FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
AFRICA CENTRE OF EXCELLENCE
FOR MYCOTOXIN AND FOOD SAFETY
safer foods, secured living
920211 Main Campus, Gidan Kwano , Federal University of Technology Minna, Niger State, Nigeria. +234(0)8035882233, 816 765 8886, acemfs@futminna.edu.ng,
www.acemfsfutminna.org

PROGRAMME NAME: MASTERS OF TECHNOLOGY (MTech) and DOCTORAL DEGREE (PhD) in MOLECULAR BIOLOGY AND BIOINFORMATICS

INTRODUCTION

This programme will balance the molecular biology, engineering, computing and modeling necessary for career in food safety and security. It connects research with application and integrates molecular genetics that explains the information in the gene expressed that give rise to abnormality traits in organisms. Modern molecular biology depends on computational data analysis refer to as Bioinformatics. The emphasis will be placed on the genetic mechanisms underlying diseases, mapping and diagnosis such as salmonellosis, entero-haemorrhagic, hepatitis A, acute and chronic aflatoxicosis, cholera, heavy metal poisoning, and the threat of antibiotic resistance arising from improper use of veterinary drugs, and chronic pesticide and industrial chemical residue exposure. The programme will also combine concepts and techniques of molecular biology with hands on bioinformatics as a necessary skill gap career to address Africa's shortage of expertise and applicable solutions to ensure a safe, controlled and sufficient food supply that will support economic growth and public health. Also, the centre focuses on training in innovation process, entrepreneurship and commercialization of biotechnology products. The knowledge and skills gain on the programmes will open doors to employment within many sectors in industry, academia and agencies concerned with patent and legal issues, education or research funding.

PHILOSOPHY

The graduate programmes (M.Tech and PhD) in Molecular Biology and Bioinformatics are full time programmes designed by the Africa Centre of Excellence for Mycotoxin and Food Safety for the purpose of advanced research based education with the goal of encouraging cross-border collaboration for the effective training of high-level independent minded, self-reliant and competent researchers that are capable of providing critical skills in effective food system.

VISION

To be the leading Centre recognized nationally and internationally for teaching and research to produce graduates knowledgeable in Molecular Biology and Bioinformatics in Sub- Saharan Africa that will solve the development challenges confronting Africa in the area of food safety and security.

MISSION

To restore quality education and training in innovative research that will address food safety and security for improve well-being and economy of West and Central Africa Sub-region.

OBJECTIVES

The MTech and PhD (Molecular Biology and Bioinformatics) programmes are designed to train to graduates from relevant/related disciplines and have the following objectives:

(a) To acquire knowledge required to create an interdisciplinary and experience based educational model that will prepare students on the rapidly emerging need for innovations at the nexus of food security, food safety, agricultural productivity and economics from local to global scales.
(b) To acquire skilled and innovative ideas that would transform Africa's natural resources into goods and services, driven by entrepreneurship and information and communication technology (ICT), to positively affect the economy and thus the quality of life of her people.
(c) To be able to foster impactful interdisciplinary research and proffer solutions that will improve the quality of life of Africans through fit-for-purpose interventions fostering economic growth and access to sufficient safe food for all.
(d) To address Africa's shortage of expertise and applicable solutions that would ensure a safe, controlled and sufficient food supply that will support economic growth and public health.

Specific objectives for Molecular Biology and Bioinformatics are as follows:

1. To provide theoretical and practical knowledge of microbial biochemistry, molecular biology and bioinformatics related to food contaminant control and safer food among postgraduate students from West and Central African region.
2. To position the postgraduate students for successful grant writing that would enable them attract grants and become independent researchers in the field of mycotoxins and food safety.
3. To provide linkages for industrial experience acquisition among the postgraduate students.
4. To help the postgraduate students understand research ethics and use of intellectual property for innovative research products for wealth creation and addressing mycotoxin control needs in West and Central African region.

ADMISSION REQUIREMENTS

Candidate for admission to the postgraduate programmes (including MTech and PhD Molecular Biology and Bioinformatics) of the Africa Centre of Excellence for Mycotoxin and Food Safety shall have the following requirements:

(a) a minimum of five 'O' level credit passes in NECO/WAEC/NABTEB or its equivalent for international students which must include English/French, Mathematics, Physics, Chemistry and Biology at not more than two sittings.
(b) Nigerian applicants must have National Youth Service Corps (NYSC) certificate or an exemption certificate.
(c) should ensure their academic transcripts are received on time to allow for consideration of the application.
(d) must have at least a second class lower honour degree or its equivalent for foreign candidate.

(e) candidates with recognized PGD with a minimum of lower credit (CGPA of 2.50) in relevant fields with, at least one year post-qualification experience in the relevant fields may be considered for MTech.

(f) must provide three referees, one of whom must be his/her undergraduate/master's thesis supervisor.

(g) applicants for PhD programme shall be Master Degree graduates and must have attained an average performance of 'B' grade or weighted average of 60% or a minimum CGPA of 3.50

(h) applicants for PhD programme must ensure that their research proposals are received on time for consideration of the application.

(a) a qualifying examination may be necessary.

The related courses that will qualify the candidates for application into the programme are: Biochemistry, Molecular Biology and Bioinformatics, Microbiology, Biotechnology, Veterinary Medicine, Bachelor of Medicine & Surgery, Pharmacy, Chemistry, Food Science, Animal Science, Crop Science, Plant Pathology and related subjects.

GRADUATION REQUIREMENTS

To be awarded a master degree in Molecular Biology and Bioinformatics, a candidate is expected to satisfy the following conditions before graduation;

(a) Pass all courses, including research project

(b) A minimum of three (3) semesters of 18 months and maximum of six (6) semesters of 36 months are required to be spent by the candidates while on the program. This includes the period spent on the course work and internship with minimum number of credits required for graduation as 44 credits.

Core credit units: **32**

Elective credit units: **4**

Internship: **2**

Thesis: **6**

(c) A conference paper presentation from MTech research project is a requirement for MTech students

(d) All MTech students must attain an overall minimum CGPA of 2.50 at the end of the course work before proceeding for research project.

Candidates from non-English speaking countries (Francophone Countries) are to undergo proficiency training in English Language (maximum of six months). The waiting period for the training is not counted as part of candidate's academic programme duration.

Doctoral Programme

All PhD candidates will be required to audit core courses from the Masters programme on assessment of their academic transcripts by Academic Board of the Centre. The courses to be audited are peculiar to each students and are on the students' portal. In so doing, a candidate is expected to satisfy the following conditions before graduation;

(a) a group of supervisors who would supervise his/her research shall be nominated by the Centre, presented to, and approved by the postgraduate board.

(b) must have presented four seminar series, including research proposal, two progress reports, and an exit seminar.

(c) at least TWO paper publications from the thesis in high impact factor journals and TWO conference paper presentations before final examination can take place.

(d) final oral examination of the prospective graduand by the external examiner who shall be invited by the PG School after satisfying all conditions.

(e) the final corrected version of the PhD thesis must be re-submitted within three months from the date of final oral defense.

Registration and Duration

PhD candidates will be required to register as full time at the beginning of the programme.

Minimum	6 Semesters or 36 months
Maximum	10 Semesters or 60 months

METHODS OF INSTRUCTION

General pedagogical approaches will be adopted. These will include: lecture method, demonstration, tutorials, group presentation, and slide presentations. Laboratory practical will include wet and dry practical, field trips and report presentation at the end of internship. Teleconferencing and mid-term papers are also included.

METHODS OF EVALUATION

Procedure for formative (CA) including assignments and mid-term test: 40 %

Procedure for summative: 60 %

Internship/Industrial experience: 3 months

Practical- based classes shall be assessed thus:

Weekly class experiments: 40 %

Advanced technique term paper: 10 %

Examination: 50 %

COMPETENCY OF THE GRADUATES

Graduates of MTech and PhD Molecular Biology and Bioinformatics shall be opportune to work as laboratory analysts, surveillance/senior inspectors, molecular biology analysts, forensic and clinical analysts, food and safety officer/food safety regulators in various MDAs, companies and industries. They would also be relevant as biosafety officers, toxicological risk assessors, food microbe analysts and instructor/lead instructors/trainers/lecturers.

EXAMINATION MALPRACTICE AND PENALTIES

1. Except where specifically stated, materials relevant to the examination should not be brought into the examination Hall.

2. The Senate shall impose penalties for any examination malpractices after thorough investigation.

3. Proven cases of cheating shall be punished with dismissal from the University. Other cases will be treated on their individual merits.

4. Suspected examination malpractices shall be investigated by the School panel and its report and recommendations submitted to the Students' Disciplinary Committee through the Registrar for determination subject to approval by the Vice-Chancellor.

5. Graded punishments include the following:

S/N	OFFENCES	PENALTIES
1.	Writing Before an Exam was officially started	First offender: Warning. Second offender: Suspension for one semester
2.	Writing beyond the official termination of examination	Letter of warning and deduction of 5 marks. To be done at the spot by the invigilator.
3.	Talking to another candidate during examination	First offender; Warning. Second offender: Suspension
4.	Writing on question paper	Letter of warning and deduction of 5 marks.
5.	Being caught with extraneous material not relevant to the examination	Cancellation of paper of the affected student.
6.	Anyone caught using foreign materials inside the examination hall that are relevant to the Examination/course.	Expulsion
7.	Anyone who brought relevant materials into the hall but was not caught using it.	Suspension for two semesters
8.	Unruly behaviour e.g. changing position without permission	Suspension for one semester
9.	Smuggling in/out of the examination hall, Blank answer booklet or continuation Sheet.	First offender: Minimum of 2 Years suspension. Those with previous records, expulsion.
10.	Anyone who brought into the examination hall already written answer script or continuation sheet.	Expulsion
11.	Aiding and abetting 'grafting'	Suspension for one semester
12.	Giving false evidence	Suspension

13.	Refusal to give evidence on request	Suspension
14.	Previous involvement in two examination misconduct with penalties less severe than rustication	Explosion
15.	Assaulting/Fighting an invigilator or any officer of the University	Expulsion
16.	Being in possession of dangerous weapon in and around the examination hall.	Expulsion
17.	Involvement in examination leakage	Expulsion
18.	Impersonation (both the impersonator and collaborator	Expulsion
19.	Those who fail to submit answer scripts at the end of examination	Suspension for one session
20.	Students who failed to sign out after Examination	First offender: Warning, Second offender: Suspension for one semester
21.	Refusal to surrender incriminating evidence, chewing or destruction of materials.	Expulsion
22.	Refusal to write statement	Expulsion
23.	Forging any document relevant to the Examination	Expulsion
24.	Anyone who refused to be identified and/or searched at the entrance of an examination hall.	Suspension from the examination for that particular paper, through Examination Officer and Dean.
25.	Staff harassment or intimidation for leakage of examination questions	Expulsion
26.	Writing on question paper	Letter of warning and deduction of 5 marks.
27.	Anyone who takes GSM handset into the Examination hall.	Suspension for one semester
28.	Refusal to appear before the Students Disciplinary Committee within a session following examination misconduct.	Expulsion
29.	Those who exchange or transfer calculator in the examination hall.	Expulsion.
30.	Exchange of answer booklets	Expulsion
31.	Writing on any part of the body and clothes	Expulsion
32.	Discussion in the course of writing an examination.	Letter of warning
33.	Making some writings relevant to the course at the back of calculators including placing	Expulsion

	relevant material inside Mathematical-set.	
34.	Exchanging answer script or question papers or any relevant writing materials during Examination.	Expulsion. Note. Relevant material: Suspension for one semester.

DRESS CODE

Students' dressing should reflect a high sense of morality and decency and show respect for the sensibilities of other members of the community. Therefore, the following types of dressing and physical appearances be prohibited on the University campus:

1. Short and skimpy dresses e.g. Body hugs, Show-me-your chest/back/stomach; Spaghetti wears and dresses exposing sensitive parts.
2. Tight shorts and skirts that are above the knees (except for sporting purposes).
3. Tattered jeans with holes and/or patches.
4. Transparent and see-through dresses.
5. Tight fittings e.g. Jeans, Shirts, Hip Star, Patra, Lactra, Cross-No Gutter, Mini-micro and others that reveal the contour of the body.
6. Under clothing, such as singlets worn publicly.
7. Unkempt and haggard appearance, including bushy hair and rough beards.
8. Dresses that make it impossible to wear laboratory coat during practical's or participate actively in practical.
9. Long and tight skirts, with long slits that reveal sensitive parts.
10. Wearing of T-shirts with offensive captions.
11. Shirts without buttons or not properly buttoned leaving the wearer hare chested.
12. Wearing of earrings by male students.
13. Plaiting or weaving of hair by male students.
14. Wearing of coloured eye glasses, except on medical grounds in the classrooms/lecture halls/library/offices.
15. Wearing bathroom slippers to class/library/offices (except on medical grounds).

DISCIPLINARY MEASURES

1. Cultism: any students guilty of participating in any occultism shall be expelled from the university after proven guilty by the Students' Disciplinary Committee (SDC).
2. Stealing: any act of stealing shall attract maximum penalty of expulsion from the university.

3. Drug abuse: any drug- related anti-social behaviours shall attract necessary disciplinary measures ranging from suspension to expulsion.
4. Any students' case involving police shall also be tried by the university Students' Disciplinary Committee (SDC).
5. In any case of co-habitation by the student(s), centre shall make available form of intent to be completed by the student(s) concerned, failure to do this shall attract penalty ranging from suspension to suspension as determined by the Students' Disciplinary Committee (SDC).
6. Any student that disobeys laboratory code of conducts shall be suspended from the lab for a period to be determined by the Students' Disciplinary Committee.
7. Physical assault shall attract punishment ranging from suspension to expulsion to be determined by the Students' Disciplinary Committee (SDC)

SEXUAL HARASSMENT

Federal University of Technology Minna will provide enabling conditions for the guarantee of academic freedom and fundamental human rights of staff, students, service providers, and all persons; regardless of gender, thereby supporting an environment that is free of sexual harassment in any form.

Vision of the Policy

To raise FUTMINNA to the status of an ideal, safe, and secure institution, where the dignity of everyone is ensured and guaranteed.

Mission of the Policy

- Provide information to staff, students, and other stakeholders on what constitutes sexual harassment
- Enlighten staff and students on their rights to seek redress in cases of sexual harassment and the consequences of such acts.
- Put in place machinery for investigating allegations and incidents of sexual harassment and /or attempted sexual harassment.
- Ensure that victims of sexual harassment do not suffer any setbacks/victimization/stigmatization/discrimination and are integrated back into University life as quickly as possible.
- Sensitize staff and students on the need to comply with decent dress code and appropriate behavior; and discourage inappropriate relationships between staff and students that may engender conflict of interest.

The Scope of the Policy

The Sexual Harassment Policy shall apply to:

- All academic and non-academic staff of the University
- All students
- All contractors of the University and other service providers
- All visitors to the University

- Other groups of persons in the University, including but not limited to children, wards, and other dependents of staff resident on both campuses

Objectives of the Policy

The objectives of the policy are to:

- Create for staff, students and service providers a safe and secured work and learning environment that is free from sexual harassment/assault.
- Guarantee respect for both sexes, and provide a transparent operating system in the university that is devoid of demands for sexual gratification.
- Eliminate all manners of gender-based violence.
- Ensure that no member of the university community or its customers suffer any form of service failure due to gender bias.
- Forbid discrimination on the basis of sex in all the University's service windows.
- Ensure firm commitment to transparency on the issues of sexual harassment and sexual violence
- Enforce the dress code as enshrined in the University's code of conduct for staff and students.
- Train students/staff to be alert to the possibility of sexual misconduct, to identify warning signs and to learn strategies for getting out of those kinds of situations before it reaches a crisis level.

WHAT IS SEXUAL HARASSMAENT?

Sexual harassment is defined as unwelcome sexual advances, request for sexual favors and other verbal or physical conduct of a sexual nature when either:

i. The conduct is made as a term or condition of an individual's employment, education, living environment or participation in a University community.

ii. The acceptance or refusal of such conduct is used as a basis or factor in decisions affecting an individual's employment, education, living environment, or participating in a University community.

iii. The conduct unreasonably impacts an individual's employment or academic performance or creates an intimidating, hostile or offensive environment for that individual's employment, education, living environment, or participation in a University community.

The following behaviors shall be considered by the University as sexual harassment:

- Unwanted sexually motivated conduct, crude jokes, comments, unwanted touching and expressions capable of prejudicing or undermining a person's freedom, rights and privileges. Such acts could include but are not limited to outright demands for sex, ogling, indecent comments and unnecessary bodily contact which could lead to psychological or physical unsolicited sexual relationships;

- Unwanted suggestive looks, phone calls or use of any other electronic medium with the intent to lure a person into a sexual relationship.
- Spousal abuse where one or both partners are members of the university community
- Sexual harassment may be from a superior to a subordinate or vice versa or among peers.
- Sexual harassment can be direct or indirect (including procuring or attempting to offer a person to another for sexual activity); and may involve persons of the same or opposite sex.
- Sexual harassment may take place over a period of time, may be a single incident and may or may not involve elements of overt coercion.

BEHAVIOURS THAT ARE CONSIDERED 'CONDUCT OF A SEXUAL NATURE'

I. Unwanted sexual statement: Sexual or 'dirty' jokes, comment on physical attributes, spreading rumors about or rating others as to sexual activity or performance, talking about one's sexual activity in front of others and displaying or distributing sexually explicit drawings, pictures and/or written material. Unwanted sexual statement can be made in person, in writing, electronically (e-mail, instant messaging, blogs, web pages etc) and otherwise.

II. Unwanted personal attention: Letters, telephone calls, visits, pressure for sexual favors, pressure for unnecessary personal interaction and pressure for dates where a sexual/romantic intent appears evident but remains unwanted.

III. Unwanted physical or sexual advances: Touching, hugging, kissing, fondling, touching oneself sexually for others to view, sexual assault, intercourse or other sexual activity.

WHAT IS SEXUAL ASSAULT?

Sexual assault/ sexual violence is any sexual act, attempt to obtain a sexual act, or other act directed against a person's sexuality using coercion, by any person regardless of their relationship to the victim, in any setting. It includes rape, defined as the physically forced or otherwise coerced penetration of the vulva or anus with a penis, other body part, or object (WHO, 2011).

FORMS OF SEXUAL HARASSMENT

Based on the definition provided above, sexual harassment in Federal University of Technology, Minna shall include but not limited to:

Verbal Conduct

- Unfriendly remarks with sexual connotations
- Forcing of females or males by staff or students to have sexual interaction.
- Demanding for sexual favors in exchange for employment, promotion, admission, grades, or any other benefits in the course of performing official duties.

- Victimizing an individual through denial of his or her entitlement for refusal to succumb to sexual advances.
- Sexually motivated jests, comments and defamation of a person(s).
- Making sexually motivated comments about a person's clothing, body or shape.
- Turning academic and occupational discussions into sexual discussions without precluding or restricting appropriate teaching methods and research.
- Compelling persons to narrate sexual fantasies, preferences or history.
- Unsolicited, sexually explicit or suggestive electronic and mobile messages.
- Directly or indirectly procuring or attempting to offer a person to another for sexual activity

Visual and Audio Conduct

- Recording and sending unwholesome pictures (videos, CDs, camera phones etc) for the purpose of blackmail or any other purpose.
- Forcing or inducing to watch pornography or X-rated movies
- Seductive postures and indecent dressing and exposure by males or females that offend public morality. Any form of dressing that exposes vital parts of the human body constitutes indecent dressing. The University shall encourage a 'dress sense' culture among males and females.
- Indecent and inappropriate public display of sexual intimacy

Physical Conduct

- Physical sexual assault and battering
- Repeated, unwelcomed and unwarranted brushing against a person's body.
- Unwelcomed caressing or fondling

WHO IS THE VICTIM OF SEXUAL HARASSMENT/ASSAULT?

In the University community, the following may be victims:

i. Students (males and females)
ii. Staff (males and females)
iii. Staff children/wards
iv. Students' children/wards

Sexual harassment by University staff/student outside the University community.

The victim could seek support from University services and duty bearers within the community the University operates in like the security, health services and Servicom.

Redress Mechanism for Complainants

All complaints on violation or infringement of the sexual harassment policy shall be made at the Gender Mainstreaming Office (GMO) or SERVICOM unit of the University. If the complainant is not satisfied, he/she can complain to the Vice Chancellor. All complaints shall be treated with confidentiality and the victim shall be properly secured while reporting the incidence and afterwards.

Complaints of violation or infringement of the policy may be formal or informal. ACEMFS has a guidance counselor desk officer whom the victim reports to as soon as it happens.

- Informal complaints (i.e. oral complaints) shall be treated administratively. The receiving officer shall however document such complaint and treat with dispatch.
- Formal complaint must be in writing, signed and submitted at the GMO or SERVICOM unit.

A report or complaint can be made by the victim (or anyone who advocates on his or her behalf), or a witness. However, the decision to make such complaint formal or informal lies with the victim (or anyone who advocates on his or her behalf) or a witness.

PENALTIES

Any person found culpable of perpetrating sexual harassment, falsely accusing any person or instigating the occurrence of false accusation shall be subject to penalty as stipulated in the Conditions of Service of the University. These may include, but will not be limited to any of the following:

- Counseling and/or therapy
- Oral admonition
- Written warning or oral reprimand
- Referral to Staff/Student Disciplinary Committee (SDC) as the case may be or
- Any other disciplinary action which the University may deem fit (including suspension, expulsion or dismissal from service with photograph pasted around the campus).

In cases of sexual harassment outside the University, there will be a need for the involvement of security agencies and hence the court. The University shall follow the case to the latter while the student/victim is fully protected.

COURSE STRUCTURE

FIRST SEMESTER

COURSE CODE	COURSE TITLE	CREDIT UNIT	
MBB 811	Biochemistry I	3	**Core**
MBB 812	Molecular Biology I	2	**Core**
MBB 813	Microbial Biochemistry	3	**Core**
MBB 814	Seminar	2	**Core**
MBB 815	Bioinformatics 1	3	**Core**
MBB 816	Laboratory Techniques	2	**Core**
MFT 811	Introduction to Nanoscience and Nanotechnology	2	**Core**

MBB 817	Cell Physiology	2	**Elective**
MBB 818	Intellectual property rights and Research Ethics	2	**Elective**
	Sub-total for Core courses	**17**	
	Sub-Total for elective courses	**4**	
	Total	**21**	

SECOND SEMESTER

COURSE CODE	**COURSE TITLE**	**CREDIT UNIT**	
MBB 821	Biochemistry II	3	**Core**
MFT 821	Research Methodology	2	**Core**
MBB 822	Molecular Biology II	2	**Core**
MBB 823	Immunology	2	**Core**
MBB 824	Biotechnology	3	**Core**
MMB 825	Bioinformatics II	3	**Core**
MBB 826	Nano Drug Modelling	2	**Elective**
MBB 827	Nanopharmaceuticals	2	**Elective**
	Sub-total for core courses	**15**	
	Sub-total for elective courses	**4**	
	Total	**19**	

THIRD SEMESTER

COURSE CODE	**COURSE TITLE**	**CREDIT UNIT**	
MFT 830	Internship	2	**Core**
MBB 830	Thesis	6	**Core**
	Sub-total	**8**	
	Total credit unit for core courses	**40**	
	Total credit unit for elective courses	**8**	
	Grand total credit unit	**48**	

COURSES DESCRIPTION

MBB 811: BIOCHEMISTRY I 3 CREDIT UNITS

UNIT-1: Chemistry of Biomolecules: Carbohydrates-Classification; Monosaccharide nomenclature; sugar ring structures, derivatives of monosaccharides – phosphate esters, acids and lactones; amino sugars; glycosides and glycosidic bonds; oligosaccharides; polysaccharides– storage and structural polysaccharides; Lipids.

UNIT II: Definition, classification, structure of fatty acids, triacylglycerols, phospholipids and sphingolipids, Fluid Mosaic Model. Steroid hormones – androgens and estrogens, prostaglandins, thromboxanes and leukotrienes; lipids as constituents of biological membranes

Amino acids - structure, properties (acid-base properties), classification; non-protein aminoacids, essential and non-essential amino acids; modified amino acids and function.

UNIT III: Nucleic acids: Structures of bases, nucleosides and nucleotides; phosphate diester bondformation, general structure of nucleic acids in brief. Hypochromicity, hyperchromicity, Tm, Chargaf's rule, importance of nucleotides.

UNIT- IV Protein structure: Primary, secondary, tertiary and quaternary structure Peptide bond – structure, stability and formation; steric interference ; Ramachandran plots and their importance; regular ways to fold the polypeptide chain; alpha helices and beta sheets; helixturn helix, helix loop helix and combination of them, fibrous proteins and globular proteins varieties of globular protein structure; Factors determining secondary and tertiary structure: information for protein folding, thermodynamics, disulfide bonds; prediction of secondary and tertiary protein structure; roles of chaperones and isomerases in protein folding; structures of collagen and DNA binding proteins (leucine zipper and zinc finger proteins); Quaternary structure of proteins - multisubunit proteins: homotropic and heterotropic protein-protein interactions.

UNIT-V: Enzymes: Classification and nomenclature; enzyme structure, monomeric, and multienzyme complex systems with examples; structural features such as substrate binding site, catalytic site, allosteric site; mechanism of enzyme activation, induced conformational changes. Cofactors and activators **–** characteristics, role of nicotinamide and flavin co-enzymes in redox reactions; concept of apozymes, prosthetic groups and holoenzyme.
Enyme kinetics: Rate of reaction, kinetic orders- first, second, third and zero and pseudo-order reactions; turn over, kcat; Derivation of Michaelis-Menton equation, Km value, Vmax, Lineweaver-Burk plot; effects of pH and temperature on reaction rates. Mechanism of enzyme catalysis- Activation energy, binding energy, transition states, acid-basecatalysis, covalent catalysis, metal catalysis; single substrate and multisubstrate reactions; Enzyme inhibition - reversible, competitive, noncompetitive, irreversible inhibition; Regulation of enzyme activity - substrate-level control; feedback control; allosteric regulation – homoallostery; heteroallostery – examples; covalent modifications to regulate enzyme activity –role of proteases.

MBB 812 MOLECULAR BIOLOGY I 2 CREDIT UNITS

Unit I: DNA: Chemical composition of DNA: DNA structure-single stranded DNA, detailed account of double stranded DNA-BDNA, Z.DNA, and other structural forms, triple stranded DNA and quadruplex DNAs, curved DNA, rod shaped DNA, and their importance. Super coiled DNA: Changes from one form to the other, and the enzymes involved, concept of Linking numbers. Importance of super helical DNA and their structural forms. Types of Topoisomerases and their function in adding or removing super helical structures. Characteristic features of highly repetitive DNA; Tandemly repetitive DNA and Mini and microsatellite DNA and Insertional elements and their role and importance

Unit II: C value paradox- Genome size and content over members of different orders and of the same family; cDNA value paradox. Resolving the paradox by DNA-DNA and DNA-RNA hybridization kinetics. Kinetics of DNA-DNA hybridization, DNA-RNA hybridization, Cot curves, Rot curves, kinetic complexity, chemical complexity, Results of kinetics – determining the portion of genomic DNA which has highly repetitive DNA, moderately repetitive DNA and Non repetitive DNA. Rot curve analysis to find the number and the kind of gene expressed in general and tissue specific manner, the copy numbers of each species of mRNAs, by subtractive method, additive method and micro array method.

Unit III: DNA replication: Prokaryotic DNA replication; replication origin and site and structure and DNA Ter regions and structure. DNA polymerases, composition and features, replication factors and the mechanism of replication, leading strand and lagging strand synthesis, procesessivity and fidelity and regulation of replication. Replication of single stranded DNA, M13 viral DNA-use of them as cloning vectors. **Eukaryotic-replication** origins, replication initiation complexes and their assembly, licensing factors, DNA polymerases and their composition, telomerase and mode of action, replication factors, disassembly of chromatin components and reassembly during replication. Organelle genome and composition, replication origins, Enzymes and factors involved in the Replication of mitochondrial DNA and Chloroplast DNA and the mechanism involved.

Unit IV: DNA damage: types and there repair – Factors involved DNA damage: types and their repair mechanisms-mechanism of DNA repair and the regulation of it; direct repair-excision-repair transcriptional excision repair, glycosylase pathway, miss-match repair, UVr A, B & C mechanism, broken end repair, recombination repair and SOS repair system. **RNAs: types** rRNAs; Structural features of rRNAs- prokaryotic and eukaryotic. tRNAs: structural features, their anticodon feature. mRNAs- prokaryotic and eukaryotic mRNAs, structural features, Genomics RNAs, Replication of Picorna and Rabies Viral RNA and mechanism; Structure of retroviruses, classification, Replication of HIV viral RNA; Sn-RNAs, Sno RNAs, RNAi

MBB 813 MICROBIAL BIOCHEMISTRY 3 CREDIT UNITS

Unit-I; Viruses: Classification of viruses and the basis; Occurrence, structural organization of capsids (including geometrical pattern), DNA or RNA viruses, infection method, replication of the genomes, regulation of replication, assembly of the viral particles, M13 virus, T4 phages, Lambda phage (Lytic and lysogenic pathways), Orthomixovirus and Adenovirus, CaMV. **Bacteria:** Occurrence, structure of bacteria in general, classification- Ultra structure of E. coli, fagella, cilia, fimbriae, sex pili, Genome organization, cell division and its regulation. Recombination in Bacteria- E. coli as an example; sex determination, F+, HfR strains, conjugation mechanism, mapping and genetic recombination, transductions, sexduction.

Unit-II Bacterial plasmids: Features, plasmid with Sex factors, R-plasmids, pathogenic plasmids, ColE1 plasmids; transformation mechanism of bacteria; transposable elements IS type, Tn type, retrotranspons, structural features and their occurrence, mode of transposition,

transposons mediated drug resistance, to locate genes using transposons and disrupt normal genes. **Cyanobacteria:** Occurrence, structural features; structural organization; mechanism of photosynthesis. Importance of Cyanobacteria. ***Agrobacterium***: Occurrence, structural features, Genome and its plasmid T-DNA and Ti and Ri plasmids, mechanism of infection and causing crown galls.

Unit-III: Fungi: General features, classification of fungi, detailed account of Yeast types, structure and reproduction, genetics of mating, cytoplasm inheritance, cell division mode, and the regulation of yeast cell cycle in brief. Microbial metabolism: Mechanism of bacterial photosynthesis, chemosynthesis, Light and dark reactions, - oxidative process. Bacterial carbohydrate metabolism, EMP pathway, Entner- Doudoroff pathway, Warburg Dickens pathway, pentose and hexose-ketolase pathways, electron transport chain, anaerobic pathways. Mechanism of Nitrogen fixation, regulation of Nod, Nif genes, hup genes. Mycotoxin Biosynthesis, genetic determinants and their expressions. Mycotoxins producing fungi, mechanisms of phytotoxicity, Significant of mycotoxins and mycotoxicosis, synergisms and /or association of mycotoxins.

Unit-IV: Microbial pathogenesis: Viral-pathogenesis (Influenza), Protozoan parasites (Plasmodium), mechanism of infection, effects on host cells, host response to infection; resistance to pathogenesis in plants, role of pathogen resistant genes R genes and the mechanism of resistance. Medically important bacteria: Mode of infection and pathogenesis of Staphylococcus, Clostridium, Streptococcus, Enteropathogenic bacteria, Salmonella and Mycobacterium, Mycotoxins in Plant pathogenesis, pathways for aflatoxin, Biodegradation.

MBB 814 SEMINARS 2 CREDIT UNITS

Two seminars to be delivered following extensive literature review on two topics approved by the postgraduate committee of the department.

MBB 815 BIOINFORMATICS 1 3 CREDIT UNITS

Unit I: Introduction to Bioinformatics concepts, principles and applications: Biological databases, exploration, Data retrieval, homology searches and interpretation (BLAST algorithm and result interpretation: coverage, percentage similarity, e-value). Sequence alignments: types tools and practical applications,; DNA Sequences: Alignments and Analysis; Proteins: Alignment, Analysis and Structure; Sequence assembly methods for multiple sequence alignment; Multiple sequence alignment tools and applications (Use of Clustal Omega and Molecular Evolution and Genomic analysis (MEGA) software package for model and approach-based phylogeny constructrion, Overview of Primers and Primer Designing; Primer Designing; Primer specificity, Primer validation, n-Silico restriction digest in SMC and webcutter. In-Silico PCR in UCSC and virtual PCR

Unit II Exploration of DNA, and proteomic tools in Expasy: Pattern analysis in sequences Motif representation: consensus, regular expressions; PSSMs; Markov models; Regulatory

sequence identification using Meme; Gene finding: composition based finding, sequence motif-based finding.

Units III : Structure-related problems Representation of molecular structures (DNA, mRNA, protein), secondary structures, domains and motifs; Structure classification (SCOP, CATH); Visualization software (Pymol, Rasmol etc.); Experimental determination of structures (X-ray crystallography, NMR); Structure databases; Secondary structure prediction; RNA structure prediction; Mfold; Protein structure prediction by comparative modelling approaches(homology modelling, threading); Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches, side-chain packing; Energy minimization; Molecular dynamics; Rosetta; Structure comparison (DALI, VAST etc.); CASP; Protein-ligand docking; Computer-aided drug design (pharmacophore identification); QSAR; Protein-Protein interactions and Bioinformatic tools (e.g. STRING) ;

Unit IV::System-wide analyses: Transcriptomics: Microarray technology, expression profiles, data analysis; SAGE; Proteomics: 2D gel electrophoresis; Mass Spectrometry; Protein arrays; Metabolomics: 13C NMR based metabolic flux analysis; Exploring and Analysing microbial and eukaryotic genomic dataset ; analysing and exploring metagenomics data; Bioinformatics for transcriptomics; Bioinformatics for Systems Biology. Diversity studies: Case study in Fungi diversity

MBB 816 LABORATORY TECHNIQUES 2 CREDIT UNITS

Practical:

Molecular Cell Physiology

1. Extraction of plant lipid and lipid from animal sources.
2. Qualitative estimation of lipids-using standard curve, emulsion test, solubility and saponification test, acid value test.
3. Determination of Iodine Number of different lipids.
4. Salicylic acid chromatography of Lipids
5. TLC of lipids and identification of different lipids.
6. Separation of Sugars by TLC.
7. Separation of amino acids by TLC.
8. Preparation of proteins by acetone extraction method and also ammonium sulfate fractionation method and running the gel.

Molecular Cell Biology

1. Preparation of Meiotic chromosomes using Haemotoxylin/Feulgen stain-*Poecilocera Picta* X- linked chromosomes-Bar Bodies
2. Isolation of Nuclei and determination of its purity
3. Isolation of mitochondria and plastids and Examination under microscope
4. Isolation of mitochondria and chloroplast DNA – run a gel to check the quality of DNA
5. Preparation of salivary gland chromosome-*Drosophila melanogaster*
6. Vital Staining-Animal and plant, Dye exclusion technique to determine cell viability.

Microbiology

1. Laboratory Safety including Chemical, Biological and Radiations. Principles and Practices of Sterilization.
2. Preparation and Sterilization of Media, Buffers, Solutions and Reagents.
3. Enumeration of microbes (bacteria and fungi) from water and soil.
4. Growth curve of *E. coli*
5. Isolation and culture of *Rhizobium* from soil and root nodules of leguminous plant.
6. Isolation and growth of cyanobacteria (Study of preserved specimens)
7. Preparation of competent cells by calcium chloride genetic transformation using PUC 18
8. Isolation of bacterial plasmid by Alkali lysis method.
9. Restriction of plasmid DNA and agarose gel electrophoresis.

Lab on Biochemistry and Analytical Techniques

1. To prepare an Acetic-NaAcetate Buffer system and validate the Henderson-Hasselbach equation.
2. To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert's Law.
3. Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by TLC. 4. An enzyme purification theme (such as *E. coli* Alkaline phosphatase or any enzyme of the institutions choice).

(a) Preparation of cell-free lysates
(b) Ammonium Sulfate precipitation
(c) Ion-exchange Chromatography
(d) Gel Filtration
(e) Affinity Chromatography
(f) Generating a Purification Table
(g) Assessing purity by SDS-PAGE Gel Electrophoresis
(h) Enzyme Kinetic Parameters: Km, Vmax and Kcat.

5. Determination of mass of small molecules and fragmentation patterns by Mass Spectrometry

Lab on Microbiology

1. Sterilization, disinfection, safety in microbiological laboratory.
2. Preparation of media for growth of various microorganisms.
3. Identification and culturing of various microorganisms.
4.Staining and enumeration of microorganisms.
5. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
6. Assay of antibiotics production and demonstration of antibiotic resistance.
7. Growth curve of *E. coli*
5. Isolation and culture of *Rhizobium* from soil and root nodules of leguminous plant.
6. Isolation and growth of cyanobacteria (Study of preserved specimens)
7. Preparation of competent cells by calcium chloride genetic transformation using PUC 18
8. Isolation of bacterial plasmid by Alkali lysis method.
9. Restriction of plasmid DNA and agarose gel electrophoresis.

Lab on Immunology

1. Selection of animals, Preparation of antigens, Immunization and methods of bleeding, Serum separation, Storage.
2. Antibody titre by ELISA method.
3. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
4. Complement fixation test.
5. Isolation and purification of IgG from serum or IgY from chicken egg.
6. SDS-PAGE, Immunoblotting, Dot blot assays
7. Blood smear identification of leucocytes by Giemsa stain
8. Separation of leucocytes by dextran method
9. Flowcytometry, identification of T cells and their subsets
10. Immunodiagnostics using commercial kits

MBB 817 CELL PHYSIOLOGY 2 CREDIT UNITS

Unit-I Water and Osmoregulation: Chemical and physical properties of water, its colligative properties; hydrodynamic and thermodynamic properties of water, diffusion, fluidity; surface tension, cohesive property, tensile strength and tensile properties. Osmosis, concepts like osmotic pressure, osmotic potential and pressure potential. Chemical free energy of water, Kinetics of movement, Water Potential, Ficks law of diffusion, turgour pressure, hydraulic conductivity, Regulation of cellular pH. **Cytoplasmic fluidity:** Cytoskeletal elements- their chemistry and structural organization and their dynamics, fluidity, cytoplasmic streaming, cell movement, and the mechanism. Energy based cellular dynamics; role of molecular motorskinesins, dyneins; structure and role of myosin, microfilaments, microtubules-actins and their role in cytoplasmic flux.

Unit II: Membrane Structure and Function: Membrane composition, structure models and turnover; Membrane associated transport systems: transport of water –Structure and mechanism of transport by Aquaporins. Structure and function of different types of transporters, ion gates, passive and active transport, Bulk Transport. Facilitated –Passive and Active-uniport, ATP powered pumps-P-class, V-class, F-class pumps, and ABC family transporters, Muscle Ca-ATPase pumps, Calmodulin mediated Ca ATPase pumps, Na/K ATPase pumps, H^+ ATPase pumps, Ion coupled transport, voltage gated, ligand gated channels, antiport and symport mechanisms. **Concept of membrane electrical potential:** Resting potential, and action potential and propagation of the same in neuronal cells; neurotransmitters and receptor and transport; mechanism of signal transmission at synapses. Synaptosomes.

Unit III: Cell Receptors: Structure and function of cell surface receptor; Intracellular receptors and nuclear receptors; signal mediated signal transduction for different types of signaling molecules G-protein and PI3 mediated signal transduction. INF and cytokine. Insulin dependent pathway, TGFB induced Receptor serine/Threonine receptor kinase, NFkB pathway and Wnt-b Catenin pathways and downstream cascade of signal transductions. LDL receptor and Chloesterol metabolism. Protease activated receptors.

Signal Transduction: Cell to cell communication- autocrine, paracrine, endocrine systems; Synaptic; role of Gap junction in signal sharing, cell potential to receive signals and

competence, kinds of signals, external and internal; Effect of concentration of signals; short-term and long-term signal induction and sustenance; chemistry of signaling molecules. **13 hrs**

Unit IV: Intracellular Membrane and Protein flow

Intracellular compartments and their characteristic features; membranes and proteins involved in transport-structures involved in trafficking of proteins. Protein sorting- secretory pathway; receptor mediated endocytosis and sorting of internalized proteins; structure and role of variety proteins involved in vesiculation, transport and targeting; clathrin and its associated proteins, adaptor proteins, CopI and Cop II and its associated proteins, receptor proteins, docking proteins, proteins involved in fusion of membrane to membranes, endocytosis, exocytosis and transcytosis

Fluid flow circulation in Plants and Humans: Include fluid flow and circulation in plants and animals-human; plant-transpiration and guttation, absorption of water and mineral salts and flow, Ascent of sap, structures involved and mechanism. Fluid flow in human body structures involved and mechanism-heart, veins and arteries, blood circulation and excretion-structure and function involved.

MBB 818: INTELLECTUAL PROPERTY RIGHTS AND RESEARCH ETHICS — 2 CREDIT UNITS

UNIT 1: Intellectual property rights (IPR), sovereignty rights, CBD, bioethics and patenting General agreement on trade and tariffs Indian sui-generis system for animal variety and farmer's rights protection act, PVFRA, WTO with reference to biotechnological affairs, TRIPs. General Introduction: Patent claims, the legal decision – making process, ownership of tangible and intellectual property, Patent litigation. Basic Requirements of Patentability: Patentable subject matter, novelty and the public domain, non-obviousness. Special issues in Biotechnology Patents: Disclosure requirements, collaborative research, competitive research. Plant biotechnology Indian patents and Foreign patents, plant variety protection act. The strategy of protecting plants. Recent Developments in Patent System and Patentability of biotechnological inventions. IPR issues in Indian Context Role of patent in pharmaceutical industry, computer related innovations. Case studies Rice, Turmeric, Margo, etc. and challenges ahead.

UNIT II: Entrepreneurship Concept, definition, structure and theories of entrepreneurship Types of start-ups Types of entrepreneurship, environment, process of entrepreneurial development, Entrepreneurial culture, entrepreneurial leadership,

Product planning and development Project management Search for business idea Concept of projects Project identification, formulation Design and network analysis Project report and project appraisal

UNIT III: Ethical Issues: Introduction – causes of unethical acts, ignorance of laws, codes, policies and Procedures, recognition, friendship, personal gains Professional ethics – professional conduct Ethical decision making, ethical dilemmas**;** Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory Modulation Bioethics & Society (Indian context): Ethical issues on New Genetics – Human Genome Project

– Gene therapy – Genetic screening – Experimentation with human subjects -National Practice of health care – Public & Private medical practice –National resource allocations.

UNIT IV: Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad Biotechnology and food safety: the GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance. Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton). Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc. International dimensions in biosafety: Catagena protocol on biosafety, bioterrorism and convention on biological weapons

MFT 811 INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY **2 CREDIT UNITS**

Emergence of Nanotechnology- Definition of nanotechnology, nano-system, nanomaterials and property-Size dependent properties - Mechanical, Physical and Chemical properties. **Nano Ethics and Environment**- Environment related case studies on nanomaterials; Screening of nanomaterials for understanding potential effects to human health and the environment.

Environmental Pollution by Nanoparticles- Health impact, safety and toxicological effects transport of nanomaterials in soil/sediments. Study of physical and chemical properties of nanomaterials influencing their behavior in the environment and in biological systems.

Application of Nanotechnology- Nanoporous polymers and their applications in water purification, nanotoxicology, use of nanoparticles for environmental remediation and water treatment. case studies and regulatory needs.

Nanotechnology in Food Production- Food and new ways of food production - efficient fractionation of crops - efficient product structuring -optimizing nutritional values - applications of nanotechnology in foods : sensing, packaging, encapsulation, nano-feed binder, engineering food ingredients to improve bioavailability - nanocrystalline food ingredients - nano- emulsions - nano-engineered protein fibrils as ingredient building blocks - preparation of food matrices - concerns about using nanotechnology in food production. crop improvement - reasons to package food products - physical properties of packaging materials - strength - barrier properties light absorption – structuring of interior surfaces - antimicrobial functionality - visual indicators – quality assessment - food safety indication - product properties - information and communication technology - sensors - radiofrequency identification technology - risks - consumer and societal acceptance.

Nanoparticles in Agricultural and Food Diagnostics- Enzyme Biosensors and Diagnostics - DNA-Based Biosensors and Diagnostics - Radiofrequency Identification- Integrated Nanosensor Networks: Detection and Response- Lateral Flow (Immuno) assay - Nucleic Acid Lateral Flow (Immuno) assay - Flow-Through (Immuno)assays - Antibody Microarrays - Surface Plasmon Resonance Spectroscopy.

Toxicology of Nanomaterials in Food- Characterization of Engineered Nanomaterials: Unique Issues for Characterization of Engineered Nanomaterials for Food Applications - Safety Assessment of Oral- Exposure Engineered Nanomaterials for Food Application - Experimental Design Considerations for Toxicology Studies - Toxicokinetics – ADME - Toxicodynamics - In Vivo Toxicity - In Vitro Toxicity - Study Reliability.

SECOND SEMESTER

MBB 821 BIOCHEMISTRY –II 2 CREDIT UNITS

Unit I: Bioenergetics: Concepts of internal energy, enthalpy, entropy, interplay of enthalpy and entropy, free energy and work, free energy change and the equilibrium constant, chemical potential, coupled reactions, laws of thermodynamics in relation to biological systems, Gibbs free energy. **Biological oxidation and electron transport:** Oxidations and energy generation; standard reduction (redox) potential; free energy changes from oxidation/reduction; mitochondrial structure and function Electron transport system – topology, chemical nature and sequence of electron carriers; inhibitors and artificial electron acceptors; shuttling electron carriers into the mitochondrion; oxidative phosphorylation; P/O ratio; mechanism of oxidative phosphorylation – chemiosmotic coupling; structural insights into oxidative phosphorylation - the F0F1 complex; integrity of mitochondrial membranes; uncoupling ETS and oxidative phosphorylation; energy yields from oxidative phosphorylation; respiratory control of oxidative phosphorylation, mechanism and photophosphorylation. Oxygen as substrate for other metabolic reactions - oxidases and oxygenases, cytochrome p450, reactive oxygen.

Unit II: Carbohydrate metabolism – I: catabolic processes Glycolysis – pathway and regulation; metabolic fates of pyruvate – anaerobic and aerobic; TCA cycle – pathway and regulation; alternate pathways – glucuronate, glyoxalate and pentose phosphate pathways; Catabolism of other monosaccharides and disaccharides Catabolism of polysaccharides – glycogen mobilization and regulation of breakdown; starch and glycogen digestion, metabolic disorders. **Carbohydrate metabolism – II: Anabolic processes** Gluconeogenesis – pathway and regulation; glycogen biosynthesis – pathway and regulation; biosynthesis of other polysaccharides.

UNIT III: Photosynthesis: Basic processes of photosynthesis; structure and organization of photosynthetic apparatus; absorption of light – the light harvesting system - the energy of light; light absorbing pigments; light gathering structures; photochemistry in plants and algae - photosystems II and I; cyclic electron flow; bacterial photosynthesis; Calvin cycle; overall reaction and efficiency of photosynthesis; regulation of photosynthesis; RUBISCo structure and function photorespiration; C4cycle and CAM pathway. **Lipid metabolism:** Mobilization of stored fat - oxidation of saturated, unsaturated and odd numbered fatty acids, regulation, peroxisomal-oxidation of fatty acids Fatty acid biosynthesis - relationship of fatty acid synthesis to carbohydrate metabolism; elongation of fatty acid chains; fatty acid desaturation; control of fatty acid biosynthesis; biosynthesis of triacylglycerol and phosphatidlyl choline. Biosynthesis of cholesterol and its regulation, metabolism of eicosanoids-prostaglandins, thromboxanes and leukotrienes metabolic disorders.

UNIT IV: Nitrogen metabolism: The nitrogen cycle; protein turnover; amino acid degradation; urea cycle; ammonia transport in the body **Amino acid metabolism** : citric acid cycle intermediates in amino acid metabolism - glutamate as a precursor to other amino acids, metabolism of ornithine and arginine; metabolism of sulfur-containing amino acids – metabolism of glutathione, S-adenosylmethionine and biological methylations, polyamines;

metabolism of aromatic amino acids in plants and animals and histidine – biosynthesis of aromatic rings, biosynthesis of histidine,; biosynthesis and metabolism of serine, glycine and threonine; metabolism of valine, leucine, isoleucine and lysine, metabolic disorders

Nucleic acid Metabolism-I: Nucleotide metabolism - biosynthetic routes: *de novo* and salvage pathways; nucleic acid degradation and the importance of nucleotide salvage; *de novo* biosynthesis of purine nucleotides; Purine degradation and clinical disorders of purine metabolism;

Nucleic Acid Metabolism-II: pyrimidine nucleotide metabolism - *de novo* biosynthesis of the pyrimidine ring, control of pyrimidine biosynthesis, pyrimidine catabolism; Deoxyribonucleotide biosynthesis and metabolism; thymidylate synthase: a target enzyme for chemotherapy.

MFT 821: RESEARCH METHODOLOGY 2 CREDIT UNITS

An in-depth study in preparation for Seminar/Abstract, Conference presentation, Visual aids, writing papers for publication, thesis preparation, writing research proposals, bibliographic citations, use of citation/referencing tools such as One Note, analysis and processing of raw quantitative data and literature search.

MBB 822 MOLECULAR BIOLOGY- II 2 CREDIT UNITS

Unit I: Post transcriptional Processing of RNA: Processing of rRNA: Precursor rRNAs of prokaryotic and eukaryotic types. Structural and functional features of U3 RNA-RNPs, sno-RNAs and sno-RNPs, sca RNAs and their role in modification and splicing of rRNAs and some Sn RNAs. Brief structural and functional features of Cajal bodies. **Processing of pre-tRNAs:** size of pre-tRNAs, number, size and position of tRNA introns; types of splicing and the mechanism of splicing. Enzymes involved in rRNA and tRNA processing-RNase P, RNase E (exosomes), RNase D, RNase III, kinases, diesterases, Polynucleotide phosphorylases. **Pre-mRNA processing:** Characteristic features of pre heterogenous nuclear RNAs (hnRNAs), structure and sizes of hn RNAs; hnRNP proteins, mRNP proteins; structural features of introns and exons; Processing of pre mRNAs **Capping and polyadenylation:** Time of capping, mechanism of capping. Factors, site, enzymes and the mechanism involved in Poly (A) addition, importance of poly (A) tail; poly (A) binding proteins, polyA-polymerases and their role. Importance of polyA-signals, cytoplasmic poly-A additional signals (CPE), CPEB and Maskins, RNA transport sequences and their importance. Splicing: Concept of splicing, types of splicing, types of proteins involved. **Cis Splicing:** Characteristic features of introns splice junction site and intron's in and signal sites; Types of splicing. snRNAs and sn RNPs involved, their structural and functional features; Mechanism of splicing event, role of specific snRNA and snRNPs; role of SR proteins and Exon enhanceosomes (ESE), spliceosomal assembly and mechanism of splicing. Processing of Histone mRNA and the role of sn-U7 RNA and its RNPs.

Unit II: Alternative splicing: Concept of alternative splicing and its implications. Alternate splicing examples from Fibronectins, Collagens, Tropomyosins, Example from Dscam from *Drosophila*. Alternative splicing in sex determination of *Drosophila*. **Trans splicing**: Trans-splicing in *C.elegans,* Trypanosome, worms; splicing components- SLRNA and other snRNA-RNPs involved in transplicing. **Pre-mRNA Editing:** Editing Apo-lipoprotein mRNA and

Glutamine receptor mRNA, features and mechanism. Special features of few mitochondrial faulty pre-mRNAs (called pre-edited mRNAs) in Trypanosomes and Leishmania; editosomes, and characters and their composition, genes for Guide RNA and the mechanism of editing. **Self-splicing introns:** Group-I introns, Group-II introns, Group III introns, Twin introns: their characters and functions, mechanism of self-splicing. **Informosomes:** Stored mRNAs in mature egg cells, normal cells and seeds, role of mRNPs, importance of poly (A) size, polyadenylation signal elements CPE), role of CPEB and Masking proteins, reactivation of mRNAs by Poly (A) addition and its regulation, role of RNA transportsignal elements; role and importance of 3' and 5' UTR sequence elements. **mRNA stability and turn over:** Sequence elements found in 5' leader sequences and 3' non-coding regions and their structural features, relationship between such sequences and sequence derived structures and stability; mechanism of protection and the mechanism of degradation and causes; eg. Casein mRNA, Transferrin mRNA, Ferretin mRNA.

Unit III: Genetic code: Genetic and biochemical basis of Genetic code, Salient features, Deviation from Universal codon dictionary in mitochondrial genomes, evolution of Genetic code. **Prokaryotic Translation:** Translation apparatus; ribosomal subunits, initiator-tRNAs, aminoacyl-tRNAs, initiating factors, elongation factors, termination factors; mechanism of chain initiation, elongation and termination; production of specific proteins on translation of apolycistronic mRNA. Post translational processing of polycistronic polypeptides, and targeting the protein to periplasmic space or to the membrane. Regulation of protein synthesis, autogenous regulation, stringent response type regulation. Polyribosomes: rate of synthesis and regulation of protein synthesis. **Eukaryotic translation Translational apparatus-** ribosomes, initiator-tRNAs, aa-tRNAs, initiation factors, elongation factors and termination factors; mechanism of translation; **Regulation of protein synthesis**: Regulation of translation at mRNA level, regulation at chain initiation factor level, ex. Heme regulated translated, regulation of Ferretin synthesis, and Transferrin receptor synthesis and interferon mediated regulation. Site of protein synthesis, membrane free site, localized synthesis- example Actin protein synthesis, mode of transportation of mRNA to specific position in the cell.

Unit IV: Post translational processing: Cotranslational processing- transferring the translating system onto ER and transferring protein into the lumen of ER, role of SRP particles, docking proteins, Translocator proteins and signal sequences in targeting the protein (mitochondria, chloroplasts, peroxisome and glyoxysomes) and also in orienting N and C- terminal ends of proteins. Mechanism of transfer of proteins into ER lumen. Folding and modification of proteins while they are transported from SER to cis Golgi and trans-Golgi and protein sorting and vesciculation carrying the cargo. **Processing of Pre-pro-proteins:** Regulated cleavage of polyproteins and pre-pro proteins in stage specific and tissue specific manner. Splicing of proteins: Brief account of structural domains of proteins to be processed with Intiens and Exiens, splicing of intiens and joining ofexiens. **Protein stability and turnover:** Sequence based structural form, half-life of proteins, unstable proteins, protein degradation, and ubiquitination of condemned proteins and degradation by Proteosome; structure and features of Proteosome and the mechanism of degradation.

MBB 823 IMMUNOLOGY 2 CREDIT UNITS

Unit I: Types of immunity: Innate immunity, anatomic barriers, physiological barriers, native microbial flora. Inflammation, fever, interferon's, complement system; Acquired immunity-Active, passive and adaptive immunity. **Organs of immune system:** Primary lymphoid organs: Bone marrow, thymus; Secondary lymphoid organs: Spleen, lymph node, mucosal associated lymphoid tissues. **Cells of immune system:** Hematopoeisis, surface molecules, structure and function of stem cells, NK cells, dendritic cells, macrophages, T and B lymphocytes.

Unit II: Antigens and Antibodies: Antigens characteristics epitopes types. Valency, haptens, Activation and maturation of B lymphocytes, lymphocyte cell surface receptors/proteins; Immunoglobulin genes organization and expression, somatic gene recombination Ig diversity, factors affecting Ig diversity, types of Abs, class switching. antibody production and maturation; Structure and function of different Ig's; Activation of T lymphocytes- response, action and maturation of T lymphocytes and their surface protein and genes. Structure and types of Tlymphocytes and their function. T-cell and B-cell receptors. TI and To antigens.

Unit III: Antigen recognition: MHC molecules (Class I and ClassII), Humoral and cell mediated immune response. Grazymeperforins, clonal selection and immunological memory, recognition of endogenous antigens, recognition of exogenous antigens; T and B cell interaction. **Vaccines-**Principles of vaccination, primary and secondary responses, whole organism vaccines, purify macromolecule as vaccines, multisubunit vaccines, DNA vaccines, edible vaccines, Monoclonal antibodies and its applications. Transplantation and rejection.

Unit IV: Disorders of immune system: Immunological tolerance, autoimmunity and autoimmune diseases. Deficiency of immune system-(congenital and acquired). Tumour Immunology. Immunological hypersensitivity: Gell and Coomb's classification, salient features of Type I, II, III and IV hypersensitive reactions. RIA, ELISA, agglutination. Immuno electrophoresis, precipitation test.

MBB 824 BIOTECHNOLOGY 2 CREDIT UNITS

Unit I: Basics Concepts: DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non- radioactive probes, Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA-Protein Interactions- Electromobility shift assay; DNaseI footprinting; Methyl interference assay

Unit II Cloning Vectors : Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies;

Methodologies to reduce formation of inclusion bodies; Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors,
Shuttle vectors

Unit III Cloning Methodologies: Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Farwestern cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression

Unit IV PCR and Its Applications: Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR - multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; Proof reading enzymes; PCR in gene recombination; Deletion; addition; Overlap extension; and SOEing; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)

Unit V Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knock out mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.

Unit VI: Plant Biotechnology: Introduction: History, aim and scope of Plant Biotechnology, Biotechnology Scenario in India. Meristem culture, virus free plants. Large scale micropropogation, hardening and its application. Anther culture for haploid plant production, Doubled haploids, application of haploids in plant breeding and crop improvement. Somaclonal variations and their use in crop improvement.
Liquid culture: Suspension cultures, Batch cultures, continuous cultures. Bioreactors, immobilized bioreactors; Improving and enhancing yield of secondary plant products using bioreactors, Hairy root cultures for production of secondary metabolites.

Unit VII: Transgenic Plants: Vectors for plant transformation - Binary vectors and integration vectors; their characteristic features in detail. Construction of expression vectors, Use of selectable markers. Marker free technology for production of transgenics. Methods for gene transfer: Gene gun and *Agrobacterium* methods. Details of *Agrobacterium*, Ti and T-DNA, mechanism of DNA transfer and integration Transgenic tissue regeneration and screening-of transgenics for gene integration using PCR and western or dot blotting techniques. Organelle Engineering: Targeting of genetically engineered DNA clones into chloroplasts of higher plants.

Disease Resistance: Disease resistance to fungi by engineering chitinase (β-1, 3-glucanase gene) and osmotin. Disease resistance to bacteria by Lysozyme gene. Resistance to pests- Bt-toxin gene, protease inhibitor genes. Generation of herbicide tolerant plants, Development of transgenics to virus resistance, using of antisense and RNA interference technologies. Transgenic plants: Plantibodies, vaccines, Biopolymers and vitamins. Transgenics for delayed fruit ripening and increased shelf life of tomato. Increase in the shelf life of cut flowers - (Carnation flowers).

Unit VII: Improvement of food crops: Increase in essential amino acids in cereal seed proteins (phaseolin protein and albumin gene (for increase in methionine content). Increase in lysine by using *E. coli* dihydropicolinate synthase (DHPS gene). Increase and change in the quality oils in Brassica species (increase in medium chain fatty acids and converting unsaturated fatty acid to saturated fatty acids). Increase in sweetness and flavor in fruits and vegetables (tomato). Increase in starch content (potato).

Unit VIII: Animal Biotechnology: Methods and protocols used for tissue and cell cultures. Maintenance of cell cultures. Animal tissue culture: skin cultures, Neuronal cell cultures, muscle cell cultures, cartilage culture, blastocysts cell culture, whole embryo culture and tissue engineering, Large scale production: Large scale animal cell culture for commercial production of the IGs, interferons, vaccines, Mabs, hybridoma cells and other downstream process and problems. Methods to induce stem cells to differentiate into specific tissues. **Animal cell Transformation and immortalization:** Methods employed for animal cell transformation, viral and oncogene methods. Characteristic features of transformed cells. **Transgenic animals:** Protocols used for developing transgenic animals; use of fertilized egg cells, use of bastocyst cells; success and failures, problems. Transgenic sheep, transgenic goat, transgenic fishes, transgenic cattle, transgenic mice, transgenic pigs for the production of recombinant proteins. Animal cloning: Techniques used in animal cloning- transfer of whole 2n nuclei to enucleated Cells (ex. Xenopus), cultured cell application and ethics.

MBB 825 BIOINFORMATICS II Credit Unit; 3

Unit 1: Gene Expression and Functional Genomics using Array Express; Gene Expression data search and quick retrieval; gene Expression across species with Expression Atlas; Genomic features that regulate gene expression with Ensemble

Unit II: Chemical Data mining techniques and applications: Exploring bioactive drug-like molecules; Computational chemistry in drug discovery; Drug repurposing; mapping tool for small molecule database and BioModels ; Biosamples Databases: Data Identity and mapping, Data Cuation and annotation, Molecular modeling, Systems Biology

Unit III: Studying interaction of ligand-protein, protein-protein, protein-DNA using molecular simulation, Development of chemical library and screening of promising compounds using computer assisted drug design (CADD) techniques.

Unit IV: Gene Ontology, Gene Ontology Annotation, Phenotype Ontology, Ontology Lookup Service (OLS); Exploring data for toxigenomics studies using diXa data warehouse

MBB 826 NANO MODELLING Credit Unit 2

Unit I & II: Simulation of nanocomposite and analysis using molecular dynamic (MD) simulation, Encapsulation of nanoparticle and interaction studies using molecular simulation.

MBB 827 NANOPHARMACEUTICALS Credit Unit 2

Unit I: Introduction -Nanobiotechnology for Drug Discovery: Gold Nanoparticles for Drug Discovery -Use of Quantum Dots for Drug Discovery -Nanolasers for Drug Discovery -Cells Targeting by Nanoparticles with Attached Small Molecules -Role of AFM for Study of Biomolecular Interactions for Drug Discovery Nanoscale Devices for Drug Discovery - Nanotechnology Enables Drug Design at Cellular Level Nanobiotechnology-Based Drug Development - Dendrimers as Drugs- Fullerenes as Drug Candidates

Unit II: Nanobodies: Nanobiotechnology in Drug Delivery –Nanoscale Delivery of Therapeutics -Nanosuspension Formulations Viruses as Nanomaterials for Drug Delivery - Nanoparticle-Based Drug Delivery -Trojan Nanoparticles -Self-Assembling Nanoparticles for Intracellular Drug Delivery -Nanoparticle Combinations for Drug Delivery Liposomes - Liposome–Nanoparticle Hybrids-Nanospheres-Nanotubes -Nanocochleates.-Nanomolecular Valves for Controlled Drug Release -Nanomotors for Drug Delivery.Nanoparticle drug system for oral administration – Drug system for nasal administration – Drug system for ocular administration – Nanotechnology in diagnostic application. Preformulation

MFT 830 INTERNSHIP/INDUSTRIAL WORK EXPERIENCE 2 CREDIT UNITS

This is the period of the Student's Industrial Work Experience Scheme (SIWES) programme which is normally undertaken for four months during the second year of study. The SIWES programme is basically devoted to practical training in the industries that are relevant to the programme. Students are expected to put into practical use the knowledge they have learned in the classroom and laboratories

MBB 830 THESIS 6 CREDIT UNITS

Independent research in selected areas of Biochemistry and Molecular Biology under the guidance of academic supervisor(s). Students will be required to carry out literature survey on the topic, perform experiments and produce dissertations. The submitted project report shall be defended before a panel of internal external examiners.

SESSIONAL PROGRESS REPORTS FOR PhD MOLECULAR BIOLOGY AND BIOINFORMATICS (NOT TO BE SCORED)

COURSE CODE	COURSE TITLE	
MBB 901	Seminar I	**Core**
MBB 902	Seminar II	**Core**
MBB 903	Seminar III	**Core**
MBB 900	Exit Seminar	**Core**

PARTNERSHIP

Africa Centre of Excellence on Mycotoxin and Food Safety will provide a platform to bring together experts with tremendous wealth of experience in the diverse areas of health, agricultural and environmental research which are major development challenges confronting Africa. Specifically, it is pertinent to mention the huge potential for success by the centre in the areas of health, agriculture and food security, nanotechnology, Industry and the environment. In mycotoxicology and development of bio-strategies and products for control of carcinogenic mycotoxins, the development of new sophisticated methodology for masked mycotoxins using LC/MS/MS by our collaborator, Professor Sarah Saeger of Ghent University, is unparalleled. Transferring the technology to Sub Saharan Africa has potential to revolutionize the laboratory analysis of food toxicants with tremendous improvement in food safety and trade as many new food toxins and their unknown effects will be determined. Similarly, deploying MLST, RAPD, REP-PCR, PFGE, WGS-CORE genome SNP Typing, highly discriminatory genetic sequencing tools which can characterize pathogens and link them to outbreaks and sporadic cases, will guarantee accelerated containment of food borne diseases outbreaks that are common features and causes of death of many Africans. The Centre will be doing this with the national and world leaders in medical research, NIMR and Dr Janie Dubois of JIFSAN, University of Maryland who has through research and training significantly reduced outbreaks of Salmonella in six Asia countries.

Our private sector partner, BIOMIN Corporation, Austria will drive the centre's translational research activities in this area beginning with capacity building and research innovation in development of mycotoxin feed binders and detoxifiers and bio-entrepreneurship. The exceptional experience and track record of World Food Preservation Center, Florida Agricultural and Mechanical University and ANAND Agricultural University, India in producing pest, drought and mycotoxin resistant cultivars and training of farmers in developing countries is guarantee of the anticipated success of the ACE in generating smart farmers for Africa.

The Centre proposes to establish new collaboration in some critical areas. The Mycology and Pathology Laboratory of the International Institute of Tropical Agriculture, Ibadan, Nigeria (Dr Joseph Atehnkeng) in collaboration with USDA/ARS Department of Plant Sciences, Division of Plant Pathology and Microbiology, University of Arizona, Tucson, USA (Dr Peter Cotty) successfully developed aflasafe and aflaguard, all spores of non-toxigenic strains of *Aspergillus flavus* for bioexclusion of aflatoxigenic fungi. This proposal intends to use such techniques for elimination of ochratoxin and fumonisins producing fungi and will seek collaboration with these institutions. Elucidation of the toxicological principles of novel fungi or toxin, or proper understanding of new toxicological properties of known toxins is achieved through meticulously designed animal experiments. Establishing the non-toxicity of nanoparticle feed binders and

efficacies of traditional medicinal plants against mycotoxin induced diseases are conducted in target animals. The expertise of an experienced veterinary toxicologist like Prof. S.D. Steov, Department of General and Clinical Pathology, Faculty of Veterinary Medicine, Trakia University, Students Campus, 6000 Stara Zagora, Bulgaria is therefore needed in this work. These two identified mycotoxicologists of international repute will also serve as external scientific advisors and reviewers of the proposed project.

PHYSICAL RESOURCES AND FACILITIES

ACEMFS has put together some building plans and is presently in the process of having her own permanent structure in addition to equipping the laboratories with necessary facilities. However, substantial support has been given to the centre by the management of the University, allowing the centre to use a section in the building of Centre for Genetic Engineering and Bio-exploration (GEBEX). The section has been renovated and presently in use. The GEBEX has state-of-the-art equipment in the key laboratories: Vaccine, Drug Discovery, Bioinformatics, and Nanotechnology. The equipment are listed in Table 1.

TABLE 1: LIST OF EQUPMENT IN THE CENTRE FOR GENETIC ENGINEERING AND BIO-EXPLORATION

S/NO	RESOURCE	CURRENTLY USED FOR AND BY	PROPOSED PROJECT USE
ELECTRONMICROSCOPY			
1.	Tecnai G2 TEM	Researchers in Centre of Genetic Engineering and Biotechnology (CGEB) for Ultrastructural Analysis of Biological and Material Science Samples	For Ultrastructural Analysis of Biological and Material Science Samples
2.	SCO MEL 30,000 SEM		
MEDICAL IMAGING AND BIOINFORMATICS LABORATORY			
3.	PC NMR(personal NMR console)	Researchers in CGEB, Physics and Biochemistry for Bioanalysis, medical imaging etc.	for Bioanalysis, medical imaging Bioinformatics training and interaction with Partners.
4.	Fast Field Cycling NMR relaxometer Smartracer (Stelar Magnetic Relaxation Tracer)		
5.	Videoconferencing System with 30 nos Desktop with Bioanalyser Desktop System and Bioinformatics Software		
NANOTECHNOLOGY LABORATORY			
6.	Malven Zetasizer Nanos	Researchers in CGEB, Physics, Chemical and Mechanical Engineering for nanomaterial characterization.	For production, characterization of nanoparticles.
7.	Ultrasonic Shaker		
8.	Raman Spectrometer		
9.	BET Surface Area and Porosity Analyser		
10.	Carbon Vapour Deposition Equipment		
DRUG AND VACCINE LABORATORY			

11.	Incubator with shaker	Researchers in CGEB, Biochemistry, Microbiology, Physics, Chemical Engineering for drug and vaccine development research.	For extraction, characterization of microbes and analysis of food contaminants.
12.	Laboratory grinding Machine		
13.	Automated large scale rotary evaporator		
14.	Digital shaker water bath		
15.	Vacufuge concentrator		
16.	Filter air drying cabinet		
17	Inverted microscope		
18.	Fluorescence microscope		
19.	Automated DNA sequence machine		
20.	HPLC		
21.	Scanning Double beam UV/visible spectrophotometer		
22.	Multiscan spectrm microplate photometer	Researchers in CGEB, Biochemistry, Microbiology, Physics, Chemical Engineering for drug and vaccine development research.	For extraction, characterization of and for drug and vaccine development research.
23.	Skanlt software drug discovery edition		
24.	Multiskan spectrum IQ/OQ/PQ Document		
25.	Multiskan spectrum IQ/OQ/PQ filed package		
26.	Multimode micro reader with 2 dispenser		
27.	GC X GC		
28.	Microplate washer		
29.	Nitrogen generator		
30.	Cellometer auto T4 Plus cell counting system.		
31.	Cellometer vision brightfield/fluorescence cell profiling system.		
32.	Complete hemoglobinometer: the dual wavelength photometer corrects for lipaemia, leucocytosis and other sources turbidity.	Researchers in CGEB, Biochemistry, Microbiology, Physics, Chemical Engineering for drug and vaccine development research.	For extraction, characterization and toxicological analysis of food toxicants.
33.	Hemoglobinometer micro cuvettes, pack of 200		
34.	Auto loader haematology, analyser, 80 samples/h.	Researchers in CGEB, Biochemistry, Microbiology, Physics, Chemical Engineering for drug and vaccine development research.	For extraction, characterization and toxicological analysis of food toxicants.
35.	Programmable Thermal Block,		
36.	Thermal cycler with added throughput capabilities of a 96x0.2mL, 60x0.5mL, 384-well, or in situ block.		
37.	Multiporator, a universal electroporator for eukaryotes, bacteria, yeast, and electrofusion.		
38.	Electrophoresis Power Pack.		
39	Programmable power supply, 5000V.		

40	Mini gel casting tray		
41	AGTI Submarine gel tank for horizontal agarose mini-gels		
42	Mini-vertical gel system –VGTI gel system Mini-vertical gel system –VGTI gel system		
43	3D Capillary Electrophoresis instrument system G1600A		
44	Photometer, Molecular Biology.	Researchers in GEBEX , Biochemistry, Microbiology, Physics, Chemical Engineering for drug and vaccine development research.	
45	Fluorimeter with excitation and emission wavelength. 200-600nm (by filter selection).		
	Photometer with thermo stated cuvette holder.		For extraction, characterization and toxicological analysis of food toxicants.
46	**Vacuum pump,** Gen. Purpose, Oil free, with Diaphragm.		
47	Large high speed, refrigerated, floor standing centrifuge.		
48.	Digital shaker;		
49.	Orbital shaker for well plates and diagnostic cards.		
50.	**Glass ware washers**, Flash scrubber.		
51.	Incubator, Swallow range Air conditioning, Fan circulation; Temperature range, ambient +5ºC to 80ºC;		
52.	Cold block water bath/incubator.		
53.	Ice Flaker with storage.		
54.	Refrigerated Centrifuge.		
55.	Refrigerated microcentrifuge,		
56.	Upright ultra-low temperature freezer:		
57.	Fume cabinet, Cabinet model, Filtair 824		
	PCR Cabinet, model PCR650E (X2)		
58.	Freeze Dryer,		
59.	Intestinal Parasite Analysis		
60.	**Glass ware Dryer,** Large capacity with microprocessor.		
61.	**Colony counter** for microbiology application.		
62.	Autoclave.		
63.	**Water Bath** with reciprocating shaker.		
64.	**Incubator,** water jacketed, general purpose.		
65.	**Giant Hot Air Oven,** with stainless steel interior,		
66.	**Freeze Dryer Bench/Tray** model		
67.	**Freeze Dryer mobile,** floor mounted		

	with microprocessor.		

The ACEMFS will also provide a platform to bring together experts with tremendous wealth of experience in the diverse areas of health, agricultural and environmental research which are major development challenges confronting Africa. The following tables indicate different roles and responsibilities of officers.

TABLE 1: ADMINISTRATIVE OFFICERS

S/No	Name of Officer	Qualification	Designation
1	Prof. Hussaini A. Makun	BSc, MTech, PhD	Centre Leader
2	Dr. Hadiza Lami Muhammad	BSc, MTech, PhD	Deputy Centre Leader
3	Prof Abdulkareem Ambali Saka	BSc, MTech, PhD	Sectoral Liason Officer
4	Dr. Helen Shnada Auta	BSc, MTech, PhD	Monitoring and Evaluation Officer
5	Mrs. Funmilayo Okoinemen Imoleayo	BSc, ACA	Project Accountant
6	Mr Ado Malik	BSc, MBA, ACA	Assistant Project Accountant
7	Mal Yusuf Yandalu	BSc, CNA	Finance Officer
8	Mr. Silas Habila Bijim	ND, BSc	Environmental Safeguard Officer
9	Mr. Abubakar Haruna	BTech, Dip CPT	Procurement Officer
10	Mr. Shafiu Ozovehe Sule	BSc, CNA	Auditor/Internal Auditor
11	Mrs. Dorothy Elaigu	BSc	Communication Officer
12	Mrs Ruth Lamai-Odepidan	BTech	Centre Secretary
13	Babawanchiko Mohammed	BTech, MTech	ACTO (APU)
14	Mrs Rahab Mamman	Cert Dip	Chief Clerical Officer

TABLE 3: ACADEMIC ADMINISTRATORS

S/No	Name of Officer	Designation
1	Professor Emmanuel Olofo Ogbadoyi	Applied Research Coordinator
2	Dr Oluwatosin Kudirat Shittu	Molecular Biology and Bioinformatics Research Theme Leader

3	Dr Alexander Ikechukwu Ajai	Heavy Metals and Pesticides Residues Research Theme Leader
4	Dr John Yisa Adama	Veterinary Drug Residues Research Theme Leader
5	Dr Tijani Jimoh Oladejo	Nanotechnology Research Theme Leader
6	Professor Chiemela Enyinnaya Chinma	Academic Program Coordinator
7	Dr. Hadiza Lami Muhammad	Food Safety and Toxicology Research Theme Leader

TABLE 3: INTERNATIONAL SCIENTIFIC ADVISORY BOARD MEMBERS

NAME	UNIVERSITY/INSTITUTION	E-MAIL
Dr Habiba Hassan Wassef	National Research Centre, Egypt	bio_egypt@hotmail.com
Dr Charles Wilson	World Food Preservation Centre, USA	worldfoodpreservationcenter@frontier.com
Dr Amare Ayalew	Partnership for Aflatoxin Control in Africa	amarea@african-union.org
Professor Sarah De Saeger	Ghent University, Belgium	Sarah.DeSaeger@ugent.be
Dr Janie Dubois	International Food Safety Training Laboratory, University of Maryland	jdubois@umd.edu
Dr Gbemenou Joselin Benoit Gnonlonfin	Economic Community of West African State	bgnonlonfin74@gmail.com
Professor Odemari Mbuya	Florida Agricultural and Mechanical University	odemari.mbuya@famu.edu
Dr. N. C. Patel	ANAND Agricultural University, India	ncpatel@aau.in
Prof. Patrick Njobeh	University of Johannesburg, South Africa	pnjobeh@uj.ac.za
Regional Coordinator of FAO/WHO Coordinating Committee for Africa	FAO/WHO Coordinating Committee for Africa (CCAFRICA)	kimutaimaritim@yahoo.co.uk

TABLE 4: SECTORAL ADVISORY BOARD MEMBERS

S/No	NAME	INDUSTRY/ORGANIZATION	E-MAIL
1	Alfa Abubakar	Market Bridge	info@marketbridge.biz
2	Dr Maimuna Habib	Federal Ministry of Agriculture	maimunahabib@gmail.com
3	Dr Bosede Oluwabamiwo Dr Adebimbo Adebayo	National Agency for Food and Drug Administration Control	oluwabamiwo.b@nafdac.gov.ng
4	Dr Omolara Okunlola	Standards Organisation of Nigeria	omolara.okunlola@son.gov.ng
5	Professor Eustace A Iyayi	Nigerian Institute of Animal Science	nias.nigeria2013@gmail.com
6	Prof. Martins Emeje	National Institute for Pharmaceutical Research and Development, Abuja, Nigeria	memeje2011@hotmail.com
7	Dr Engr. Olasupo Olayode	NASENI, Abuja, Nigeria	solayode@gmail.com
8	Dr Gerd Schatzmayr	BIOMIN Holding GmbH, Austria	gerd.schatzmayr@biomin.net
9	Dr Gbemenou Joselin Benoit Gnonlonfin	Economic Community of West African State	bgnonlonfin74@gmail.com
10	Dr Chindo Bissala Ibrahim	Ministry of Health, Minna, Niger State	chindoibro@gmail.com
11	Prof. Ardjouma DEMBELE	Ministere De L'agriculture Et Du Developpement Rural, Republique De Cote D'ivoire	ianada@aviso.ci
12	Professor Pane Bernadette Sourabie Quattara	National Public Health Laboratory, Ministry of Health, Quagadougou, Burkina Faso	b_sourabie@yahoo.for
13	Prof. Kabre Elie	National Public Health Laboratory, Ministry of Health, Quagadougou, Burkina Faso	kabre@gmail.com
14	Dr Abakar Mahamat Nour Mallaye	Ministry of Livestock and Animal Production, Chad	bennourmallaye@yahoo.fr
15	Prof. Van Emery Tshiombe Mulamba	General Atomic Energy Commission, Kinshasa, Congo	tshiombevan@gmx.fr
16	Dr Eve Gadzikwa	Standards Association of Zimbabwe	info@saz.org.zw
17	Mr. Mohamed Fofana	Sierra Leone Standards Bureau	morikeh@gmail.com

ACADEMIC FACULTY FOR MTECH MOLECULAR BIOLOGY

S/No	NAME	UNIVERSITY/ORGANIZATION	STATUS	EMAIL
1	Prof. Ogbadoyi E. O	Federal University of Technology, Minna	Full time	eogbadoyi@futminna.edu.ng
2	Prof. Egwim E. C.	Federal University of Technology, Minna	Full time	e.egwim@futminna.edu.ng
3	Prof. Abdulkareem A.S	Federal University of Technology, Minna	Full time	kasaka2003@futminna.edu.ng
4	Prof. Kovo A.S	Federal University of Technology, Minna	Full time	kovo@futminna.edu.ng
5	Prof. Sheila O.	University of Nairobi, Kenya	Visiting	dorisokothe@yahoo.com
6	Prof. Emeje. M	National Institute for Pharmaceutical Research and Development Abuja, Nigeria	Visiting	memeje2011@hotmail.com
7	Dr. Shittu O.K	Federal University of Technology, Minna	Full time	toscueyusuf@futminna.edu.ng
8	Dr. Salaudeen M.T	Federal University of Technology, Minna	Full time	mtsalaudeen@futminna.edu.ng
9	Dr. Mabula S. M	University of Abuja, Nigeria	Visiting	ssmambula@hotmail.com
10	Dr. Abarshi M.M	Ahmadu Bello University Zaria, Nigeria	Visiting	muawiyam@yahoo.uk
11	Dr. Adabara N.U.	Federal University of Technology, Minna	Full time	nasiru.adabara@futminna.edu.ng
12	Dr. Ndagi U.	IBB Specialized Hospital Minna, Nigeria	Visiting	ndagiumar2@gmail.com
13	Dr. Olasupo O. A	National Agency for Science and Engineering Infrastructure NASENI, Abuja, Nigeria	Visiting	solayode@yahoo.com
14	Dr. Bala J.D	Federal University of Technology, Minna	Full time	bala.jeremiah@futminna.edu.ng
15	Dr. Tijani J.O	Federal University of Technology, Minna	Full time	jimohtijani@futminna.edu.ng
16	Dr. Chechet G.D	Ahmadu Bello University Zaria, Nigeria	Visiting	daglo2000@yahoo.com
17	Dr. Samuel N.	Ahmadu Bello University Zaria, Nigeria	Visiting	boukwenu.sun@gmail.com
18	Dr. Umar M.B	Federal University of Technology, Minna	Full time	maimuna.umar@futminna.edu.ng
19	Dr. Aliyu M.	Ahmadu Bello University Zaria, Nigeria	Visiting	aliyumuhammad@abu.edu.ng
20	Dr. Ibrahim M.A	Ahmadu Bello University Zaria, Nigeria	Visiting	muawalibrahim@gmail.com
21	Dr. Balogun E.	Ahmadu Bello University Zaria, Nigeria	Visiting	eobalogun@abu.edu.ng
22	Dr. Bankole M.T	Federal University of Technology, Minna	Full time	bankole.temitope@futminna.edu.ng
23	Dr. Aimola A.I	Ahmadu Bello University Zaria, Nigeria	Visiting	iaaimola@abu.edu.ng

24	Dr. Abdullahi A.S	Ahmadu Bello University Zaria, Nigeria	Visiting	asalmanabdullahi@abu.edu.ng
25	Dr. Helena F.	Ahmadu Bello University Zaria, Nigeria	Visiting	helenafodeke@gmail.com

ACADEMIC FACULTY FOR PhD MOLECULAR BIOLOGY

S/No	NAME	UNIVERSITY/ORGANIZATION	STATUS	EMAIL
1	Prof. Ogbadoyi Emmanuel. O	Federal University of Technology, Minna	Full time	eogbadoyi@futminna.edu.ng
2	Prof. Egwim E.C	Federal University of Technology, Minna	Full time	e.egwim@futminna.edu.ng
3	Prof. Abdulkareem A.S	Federal University of Technology, Minna	Full time	kasaka2003@futminna.edu.ng
4	Prof. Kovo A.S	Federal University of Technology, Minna	Full time	kovo@futminna.edu.ng
5	Prof. Sheila O.	University of Nairobi, Kenya	Visiting	dorisokothe@yahoo.com
6	Prof. Emeje. M	National Institute for Pharmaceutical Research and Development Abuja, Nigeria	Visiting	memeje2011@hotmail.com
7	Dr. Shittu O. K	Federal University of Technology, Minna	Full time	toscueyusuf@futminna.edu.ng
8	Dr. Salaudeen M.T	Federal University of Technology, Minna	Full time	mtsalaudeen@futminna.edu.ng
9	Dr. Mabula S.M	University of Abuja, Nigeria	Visiting	ssmambula@hotmail.com
10	Dr. Abarshi M.M.	Ahmadu Bello University Zaria, Nigeria	Visiting	muawiyam@gmail.com
11	Dr. Adabara N.U	Federal University of Technology, Minna	Full time	nasiru.adabara@futminna.edu.ng
12	Dr. Ndagi U.	IBB Specialized Hospital Minna, Nigeria	Visiting	ndagiumar2@gmail.com
13	Dr. Olasupo O. A	National Agency for Science and Engineering Infrastructure NASENI, Abuja, Nigeria	Visiting	solayode@yahoo.com
14	Dr. Bala J. D	Federal University of Technology, Minna	Full time	bala.jeremiah@futminna.edu.ng
15	Dr. Tijani J.O	Federal University of Technology, Minna	Full time	jimohtijani@futminna.edu.ng
16	Dr. Chechet G.D	Ahmadu Bello University Zaria, Nigeria	Visiting	daglo2000@yahoo.com
17	Dr. Samuel N.	Ahmadu Bello University Zaria, Nigeria	Visiting	boukwenu.sun@gmail.com
18	Dr. Umar M.B	Federal University of Technology, Minna	Full time	maimuna.umar@futminna.edu.ng
19	Dr. Aliyu M.	Ahmadu Bello University Zaria, Nigeria	Visiting	aliyumuhammad@abu.edu.ng
20	Dr. Ibrahim M. A	Ahmadu Bello University Zaria, Nigeria	Visiting	muawalibrahim@gmail.com
21	Dr. Balogun E.	Ahmadu Bello University Zaria, Nigeria	Visiting	eobalogun@abu.edu.ng

LIST OF TECHNICAL STAFF FOR THE PROGRAMMES

S/No	NAME OF NON-ACADEMIC STAFF	AREA OF SPECIALIZATION	DISCIPLINE	QUALIFICATION	
1	Busari Musa Bola	Toxicology	Biochemistry	MTech (PhD-Ongoing)	
2	Hamidu Abdullahi	Medical Microbiology	Microbiology	MTech	
3	Ibrahim R. Dauda	Science Laboratory Technology	Biochemistry	HND (PGD-Applied Chemistry)	
4	Okorie Ikemefuna Isaac	Science Laboratory Technology	Biochemistry	HND	
5	Oluwajemi Oghenekevwe Juliana	Science Laboratory Technology	Biology	HND	
6	Tina Danjuma	Science Laboratory Technology	Biochemistry	HND	
7	Abdulkareem AbdulRahman	Science Laboratory Technician	Physics Elect.	HND	
8	Ahmed Tanimu Danjuma	Science Laboratory Technology	Biochemistry	HND	
9	Shuaibu Ma'aji	Science Laboratory Technology	Biochemistry	HND	
10	Maryam Umar Namama	Science Laboratory Technology	Biology	HND	
11	Aliyu Ibrahim Kpaki	Spreadsheet and Word processing	Secretarial Studies	OND	
12	Adamu Aliyu Bokani	L.L.B	Law	OND	

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