance and handling of microscopes.

2. **Instrument Maintenance**

On completion of the course, the candidate should be able to understand and apply -

2.1 Installation of common laboratory equipment
2.2 Troubleshooting and fault finding in laboratory equipment
2.3 Servicing and repairs of common laboratory equipment
2.4 Electrical and electronic components in the laboratory

2.5 Maintenance of analytical, audio-visual and diagnostic instruments
2.6 Reading and interpretation of circuit diagrams, circuit training, and repair of different electronic and electric devices
2.7 Maintenance, services and repair devices procedures of electric and electronics devices.
2.8 Types of Maintenance
2.9 Factors affecting maintenance

2.10 Power Supplies

3. **Laboratory Service Units**

On completion of the course, candidates should be able to be conversant with features, design and applications in -

3.1 Workshops: mechanical, metal and wood
3.2 Photography: Photomicrography and photographic studios
3.3 Vacuum Techniques
3.4 Glass blowing techniques (Glass technology)

PE IV COURSE CONTENT

4. **Laboratory Organisation / Management**

On completion of the course, the candidate should be able to understand and apply -

4.1 Planning and design of laboratories
4.2 Acquisition of laboratory accommodation
4.3 Features specific to teaching, industrial, research and hospital laboratories
4.4 Laboratory fittings
4.5 Laboratory services
4.6 Laboratory stress management
4.7 Laboratory administration
4.8 Laboratory store management
4.9 Laboratory management techniques and functions
4.10 Organization of Laboratory practice – Good Laboratory Practice
4.11 Health and safety in the Laboratory
4.12 Entrepreneurship Development
- starting a business
- legal aspect of starting a business

4.13 Standard Operating Procedures (SOP) for Laboratories
4.14 Professional Ethics, Statutory duties and Allied Matters
4.15 Purchasing, Procurement and Store Management.

5 Application of Information and Communication Technology (ICT) in the Laboratory

The course is designed to examine the students on the practical operation and the basic computer packages:

5.1 Computer appreciation – understand how a computer works, computer input and output system, operating system, different application packages and their features

5.2 Microsoft office package – practical knowledge of MS Word, Excel, PowerPoint, Access

5.3 Computer graphics – understand different graphics packages, Use of CorelDraw

5.4 Data analysis – understand the use of SPSS for data analysis and presentation

5.5 Computer Aided Design (CAD) – understand basics of CAD, fundamentals of AutoCAD

5.6 Computer interfacing – understand computer ports, methods of interfacing computer with modern analytical equipment

BIOLOGY TECHNIQUES

Introduction

The key objective of this SLT Programme as set by NISLT is to inculcate good laboratory practice through exposure and usage of laboratory equipment, enabling persons seeking to be registered member into the profession to imbibe good practical skills.

Candidates wishing to offer Biology Technique as outlined in this curriculum must study and cover the following:

PE III

General Courses:

(i) Cell Biology
(ii) Ecology, Pathology and Genetics
(iii) Plant/Animal Morphology and Taxonomy
(iv) Vertebrate Anatomy and Physiology
(v) Animal Morphology and Taxonomy
(vi) Histology/Embryology

Optional Courses:

(i) Principles of Storage and Storage Mechanisms
(ii) Plant Pathology and Mycology

In **PE III**, candidates are to take all the general courses and select one of the two optional courses. Candidates shall be examined and PASS the courses at this stage before proceeding to study courses of the next stage.

PE IV

General Courses:

(i) Plant/Animal Anatomy and Physiology
(ii) Animal Parasitology

Optional Courses:

(i) Applied Genetics (Plant Breeding)
Economic Botany *(to be taken along with Plant Breeding)*

(ii) Applied Genetics (Animal Breeding)
Pests, Pest Control/Entomology *(to be taken along with Animal Breeding)*

At this stage, candidates are to take the two general courses along with one of the two optional courses as stated above. Candidates shall be examined and PASS these courses which is the final stage before s/he qualifies to apply for professional membership.

BIOLOGY TECHNIQUES

1.0 Cell Biology

Candidates are expected to study and carry-out practical on all the aspects of this technique. On completion of this course the candidates should be able to:

1.1 Identify the various parts of the light microscope including the various types of illuminators and filters.
1.2 Know the use of different types of microscopes i.e. dark-field, phase contrast fluorescent, electron microscopy and photomicrography.
1.3 Observe and draw samples of plant and animal cells from appropriate sources under the microscope e.g. cheek, blood, epidermis of aliumcepa bulbs, etc.
1.4 Examine single celled animals and plants under the microscope i.e. Animal: amoeba, paramecium, plasmodium; Plant: chlamydomonas, chlorella.
1.5 Examine single celled organisms of uncertain taxonomic positions under the microscope e.g. Euglena, gleocaspa etc.
1.6 Know the cell structure of monocotyledonous and dicotyledonous plants.
1.7 Perform experimentally the effects of hypertonic and isotonic solutions on the cytoplasm.
1.8 Observe and draw different stages of mitosis as shown by root tips of onion aliumcepa under the microscope.
1.9 Observe and draw different stages of meiotic division under the microscope.
1.10 Prepare and examine slides of plant and animal tissues under microscope.
1.11 Separate pigments by using chromatographic methods.
1.12 Prove experimentally that germinating seeds produce heat.
1.13 Prove experimentally that $C0_2$ is produced by green plants during respiration.
1.14 Measure the rate of transpiration in plant using photometer.
1.15 Perform experimentally phototropism, geotropism, hydrotropism, chemotropism and thermotropism in plants.

2.0 *Ecology, Pathology and Genetics*

2.1 Measure the pH, turbidity and salinity of aquatic habitats.
2.2 Identify various instruments used in measuring environmental factors.
2.3 Observe closely laboratory culture of lemma fruit fly (drosophilia) and other stored products insects such as sitophilus over a period of time and describe their population growth.
2.4 Isolate fungi and bacteria from soil sample.
2.5 Determine the fertility or otherwise of different soil types.
2.6 Collect urine and stool specimens to detect presence of the following parasites, trematodes e.g. Fasciola hepatica or F. gigantica; Schistosoma mansoni and S. haematobium, taenia and saginata

2.7 Examine blood and stool for living specimens of the following protozoa – Entamoeba histolytica, Mastigophora, Trypanosome gambiense; T. rhodisense or T. brucei.

2.8 Examine adult parasites and eggs from prepared slide specimens of 2.6 above.

2.9 Collect and examine macroscopically and microscopically infected plant specimens and identify the pathogens causing diseases in them.

3.0 ***Principles of Storage and Storage Mechanisms (OPTIONAL)***

3.1 Demonstrate experimentally the effect of extreme heat or cold using dryer or freezer on foods and food stuffs like fish, milk or meat.

3.2 Demonstrate experimentally the effect of excess salt on food or food raw products.

3.3 Identify various chemicals (insecticides, pesticides, dusting, fumigation, smoking) used in stored products for protection and preservation.

3.4 Observe quality control facilities for transporting stored food products.

4.0 ***PESTS, PEST CONTROL AND ENTOMOLOGY (OPTIONAL)***

4.1 Collect, examine and identify vectors and pests of economic importance e.g. insects, ticks, mites, molluses, birds, rodents etc.

4.2 Identify animal pests belonging to the Phyla: Nematoda, Mollusca, Arthropoda and Chordata.

4.3 Collect, observe, identify and study various pests of plant and animal.

4.4 Collect, identify and do detailed study of the biology of vectors of animal diseases and their control e.g. mosquitoes, tsetse fly, black fly, house fly, sand fly, etc.

4.5 Collect and identify invertebrate vectors of plant diseases e.g. aphids and other scaled insects.

4.6 Identify invertebrate pests of stored fish, wildlife products, meat, tuber, root crops vegetables, fruits, cereals, legumes, leather etc.

4.7 Collect, examine and identify mealy bugs and capsides on tree crops.

4.8 Draw and label a typical insect and identify its external features.

4.9 Dissect, draw and label the internal organs of a named insect.

4.10 Identify those insects involved in common diseases and pestilence (e.g. myiasis, yellow fever, malaria, sleeping sickness, river blindness and filariasis).

5.0 ***PLANT/ANIMAL MORPHOLOGY AND TAXONOMY***

5.1 Examine and identify the major groups of the plant kingdom i.e. phycophyta, algae, mycophyta or fungi, bryophyte, tracheophyta, pteridophyta, spermatophyta using microscope or hand lens.

5.2 Collect, classify and preserve samples of the following: algae, ferns, fungi, mucor, pythium, lichens, bryophyte, mosses, pteridophytes, gymnosperm, angiosperm, monocotyledonous and dicotyledonous plants.

5.3 Collect and identify the external parts of a named flower.

5.4 Collect, identify and draw samples of named angiosperm (dicotyledonous and monocotyledonous plants).

5.5 Collect and identify the external features of seeds and fruits.

5.6 Collect, identify and draw samples of gymnosperms.

5.7 Collect, identify and draw the important species of the following families using the binomial nomenclature.

(a) *Monocotyledonous Plants:*

(i) *Graminae e.g. grass, bamboo, etc*

(ii) Palmas e.g. palms

(iii) Lilia leaves e.g. onions

(b) *Dicotyledonous Plants:*

(i) *Legumniosae e.g. crotalaria, cassia*

(iv) Combratadeae e.g. combratum

(v) Stereuliaceae e.g. cola

(vi) Malvaceae e.g. hisbiscus

(vii) Bombacaceae e.g. bombax

(viii) Rutaceae e.g. citrus

(ix) Anacardiaceae e.g. mango, cashew nuts

(x) Maliaceae e.g. mahogamy

(xi) Cerupositae e.g. tridax

5.8 Collect common flora using appropriate techniques; draw and preserve the specimens collected.

5.9 Collect, identify, classify, draw, label and preserve the samples of:

(i)	Protozoa	(v)	Annelida
(ii)	Coelentorate	(vi)	Mollisca
(iii)	Platyhelminthes	(vii)	Arthropod
(iv)	Nematode	(viii)	Echimoderms

6.0 PLANT/ANIMAL ANATOMY AND PHYSIOLOGY

6.1 Draw and label the following organs and systems of mammals: nervous, circulatory, digestive, excretory, regulatory and reproductive systems using already labelled drawings from laboratory charts, explain the physiological processes of the organs and systems you have drawn

6.2 Collect, dissect, draw and identify the internal organs of (i) bony fish (ii) toad/frog and any other small mammal.

6.3 Outline the characteristics and identify the following major classes of vertebrates; draw and label samples from them.

(i) Pisces (fish)

(ii) Amphibia (amphibious)

(iii) Raptilia (reptiles)

(iv) Aves (birds)

(v) Mammalia (mammals)

6.4 Prepare and examine slides of plant and animal tissues under the microscope.

7.0 PLANT PATHOLOGY *(OPTIONAL)*

7.1 Observe, collect and examine macroscopically and microscopically infected plant specimens and identify the pathogens causing diseases in them
Label all drawings/sketches.

7.2 Isolate and identify nematodes associated with some plant diseases.
7.3 Collect, observe and identify major fungal diseases of the following:
- (i) Black pod of Cocoa
- (ii) Damping of seedling leaf spot of groundnut
- (iii) Rusts and smut of maize
- (iv) Rice blast

7.4 Collect, observe and identify major bacterial diseases of the following:
- (i) Blights of Soya bean
- (ii) Wilt - off diseases
- (iii) Citrus canker
- (iv) Bacterial spot of tomato

7.5 Collect, observe and identify major viral diseases of the following:
- (i) Cocoa swollen shoot
- (ii) Cassava mosaic

7.6 Identify vectors of plant diseases e.g. Aphids.
7.7 Carry out and describe the procedures employed in the staining of bacteria in plant material and animal tissue (i.e. Gram's staining, capsule, spores, haematoxelin and fast green; haematoxelin safranin and fast green, haematoxelin and eosin etc.
7.8 Stain some fresh biological specimens (e.g. paramecium, amoeba, epithelial tissue bacteria etc) as a whole and mount the preparation.
7.9 Prepare and examine slides of plant and animal tissues under the microscope, draw and label.

8.0 MYCOLOGY *(OPTIONAL) to be taken with Plant Pathology*

8.1 Identify the various somatic structures in fungi.
8.2 Examine known fungi under microscope, draw and label the various morphological features.
8.3 Culture known fungi on different culture media identify various classes of fungi.
8.4 Examine, identify and classify at least a member from each class listed in 8.3 above.
8.5 Identify fungi that cause damage to field crops and animal skin.
8.6 Examine and identify the morphology, life cycle and mode of spread of fungi that causes damage to plant and stored products.
8.7 Know fungi of agricultural importance

9.0 Applied Genetics, Plant Breeding *(OPTIONAL)*

9.1 Trace the development of the embryo sac (mega gametophyte) from the spore mother cell (megasporocytes).
9.2 Trace the development of the pollen (microspore) from the spore mother cell (microsporocycles).

9.3 Carry out the process stated in 9.2 using different stages of the flower buds to the opened flower

in a named plant.

9.3.1 Carry out the process in 9.1 above using the microspore.

9.4 Examine different pollen grains and characterize each according to the plant.

9.5 Identify the two kinds of behaviour of non-allelomorphic characters in linkage groups e.g. coupling and repulsion.

9.7 Carry out synthetic breeding of cross-pollinated crops

9.8 Carry out mutation breeding

9.9 Carry out inter specific hybridization breeding

9.10 Carry out tissue culture breeding and choral breeding

10.0 Economic Botany *(OPTIONAL) to be taken along with Applied Genetics (Plant Breeding)*

10.1 Collect and classify tropical economic plants under different heads e.g. food crops, tree crops, fibres crop etc.

10.2 Examine various methods of preservation and storage of cereal crops.

10.3 Examine the preservation and storage methods of legumes.

10.4 Identify various types of root and tuber crops.

10.5 Examine various methods of preservation and storage of root and tuber crops

10.6 Identify various types of vegetable crops.

10.7 Examine various methods of preservation and storage of vegetable crops.

10.8 Identify major tropical fruits and nuts in Nigeria.

10.9 Examine various types of spoilage of tropical fruits and nuts in Nigeria.

10.10 Know and demonstrate methods of extraction of non-drying oils and fats such as castor, groundnut, coconut and palm oil.

10.11 Examine deteriorated wood and identify organisms associated with the spoilage.

11.0 Vertebrate Anatomy and Physiology

11.1 Examine prepared slides, draw and describe surface view of the vertical section of the skin and a section through the nail.

11.2 Examine and draw mammalian skeletal system.

11.3 Examine, draw and label various parts of the mammalian skeleton, i.e. cervical, thoracic, lumber and sacral vertebrae.

11.4 Examine, draw and label the thorax, sternum, ribs, intercoastal muscles and cartilages.

11.5 Examine, draw and label the skull and explain its composition.

11.6 Examine, draw and label the bones of the forelimb including the scapula.

11.7 Examine, draw and label the bones of the hind limb including the pelvis.

11.8 Isolate, examine and draw the different types of muscle from frog and toad.

11.9 Observe the contraction of an individual muscle e.g. in the toad.

11.10 Dissect, observe and draw the various sections of the alimentary canal i.e. in the rat.

11.11 Examine and draw arteries, veins, lungs, thoracic cavity and pericardium.

11.12 Examine and draw cross section of animal heart.

11.13 Prove experimentally the oxygen consumption in various classes of vertebrates.

11.14 Examine and draw sections from various parts of the nervous system.

11.15 Examine and draw organs of the senses in animal e.g. tongue, nose, eye and ear.

12.0 ANIMAL MORPHOLOGY AND TAXONOMY

12.1 Collect as many animal specimens as possible. Identify with reasons all specimen collected into kingdom, phylum, classes, orders, genera and species. Know the characteristics and classification of invertebrates; Know the characteristics and classification of vertebrates.

12.2 Understand the methods of identification of specimens, prepare slide and view under the microscope for the purpose of Identification

12.3 Collect Pond protozoa e.g. amoeba and paramecium, culture the collected protozoa in appropriate culture media.

12.4 Know the techniques of collection, preservation and dissection of the following specimens e.g. earthworm, *Ascaris*, cockroaches

12.5 Dissect accurately the specimens collected in 12.4 above and trace, draw and label all the important systems e.g. digestive, circulatory, muscular etc.

12.6 Analyse from a dissected specimen, the main differences in internal organs of animals collected in 12.4 above.

13.0 HISTOLOGY/EMBRYOLOGY

13.1 Collect from various locations epithelia tissues in the body of an animal and examine the epithelia cells microscopically.

13.2 Observe microscopically slides of structures of various types of connective tissues.

13.3 Describe the microscopic structures of aorta walls.

13.4 Examine and describe slides of cross section of aorta, arteries and veins.

13.5 Examine and prepared slides of muscle fibre.

13.6 Examine the slide of a 48hr chick embryo, identify the amniotic fluid, heart (enlarged) ear and neural tube.

13.7 Make plasticine models of 18, 24-, 43-, 48- and 72-hour chick embryo.

14.0 ANIMAL PARASITOLOGY

14.1 Collect and identify the specimen of the following protozoa; *Entamoeba hystolitica Trichoirohas vaginalis, Trichanuas homonis, Balantidium coli.*

14.2 Prepare mount and examine slides of parasites listed above.

14.3 Stain and examine various stages in the life cycle of the protozoa listed above.

14.4 Isolate and identify various stages in the life cycle of nematodes. Apply various techniques such as concentration, floatation and sedimentation.

14.5 Isolate and examine various stages in the life cycle of tapeworm.

14.6 Prepare slides of various stages in the life cycle of tapeworm.

14.7 Isolate and identify the various stages in the life cycle of flukes applying various materials such as centrifugation and sedimentation.

14.8 Know the diseases caused by the parasite(s) and their control measures

15.0 ***APPLIED GENETICS; Animal Breeding (OPTIONAL) to be taken along with course 5.0 & 6.0***

15.1 Examine the prepared slides of various stages of meiosis under the microscopes.

15.2 Dissect a rat (male/female) to show male/female reproductive system.

15.3 Isolate and culture various diseases in the urine and blood of infected domesticated animals to identify their causative organisms.

15.4 Identify and draw electro ejaculator and.

(i) Use the equipment to collect semen from male animal.

(ii) Examine microscopically semen collected for quality and mobility.

(iii) Practice the technique of depositing the semen in the female reproductive tract (i.e. artificial insemination).

15.5 Identify two types of record keeping in use in animal farms (i.e. technical and business records).

MICROBIOLOGY/VIROLOGY TECHNIQUES

PE III

General Course

I. General Microbiology I
II. Microbial Genetics
III. Environmental Microbiology

- Immunology/Immunochemistry
- Pharmaceutical Microbiology
- Principle of Biotechnology
- Virology
- Pathogenic *Bacteriology*

In **PE III**, candidates are to take all the general courses and select one of the two optional courses. Candidates shall be examined and PASS the courses at this stage before proceeding to study courses of the next stage.

PE IV

General Course

I. General Microbiology II
II. Food Microbiology

- Industrial Microbiology
- Parasitology
- Analytical Microbiology/Quality Control
- Soil / Environmental Microbiology

At this stage, candidates are to take the two general courses along with one of the two optional courses as stated above. Candidates shall be examined and PASS these courses which is the final stage before s/he qualifies to apply for professional membership.

MICROBIOLOGY/VIROLOGY TECHNIQUES

1.0 GENERAL MICROBIOLOGY I

Introduction: The candidate is expected to study and carry-out practical on all the aspects of this technique.

On completion of this course the candidate should be able to:

1.1 Identify the mechanical and optical parts of the light-microscope including the various types of illuminators and filters that can be used with it.
1.2 Understand the characteristics of microorganisms; i.e. their growth and reproduction.
1.3 Understand principles of sterilization and disinfections.
1.4 Classify micro-organisms into pathogenic and non-pathogenic.
1.5 Identify some antimicrobial agents and carry out sensitivity tests on them.
1.6 Understand the technique involved in preparation of common biological reagents/ stains in identification of bacteria.
1.7 Understand the methods and techniques for the isolation/culturing of various micro-organisms

2.0 GENERAL MICROBIOLOGY II

On completion of this course the candidate should be able to:

2.1 Understand and demonstrate systematic classification of microorganisms.
2.2 Understand microbial variation and hereditary.
2.3 Understand and demonstrate biological and biochemical reactions of micro-organism.
2.4 Carry out various staining techniques for the identification of bacteria.
2.5 Understand and demonstrate the methods of the identification of micro- organisms found in the air, food, milk and water.
2.6 Study and demonstrate immunological methods for the study of microbial infections such as Agglutination reaction, Enzyme immunosorbent assay ELISA.

3.0 Pathogenic Bacteriology

On completion of this course the candidate should be able to:

3.1 Understand host-parasite relationship as well as its defence mechanism
3.2 Determine pathogenic microorganisms and the diseases they cause.
3.3 Know virulence, spectrum and symptoms of infection, treatment and control.
3.4 Demonstrate methods of isolation of pathogens.

4.0 Environmental *(Water, Air and Soil)* Microbiology

On completion of this course the candidate should be able to understand the concept of environment such as Air, water and soil:

4.1 Know and demonstrate micro-organisms and other organisms important in the environment.
4.2 Know the ecology of micro-organisms in water, soil and air.
4.3 Demonstrate the contamination and methods of purification of water.
4.4 Know and identify microbial water borne disease, causative agents and their control measures.

4.5 Demonstrate the microbiological examination of water.
4.6 Identify micro-organisms associated with waste disposal.
4.7 Know and demonstrate micro-organisms important the air.
4.8 Know the conventional methods of waste and waste water treatment
4.9 Understand the sources and effect of air pollution.

5.0 Food Microbiology

Understand the sources of microbial contamination of food

5.1 Know the various food transmitted (borne) diseases.
5.2 Know the mechanisms and demonstrate the microbial spoilage of food.
5.3 Know the intrinsic, extrinsic factors influencing spoilage and causing food borne diseases.
5.4 Determine the microbiological quality of foods and indices of sanitary quality.
5.5 Demonstrate the methods of control of contamination and the inhibition of the growth of microorganisms.
5.6 Understand the microbiological reference values of foods.
5.7 Understand the diseases of animals transmissible to man via animal food products.
5.8 Understand the quality assurance and hazard assessment of food.

6.0 Microbial Genetics

On completion of this course the candidate should be able to:

6.1 Understand the general and specialized methods in microbial genetics.
6.2 Carry out experiments with virulent phases, temperate phases and lysogenic phases of bacteria.
6.3 Demonstrate the culture methods of fungi and other lower eukaryotic genera.
6.4 Know the modern state of microbial genetics i.e. bacteria, viruses, protozoa and fungi.

7.0 Pharmaceutical Microbiology

On completion of this course the candidate should be able to:

7.1 Know the chemistry and mode of actions of synthetic chemotherapeutic agents and antibiotics.
7.2 Understand the methods of the production and synthesis of antibiotics and antimicrobial agents.
7.3 Demonstrate the quality control of pharmaceutical products and the concepts of growth and death in micro-organism.
7.4 Demonstrate the Kinetics/mode of action and assay of antimicrobial agents.
7.5 Know the concepts of antibiotic sensitivity and resistance as related to microbial physiology.
7.6 Determine the chemical nature and mode of action of disinfectants.
7.7 Determine the in-vitro and in-vivo evaluation of antimicrobial agents.
7.8 Understand the pharmacological considerations in the administration of antimicrobial agents.
7.9 Demonstrate the methods of the extraction of antimicrobial substances from medicinal plants.

7.10 Know the problems associated with use of chemotherapeutic agents including drug resistance and allergy.

8.0 Analytical Microbiology and Quality Control

On completion of this course the candidate should be able to:

8.1 Demonstrate the use of micro-organisms as reagents in quantitative analysis.

8.2 Demonstrate the methods of selection of test organisms for assay i.e. antibiotics, amino acids, vitamins, etc.

8.3 Explain the reactions of micro-organisms in assays.

8.4 Demonstrate methods of the preparation of assay samples.

8.5 Explain the aspects of quality control and safety in microbiology.

8.6 Demonstrate methods of plant and equipment sanitation.

8.7 Know the methods of determining microbiological standards and their specifications.

9.0 Immunology and Immunochemistry

On completion of this course the candidate should be able to:

Understand the nature of immune system; understand antigen-antibody and allergic reactions
Understand compliment fixation tests
Know the nature of toxin and anti-toxin
Know the application of Immunology in disease detection and controls
Know types of methods in immunology assays

9.1 Demonstrate the paper and thin layer chromatography methods and applications.

9.2 Know the gel-filtration techniques and applications.

9.3 Understand the spectrophotometric methods and applications.

9.4 Understand the centrifugation techniques and applications.

9.5 Know the atomic absorption spectrophotometry and applications.

9.6 Know the principles of Immunology, immunochemistry and immunochemical methods and their applications.

9.7 Know the principles of humoral and cellular immunity.

9.8 Understand the classes, structures and properties of immunoglobulin.

9.9 Determine the methods of preparation of vaccines and the techniques of vaccination.

9.10 Know the serological techniques and their applications.

9.11 Demonstrate the electrophoresis methods and their applications.

9.12 Know radioimmunoassay (RIA) and fluoroimmunoassay (FIA) methods and their applications.

10.0 Soil/Environmental Microbiology

On completion of this course the candidate should be able to:

10.1 Determine the characteristics of soil environment.

10.2 Determine the microbial flora of soil.

10.3 Determine the microbial activities in soil.

10.4 Determine the nitrogen cycle; carbon cycle; mineral transformation by microorganisms.

10.5 Demonstrate methods of biodegradation and biofuels generation.

11.0 Industrial Microbiology

On completion of this course the candidate should be able to:

11.1 Understand the nature and principles of industrial microbiology.
11.2 Understand the principles of microbial fermentations processes
11.3 Know and demonstrate micro-organisms of industrial importance.
11.4 Determine the aspects of the biology of industrial culture techniques and maintenance.
11.5 Demonstrate the methods of optimization of fermentation processes.
11.6 Understand the technology of fermented foods other than fermented alcoholic beverages

12.0 Principles of Biotechnology

On completion of this course the candidate should be able to:

12.1 Know the principles of biotechnology.
12.2 Demonstrate the methods of fermentation in biotechnology.
12.3 Demonstrate the primary and secondary metabolites in biotechnology.
12.4 Demonstrate the mechanism or methods in genetic manipulations in-vitro and in-vivo.
12.5 Understand the various applications of DNA and gene cloning in biotechnology.
12.6 Demonstrate the safety aspects of biotechnology and gene manipulations.
12.7 Know the effects of scale-up in biotechnology.
12.8 Demonstrate biotechnology techniques involved in food production, health and medical care, manufacturing, industry, environmental control and diagnostic application.
12.9 Know the basic principles and application of forensic science.
12.10 Know the legal aspects of biotechnological processes and applications.

13.0 Parasitology (OPTIONAL)

On completion of this course the candidate should be able to:

13.1 Define the following terminologies in parasitism giving examples in each case: symbiosis, parasitism, commensalisms, horesis, definite host, intermediate host and vector.
13.2 Describe the life cycle, mode of infection, methods of control and economic importance of the following protozoa class Rhizopoda: i.e. Entamoeba histolytica Mastigophora, Trypanosoma gambienze, T. rhodisenie, T. brucei and Sporozoa; Plasmodium; Filarial worms, Ascaris lumbricoides Ancylostoma, Guinea worms and describe their mode of transmissions.
13.3 Demonstrate various techniques involved in the examination and identification of various protozoa.
13.4 Demonstrate various techniques involved in the isolation and identification of nematodes, tapeworms and flukes.
13.5 Examine the morphology, the life cycle, pathogenesis, laboratory diagnostic methods, chemotherapy and epidemiology of the different parasites i.e. protozoa, platyhelminthes of medical and veterinary importance.
13.6 Know the methods, preparations and mounting of slides to preserve parasites in 13.5 above.
13.7 Describe, classify and prepare stained slides of the following parasites in the class: Trematodes i.e. Fasciola hepatica, Schisosome mansoni, S. heamatolicin, Taenia saginata, etc.
13.8 Know the economic importance of Ascaris lumbricoides, Ancylostoma, Filarial worms, Guinea worms and describe their mode of transmission.

14.0 Introduction to Virology (OPTIONAL)

On completion of this course the candidate should be able to:

14.1 Know the criteria for viral taxonomy.

14.2 Know the nature and structure of viruses and their functional sequences at cellular level of viral infections.

14.3 Know the replication processes of viruses.

14.4 Demonstrate the effect of physical and chemical agents on viruses.

14.5 Know important terms in viral pathogenesis.

14.6 Determine the causes and rates of spread of viruses in a community.

14.7 Know the patterns of diseases and the causes of infection by viruses.

14.8 Demonstrate the viral pathogenesis and the host defence mechanisms.

14.9 Demonstrate cell culture, microscopy and serology as it relates to virology.

HISTOLOGY/CYTOLOGY/HISTOCHEMISTRY TECHNIQUES;

The key objective of the SLT programme is set by NISLT is to inculcate good laboratory practice through exposure and usage of laboratory equipment, enabling persons seeking to be registered member into the profession to imbibe good practice skills.

Candidates wishing to offer Histology/Cytology/Histochemistry Techniques as outlined in this curriculum must study and cover the following:

PE III

(i) Microscopy
(ii) Fixation
(iii) Decalcification
(iv) Delydraton
(v) Clearing Agents
(vi) Embedding Media
(vii) General Microbiology I
(viii) Microtomy

In **PE III**, Candidates shall be examined and PASS the courses at this stage before proceeding to study courses of the next stage.

PE IV

In **PE IV**, Candidates shall be examined and PASS these courses which is the final stage before s/he qualifies to apply for professional membership.

Candidate are to study and cover the remaining general and optional courses as follows.

(i) Demonstration of Connective tissue
(ii) Mounting Media
(iii) Extfoliative Cytology
(iv) General outline of the theory and practice of staining
(v) Section Cutting
(vi) Pigments
(vii) General Microbiology II

Candidates shall be examined on these courses.

HISTOLOGY/CYTOLOGY/HISTOCHEMISTRY;
to be taken along with General Microbiology I & II

1.0 MICROSCOPY

Candidates are expected to study and carry out practical on all the aspects of this technique.
On completion of this course the candidate should be able to:

1.1 Identify and know the use of various parts of the light microscope including various types of illuminators.

1.2 Know the use of dark-field, phase contrast, fluorescent, electron microscopy and photomicrography.

1.3 Know and identify various types of filters that are used with microscope**.**

2.0 FIXATION

On completion of this course the candidate should be able to:

2.1 Know the principles, uses, and effects of fixation on tissues.

2.2 Demonstrate practically common fixing agents and simple fixatives with examples.

2.3 Understand common fixatives and their uses; i.e.

(i) Micro-Anatomical fixatives e.g. formal saline,
(ii) Cytological fixative,
(iii) Nuclei fixative and
(iv) Cytoplasmic fixative
(v) Post-chroming and post mordanting.

2.4 Demonstrate practically the preparation of the fixatives listed above.

3.0 DECALCIFICATION

On completion of this course the candidate should be able to:

3.1 Understand decalcifying agents e.g. acids, ion-exchange resins with decalcifying fluids, electrolytic decalcification and chelating agents.

3.2 Prepare and use the various decalcifying agents listed above.

3.3 Understand the preparation of un-decalcified bone sections i.e. sawing, grinding, and the use of adhesive tape method.

4.0 DEHYDRATION

On completion of this course the candidate should be able to:

4.1 Know the use of various types of dehydrants including their advantages and disadvantages in histology.

5.0 CLEARING AGENTS

On completion of this course the candidate should be able to:

5.1 Know the characteristics and uses of various clearing agents, their advantages and disadvantages.

6.0 EMBEDDING MEDIA

On completion of this course the candidate should be able to:

6.1 Understand the use of various types of embedding, their advantages and disadvantages.

6.2 Demonstrate practically the use of vacuum embedding oven.

6.3 Know the use and care of the automatic tissue processor.

7.0 MICROTOMY

On completion of this course the candidate should be able to:

7.1 Know the principles, use and care of various types of microtomes.

7.2 Know the processes of sharpening of microtome knives with the back –stroke and the maintenance of hones, stropes and the use of automatic knife sharpeners.

8.0 SECTION CUTTING

On completion of this course the candidate should be able to:

8.1 Understand the relationship of the knife to the object, rate of cutting and the effect of temperature on sectioning of tissues.

8.2 Demonstrate the effect of orientation of the block, cutting of sections and manipulation of sections on the microscope slide.

8.3 Carry out serial sectioning of tissues i.e. kidney, liver, heart, brain, skin, intestine, pituitary, thyroid, para-thyroid, spinal cord, pancrease and lung.

9.0 PIGMENTS

On completion of this course the candidate should be able to know and understand:

9.1 (1) Artifact pigment e.g. formalin pigment and mercuric chloride pigment.

9.2 Demonstrate practically the removal of both formalin and mercuric chloride pigments from the tissue.

9.3 Endogenous pigment e.g. haemosiderin (free iron), hemozoin (bile pigment); melanin and lipofuscin (brown atrophy pigment). Practical confirmation of these pigments should be performed.

9.4 Exogenous pigments i.e. carbon, silica, asbestos, silver, iron, ore, lead and copper. Practical confirmation of these pigments should be performed.

10.0 GENERAL OUTLINE OF THE THEORY & PRACTICE OF STAINING

On completion of this course the candidate should be able to:

10.1 Understand and demonstrate practically: vital staining, metallic impregnation, staining with natural and synthetic dyes, basic, acidic and neutral stain, metachromatic staining, fluorescent staining, progressive and regressive staining and mordants.

10.2 Know the preparation and the use of Ehrlichs', Harris's, Mayer's, Cole's and Weigerts haematocylin.

10.3 Know the preparation and use of Eosin and Neutral red as counter stains.

11.0 DEMONSTRATION OF CONNECTIVE TISSUE

On completion of this course the candidate should be able to:
understand and demonstrate practically:

11.1 (a) Elastic fibres using Verhoeff's Haematocylin, Weigert's Elastic Stain and Gomori's acetaldehyde fuchsin stain.
(b) Collagen fibres using Gomori's rapid trichrome stain, Masson trichrome stain and Van Gieson stain.
(c) Reticulin fibres using Gordon and Sweet method; Foot's method, Nassar and Shanklin method.

11.2 Demonstrate practically the staining of amyloid connective tissue using Bennhold's Congo Red Method, Mayers Methyl Violet Method and Thioflavin T. Method.

11.3 Demonstrate practically the staining of Glycogen tissue using Best's Carmin method.

11.4 Demonstrate practically the staining of Nissle granuoles using Toludene blue method.

11.5 Demonstrate practically the staining of Bacterial cell using Gram stain.

11.6 Demonstrate practically the staining of Tubercle bacilli using Modification of Zeihl-Neelsen Method.

11.7 Demonstrate practically the staining of DNA & RNA using Methyl green pyronin method.

11.8 Demonstrate practically the staining of lipid using Sudan III or IV or Black Oil Red Method.

12.0 MOUNTING MEDIA

On completion of this course the candidate should be able to:

12.1 Know the use of various mountants i.e. aqueous mountant and resinous mountant, including their merit and demerit.

13.0 EXFOLIATIVE CYTOLOGY

On completion of this course the candidate should be able to:

13.1 Know the method of preparation and staining of sputum, aspirated tissue and malignant cells using Haematoxylin and eosin, and Papaniculaou stain.

13.2 Have basic knowledge of the following:
(a) Autoradiography
(b) Micro-incineration and
(c) Vital staining

13.3 Prepare blood smear to differentiate the white blood cells from other blood cells.

13.4 Understand the preparation of museum specimens using perspex: - Kaiserling and hydrosulphite method.

13.5 Understand the uses of freeze drying for the removal of water from a sample.

13.6 Know the use of cryostat, and demonstrate tissue sectioning using acid and alkaline phosphatase method.

PHYSICS WITH ELECTRONICS

INTRODUCTION

Candidates taking this option must take all the components of the "common courses". However, candidates shall have the option to take only one "specialized course" depending on the area relevant to their work schedule.

Physics with Electronics will run the same common courses with physics with Engineering Production:

PE III

General Laboratory Techniques and Administration

1.0 Mechanics
2.0 Thermal Physics
3.0 Optics
4.0 Electricity
5.0 Properties of Magnetism
6.0 Vacuum Technology
7.0 Electronics I
8.0 Study of Thevenin's Network theory & Fourier
9.0 Electronics II
10.0 Telecommunication
11.0 Integrated circuit
12.0 Solar energy

PE IV

13.0 Power amplification
14.0 Microelectronic Systems
15.0 Understand Methods of Measurement of Time, Periods, Frequency and Speed
16.0 Fault findings in Instruments
17.0 Instrumentation and Control
18.0 Instrumentation and Measurement
19.0 The Fetch executive sequence
20.0 Board design and system layout
21.0 Equipment reliability
22.0 Methods of forming plastics into shapes using additives
23.0 Sound storage and Reproduction
24.0 Production and Application of Ultrasonic Waves
25.0 Physics Laboratory Techniques & Practice
26.0 Sound

27.0 Light (Optics)
28.0 Electricity
29.0 Maintenance, Repair, Installation of Laboratory equipment
30.0 Material Science
31.0 Polymers

1.0 MECHANICS

On completion of this course the candidate should be able to:

1.1 Measurement of distance and associated parameters with error.
Take readings of diameter of wire using micrometre screw gauge and travelling microscope. Measure external and internal diameters of metal or glass pipe by using vernier calliper. Measure thickness of a line using vernier Calliper and traveling microscope.
Measure distance between two given points.
Express appropriate level of errors in each case.
Use the values measured for determination or calculation of other parameters and interpretation of error.

1.2 Surface Tension: Determination of surface tension of water by rise in a capillary tube

1.3 Viscosity: Determination of coefficient of viscosity of liquid by the method of falling sphere viscometer and Oswald viscometer.

1.4 Density/relative density
Determination of the density of a liquid using
Density bottle
Loaded test – tube
Hare's apparatus
Determination of density of solid using Archimedes principle

1.5 Rigidity of a wire Young's modulus: The use of Maxwell's needle determination of young's modulus from the period of vibration of a loaded cantilever. By bending a beam determination of young's modulus for a wire.

1.6. Hooke's law: Determine elasticity and spring constant and effective mass

1.7 Pendulum: Have the Knowledge of various types for determination of acceleration due to gravity.

2.0 THERMAL PHYSICS

On completion of this course the candidate should be able to:

2.1. Thermionic Emission: Perform experiments on thermal electron emission

2.2. Specific heat capacity: Perform experiment on determination of specific heat capacity of a bad conductor such as wood, soil sample and metal.

2.3 Thermal conductivity
Determine of thermal conductivity of materials using any of the methods to be specified know principle of thermocouple and perform experiment on determination of the characteristics of a

thermocouple know elements used for production of thermocouple, know Thermometer – types and differences comparison of thermocouple with the conventional thermometer and other temperature measuring instruments.

Heat Temperature Measurement:

(i) Conduct practical to calibrate a thermocouple.

(ii) Determine the specific heat capacities of liquid e.g. water or kerosene

3.0 OPTICS

Perform Experiments with Michelson interferometer perform experiment and determine refractive index of a liquid using a concave mirror.

Demonstrate practical use of spectrophotometer.

Demonstrate Practical use of spectrometer.

Perform experiment to determine the refractive index of (a) glass and (b) a liquid, using a traveling microscope.

Perform experiment to determine the radius of curvature of the surface of convex lens, and the refractive index of the glass by boy's method.

3.1 KNOW INTERFERENCE PHENOMENON

- Measure wavelength of liquid using Young double slit.
- Determine wavelength of liquid with grating slit.
- Determine the wavelength of sodium liquid by Newton's Ring
- Determine the wavelength of sodium liquid by Fresnel's bi-prism.
- Determine the diameter of a fine wire by interface fringe measurement.
- Conduct a demonstration in spectrometer, interferometer

4.0 ELECTRICITY

KNOW STATIC ELECTRICITY AND ITS APPLICATION:

(i) Measure the capacitance of a capacitor using Meter Bridge.

(ii) Conduct practical on capacitance of a capacitor and on charging and discharging of a capacitor.

4.1 Know Electrical Circuit Application

(i) Conduct practical on the determination of inductance.

(ii) Discuss the practical applications of electromagnetic induction.

5.0. PROPERTIES OF MAGNETISM

KNOW PROPERTIES OF MAGNETIC MATERIALS

5.1 Specification and importance

Determine the properties of magnetic materials.

- Explain the importance and uses of Permanent Molecular Magnetic Diode
- Discuss the making of magnetic.
- State the differences between magnetic fields H and B.
- State the relationships between magnetic fields B and H.

- Distinguish between permanents and temporary magnets.

6.0 VACUUM TECHNOLOGY

Uses and applications of vacuum technology production of vacuum, properties of gases, Fluid flow and pumping concepts. Vacuum measurement. Out sealed mechanical rotary pumps, oil free mechanical primary pumps, Diffusion pumps and accessories, Integrated vapour pumping groups and vapour boosters, Molecular pumps Cryogenic pumps sorption and getter pumps and ultra-high vacuum pumps.

Emphasis on design features, operational aspects, performance. Applications, maintenance and trouble shooting. Vacuum system connections, components and assembly considerations in system design. Vacuum leak detection and Safe use of vacuum equipment.

7.0 ELECTRONICS I

7.1 Characteristics of a transistor.

Candidate is expected to carry out or perform laboratory experiments to determine Characteristic of a transistor and determine load line quiescent point output power efficiency.

7.2. Identification of transistors

Candidate is expected to identify transistors, by using measuring instrument such as multimeter or Avometer to determine whether the transistor is NPN or PNP.

Practical identification of the terminals using manufacturer code to identify whether the transistor is silicon or germanium made, and state the function of the transistor based on the coding e.g. power transistor.

7.3 Study and understanding of circuit and layout diagram

Candidate is expected to transform circuit diagram into a layout diagram. Such candidate should be able to:

- Construct practically a single stage or double stage common emitter small signal amplifier.
- Analyse the output-frequency response of an audio amplifier in terms of output, gain, and bandwidth.
- Practically, construct multivibrator.
- Different amplifier and oscillator.
- State the effects of positive feedback and negative feedback.

8.0 STUDY OF THEVININ'S NETWORK THEOREM AND FOURIER

Perform experiment on verification of Thevenin's network theorem.

8.1 Study of Fourier series theorem.

Perform Experiment on verification of Fourier series Theorem

Differentiate and integrate network, to study some analogue computer circuit components, and their effect on original signal.

Perform Experiment on verification of Kirchoff's law (current and voltage).

9.0 ELECTRONICS II

9.1 Study of digital electronics

Practical question would be set on the application of parallel resonance.

The application of parallel resonance circuit.

Application of T – π Transformation in filter design.

To be familiar with the twin tee – network.

To apply T – π transformation techniques.

To determine the frequency of zero output voltage at 50Hz

Candidate is expected to study the combination of logic gates; connect the circuits and form the truth table. Determine Logic circuits e.g. AND, OR, NAND, NOR, NOT.

9.2 Logic Electronics/Semi-conductor

Logic gates AND, OR, NAND, NOR EX-OR EX-NOR flip-flow. Types of gates DTL, TTL, CMOS, NMOS, ECL, Boolean algebra and methods of solution using Morgan's Law, Karnaugh Maps Quine-MeCluskey digital switches and counters. Introduction to Microprocessors, Semi-conductor devices such as diodes, transistors, special power semiconductor devices. Analysis of electronics semiconductor devices. Analysis of electronic circuits like passive and active filters.

Practical work on digital and analogue Electronic Circuits.

Analysis and troubleshooting technique circuits.

Electronics

. Design of electronic circuits

Analysis of CRO – block diagram showing functional units and their operation

. Colour coding

. Classification of components into active and passive

, Electronic circuit analysis

. Drawing of lay – out diagrams from circuit diagrams

. Electronic testing techniques

. Identification of functional units from circuit diagrams

Technique of Circuits.
Electronic practical
Determine the static and diagram characteristics of a silicon diode (General Purpose diodes)
Investigate the working of a diode as a limiter and damper.
Determine Zener diode characteristics.
Investigate the working of a diode in single phase, half-wave and full wave rectification.

Conduct practical to determine the characteristics of diode and investigate their use on half wave and full wave rectifier and relate your construction to industrial use.
Understand the characteristics of various transistors.
Measure the basic parameters of a transistor in C-E configuration.
Measure the basic parameters transistor in the C-B configuration.

Determine the characteristics of FET
Conduct practical to measure the basic parameter of transistors in the C-E and C-B configuration.
Conduct practical to investigate the properties/parameters of transistors.
Conduct practical to determine high and low frequency response of coupled amplifier.
Conduct practical to determine the frequency of differently coupled amplifiers.
Conduct practical to determine the bandwidth of tuned amplifier.
Conduct practical to determine efficiently of class A and B power amplifier.

Identify the following electronics components in relation to their symbols, types, rating, colour coding/values, and areas of applications:

- Resistors
- Capacitors
- Inductors
- Diode (PN-junction, Zener, tunnel, LED)
- Transistors (BJT, FET, UJT)
- Silicon controlled rectifier (SCR)
- Diac
- Triac
- Integrated circuits, operational Amplifiers, logic gates, rectifiers, regulators, etc.

Test using appropriate instruments, the conditions of components listed above.
Obtain necessary information on component listed above using data books.

10.0 **Telecommunication**

10.1 Frequency response of RC coupled amplifiers.

(i) Determine the bandwidth of an RC couple amplifier from the frequency response curve.
(ii) Give assignments to students on RC coupled amplifier.

10.2 Understand Different Communication System:

Explain types of communication systems. Using diagram and wave form sketches, explain the principles and operation of communication systems.

10.3 Radio Communication

Various frequency bands within the radio spectrum

List the frequency /wavelength ranges allocated to each of the following bands

-Extremely Low Frequency. E.L.F
-Very Low frequency l.f
-low frequency l.f
-medium frequency m.f
-Very high frequency v.h.f
-Ultra high frequency u.h.f
-Super high frequency s.h.f
-Extremely high frequency e.h.f

Demonstrate and explain the application of each frequency range as stated above.

10.4 Electromagnetic wave radiation and Aerial

- List various types of aerials and discuss factors to be considered in the choice of aerials.
- Discuss the importance of frequency on aerial dimensions of performance.

10.5 Radio wave propagation

- Explain the various types and characteristics of radio waves
- Discuss the importance of troposphere in radio wave propagation
- Discuss the various frequencies at which radio waves can be propagated.
- Explain the relevance of radio wave propagation in broadcasting etc.

10.6 Modulation and Demodulation

- Discuss modulation
- Explain the types of signal carriers
- List out their advantages and disadvantages
- Sketch a sine wave for
- (i) AM wave pattern
  (ii) PM wave characteristics

Explain demodulation

10.7 Transmitter

- Discuss the principles involved in frequency multiplication in radio transmitters
- Explain the circuitry associated with amplitude modulated signals.

Discuss how an r.f. frequency power amplifier with aerial amplifier arrangement.

10.8 Principles of Radio Receiver

Demonstrate with the aid of a diagram should concentrate on

(i) Straight radio receiver

(ii) Circuit arrangement of

(a) r.f. variable tuned amplifier

(b) demodulator

(c) a.f, amplifier feeding local speakers.

- Explain the disadvantages of straight radio receiver.
- Discuss with the aid of a diagram (i) working principle of superheterodyne radio receiver circuit.

(iii) I.f. amplifier and an oscillator's circuitry

11.0 INTEGRATED CIRCUIT

- Fabrication of Integrated Circuit.
- Composition of Integrated Circuit.
- Explain the advantages of IC fabrication over discreet components

State the general applications of integrated circuits

12.0 SOLAR ENERGY

- Explain solar declination
- Define hour angle
- Apparent solar time and clock time
- Discuss the Motion of the earth in space
- Explain the various ways of estimating direct radiation
- Use charts of sun structure
- 150 radiation map of Nigeria
- Charts of various types of solar collectors
- Flat plate collector
- Concentrator collector
- Discuss the principles of operation of a dynamometer
- Explain the ways at which heat passes through flat plate cylinder.
- Explain forced convection over a flat plate and through a tube.
- Explain the usefulness of concentrators in solar energy; itemize the applications of solar air heaters.
- List the applications of solar pond.
- Describe a solar furnace.

List the applications of types of solar energy conversion techniques to: Chemical Energy, Electrical Energy (full cell), and photovoltaic cell

Describe the Various ways of Storing Solar Energy Mechanically.

- Discuss how solar cells can be used to generate power.
- Explain how to produce distilled water, hydrogen using solar energy.

Discuss how solar energy can be applied to the construction of farm produce devices.

13.0 POWER AMPLIFICATION

Explain each class of power amplifiers. Illustrate the working principle of the push-pull amplifiers with suitable circuit diagrams. State the practical application of classes of push pull power amplifiers.

13.1 Operational Amplifier

- Explain the principle of operational amplifiers. Illustrate the characteristics of OP-AMP with the aid of diagrams.
- Discuss the importance of OP-AMP parameter such as open loop voltage gain, output resistance without feedback, differential iron resistance, input offset voltage, input bias current and input offset current, common mode rejection ratio (CMRR) and slow rate.
- Explain the OP-AMP specifications in the manufacturer data sheet.

13.2 Principle of Oscillator

- Explain positive feedback using an oscillator circuit.
- Explain the working principles of various types of oscillator circuit.

  Discuss frequency stability of an oscillator. State the application of crystal oscillator in practical systems.

13.3 Operation of Analogue Instrument

- Calibrate an ammeter using potentiometer.
- Calibrate a voltmeter using a potentiometer
- Calibrate a ballistic galvanometer using a standard capacitor
- Determine the sensitivity of a galvanometer
- Determine the capacitance of a capacitor using a Q meter
- Determine the inductance of an inductor using a Q meter
- Conduct practical demonstration in the use of Carrey, foster Bridge and X-Y/T recorder.
- Operation of digital instrument
- Calibrate a D.C voltmeter using digital voltmeter.
- Conducts an experiment on the use of D.C and digital voltmeters.

13.4 Frequency Response of Simple Control Element or Systems

- Determine the frequency response of a single stage amplifier
- Determine the frequency response of a second order RC net work
- Determine the frequency of the A.C. mains using a sonometer

  Conduct practical in frequency response in single stage, RC network, A.C. mains using oscilloscopes and sonometer

13.5 The Time Response of Simple Control System

- Determine the time response of a first order R.C network.

- Conduct practical on time response.

Conduct practical on time response on RLC network

14.0 MICROELECTRONIC SYSTEMS:

- Discuss the use of address selection in a microprocessor system.
- Explain the importance of address bus, control bus and date bus in a micro-processor system.
- Explain the internal structure of a microprocessor.
- Explain the function of each unit of a microprocessor system.

State the application of microprocessor in practical systems.

15.0 UNDERSTAND METHODS OF MEASUREMENT OF TIME, PERIODS, FREQUENCY AND SPEED:

I. Measure frequency using the CRO
II. Calibrate the frequency scale of a signal generator using
   (a) CRO
   (b) a standard signal generator
   - Conduct practical to measure frequency and calibrate signal generator.

16.0 FAULT FINDINGS IN INSTRUMENTS

16.1 Demonstrate the two main methods of fault finding in instruments

I. Static testing – power supply unit, radio receiver, signal generator etc.
II. Dynamic testing

Identify different functional blocks of equipment from circuit diagram.

16.2 Measuring Instrument

- Demonstrate how instrument can be classified into type.
- Explain the factors affecting instrument.
- Explain the classification of error in measuring systems.

16.3 Composition of measuring instrument systems.

- Explain the importance of basic components of an instrument system
- Explain the term transducer.
- Explain the broad classes of transducer.

Explain the factors affecting transducer.

17.0 **INSTRUMENTATION AND CONTROL (GENERAL USES OF ANALOGUE AND DIGITAL INSTRUMENT)**

- Explain the difference between analogue and analogue instrument.
- Group each type of instrument and list out its applications

- Discuss the uses of instruments like (i) D.C voltmeter,
  (ii) A.C voltmeter (iii) null detector (iv) 'Q' meter (v) Hall effect devices.
- Describe the mode of operation of a moving coil instrument.
- Relate instrument (moving coil) to (i) Galvanometer (ii) An ammeter(iii) A Voltmeter (iv) A millimetre
- Discuss the application moving coil recorder, potentiometer reorder, X-Y plotter, UV recorder and cathode ray oscilloscope (CRO).

Describe conversion of analogue system to digital system.

18.0 **INSTRUMENTATION AND MEASUREMENT**

- Principles of measurement errors, accuracy.
- The working principles of Electrical/Electronic instruments like Q-meter, Wattmeter, Semi-Conductor Tester, X-Y plotter, Digital and analogue meters, Transducers and Sensors, Noise in instrumentation systems.
- Practical and the use of these equipment to analyse instrument circuits and test the working condition of components.

19.0 THE FETCH EXECUTIVE SEQUENCE:

- Explain the fetch cycle in a micro-processor.
- Explain with the aid of suitable diagrams the synchronization of the microprocessor system.

19.1 Identify the main classes of instruction within the instruction set of a microprocessor and understands their operations.

- Discuss the types of instruction set

Describe the features of the addressing modes

19.2 Simple machine code programme

- Explain the importance of flow chart in writing programme.

Guide the students to write, debug and create programs in assembly language.

19.3 Principles of interrupt

- Explain the principles of interrupt in data transfer
- Explain the relationship between registers, stack and interrupt.

State the types of interrupts and their applications

19.4 Application classification and packaging of and technologies used in integrated circuits in microprocessor-based system.

- Discuss using manufacturer's literature, the function, operation and distinguishing characteristics of static RAM, dynamic RAM, MOS, EPROM, EEPROM, parallel output port.

- Investigates practically the performance of these devices with reference to manufacture's data sheets and the system design.

20.0 BOARD DESIGN SYSTEM LAYOUT BUS HOARDING AND DISTRIBUTION RELATE TO SIGNAL

Explain the sources of digital signal degradation in printed circuit board.

21.0 **EQUIPMENT RELIABILITY.**

- Explain the importance of reliability with respect to electronic equipment and systems.

Discuss the meaning of

(i) failure
(ii) misuse failure
(iii) inherent weakness failure
(vi) sudden failure
(v) gradual failure
(vi) partial failure
(vii) catastrophic failure and
(viii) degradation failure

- Explain wear out life of equipment
- Explain what is meant by passive and active redundancy

21.1 Cause and remedies of component failure

- Discuss into details the cause of component failure.
- List methods of solving failure due to mechanical and environmental factors.

21.2 Basic principle of maintainability

- Discuss how maintenance is important and relate it to reliability. list out the methods of improving maintainability.
- Explain the importance of corrective and preventive maintenance

22.0 METHODS OF FORMING PLASTICS INTO SHAPES USING ADDITIVES

State the uses of the following additives in the compounding of plastics

(i) Reinforcement
(ii) Filler
(iii) Plastizers
(iv) Dyes

State examples of each of the additives listed above:

Explain the process involved in

(i) injection moulding
(ii) compression moulding
(iii) extrusion moulding
(iv) casting
(v) drawing
(vi) blowing

23.0 SOUND STORAGE AND REPRODUCTION

- Explain the operational principle of microphones, earphones.
- Explains how speakers work.
- Explains the process of tape recording and reproduction.

24.0 Production and Application of Ultrasonic Waves

- Explains the features of Piezo elective and magneto strictive generation of ultrasonic waves.
- Explain ultrasonic sonar and ultrasound.

25.0 PHYSICS LABORATORY TECHNIQUES AND PRACTICE

***Mechanics**:*

Construction of toy track and its application to the experimental verification of uniform acceleration.

Construction of knife edges with wood and metal.

Use of burnt fluorescent tube for experimental determination of stokes' law – also comparison of viscosities of liquids.

The use of Oswald viscometer for viscosity measurement

Inertia and motion – application of Newton's first law of motion

26.0 SOUND:

1. Production of resonant tubes from burnt fluorescent tubes
2. Construction of sonometer boxes and the calibration of the boxes.
3. Using either (1) or (2) above and tuning forks to determine velocity of sound in air and wave motion.

27.0 LIGHT (OPTICS)

1. Construction of simple plane mirror
2. Care and maintenance of optical instruments commonly used in the laboratories e.g. microscope, cathetometer
3. Use and maintenance of interferometers. Use the Newton's ring and gratings in the determination of optical laws
4. The laser – use and care of the laser. Difference types of lasers available and them characteristics.
5. Application of laser in optical experiment

6. Construction of reflectors.

28.0 ELECTRICITY:

Collection and classification of conductor/ insulators.

1. Making of Dry cell boxes
2. Connection of dry cells in series and in parallel
3. Practical use of d.c ammeters and voltmeters
4. Construction modification of d.c and a.c meters
5. Production and uses of shunt and multipliers
6. Simple a.c/d.c tests with meters
7. Capacitor testing technique
8. Construction of resistors, resistance box and post office box. Testing of the resistances constructed with Ohmmeter/AVO or multimeter
9. Comparison of resistances constructed with standard resistance
10. Construction of Meter Bridge.
11. Construction of potentiometer
12. Application of bridges to experiments
13. Voltmeters and ammeters
14. Wiring technique – lamps and switching arrangements in wiring.
15. Other electrical indication instruments – the galvanometer.
16. Application of wheat's stone bridge
17. Different galvanometers in common use in the laboratories
18. Construction and use of jockeys
19. Connection of resistances- series/parallel resistivity tests
20. Comparison of e.m.f of cells
21. Experimental determination of Ohm's and Kirchoff's laws.
22. Simple construction of parallel plate capacitors
23. Preparation of printed circuit board.
24. Practical making of Daniel cell, Lechanche' cell,
25. Charging of cell/battery and maintenance

29.0 MAINTENANCE, REPAIR, INSTALLATION AND CONSTRUCTION OF LABORATORY EQUIPMENT

Candidate is expected to know routine maintenance, basic and preventive maintenance.
Troubleshooting for broken down equipment should be taught and the candidate supposed to know how to determine the problem, probable cause and solution that could make the equipment to work.
In the area of installation, the candidate should be taught installation requirement on newly purchased equipment. The candidate should be tested on the knowledge he\she possesses.
A final project should be given and use the project to test the ability of the candidate what he\she has done

30.0 MATERIAL SCIENCE

Classification of materials, mechanical properties of materials, simple crystal structures, microscopic nature of metallic surfaces, different techniques for X-ray study of materials, micrographic examination, crystal structure relations and stability of material, processes of alloying, deterioration of metals during use and ways of limiting deterioration, different methods of fabricating metals.

31.0 POLYMERS

relevant properties of polymers, types and uses of polymer, methods of forming plastics into shapes using additives, compounding of plastics, stability of polymers. Ceramic materials, classification, formation, glazing, effect of heat on ceramics.

31.0 Wood – Properties, Production, Preservation Techniques, uses, Classification
Plastics and Rubber – properties, production and uses.
Mechanical and non-destructive tests, macro-examination and micro-examination of metals and other materials, solidification technique, interpretation of Equilibrium Diagrams, Deformation of metals, Hardening and Annealing of metals Heat-treatment, metallurgical aspects of metal joining and measurement of temperature. Introduction to basic terminologies relating to workshop material, treatment and choice e.g. Ductility, Malleability, strength, Toughness, Brightness, Elasticity, Practical test for these properties, and choice of material.

32.0 Understand the Deterioration of Metals during use and ways of Limiting Deterioration:

(i) Effects of strain hardening cold work, hot work annealing, heat treatment and temporary, dispersion, hardening, or sintering in improving quality of metals.

(ii) Methods of preventing corrosion

PHYSICS / PRODUCTION TECHNOLOGY

INTRODUCTION

Candidates taking this option must take all the components of the "common courses". However, candidates shall have the option to take only one "specialized course" depending on the area relevant to their work schedule:

Physics engineering production will run the same common courses with Physics with Electronics as stated in modules:

PE III

1. General Laboratory Techniques and Administration Sections A B C D & E
2. Mechanics
3. Thermal Physics
4. Optics
5. Electricity
6. Properties of Magnetism
7. Electronics I
8. Study of Thevenin's Network theory & Fourier
9. Air conditioning & Refrigerating
10. Vacuum Technology
11. Power Plant
12. Solar energy

PE IV

13 Power amplification
14 Microelectronic systems
15 Measurement of Time, Period, Frequency
16 Fault findings
17 Instrumentation and control
18 The Fetch executive sequence
19 Board design and system layout
20 Equipment reliability
21 Methods of forming plastics
22 Physics Laboratory Techniques & Practice
23 Maintenance, Repair, Installation of Laboratory & Workshop equipment
24 Workshop design & Practice
25 Material Science
26 Polymers
27 Wood- Properties and testing of metals
28 Understand the Deterioration of metals

1.0 MECHANICS

On completion of this course the candidate should be able to:

1.1. Measurement of distance and associated parameters with error
Take readings of diameter of wire using micrometre screw gauge and traveling microscope.
Measure external and internal diameters of metal or glass pipe by using vernier calliper.
Measure thickness of a line using vernier
Calliper and traveling microscope.
Measure distance between two given points.
Express appropriate level of errors in each case.
Use the values measured for determination or calculation of other parameters and interpretation of error.

1.2 Surface Tension
Determination of surface tension of water by rise in a capillary tube

1.3 Viscosity
Determination of coefficient of viscosity of liquid by the method of falling sphere viscometer and Oswald viscometer.

1.4 Density/relative density
Determination of the density of a liquid using
Density bottle
Loaded test – tube
Hare's apparatus
Determination of density of solid using Archimedes principle

1.5 Rigidity of a wire Young's modulus
The use of Maxwell's needle
Determination of young's modulus
From the period of vibration of a loaded cantilever.
By bending a beam
Determination of young's modulus for a wire.

1.6 Hooke's law
Determine elasticity and spring constant, and effective mass

1.7 Pendulum
Have the Knowledge of various types for determination of acceleration due to gravity.

2.0 THERMAL PHYSICS

On completion of this course the candidate should be able to:

2.1 Thermionic Emission
Perform experiments on thermal electron emission

2.2 Specific heat capacity

Perform experiment on determination of specific heat capacity of a bad conductor such as wood, soil sample and metal.

2.3 Thermal conductivity

Determine of thermal conductivity of materials using any of the methods to be specified know Principle of thermocouple and perform experiment on determination of the characteristics of a thermocouple, know elements used for production of thermocouple
Know Thermometer – types and differences
Comparison of thermocouple with the conventional thermometer and other temperature measuring instruments.

Heat
Temperature Measurement:

(i) Conduct practical to calibrate a thermocouple.
(ii) Determine the specific heat capacities of liquid e.g. water or kerosene

3.0 OPTICS

Perform Experiments with Michelson interferometer
Perform experiment and determine refractive index of a liquid using a concave mirror.
Demonstrate practical use of spectrophotometer
Demonstrate Practical use of spectrometer
Perform experiment to determine the refractive index of (a) glass and (b) a liquid, using a traveling microscope.
Perform experiment to determine the radius of curvature of the surface of convex lens, and the refractive index of the glass by boy's method.

3.1 Know Interference Phenomenon

- Measure wavelength of liquid using Young double slit.
- Determine wavelength of liquid with grating slit.
- Determine the wavelength of sodium liquid by Newton's Ring
- Determine the wavelength of sodium liquid by Fresnel's bi-prism.
- Determine the diameter of a fine wire by interface fringe measurement.

Conduct a demonstration in spectrometer, interferometer

4.0 KNOW STATIC ELECTRICITY AND ITS APPLICATION:

(i) Measure the capacitance of a capacitor using Meter Bridge.
(ii) Conduct practical on capacitance of a capacitor and on charging and discharging of a capacitor

4.1 Know Electrical Circuit Application

(i) Conduct practical on the determination of inductance.

(ii) Discuss the practical applications of electromagnetic induction.

5.0 KNOW PROPERTIES OF MAGNETIC MATERIALS

5.1 Specification and importance

Determine the properties of magnetic materials.

- Explain the importance and uses of specification
- Permanent Molecular Magnetic Diode
- Discuss the making of magnetic.
- State the relationships between B and H.

Distinguish between permanents and temporary magnets

PHYSICS/ PRODUCTION TECHNOLOGY

21.0 Physics Laboratory Techniques and Practice

Mechanics:

Construction and graduation of meter rule. Scales practical use of timers

Production of standard mass 50g, 100g, 150g up to 500g.

Coiling of helical springs as practical means of measurements of oscillations and motion – straight line graphs elongation – introduction to young modulus of elasticity.

Construction of pulleys and force diagram boards and using the pulley, boards and masses for resolution of forces

Construction of toy track and its application to the experimental verification of uniform acceleration.

Construction of knife edges with wood and metal.

Construction of simple lever systems

Use of burnt fluorescent tube for experimental determination of stokes' law – also comparison of viscosities of liquids.

The use of Oswald viscometer for viscosity measurement

Inertia and motion – application of Newton's first law of motion

21.1 Sound:

1. Production of resonant tubes from burnt fluorescent tubes
2. Construction of sonometer boxes and the calibration of the boxes.
3. Using either (1) or (2) above and tuning forks to determine velocity of sound in air and wave motion.

21.3 Light (optics)

1. Construction of simple plane mirror
2. Care and maintenance of optical instruments commonly used in the laboratories e.g. microscope, cathetometer
3. Use and maintenance of interferometers. Use the Newton's ring and gratings in the determination of optical laws
4. The laser – use and care of the laser. Difference types of lasers available and their characteristics.
5. Application of laser in optical experiment
6. Construction of reflectors.

21.4 Electricity:

Collection and classification of conductor/ insulators.

1. Connection of dry cells in series and in parallel
2. Practical use of d.c ammeters and voltmeters
3. Production and uses of shunt and multipliers

4. Simple a.c/d.c tests with meters
5. Capacitor testing technique
6. Comparison of resistances constructed with standard resistance
7. Application of bridges to experiments
8. Voltmeters and ammeters
9. Wiring technique – lamps and switching arrangements in wiring.
10. Other electrical indication instruments – the galvanometer.
11. Application of wheat's stone bridge
12. Different galvanometers in common use in the laboratories
13. Connection of resistances- series/parallel resistivity tests
14. Comparison of e.m.f of cells
15. Experimental determination of Ohm's and Kirchoff's laws.
16. Preparation of printed circuit board
17. Charging of cell/battery and maintenance

22.0 MAINTENANCE, REPAIR, INSTALLATION AND CONSTRUCTION OF LABORATORY EQUIPMENT

Candidate is expected to know routine maintenance, basic and preventive maintenance.
Troubleshooting for broken down equipment should be taught and the candidate supposed to know how to determine the problem, probable cause and solution that could make the equipment to work.

In the area of installation, the candidate should be taught installation requirement on newly purchased equipment. The candidate should be tested on the knowledge he\she possesses.
A final project should be given and use the project to test the ability of the candidate what he\she has done.

23.0 WORKSHOP DESIGN AND PRACTICE

Mechanical workshop/laboratory practice; safety, design techniques, and tools, bench work, marking out, drilling, machine tools, lathe machine, drilling machine, parts operations and accessories. Metal joining, nuts, bolts, brazing, soldering, welding, drawings, projects. Heat treatment, bending and grinding techniques general safety rules and regulations in the workshop with emphasis on the following elements, workers, working tools, machines and working environment.

24.0 MATERIAL SCIENCE

Classification of materials, mechanical properties of materials, simple crystal structures, microscopic nature of metallic surfaces, different techniques for X-ray study of materials, micrographic examination, crystal structure relations and stability of material, processes of alloying, deterioration of metals during use and ways of limiting deterioration, different methods of fabricating metals.

25.0 POLYMERS

Relevant properties of polymers, types and uses of polymer, methods of forming plastics into shapes using additives, compounding of plastics, stability of polymers. Ceramic materials, classification, formation, glazing, effect of heat on ceramics.

26.0 WOOD – PROPERTIES, PRODUCTION, PRESERVATION TECHNIQUES, USES, CLASSIFICATION

Plastics and Rubber – properties, production and uses.

Mechanical and non-destructive tests, macro-examination and micro-examination of metals and other materials, solidification technique, interpretation of Equilibrium Diagrams, Deformation of metals, Hardening and Annealing of metals Heat-treatment, metallurgical aspects of metal joining and measurement of temperature. Introduction to basic terminologies relating to workshop material, treatment and choice e.g. Ductility, Malleability, strength, Toughness, Brightness, Elasticity, Practical test for these properties, and choice of material.

27.0 UNDERSTAND THE DETERIORATION OF METALS DURING USE AND WAYS OF LIMITING DETERIORATION:

(I) Effects of strain hardening cold work, hot work annealing,
heat treatment and temporary, dispersion, hardening, or sintering in improving quality of metals.

(II) Methods of preventing corrosion

PHYSIOLOGY / PHARMACOLOGY TECHNIQUES

The key objective of the Science Laboratory Technology programme as set by Nigerian Institute of Science Laboratory Technology is to inculcate Good Laboratory practice through exposure and usage of Laboratory equipment. Enabling persons seeking to be registered member into the profession to imbibe good practical skills.
Candidates wishing to offer Physiology / Pharmacology techniques as outlined in this curriculum must study and cover the following

PE III

i) Introductory Physiology
ii) Research Method in Physiology and Pharmacology
iii) Haematology
iv) Cardiovascular System
v) General Principle of Pharmacology
vi) Pharmacology of Organ
vii) Qualitative and quantitative Pharmacology (Drug receptor theory)
viii) Metabolism, temperature regulation
ix) Renal physiology

In **PE III**, Candidates shall be examined and PASS the courses at this stage before proceeding to study courses of the next stage.

PE IV

In **PE IV**, Candidates shall be examined and PASS these courses which is the final stage before s/he qualifies to apply for professional membership.

i) Digestive system
ii) Endocrinology
i) Chemotherapy
ii) Reproductive system
iii) Sensory physiology
iv) Neurophysiology
v) Animal management

PHYSIOLOGY/PHARMACOLOGY TECHNIQUES

A. PHYSIOLOGY

1.0 **Introductory Physiology**

On completion of this course the candidate should be able to

1.1 Understand the Cell and general physiology
1.2 Understand transportation through the cell membrane
1.3 Demonstrate practically the erythrocyte Osmotic fragility

2.0 **Research Methods in Physiology and Pharmacology**

On completion of this course the candidate should be able to.

2.1 Demonstrate and record Isotonic and Isometric muscle contraction, mechanical and electrical recordings, measurement of temperature, force, displacement and pressure

2.2 Record techniques of invitro and in-vivo studies in physiology and pharmacology
2.3 Understand the principle and use of common research and experimental technique in physiology, pharmacology and toxicology.

2.4 Demonstrate the measurements of biopotentials using electrocardiogram, electromyogram and electroencephalogram

2.5 Understand the Statistical analysis of experiments, data, Literature review, methods of writing experimental results for publication in physiology and pharmacology.

2.6 Demonstrate practically the use of the following apparatus and instrument used for experimental physiology and pharmacology e.g. surgical instruments, recording apparatus, stimulator, transducers, physiograph, oscilloscope, electrode, chromatography, electrophoresis spectrophotometer, chemical balance, pH meter, microscope, recording Chart, flame Photometer, coulter counter, preumograph and spirometer

3.0 **Haematology**

On completion of this course the candidate should be able to.

Understand and describe the following blood parameters

3.1 Red blood cell: production, structure, metabolism, life span, destruction
3.2 Haemoglobin: synthesis, functions, degradation, iron metabolism
3.3 Lymphocytes: Production, structure, kinetics and functions

3.4 Thrombocytes: Production, structure, kinetics and functions
3.5 Blood coagulation
3.6 Plasma Proteins: Classification, production and functions.

Practical Topics

3.7 Demonstrate practically blood volume measurement, PCV, Hb, RBC and WBC (relative and absolute) values
3.8 Demonstrate practically blood electrolytes, enzyme and protein measurements
3.9 Demonstrate Blood grouping ABO, Rhesus factor genotyping, determination of HIV status and determination of Hepatitis B Virus.

4.0 Cardiovascular System

On completion of this course the candidate should be able to

4.1 Understand electrophysiology and electro cardiogram
4.2 Study the physiological properties of cardiac muscles, conducting tissues and contractile cells.
4.3 Understand Cardiovascular reflexes; baroreceptors, chemoreceptors, axial receptors, lung receptors, Bezold-Jarisch reflex, pulmonary curterial receptors, sympathetic afferents, sympathetic vasodialater pathways.

4.4 Demonstrate practically the cardiac cycle of isolated heart preparations.
4.5. Demonstrate practically initiation of construction (Stannium ligatures Experiments)
4.6 Effects of drugs on isolated heart preparations (Langendorff's method)
4.7 Demonstrate practically the effect of temperature and mechanical stimulation on the frog's heart and latent periods of cardiac muscle.
4.8 Demonstrate perfusion of the frog's heart to show effects of temperature, drugs and ionic composition on the Rhythm and output of the heart.
4.8 Demonstrate and record blood pressure in anaesthetized animal
4.9 Demonstrate the effect of drug stimulation on nerve (vagus) e.g. adrenaline and acetylcholine

4.9 Demonstrate practically the following parameters in man
Heart sound, blood pressure and electrocardiogram

5.0 Respiratory System

On completion of this course the candidate should be able to

5.1 Understand the mechanisms of Gas transfer and Gas transport in mammals.
5.2 Study the regulation of respiration

5.3 Demonstrate practically measurement of respiratory parameters with emphasis on equipment.

6.0 **Metabolism, Temperature Regulation**
On completion of this course the candidate should be able to

6.1 Understand the metabolism of carbohydrates, lipids, fats and mineral salts
6.2 Study body temperature and it's regulation
6.3 Understand body fluids– osmotic equilibra between extracellular fluids and effects of addition of water to extracellular fluids and dehydration.

6.4 Demonstrate practically measurement of body temperature under normal conditions and when the body is subjected to physiological changes.

7.0 **Renal Physiology**
On completion of this course the candidate should be able to

7.1 Understand the formation of urine by the kidney
7.2 Study the regulation of extra cellular fluids and acid-base balance
7.3 Demonstrate practically osmoregulation and assessment of diuretic drugs.
7.4 Demonstrate practically estimation of sodium and potassium concentration in urine.

8.0 **Digestive System**
On completion of this course the candidate should be able to

8.1 Understand the process of digestion, absorption and defecation.
8.2 Study the Secretory functions of the alimentary tract.
8.3 Understand the principles of gastro intestinal motility.
8.4 Understand the effect of salivary and gastric secretion.
8.5 Demonstrate the following e.g. importance of physiological salt solution, dose-response relationship, actions of some agonists and antagonists and Peristalsis in the Isolated intestine.

9.0 **Endocrinology**

On completion of this course the candidate should be able to

9.1 Understand the functions of hormone and its physiological effects.

9.2 Demonstrate practically hormonal assays of plasma or sera samples.

10.0 **Reproductive System**

On completion of this course the candidate should be able to

10.1 Understand the physiological anatomy of reproductive system of the male and female.

10.2 Understand the functions of male and female reproductive hormones.

10.3 Demonstrate practically the Dissection of male and female reproductive system.

10.4 Demonstrate practically pregnancy diagnostics techniques.

11.0 **Sensory Physiology**

On completion of this course the candidate should be able to

11.1 Understand vision, electro retinogram

11.2 Study ear, Chemical senses and cutaneous Sensation

11.3 Demonstrate practically human cutaneous sensation

11.6 Demonstrate practically various sensitivity experiment on vision and hearing

11.7 Demonstrate practically action of drugs on the eye and pain threshold

12.0 **Neurophysiology**

On completion of this course the candidate should be able to.

12.1 Understand the Neuron: Structure, maintenance of membrane integrity and measurement of membrane potential.

12.2 Understand the Nerve degeneration and regeneration

12.3 Study cortical and cerebellar control of motor functions

12.4 Study stimulus characteristics (Accommodation, threshold, conduction velocity, summation)

12.5 Know “All or non-law”

12.6 Understand synaptic transmission (EPSP, IPSP)

12.7 Understand synapsis in the Central nervous system (CNS)

12.8 Know Neuromuscular Transmission

12.9 Study autonomic nervous system

B **Pharmacology**

1.0 **General Principle of Pharmacology**

On completion of this course the candidate should be able to.

1.1 Understand basic definition in pharmacology
1.2 Understand sources of drugs
1.3 Understand the mechanism and site of drug action (Pharmacodynamics)
1.4 Know the basic principle of toxicology
1.5 Understand the concept of receptors
1.6 Understand dose – response relationship
1.7 Demonstrate practically the preparation of drug solution and the storage
1.8 Demonstrate practically the concentration of drug solution
1.9 Study and compare the activity of different agonists, dose-rations and affinity constants, effect of irreversible antagonists and route of drug administration

2.0 **Pharmacology of Organs**

On completion of this course the candidate should be able to
Understand the following

2.1 Parasympathetic/Sympathetic nervous system
Pharmacology of drugs affecting cholinergic nerve transmission
Sites of action; cholinergic receptors and classification, cholinesterases and anticholivestarases
2.2 Demonstrate practically the effect of drugs on pendular movement of rabbit jejunum
2.3 Demonstrate practically the effects of drugs on guinea pig part
2.4 Demonstrate practically the effect of drug on pendular movement of rabbit intestine using Finkel man method.
2.5 Demonstrate the use of neuromuscular blocking agent using the phrenic diaphragm preparation of the rat.

3.0 **Qualitative and Quantitative Pharmacology (Drug Receptor Theory)**

On completion of this course the candidate should be able to

3.1 Understand affinity, efficacy and intrinsic activity
3.2 Understand pharmacokinetic principles as applied to the understanding of fundamental elements of pharmacodynamics and drug action.

3.3 Evaluate drug action in man and animals
3.4 Demonstrate practically bioassay techniques and its uses
3.5 Understand the drug antagonism.
3.6 Demonstrate practically the qualitative and quantitative experiments on agonist, three-point assay (2 x 1 bracketing assay) and antagonists.

4.0 **Chemotherapy**

On completion of this course the candidate should be able to

4.1 Understand the basic concept in chemotherapy
4.2 Understand and study the principal agent in chemotherapy i.e.
(a) Principle of sulphonamide treatment
(b) Antiprotozoan agents (antitrypanosomal and anti-malaria drugs)
(c) Antibiotics
(d) Antihelminthics
(e) Anti-cancer drugs

4.3 Demonstrate practically the examination of parasites e.g. Trypanosomes, malaria parasites)
4.4 Demonstrate the method of separation of Trypanosome
4.5 Understand the mode of Infection
4.6 Demonstrate practically the chemotherapeutic Index
4.7 Understand the counting methods for trypanosomes e.g. approximate and accurate count.

5.0 **Animal Management**

On completion of this course the candidate should be able to

5.1 Know the design of animal house for various colony of Laboratory animals
5.2 Understand breeding and handling methods
5.3 Understand the disease and control of Infection
5.4 Demonstrate practically the collection of blood and humane killing methods e.g. physical and chemical
5.5 Study and know the laws governing the use of Laboratory animals
5.6 understand various sterilization technique.

GEOLOGY TECHNIQUES

INTRODUCTION

Candidates offering Geology Techniques as an option are expected to take and pass all the courses outlined in the curriculum in each module of the programme.

PE III

1. Fundamentals of Geology I & II
2. Earth deformation and materials
3. Basic Introduction to Atomic and lonic Theory. Properties of matters, atoms and molecules.
4. Assorted shapes-cubic, tetrahedral, octagonal etc. using models' package of atoms and formation of bonds.
5. Geochemistry
6. Physical and chemical properties of minerals, mineral formation, identification of rocks and minerals.
7. Structural crystallography and crystal morphology. Crystal growth
8. Classification of knowledge X-ray
9. Introductory knowledge of X-ray

PE IV

10 Various methods of mineral analysis
11 Elementary staining techniques
12 Curating: Classification, labelling, storing and displaying of specimens
13 Distribution, classification and stratigraphic application of major groups of microfossils, especially foraminifera. Significance of fossils.
14 (Sources, transportation and deposition of sediments. Texture and structures of sediment and sedimentary rock.
15 Economic geology
16 Environmental, rock and palaeomagnetism

GEOLOGY TECHNIQUES

Contents
Theory

1. **Fundamental of Geology I and II**

    I. History, Geologic time, Geologic materials and Whole-Earth Structure

    II. Geological Evolution, Methods of Geology, Applied Geology, Related disciplines

2. **Earth Deformation and Materials**
    - Stress, strain, Thermodynamics, elasticity, etc.

3. **Basic Introduction to Atomic and Ionic Theory. Properties of Matters; atoms and molecules**

4. **Assorted shapes- cubic, tetrahedral, octagonal etc, using models' package of atoms and formation of bonds**

5. **Geochemistry**
    - The study or the chemical composition of the earth and its rocks and minerals

6. **Physical and chemical properties of minerals, Mineral formation, identification of rocks and minerals**

7. **Structural crystallography and crystal morphology. Crystal growth**

8. **Classification of knowledge X-ray**

9. **Introductory Knowledge of X-ray**

    Properties and generation of X-ray in qualitative analysis
    Bragg's Law. Principles of X-ray diffractometer, Operational procedure of X-ray diffractometer. Principles of Interpretation of simple X-ray spectrographs.

10. **Various methods of Mineral analysis**

    Principles and uses of Microscopes (Petrological/Research). Care, Uses and maintenance of optical equipment in Geology.

11. **Elementary staining techniques**

    Various methods of sample duplication, Moulding and casting

12. **Curating: Classification, Labelling, storing and displaying of specimens**

    Care, source. Uses and curating of Maps and aerial photographs

13. **Distribution, Classification and stratigraphic application of major groups of Microfossils, especially foraminifera. Significance of fossils**

14. **Sources, transportation and Deposition of sediments. Texture and structures of sediment and sedimentary rock.**

15. **Economic Geology**
    - Is concerned with earth materials that are or can be potentially, economically utilized by society. This includes metals, non-metallic minerals, rocks, fuels, and water.

16. **Environmental, rock and Palaeomagnetism**
    - Study of the magnetic properties of rocks in order to reconstruct. The earth's ancient magnetic field and the former position of the continents
    - Is the study of the record of the earth's magnetic field in rocks.

CHEMISTRY/BIOCHEMISTRY TECHNIQUES

INTRODUCTION

The key objective of this SLT Programme as set by NISLT is to inculcate good Laboratory practice through exposure and usage of Laboratory equipment, enabling persons seeking to be registered members of the profession to imbibe good practical skills.

Candidates wishing to offer chemistry/Biochemistry techniques as outlined in this curriculum must study and cover the following:

PE III

General Courses:

(i) Preparation of standard reagent and Solutions
(ii) Data analysis and Treatment
(iii) Conversion of Analytical results
(iv) Water analysis
(v) Soil and plant analysis
(vi) Colorimetry/ Spectrophotometry (Introduction)
(vii) Food analysis
(viii) Fertilizer Analysis

Optional Courses

(i) UV-Visible Spectrometry
(ii) Infra-Red Spectrometry
(iii) Flame Photometry

Candidates are to take all the general courses along with two optional courses. Candidates shall be examined on these courses before proceeding to study courses of PE IV.

PE IV

General Courses

(i) Polarimetry
(ii) Refractometry
(iii) Pharmaceutical analysis
(iv) Cosmetics analysis
(v) Chromatographic Techniques
(vi) Electrophoresis Techniques
(vii) Quality System Policy

Optional Courses

(i) Atomic Absorption Spectrometry
(ii) Spectrofluorimetric Techniques
(iii) HPLC and Gas Chromatograph

In the PE IV, candidates are to take all the general courses along with the optional courses as stated above. Candidates shall be examined on these courses and pass before being registered as a member.

CHEMISTRY TECHNIQUES

Introduction

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(iv) Water Analysis
(v) Soil and Plant Analysis
(vi) Colorimetry/ Spectrophotometry (Introduction)
(vii) UV-Visible Spectrometry
(viii) Infra-Red Spectrometry
(ix) Food analysis
(x) Fertilizer analysis
(xi) Polarimetry

Candidates are to take all the courses. Candidates shall be examined on these courses before proceeding to study courses of PE IV.

PE IV

(i) Refractometry
(ii) Flame Photometry
(iii) Atomic Absorption Spectrometry
(iv) Pharmaceutical analysis
(v) Cosmetics analysis
(vi) Chromatographic Techniques
(vii) Spectrofluorimetric Techniques
(viii) Electrophoresis Techniques
(ix) HPLC and Gas Chromatography
(x) Quality System Policy

In the PE IV, candidates are to take all the general courses along with the optional courses as stated above. Candidates shall be examined on these courses and pass before being registered as a member.

CHEMISTRY / BIOCHEMISTRY

Note: Candidates are expected to understand the rudiments of the following analytical procedures and concepts, as well as put them to practical use.

1.0 Preparation of Solutions

On completion of this course the candidate should be able to:

1.1 Understand and prepare Molar solution (solid and liquid)
1.2 Understand and prepare Normal solution (solid and liquid)
1.3 Understand the concept of Molarity
1.4 Understand and prepare Solution in % (w/v and v/v)
1.5 Understand the units of measurement (Ppm or mg/kg or mg/l)
1.6 Understand the dilution ratio
1.7 Understand and demonstrate Unsaturated, saturated and super saturated solutions

2.0 Conversion of Analytical Results

On completion of this course the candidate should be able to:

2.1 Understand the conversion of ppm to other units of measurement, i.e. mg /litre to %(g/100g) etc.
2.2 Understand the conversion of Molarity to g/dm^3 or g/Liter
2.3 Understand the conversion of Molarity to Normality
2.4 Understand the conversion of Molarity to %
2.5 Understand the conversion of elements to its Oxides, e.g. Fe to Fe_2O_3

3.0 Data analysis and Treatment

On completion of this course the candidate should be able to:

3.1 Understand Precision and accuracy of analytical results
3.2 Understand the limit of detection (LOD)
3.3 Understand the limit of quantification (LOQ)
3.4 Understand Percentage recovery
3.5 Understand Correlation and Regression Model
3.6 Understand descriptive analysis
3.7 Explain the two classes of error
(i) Determine or constant error
(ii) In-determine or accidental errors.
3.8 Explains ways by which errors in analysis can be minimized:
(i) Calibration of apparatus
(ii) Running of Control
(iii) Introduction of check samples etc.

3.9 Understand advantages and disadvantages of classical methods over instrumental analysis

4.0 Water Analysis

On completion of this course the candidate should be able to:

4.1 Analyse the physicochemical quality parameter for treated and waste water (see appendix 1)
4.2 Understand the digestion method for the elemental **analysis**

5.0 Soil/Plant analysis

On completion of this course the candidate should be able to run:

5.1 Analysis of soil for organic matter
5.2 Micronutrients and Macronutrients determination
5.3 Pesticide residue analysis
5.4 Determination of phosphate, Nitrate, sulphate, phosphorous etc.

6.0 Food Analysis

On completion of this course the candidate should be able to carry out:

6.1 Compositional analysis of food samples (See appendix 2)
6.2 Dry and Wet method s of digesting food samples for elemental analysis
6.3 Digestion method for Nitrogen/Protein analysis

7.0 **Fertilizer analysis**

On completion of this course the candidate should be able to:

7.1 Determine phosphorous, Nitrogen, etc.
7.2 Analyse the feeding stuff for proximate composition
7.3 Determine the micronutrients and macronutrients element

8.0 **Pharmaceutical analysis**

On completion of this course the candidate should be able to determine:

8.1 Compositional analysis of drugs (see appendix 3)
8.2 Identification of drugs
8.3 Particle size analysis
8.4 Stability test

9.0 **Cosmetics analysis**

On completion of this course the candidate should be able to analyse:

9.1 Compositional analysis of cosmetics (see appendix 4)
9.2 Specific gravity

9.3 Water determination
9.4 Stability test
9.5 Colour etc.

10.0 Refractometry

On completion of this course the candidate should be able to:

10.1 Define molar refraction and relate it to atomic and bond refractions.

10.2 Relate changes in refractive index to changes in density and concentration of pure substances in solution.
10.3 Draw a schematic diagram of Abbe's refractometer.
10.4 Describe the operation and working of the Abbe's refractometer
10.4 Describe the various applications of refractometry
10.5 Determine experimentally the refractive index of glucose solution using Abbe's refractometer
10.6 Define plane polarized light and optically active compounds.
10.7 Explain the effect of optical activity on rotation of plane polarized light.

11.0 Polarimetry

On completion of this course the candidate should be able to:

11.1 Measure specific rotation using polarimeter
11.2 Determine experimentally the concentration of sugar and the specific rotation of other substances using polarimeter.
11.3 Explain that colour may result from the selective absorption of light in the visible region of the spectrum
11.4 Explain that the extent of such absorption in coloured solutions depends on the concentration of the absorbing species and the light path length through the solution.

12.0 Colorimetry/ Spectrophotometry

On completion of this course the candidate should be able to:

12.1 State Beer – Lambert's Law
12.2 Define percentage transmittance and absorbance (optical density) and molar absorptivity (molar extinction coefficient).
12.3 Verify Beer- Lambert law experimentally
12.4 Measure colour (visual and photoelectric methods) applying the methods above
12.5 Draw a block diagram of calorimeter/ spectrophotometer
12.6 Describe the function of the part of calorimeter/spectrometer
12.7 Describe the operation and working of a calorimeter / spectrophotometric equipment
12.8 Describe the methods for quantitative determination of substances in solution.

13.0 Flame Photometry

On completion of this course the candidate should be able to:

13.1 Explain the relationship between the emission intensity of coloured flame and concentration of substances.

13.2 Draw a schematic diagram of a flame photometer

13.3 Draw the standard curve of emission intensity versus concentration of analytic

13.4 Interpret the result of the curve above

13.5 Explain the error and interferences inherent in flame photometric analysis

13.6 Outline the evaluation methods used in flame photometry.

13.7 Describe the methods of preparing sample and stock solutions of standards for flame photometry.

13.8 Prepare standard solutions.

13.9 Construct a calibration curve from the measurement of a standard solution

13.10 Apply the calibration curve method in the determination of Na, K, Ca in natural samples.

13.11 Outline the general applications of flame photometry.

14.0 Atomic Absorption Spectrometry (AAS)

On completion of this course the candidate should be able to:

14.1Outline the working principles of atomic Absorption Spectrometer (AAS).

14.2Draw the schematic diagram of AAS instrument.

14.3Explain the errors and interferences in AAS

14.4Outline the advantages and disadvantages of AAS over flame photometer

14.5Outline the evaluation methods used in AAS

14.6Describe the preparation of sample and stock solutions of standards.

14.7Prepare working standard solutions.

14.8Construct a Calibration curve from measurement of the above

14.914.9Apply the calibration method in the determination of Ca, Fe, Mn, Mg, etc in a given sample

14.10 14.10 List the application of atomic absorption spectrometry

14.11 Explain Flameless AAS and its applications.

15.00 Infra-Red (IR) Spectrometry

On completion of this course the candidate should be able to:

15.1 Explain the fundamental principles of the infra spectroscopy (high – lighting vibration of diatomic molecules and polyatomic molecules).

15.2 Classify molecular vibrations.

15.3 Describe the characteristic absorption frequency (group frequency) of certain groups in the molecules e.g. –OH, -COOH, -HN2, -CO.

15.4 Explain how –CO group frequencies are independent of the nature of the rest of the molecule.

15.5 Describe the component of an infrared spectrum e.g. light source, detector, monochrometer etc.

15.6 Describe diagrammatically the outlay of IR spectrophotometer (single and double beam spectrophotometer).

15.7Describe the preparation of substance for infrared analysis using Nujol emulsion and KBr pellets etc.

15.8Explain the limitation of IR in analytical work.

15.9Solve problems on IR spectroscopy

16.0 UV-Vis Spectrotrophotometry

On completion of this course the candidate should be able to:

16.1 Outline the fundamental principles of UV/ visible absorption spectrometry.

16.2 Classify electron transitions with relationship to UV absorption.

16.3 Explain the theory of light absorption and transmission (Beer- Lambert's Law).

16.4 Describe the spectra of the main classes of organic compounds –alkenes, unsaturated compounds, nitrogen compounds, nitro-compounds, aromatic compounds and heterocyclics.

16.5 Define the terms frequently used in the discussion of electronic spectra (e.g. chromorphoresis, anxochromic shift, hypochronic shift, hyperchronic effect).

16.6 Illustrate diagrammatically the layout of UV visible spectrophotometer (power supply, light sources, monochromators, detectors and measuring device).

16.7 Describe the optical layout of a double – beam UV spectrophotometer.

16.8 Describe the main five sections of the spectrophotormeter (radiation source, monochromator, photometer, sample area and detector area)

16.9 List the advantages of a double beam over the single beam spectrophotometer.

17.0 Chromatographic Techniques

On completion of this course the candidate should be able to:

17.1 Understand the basic concept of chromatography

17.2 Explain the Instrumentation/ working principle of chromatographic equipment.

17.3 Describe the Working principles of detector on chromatographic equipment

17.4 Understand Application of chromatographic equipment

17.5 Understand Column preparation, validation & storage of chromatographic equipment.

17.6 Understand Method development & validations on chromatographic analysis

17.7 Understand Data integration on chromatographic equipment.

17.7 Understand Solvent extraction

18.0 Spectrofluorimetric

On completion of this course the candidate should be able to:

18.1 Explain that the intensity of florescence is proportional to the substance in the dilute solutions

18.2 Explain the term “quantum yield”

18.3 Explain the term “quenching”

18.4 Describe the various units of a Spectro-fluorimeter e.g. light source, monochromator, light trap, photomultiplier, and recorder.

18.5 Describe diagrammatically the outlay of a spectrofluorometer

19.0 **Quality System Policy**

On completion of this course the candidate should be able to:

19.1 Understand Quality Control

19.2 Understand Quality assurance

19.3 Understand Good Laboratory Practices

19.4 Understand Good Manufacturing Practices

19.5 Understand Standard Operation Procedure

19.6 Understand Method Validation

19.7 Understand the concept of Computer Application & validation

19.8 Understand the Development of check sample

19.9 Understand the Proficiency Testing

19.10 Understand the Laboratory Management & Administration

19.11 Understand Laboratory Equipment procurement & Auditing

15.12 Understand and demonstrate Laboratory Equipment calibration & Validation.

APENDIX I

ANALYSIS OF TREATED WATER, WASTE WATER AND POTABLE WATER

S/N	***EXPERIMENTS***	***ANALYTICAL METHOD***
1.	Appearance	Sensory evaluation
2.	Colour	Colorimetry
3.	Odour	Sensory evaluation
4.	$_{p}H$	Electrometry
5.	Turbidity, FTU	Nephelometry
6.	Total hardness, mg/L	Titrimetry (EDTA)
7.	Total dissolved solids, mg/L	Gravimetry
8.	Alkalinity, mg/L	Titrimetry
9.	Residual chlorine, mg/L	Titrimetry(iodometry)
10.	Chloride, mg/L	Titrimetry
11.	Cyanide, mg/L	Colorimetry
12.	Floride, mg/L	Ion-selective electrode, Colorimetry
13.	Nitrate, mg/L	Colorimetry
14.	Phosphate, mg/L	Colorimetry
15.	Sulphate, mg/L	Turbidimetry
16.	Dissolved oxygen, mg/L	Titrimetry, membrane electrode
17.	Biochemical Oxygen Demand (BOD), mg/L	as for DO
18.	Chemical Oxygen Demand (COD), mg/L	Titrimetry
19.	Phenols	Colorimetry
20.	Total hydrocarbon, mg/L	IR, UV, GC, Extraction/gravimetry
21.	BTEX, mg/L	Gas chromatography

APPENDIX II
EXPERIMENT ON FOOD

Experiment	*Sample*
1. *Determination of total solids using*	Beverages, Dairy products, Fruits and
i. Air-oven drying method	vegetables
ii. Vacuum-oven drying method	ii. Dairy product with low water content and Beverages
2. Fat determination using	
i. *Soxhlet* extraction method	Legumes, Sea foods, Meat and meat products
ii. Alkaline hydrolysis method (*Rose-gottlies*)	Dairy products, Legumes, Sea foods, meat and meat products
iii. Acid hydrolysis method(*werner-schmid*)	Dairy products, Sea foods, meat and meat products
3. Determination of moisture content using	
i. *Karl fischer* (Chemical method)	Beverages, Fats and oils, Sugar confectionery
ii. Air-oven drying method	Tubers, Cereal and cereal products, Dairy products
iii. Instrumental method using moisture	Dairy products, Cereal and cereal products analyser
4. ***Ash determination using***	
i. Dry ashing method	Choose from the samples above
ii. Wet ashing method (acid digestion)	
5. ***Determination of crude fiber***	**Choose** from the samples above
6. ***Fruits and vegetable product***	
i. Determination of tomato solids	Fruits and vegetable products
ii. Determination of Fruit juice	
iii. Content using potassium and phosphorus	Fruit products
7. ***Egg products***	
i. Determination of egg content	Egg products
8. ***Cocoa and cocoa products***	
i. Determination of bromine content	Cocoa beverage
9. Sea foods	
i. Determination of total volatile nitrogen	Poultry, Sea foods, meat and meat products
10. Tea and coffee	
i. Determination of alkalinity of soluble ash	Beverages
ii. Determination of caffeine	
iii. Determination of water extractives	
11. Dairy products	
i. Determination of vieths ratio and Milk Solid not far (MSNF)	Dairy products
12. Alcoholic beverages	
i. Determination of contaminants in Alcoholic Beverages	Alcoholic beverages using instrumental

	And chemical methods
ii. Determination of ethanol content	
13. Fat and oils	
i. Determination of acid value, peroxide level,	Fat and oils products
ii. iodine level, saponification value, soap content	
iii. relative density, mineral oil content	
14. Food additives	
i. Determination of benzoic acid	Vegetable products etc
ii. Determination of sulphur dioxide	Vegetable products etc
iii. Determination of food colours (artificial colours)	Cereal and cereal products
15. Sugar artificial sweetners	
i. Determination of sugars	
ii. a non-reducing sugar: sucrose	soft drinks, dairy products etc
iii. Reducing sugars: Glucose, Lactose etc	
iv. Polarimetry determination of sugar	Sugar and sugar products
v. Determination of fructose/dextrose ratio in Honey	honey
vi. *Lane eynon* method	soft drinks, dairy products, confectionery

APENDIX III
PHARMACEUTICAL ANALYSIS

S/N	***EXPERIMENTS***		***ANALYTICAL METHOD***
1.	***Pharmaceuticals***		
	i.	Potency/assay	Uncoated tablets
	ii.	Uniformity of content	Coated tablets
	iii.	Moisture content	Capsules
	iv.	Dissolution	
	v.	Disintegration	
	vi.	Hardness (uncoated tablets only)	
	vii.	Friability (uncoated tablets only)	
	viii.	Odour (coated tablets only)	
	ix.	Solvent (coated tablets only)	
	x.	Average weight	
	xi.	Moisture content	
	xii.	Leakage test	
2.	***Liquid pharmaceuticals***		
	i.	Potency/assay	Syrups,
	ii.	Preservative	Oral suspensions, paracetamol syrup
	iii.	Flavour	Solutions etc.
	iv.	Visual identity	
	v.	Pour out volume	
	vi.	Viscosity	
	vii.	Odour	
	viii.	Specific gravity	
	ix.	Fill variation	
	x.	Identification	
	xi.	Antioxidant	
	xii.	Alcohol	
	xiii.	Acidity	

APENDIX IV
EXPERIMENT ON COSMETICS

S/N	***EXPERIMENTS***	***SAMPLES***
i.	Net weight	Powder, Relaxers, Cream, Perfume
ii.	pH	Lotions, Jelly, Nail polish, Shampoo,
iii.	Moisture content	Soap: Bar, Flakes.
iv.	Homogeneity	Hairfixures, Detergent etc.
v.	Specific gravity	
vi.	Non-volatile matter	
vii.	Purity test	
viii.	Identification	
ix.	Volume	
x.	Refractive index	
xi.	Water content	
xii.	Oil content	
xiii.	Clarity	
xiv.	Emulsion type	
xv.	Acidity/alkalinity test	
xvi.	Total fatty matter	
xvii.	Total active matter	
xviii.	Active ingredient	
xix.	Heavy metals(test)	
xx.	Adhesion ability	
xxi.	Viscosity	
xxii.	Bulk density	
xxiii.	Fineness	
xxiv.	Chloride content	

PETROCHEMICAL TECHNIQUES

1.0 THERMODYNAMICS

On completion of this course the candidates should be able to:

1.1 Define the following terms and state their general concepts;
- i. system
- ii. surrounding
- iii. process
- iv. temperature heat
- v. work & energy,

1.2 State the laws of Thermodynamics and its applications
1.3 Understand Perfect Gasses
1.4 Understand Joule Thompson coefficient
1.5 Understand Equilibrium processes
1.6 Maxwell's relations two phase system thermodynamic functions of solution P-V-T relationship
1.7 Know Work from Heat energy

2.0 APPLIED MECHANICS

On completion of this course the candidates should be able to:

2.1 Understand Vectors and its operations with forces, resultants of coplanar force systems.
2.2 Know Resultant of spatial force systems
2.3 Equilibrium and coplanar force systems
2.4 Centre of gravity, centre of mass
2.5 Study Newton's laws of motion and their applications, impulse and momentum;
2.6 Understand Kinematics of a point, composition and resolution of velocities and accelerations relative velocity and acceleration, representation by vectors
2.7 Know Plane Kinematics of rigid body, angular velocity diagrams applied to simple mechanisms instantaneous centre of rotation
2.8 Understand Equations of motion, linear momentum and moment of momentum
2.9 Know Kinetic energy, moment of inertia and free vibrations of systems with one and two degrees of freedom including damping-Tensional vibration.

3.0 INDUSTRIAL PROCESS CALCULATIONS

Candidates are expected to:

- 3.1 Understand units and dimensions
- 3.2 Stoichiometry Vaporization Processes
- 3.3 Material balance involving Chemical reaction
- 3.4 . Heat balanced; simultaneous heat and mass balances
- 3.5 Unsteady state heat & Mass balances introductory Process Economics.

4.0 WORKSHOP PRACTICE

On completion of this course the candidates should be able to:

- 4.1 Know basic manufacturing processes
- 4.2 Conduct Organization of workshop
- 4.3 Know workshop hazard and safety practices and codes

4.4 State the Properties of engineering materials
4.5 Understand and Practice Bench-work and fitting
4.6 Discus turning exercises – straight and step tuning chamfering
4.7 Know Screw cutting and Practice Milling and milling exercise
4.8 Understand Drilling techniques and exercise
4.9 Know Sheet metal work, welding and soldering technique with exercises
4.10 Know Properties of wood
4.11 Understand Wood work and joinery exercises.
4.12 Know workshop measurements
4.13 Understand Refrigeration and air conditioning principle of operation, refrigerants and trouble shooting
4.14 Know methods of leak detection, charging and discharging
4.15 Understand Safety precautions
4.16 Know automotive workshop practice; Principle of operation of the motor car
4.17 Understand turning carburettor, setting contact breaker gap setting ignition timing
4.18 Know how. Engine routine may enhance procedure and engine service. Tyre types and care. Battery care, lopping up and charging.

5.0 **CHEMICAL THERMODYNAMICS**

On completion of this course the candidates should be able to:
5.1 Understand the ideal gas P-V-T Relationship
5.2 Explain the P-V-T behaviour of pure substances.
5.3 Write the equation of state for gases
5.4 Describe the principle of corresponding state, Compressibility relations, reduced pressure, reduce volume, temperature and Pseudocritical constants.
5.5 Understand Dalton's law of additive pressure,
5.6 Understand Amagat law of additive volumes
5.7 Understand Gililand's method Behaviour of liquids.
5.8 Calculations based on fuel reaction for nitrogen and oxygen in the fuel: correction for Sulphur calculation based on fuel-gas analysis.
5.9 Understand net hydrogen-carbon ratio in the fuel and percent excess air. Air/fuel and fuel-gas/air ratios
5.10 Describe the Thermodynamics of Flow Processes
5.11 Know the criteria of equilibrium and understand Raoult's law, Henry's law.
5.12 Understand the Chemical Reaction Equilibria and effects of temperature and pressure on equilibrium constants.
5.13 Calculations of conversion.

6.0 **APPLIED FLUID MECHANICS**

On completion of this course the candidates should be able to:
6.1 Understand Fluid statics; Newtonian and non-Newtonian fluids.
6.2 Understand Forces on submerged surfaces, Equations of fluid motion.
6.3 Know Flow measurements, forces exerted by flowing fluids, laminar and turbulent flow.
6.4 Know the Reynolds number flow in pipes and channels, dimensional analysis-, one-, two- or three-dimensional steady flows of a comprehensible fluid, critical flow, small amplitude waves, shock waves fluid machinery.

7.0 METALLURGY

7.1 Understand Metallurgy, Hardening of metals

7.2 Describe the deformation and annealing of metals.

7.3 Know Corrosion Annealing of metals.

7.4 Describe Corrosion and Oxidation phenomena.

7.5 Alloy steels Stainless, creep of metal joining

7.6 Describe the measurement of temperature

7.8 Know Electrical and magnetic alloys, Copper and its alloys, Polymers, Aluminium magnesium and light alloys, Titanium and other flow metals.

7.0 TECHNOLOGY OF MATERIALS

On the completion of this course the candidates should be able to:

7.1 Understand the structure of matter and crystal imperfection

7.2 Understand Simple phase diagrams of alloys

7.3 Know the Physical and mechanical properties of engineering materials

7.4 Understand Engineering and true stress-strain curve

7.5 Know ultimate strength, ductile, impact strength, hardness, torsion, creep and fatigue failure.

7.6 Electrical properties –conductivity, semi-conductivity and super conductivity. Optical.

8.0 PETROCHEMISTRY

On completion of this course the candidate should be able to:

8.1 Know the Origin of petroleum and Exploitation technique.

8.2 Know the Parameters for evaluation (grading). Constituents.

8.3 Understand the fractionation and methods of identification

8.4 Know Chemistry of refining processes, characteristics and uses of refinery products

8.5 Know Economic aspects of crude petroleum oil pollution and its control.

9.0 INTRODUCTION TO TRANSFER PROCESSES

9.1 Basic laws of mass momentum and energy transfer processes and their relationship.

9.2 Simple problems involving dimensionless groups such as Re, Sc, Pr, Measurement, Calculation & Prediction of Transport coefficient.

10.0 MASS TRANSFER

On completion of this course the candidate should be able to:

10.1 Know the theories for prediction of mass coefficients.

10.2 Understand the application of distillation (Mccable Thiele and Ponolion Savant method) extractive and azeotixpic distillation.

10.3Know the multicomponent distillation gas absorption, liquid/liquid extraction drying, leaching and humidification.

11.0 HEAT TRANSFER

11.1 Understand the nature of processes of conduction, convection and radiation.

11.2 Definition of thermal conductivity and heat-transfer coefficients.

11.3 Understand conducting through materials with constant and varying heat-transfer areas.

11.4 Know Unsteady-state conduction: Solution of equations for simple cases.

11.5 Know Schmid's methods

11.6 Understand Dimensional analysis and heat transfer.

11.7 Describe Reynolds analogy and its developments

11.8 Know Heat exchangers – log mean temperature difference in single and multiple pas exchangers; Calculation of heat transfer coefficient. Optimum design. Finned tubes lagging effectiveness and economic thickness. Radiation Kirchhoff's and Stefan's laws. Emissivity. Calculation of net heat exchange between bodies – multiple reflection and net radiation methods. Radiator from gases

11.9 Understand Heat transfer during condensation of vapors Derivation of Nussel equation Drop – wise and film-wise condensation.
11.10 Know the effect of non-condensable gases, heat transfer to boiling liquids
11.1Know the types of boiling and influence condition on heat fluxer and transfer coefficients.

12.0 CHEMICAL TECHNOLOGY OF PETROLEUM
On the completion the completion of this course the candidate should be able to:
12.1 Understand Distillation processes, Atmospheric and vacuum distillation of petroleum and petroleum fractions.
12.2 Know Gasoline stabilization and sweetening.
12.3 Know the Properties of fuels octane number, cetane number etc. Hydrocarbon gas purification and separation
12.4 Understand LPG Production Gas Processing – alkylation and polymerization. Thermal processes – cooking, thermal cracking and pyrolysis. Catalytic reforming and isomerization.

13.0 POLYMER SCIENCE AND TECHNOLOGY
13.1 Know Polymers and their characteristics, Sources of polymers Structure and physical properties of polymers, theology, solution and molecular weight.
13.2 Understand Plasticity and elasticity the William Lande Ferry Equation Polymerization reactions and manufacturing methods.
13.3 Zegler Natta catalysis Processing and Technology of Polymers.

14.0 PULP AND PAPER TECHNOLOGY
On completion of this course the candidate should be able to:
14.1 Understand Cellulose and Hemicellulose-structures and characteristics
14.2 Know Lignin. Pulp woos-types and properties
14.3 Describe the types of pulping processes – sulphite, alkaline, mechanical semichemical etc. bleaching fiber preparation, nature of fiber bonding.
14.4 Know Sheet formation, water usage and disposal in pulp and paper industries 14.5 Understand the Microbiology of Internal and surface sying, Wet strength Colouring Properties of paper, Pigment, coating printing, laminating and comigating saturation of paper and paper plastics.

BIOTECHNOLOGY TECHNIQUES

1. INTRODUCTION TO MOLECULAR BIOLOGY

A) Molecular biology and r-DNA technology

UNIT – 1 Gene expression

1.1 Transcription in prokaryotes: Enzymatic Synthesis of RNA, Basic features of RNA synthesis, E.coli RNA polymerase, Classes of RNA molecules, Transcription mechanism in prokaryotes- Promoter, initiation, elongation, proof reading and Rho dependent and Rho independent termination.

1.2 Transcription in Eukaryotes: Polymerases of eukaryotes, Promoters of eukaryotes,

1.3 Synthesis of hn RNA, Splicing Mechanisms-Self splicing, protein mediated splicing, alternative splicing, Capping and polyadenylation.

1.4 The Genetic Code, properties of genetic code.

1.5 Translation mechanism in prokaryotes and eukaryotes

UNIT – 2 Regulation of Gene expression

2.1. Regulation in Prokaryotes: General aspects of Regulation

2.2. Transcription level regulation-positive, negative, auto and coordinated regulation

2.3. Operon and its concept – lac, trp, operons.

2.4. Transcriptional Control through Transcription factors.

2.5. Translation regulation in Eukaryotic and prokaryotic organism.

2.6 Gene mutation and types

UNIT – 3 r-DNA technology

3.1. List of Enzymes used in gene cloning: restriction endonucleases, ligases, phosphatases, methylases, kinases.

3.2. Types of Cloning vehicles, plasmids, cosmids, phage vectors

3.3. Construction of genomic and cDNA libraries. Identification of cloned genes

3.4. Principles involved in blotting techniques- southern, northern and western.

3.5. Principles and application of PCR Technology and DNA fingerprinting technique and its application.

1. Isolation of DNA from plant, animal/bacterial cells
2. Isolation of plasmid DNA
3. Analysis of DNA by agarose gel electrophoresis
4. Restriction digestion of DNA, pcr

5. Competent cell preparation, transformation and selection.

B) PLANT BIOTECHNOLOGY

UNIT – 1 Introduction

1.1. Historical perspectives of plant tissue culture, and Basic requirement for tissue culture laboratory

1.2. Culture mediums for plant tissue culture- MS medium and B5 Medium. Sterilization of media-steam, dry and filter sterilization- Explants and methods of sterilisation sterilization

1.3. Plant growth regulators and differentiation.

1.4. Method of tissue culture-formulation of medium explants collection, surface sterilization, Inoculation, Callus induction, subculture and regeneration of plants

1,5. Suspension cultures- growth and subculture, types and synchronization of suspension cultures.

UNIT - 2. Applications of plant tissue culture

2.1. Meristem culture and its uses in production of virus free plants

2.2. Clonal propagation, Micro propagation of plants – medicinal plants and endangered plants –method and advantages

2.3. Somatic embryogenesis- Principle, protocol and importance. Artificial seeds –production, applications and limitations.

2.4. Another culture and production of androgenic haploids.

2.5. Somaclonal variations; - sources of somaclonal variatins, selection of soma clones, progeny testing of soma clones, applications of somaclonal variations to crop improvement, Embryo rescue

UNIT - 3: Applications of plant tissue culture

3.1. Protoplast – properties of protoplast, Protoplast – Isolation (mechanical and enzymatic methods), Culturing and regeneration of protoplasts, Different methods of protoplast fusion (mechanical fusion, Chemo fusion, electro fusion) and Selection of somatic hybrids and cybrids.

3.2. Cryopreservation of plant cultures and application of plant tissue culture.

3.3. Immobilization of cells and the effect of elicitors on the production of secondary metabolites of commercial value

3.4. Physical gene transfer methods – Particle Bombardment, Electrophoration and Microinjection.

C) MICROBIAL TECHNOLOGY/ INDUSTRIAL BIOTECHNOLOGY

Unit 1: Introduction to Microbial technology

1.1. Introduction to industrial biotechnology, scope and applications

1.2. Principles and exploitation of microorganisms and their products

1.3. Isolation and screening of microorganisms for industrial products

1.4. Strategies for Strain improvement (mutation, selection, recombination)

1.5. Preservation of industrial microorganisms

Unit 2: Microbial fermentation

2.1 Principles of Fermentation technology

2.2 Fermentation concept and Design

2.3 Types of Fermentations, Formulation and Design of fermentation Media

2.4 Substrates used as Carbon and Nitrogen Inoculum development.

2.5 Factors affecting fermentation process

Unit 3: Microbial technology products and applications

3.1 Microbial production of Organic acids (Lactic acid and citric acid)

3.2 Microbial production of Amino acids (Glutamic acid and Aspartic acid)

3.3 Fermentation by microbes for food additives: dairy products (Bread and SCP), beverages (Beer and Wine) and antibiotics (Penicillin and Streptomycin,)

3.4 Therapeutic drugs: Monoclonal antibodies and insulin,

3.5 Biofuel: Alcohol and Methane

D) ANIMAL BIOTECHNOLOGY

UNIT-I Introduction to Animal Biotechnology

1.1. Animal tissue culture, history, requirements for animal cell culture

1.2. Substrate, liquids, culture mediums-Natural (Clots, Biological fluids, Tissue extracts), complex natural and chemically defined media

1.3. Explant-culture of explants, Cell culture technique- initiation, preparation and sterilization of media, isolation of explants, disaggregation of explants, culture, subculture

1.4. Cell lines, evolution of cell lines, maintenance of cell lines, large scale culture of cell lines-monolayer, suspension and immobilized cell culture, Development of primary culture and cell lines, subculture

1.5. Stem cells: Characteristic features, maintenance, culture and Applications of Embryonic and adult stem cells, Animal cloning- nuclear transfer and embryonic stem cell method

Unit-2 Secondary Cultures

2.1. Cultured cells and evolution of continuous cell lines (established cell lines)

2.2. Commonly used cell lines - their origin and characteristics

2.3. Cell line preservation and characterization

2.4. High level expression of foreign gene in animal cells-expression vectors, enhancers, regulatory sequences. The need to express foreign genes in animal cells: advantage and disadvantages.

2.5. Molecular pharming: Transgenic animals and their applications, methods used for transgenesis with reference to transgenic mice, cattle, sheep, goats, pigs, chicken and fish.

Unit-3 Application of animal cell culture

3.1. Transfection methods of animal cells (Calcium phosphate, DEAE-dextran, Lipofection, Electroporation, Microinjection, Embryonic stem cell transfer)

3.2. Selection of recombinant cells with various marker genes (Thymidine Kinase, Dihydrofolate reductase, CAD protein, XGPRT, HAT, Neomycin phosphotransferase)

3.3. Production of transgenic animals (Mice, Cattle, Sheep, pigs, Fish and Birds)

3.4. Animal cells as a bioreactors for the production of commercially important products

3.5. Applications, advantages and disadvantages of animal tissue culture and Ethical issues related to transgenic animals.

F) **Pharmaceutical Biotechnology**

Unit I Clinical Pharmacy

I. Biopharmaceutics

Course Description:

Understanding different methods of drug administration, fate of a drug after administration, influence of the route of administration on bioavailability.

Objectives:

Students should understand:

(a) The factors affecting absorption, distribution, metabolism and excretion of drugs

(b) The different pathways of drug metabolism

(c) The methods of studying drug metabolism

Unit 2. Pharmacokinetics I

Course Description:

Understanding the kinetics of drug absorption, distribution, elimination. Evaluation of studies involving drug product bioequivalency and bioinequivalency. Development of Mathematical models for the processes of bioequivalency and bioinequivalency, its application to bioavailability and dosage regimen design.

Objectives:

The students should understand:

(a) Basic concepts of pharmacokinetics

(b) Use raw data and derive pharmacokinetic models and parameters that best describe the process of drug absorption, distribution and elimination.

(c) Critically evaluate biopharmaceutic studies involving drug product bioequivalency and bioinequivalency.

(d) Design and evaluate dosage regimens of drug using pharmacokinetic and biopharmaceutic parameters.

Unit 3 PHARMACEUTICAL ANALYSIS

Objectives:

(1) Understanding problems of drug quality control and assurance as well as the official methods of analysis of some essential drugs, radiopharmaceuticals and antimicrobial agents.

(2) To provide exposure to analysis of drugs in biological samples

I. **Pharmaceutical Analysis I**

(1) Drug Quality control assurance systems

(2) Monographs and specifications for drugs and drug products; Equivalence and bioequivalence of drug products.

(3) Applications of chemical, biopharmaceutical and physicochemical analytical methods in purity determinations.

Identification and quantification of pharmaceuticals, radiopharmaceuticals and medicinal products.

(4) Basic tests methodology for essential drugs.

Unit 4 PHARMACEUTICAL CHEMISTRY

MEDICINAL CHEMISTRY I

Objective:

1. Understanding the principles used in the development and design of new drugs.

2. To emphasize the relationship between physical and chemical properties of chemical structures and the biological activity of some selected medicinal compounds.

3. To emphasize on the basic principles and general applications of instrumental methods and procedures in the analysis and quality control of pharmaceuticals and as a tool for the interpretation of spectra as an aid to structure elucidation.

Course Content:

1. Drug design: Physicochemical approaches to drug design. Historical,

Free-Wilson and Hansch approaches. The concept of isosterism. Bioisosterism

as a tool in drug design. The design of antihistamine, Sulphonamide and analgesic drugs. SAR in drug design. Antimetabolite and pro-drug approach to design of new drugs.

2. Introduction to medicinal chemistry of some selected compounds.

3) Knowledge about classes of drugs such as General and local anaesthetics, Sedative, hypnotics including barbiturates, Tranquilizers, Anticonvulsants, Analgesics – Antipyretic and Narcotic, Cholinergic and Adrenergic agents and Vitamins in respect to their nomenclature, physical and chemical Properties, structure, mode of action, metabolism and uses.

II **Pharmaceutical Analysis II – Instrumental Method of Analysis of Pharmaceuticals.**

Objective:

Understanding the uses and handling of analytical instruments in the identification, structures, elucidation and quantitation of bioactive products using the following equipment

(a) Absorption spectrophotometry

(b) Infra-red spectroscopy

(c) Fluorimetry

(d) Atomic Absorption Spectroscopy

(e) N.M.R. Spectrometry

(f) Gas-liquid chromatography and

(g) HPLC Chromatography

Unit 5 PHARMACEUTICAL MICROBIOLOGY

1. **Applied Microbiology**

Course outline

(1) Definition of Antimicrobial agents as preservative, antibiotics, disinfectants, antiseptics, chemotherapeutic agents.

(2) Knowledge about evaluation of antimicrobial activities and antibiotic assays

(3) Industrial uses of microorganisms for production of solvents, steroids etc.

G) ENVIRONMENTAL BIOTECHNOLOGY

Course Objectives:

To acquaint the students with conservation and reclamation of environment through biotechnology.

Course Contents:

Introduction to Environmental biotechnology, Fundamentals of Biological Intervention, Genetic manipulation strategies in environmental biotechnology, Pollution indicators, Pollution control strategies, Biology of Waste water and its treatment, Sludge treatment, Contaminated land and bioremediation, Aerobes and fluents, Phytotechnology (Terrestrial Phyto-systems, Metal

Phytoremediation, Rhizofilteration etc) Hyper accumulation, Solid Waste treatments, Concept of integrated Environmental biotechnology, Detoxification of hazardous chemicals: biodegradation, Biotransformation, Products of environmental biotechnology.

H) BIOSAFETY AND ETHICS IN BIOTECHNOLOGY

Objectives

On completion of this course the candidate should be able to:

1. Define Bio safety and Bioethics in Biotechnology.
2. Understand the General principles of laboratory and environmental Bio-safety.
3. Identify the issues in bio safety in Biotechnology.

Course outline

i. Agriculture and food system issues
ii. Market and consumer issues
iii. Institutional issues,
iv. Business issues
v. Social issues

4. Know the principles, scope and perspective of Bio-safety.
   i. Perspectives and methodology
5. Be cognizant with the National and International Bio safety policies, Regulation and law.
   i. Approval Regulatory bodies of different aspect of Biotechnology.
6. Know the Safety Assessment of Genetically Modified food for Humans.
7. Know the Safety Assessment of Genetically Modified Feed for Animals.
8. Know the general Principles of Risk Assessment.
   i. Health Risks
   ii. Environmental Risks
   iii. Risks to Biodiversity
   iv. Socioeconomic Risks
9. Assessing Risks of Genetically Modified Organisms.
10. Understand the Classification of Natural Organisms on the Basis of Hazard.
11. Identify the Biohazards, and risk assessment
    i. Hazardous materials used in biotechnology
    ii. Handling and disposal of Waste
    iii. Reporting accidents and incidents
12. Types of Containment processes
    i. Primary containment

ii. Secondary containment

13. Bio safety level of laboratories

i. Bio safety level 1

ii. Bio safety level 2

iii. Bio safety level 3

iv. Bio safety level 4