School of Health Sciences

Diploma in
Bioanalytical Laboratory Technology

PROGRAMME DOCUMENT

DBLT v1.0

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University of Technology, Mauritius
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Diploma in Bioanalytical Laboratory Technology

A. PROGRAMME INFORMATION

Scientific laboratory facilities are present across numerous industries including sectors of health, pharmaceuticals, food, agriculture, education and research. Recent advances in laboratory technology have greatly enhanced the testing/diagnostic capabilities of such facilities in terms of accuracy, reliability, rapidity and specificity. The singularity of each laboratory, based on specific combinations of equipment, quality norms and standards, bio-safety level, infrastructure layout and tests panel, requires high levels of versatility and adaptability from the laboratory personnel. Hence, undergraduates and postgraduates aspiring to a career in any type of laboratory must have the necessary skills and competencies to evolve professionally in such a dynamic and unique working environment.

The Diploma in Bioanalytical Laboratory Technology course has been developed taking into account the specific job skill requirements of the different types of laboratories present in the private and public sector in Mauritius.The programme integrates fundamental aspects of molecular biology, immunology, biochemistry and analytical sciences involved in laboratory work together with modules having practical components and a laboratory-based project to provide students with hand-on laboratory work experience. Concepts of quality assurance, laboratory Safety & Health and laboratory-based research have also been included so that the course produces *laboratory-ready* diploma holders.

Equipped with this Diploma, awardees will be able to integrate confidently in a variety of working environments, such as: diagnostic department of private and public health institutes, academic laboratories, food testing laboratory, biotechnology and research facilities.

The programme offers an exit point which will enable the student to qualify for the award of a Certificate in Bioanalytical Laboratory Technology.

B. PROGRAMME AIMS

This programme has been designed to cover a variety of laboratory skills and techniques required to conduct laboratory sampling and testing in most industry sectors.

C. PROGRAMME OBJECTIVES

This programme is conducted in a learner-centered environment which will enable students to gain the necessary skills required for a profession as a laboratory technician.

At the end of the programme, students will be able to:

- Perform microbiological tests
- Apply routine analytical techniques
- Perform chemical and quality control tests
- Perform biological procedures

- Process and analysis of human samples
- Prepare, standardize and use solutions and reagents
- Process, interpret and report data
- Develop and maintain laboratory documentation
- Plan and conduct laboratory work safely

Part I - REGULATIONS

D. GENERAL ENTRY REQUIREMENTS

As per UTM'Admissions Regulations' and 'Admissions to Certificate and Diploma Programmes'.

E. PROGRAMME ENTRY REQUIREMENT

None.

F. PROGRAMME MODE AND DURATION

Full Time: Minimum Duration :2 Years
Maximum Duration: 4 Years

Each academic year includes 2 semesters.

G. TEACHING AND LEARNING STRATEGIES

The program includes didactic (lectures, tutorials and seminars), simulated (lab/practical), and experiential components. Self-learning is a key feature of the programme which will enable students to explore, investigate and research various issues related to the laboratory work.

All laboratory-based activities will be conducted on university campus in the laboratory of the School of Health Sciences.

H. STUDENT SUPPORT AND GUIDANCE

In addition to traditional lectures, group tutorial sessions are arranged for students.

I. ATTENDANCE REQUIREMENTS

As per UTM Regulations.

J. CREDIT SYSTEM

1 credit = 15 hours of lecture
1 credit= 30 hours of practical/tutorial/seminar/directed-study
1 credit = 60 hours of laboratory work for the project module

Total number of credits for the Diploma programme: 66

K. STUDENT PROGRESS AND ASSESSMENT

For the award of the Diploma, all modules must be passed in the examinations, coursework and other forms of assessment.

Written examinations for modules carrying 3 credits will be of maximum duration 3 hours and will contribute 70% of the total marks. Continuous assessment will carry30% of total marks and will be based on assignments, practical reports, seminars, and class assessments.

Written examinations for modules carrying 4 credits will be of minimum duration 3 hours and will contribute 50% of the total marks. Continuous assessment will carry 50% of total marks and will be based on assignments, laboratory experiments, practical reports, seminars, and class assessments.

The modules *Laboratory Mathematics* and *Methods in Laboratory-Based Research* will be assessed by 100%coursework.

EXIT POINTS

Students may exit the program with a Certificate in Bioanalytical Laboratory Technology with 33 credits.

L. EVALUATION OF PERFORMANCE

Grading

Grade	Marks x (%)
A	70 ≤ x ≤ 100
B	60 ≤ x < 70
C	50 ≤ x < 60
D	40 ≤ x < 50
F	x < 40
A-D	Pass
F	Fail

M. PROGRAMME DEVELOPMENT COMMITTEE:

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External assessors:

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Part II - PROGRAMME STRUCTURE AND SYLLABUS OUTLINE

N. Diploma in Bioanalytical Laboratory Technology

PROGRAMME STRUCTURE AND PLAN- (FULL-TIME)

YEAR 1							
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs** L+T/P+ DS	**Credits**	**Code**	**Modules**	**Hrs** L+T/P+ DS	**Credits**
DBLT1101	Basic Laboratory Techniques	2 + 1 + 1	3	DBLT1201	Fundamentals of Immunology	2 + 2 + 2	4
DBLT1102	Human Anatomyand Physiology	2 + 1 + 1	3	DBLT1202	Methods in Cellular Biology	2 + 2 + 2	4
DBLT1103	Chemistry and Biochemistry	2 + 1 + 1	3	DBLT1203	Genetics and Bioinformatics	2 + 1 + 1	3
DBLT1104	Laboratory Mathematics	2 + 1 + 1	3	DBLT1204	Microbiology	2 + 2 + 2	4
DBLT1105	Health Information, Communication and Technology	2 + 1 + 1	3	DBLT1205	Laboratory Management and Practices I	2 + 1 + 1	3
YEAR 2							
Semester 1				**Semester 2**			
Code	**Modules**	**Hrs** L+T/P+ DS	**Credits**	**Code**	**Modules**	**Hrs** L+T/P+ DS	**Credits**
DBLT2101	Laboratory Techniques in Food Sciences	2 + 2 + 2	4	DBLT2201	Hematology	2 + 2 + 2	4
DBLT2102	Communicable Diseases	2 + 1 + 1	3	DBLT2202	Trends in Biotechnology	2 + 1 + 1	3
DBLT2103	Analytical Chemistry	2 + 2 + 2	4	DBLT2203	Diagnosis of non-Communicable Diseases	2 + 1 + 1	3
DBLT2104	Methods in Laboratory-based research	2 + 1 + 1	3	DBLT2204	Laboratory Management and Practices II	2 + 1 + 1	3
PROJ2000	Laboratory-Based Project					-	6

O: Syllabus Outline

Basic Laboratory Techniques

Familiarization and maintenance of laboratory equipment, measuring tools used for weight, volume, mixing, filtration and heating, safe handling, storing, labelling and precautionary measures whilst using chemicals, Good Laboratory Practice (GLP), sterilization techniques, microscopy, basic spectrophotometry, chromatography, size separation,enzyme-linked immunosorbent assay (ELISA), calibration methods.

Practicals will include: preparation and visualisation of microscope slides using plant and animal cells, autoclaving of liquids and solids, calibration of electric balance and micropipette, spectrophotometric determination of protein concentration, mixture separation using centrifugation.

Human Anatomy and Physiology

Introduction to basic anatomical and physiological concepts, structure, function and physiology of various body systems including nervous, cardiovascular, immune, respiratory, endocrine, digestive, urinary and reproductive systems, endocrine glands and hormones, insulin regulation, homoeostasis, negative feedbacks, introduction to physiopathology.

Demonstrations will include: the use of human-body model and video tutorials.

Chemistry and Biochemistry

States of matter, atoms elements and compounds, chemical bonding, stoichiometry, electrolysis, energetics of a reaction, energy transfer, rate of reaction and equilibria, redox reactions, properties of acids, bases and salits, oxides, identification of ions and gases, chemical and physical properties of inorganic compounds, Introduction to formulae writing, functional groups and naming of organic compounds, types of organic chemical reactions, nomenclature, properties and reactions of functional groups, formation of reactive oxygen and nitrogen species, polymers, carbohydrates, proteins, lipids and nucelic acids, enzymatic reactions.

Practicals will include: calculation of mass, volume and concentration of gases and solutions, application of electrolysis, interpretation of data from chemical reactions, identification of ions, gases and transition metals, investigation of catalysed reactions.

Tutorials will include: Sequence alignment and Basic Local Alignment Search Tool (BLAST) to search for sequences from existing databases, characterization of protein families & sequences using CATH, SCOP and DALI, use of SWISS-MODEL to construct homology models,use of Ensembl for phylogenetic data analysis.

Laboratory Mathematics

Solving equations, ratios and proportions, percentage, exponents, significant digits and roundings, measurement systems and conversion procedures involving the metric system ,temperature, weight and volume, dilution factor, serial dilution, titers, standard curves, rate of change, calculations involving solution concentration, percentage and molarity, graphs.

Health Information, Communication and Technology

The process of effective communication,Verbal communication (importance of clear pronunciation, correct use of grammar, tone and volume variation), Presentation of technical and non-technical information (e.g. concepts for creating posters, leaflets, PowerPoint™ presentations, reports etc), Fundamentals of information & communications technology (ICT), Computing and information technology (IT) skills, Integration of ICT in the healthcare industry (including Health Information Management System, Electronic Health Record systems, Health Information Exchange), telemedicine, m-health and e-Health, Technological modernization of laboratory testing.

Fundamentals of Immunology

Introduction to the immune system (lymphoid organ, tissue and system), function of cells of the innate immune system (eosinophil, basophil, neutrophil, mastocyte, macrophage), the complement, antigen recognition, development and function of B lymphocytes and T-lymphocytes, antibodies, inflammation, activation of an immune reaction, brief about vaccination, diseases of the immune system, immuno-assays, flow cytometry principles, monoclonal antibody production.

Practicals to include: analysis of flow cytometry data, enzymatic fragmentation of monoclonal antibodies, agglutination test, dosage of cytokine.

Methods in Cellular Biology

Understand the origins of cells, differentiating between prokaryotic & eukaryotic cells, cellular dynamics (role of cell organelles and membranes), structural and molecular properties of nucleotides & proteins (enzymes, co-enzymes), principles of cellular replication (mitosis, meiosis, binary fission), cell signalling systems, cellular protein synthesis, molecular trafficking in cells, cellular senescence &apoptotic mechanisms, study of gene structure and function, packaging & compression of genetic material (chromosomal organization), genotype-phenotype relationship, environmental involvement in gene flow

Practicals will include: Basic cell staining & microscopic visualization using chromogens (cheek epithelial cells or onion cells), microscopic identification of cell division stages in mitosis & meiosis, cellular components separation & characterization using centrifugal forces, basic pipetting techniques for DNA stock & visualization using electrophoresis, immunological principles using ELISA for protein mapping.

Genetics and Bioinformatics

Pattern of inheritance, mechanistic overview of gene expression, functional activation of genetic transcription & translational mechanisms, RNA transcripts post-processing, growth factor signalling, regulation of gene expression & repair pathways, cell cycle regulation, gene mutations: mechanisms, causes & consequences, organisms used in genetic studies, genomic analysis of different species, forward genetic approaches and gene function, biological data mining, analysis and interpretration of bioinformatics data sets, bioinformatics tools for DNA and protein sequences comparison, Mendelian genetics, screening systems for genetic variants, analysis of transcriptome data and genomic signatures for adaptation, data processing from microarray experiments.

Microbiology

Pathogenic microbial organisms: viruses, fungi, bacteria, microalgae, protozoa, mechanisms of infectious diseases, the role of vectors in disease transmission and epidemics, general techniques in microscopy and anti-bacterial assays, Good Laboratory Practice and Safety, physical and chemical control of microbial growth, host-parasite relationships in transmission of infectious vector-borne diseases, mechanism of action of antibacterial drugs, immunization, infection control methods.

Practicals will include:sub-culturingof bacteria, antibiotic sensitivity assay, identification of bacteria by staining and biochemical tests (coagulase, catalase and oxidase test), assessment of microbial growth using turbidity,streak-plate and pour-plate techniques.

Laboratory Management & Practices I

Basic laboratory principles: Good Laboratory Practices (GLP), laboratory safety facilities, characterization and handling of dangerous laboratory chemicals, Material Safety Data Sheet (MSDS) files, separation of biohazard materials and chemicals, treatment and disposal of laboratory waste materials, handling of chemical spills, handling microorganisms (culture & spillage),effect of untreated waste on the environment, undertaking risk assessment & recommendations for a safe workplace, maintenance and calibration of analytical equipment, Quality Control (QC) standards (internal and external), validating tests results, documentation and information archiving, conditions for storage of samples (chemicals and biological), laboratory safety practices: Personal Protective Equipment (PPE), OSHA Act, role of stakeholders in ensuring safety, lab inventory management, health surveillance systems.

Laboratory techniques in Food Science

Understanding food matrix (macronutrients: carbohydrates, fats, proteins), analyzing nutritional information (food ratio & composition, dietary reference values (DRV), reference daily Intake (RDI)), preparation of samples for analysis, methods of lipid determination & characterization, protein determination & quantification, principles of fermentation, moisture determination (dry mass technique), analysis of sugars (enzymatic activity on sugar degradation), analytical techniques for food additives & chemicals (atomic absorption, spectrophotometry, chromatography), analytical techniques for water quality assessment (total coliforms analysis: colilert method, O-nitrophenyl-beta-D-galactopyranoside(ONPG/MUG) tests), identification of fecal coliforms (Indole test. Methyl red test. Voges-Proskauer(IMViC) tests, microbiological determination using culturing techniques), water turbidity assessment, identification of food-borne pathogens and morphological analysis.

Practicals will include: Protein quantification using the Bradford's method & spectrophotometric analysis, quantification of moisture content using dry mass measurement, basic chromatography using dye separation, spectrophotometric analysis of water turbidity, detection of coliforms using ONPG/MUG reagent, quantification of coliforms using the most probable number (MPN) technique, morphological analysis of selected food-borne pathogens using selective & differential media.

Communicable Diseases
Introduction to Communicable Diseases (terminologies and definitions), principles of Infection, chain of infection, concept of reservoirs and carriers, types of communicable diseases based on mode of transmission, emerging and re-emerging diseases, HIV/AIDS, prevention & control, immunisation, epidemiology of communicable diseases, diagnosis and treatment of communicable diseases.

Analytical Chemistry
System International of Units, conversion methods, calculation of concentration, chemical equilibrium, solubility, titration methods, acid-base and redox reactions, preparation of buffers, application of spectrophotometry (absorption, emission and fluorescence), spectroscopy, principles of chromatography techniques (thin layer, high performance liquid chromatography, gas chromatography), electrophoresis, extraction techniques (liquid-liquid extraction, solid-liquid phase, micro-extraction, microwave-assisted), overview of sample preparation techniques for metal analysis, DNA and RNA analysis, sample preparation for microscopy and spectroscopy.

Practicals will include: nucleic acid measurement, titration, preparation of buffers and interpretation of chromatograms

Methods in Laboratory-Based Research
Review of scientific literature, access & retrieve information from databases, plan & undertake a research project using analytical techniques from the laboratory, use of statistical software, quantitative statistical tools: Student's t-test, one-way anova, two-way anova, multivariate analysis, repeated measures, standardization & normalization of data, data filtering (marking outliers), data reporting: analyzing, illustrating & interpretation of data, ethical aspects of research, project proposal design

Hematology
Haematopoiesis, morphology and function of Red Blood Cell (RBC) and White Blood Cells (WBC), plasma, blood group serology and transfusion,platelets and coagulation, specimen collection, Overview of general types of hematological test and analysis,Basic calculations in hematology

Practicals to include: use of automated hematology analyser, blood smear and staining, slide analysis, blood fractionation, m
anual WBC differential count, platelets estimate, identification of platelets clumps and platelets satellitism

Trends in biotechnology
Polymerase Chain Reaction (PCR) and its applications, principles of cloning & sequencing, amplification methods for genetic material (Rapid amplification of cDNA ends, RACE), site-directed mutagenesis Immunological techniques in protein analysis, radiolabeling,DNA chips, DNA arrays; proteomic analysis, genome manipulation using gene editing tools (CRISPR-Cas9, ZFNs, TALENs, rAAV, transposons), cell line engineering, applications of stem cell therapy & gene therapy in medical science, RNAi technologies & expression profiling, Biological databases & data storage, data mining in biotechnology, recombinant DNA technology in pharmaceutical applications, Genetically Modified Organisms (GMOs), G-quadruplexes& biological applications, biological tools & environmental

enhancement, molecular sensors & their therapeutic abilities, plant cell and tissue culture methodologies, stages in the creation of transgenic plants, crop enhancement using transgenic technologies, transgenic plants as bioreactors, genetic manipulation of plant cell walls for the food industry.

Diagnosis of Non-Communicable Diseases

Introduction to non-communicable diseases (NCDs), concept of risk factor and causes, modifiable and non-modifiable risk factors , Upstream factors and the social determinants of health, Socio-economic impacts of NCDs, overview of major NCDs, epidemiology and surveillance of NCD, prevention and control, Diagnosis of NCDs: Cardiovascular diseases (blood test, stress test, computerized tomography (CT) scan, Cardiac magnetic resonance imaging (MRI)), Cancer (histology, flow-cytometry, PCR), chronic respiratory diseases (lung function test,trigger tests), diabetes (blood test).

Laboratory Management & Practices II

Understanding aspects of quality & quality management systems, features of quality assurance, quality system essentials (12 Quality System Essentials), laboratory organization to enhance safety & productivity, leadership & management principles (McGregor's X and Y, Blake and Mouton grid, Maslow's theory), aspects of management (planning, organization & execution), human relation skills, QC for quantitative & qualitative tests (process implementation & interpretation), accreditation principles, laboratory standards (ISO 9001:2008, ISO 15189:2007, ISO/IEC 17025:2005, ISO 15189), quality systems documentation, occurrence management, laboratory productivity, Laboratory Information Management Systems (LIMS), laboratory audits.

PROJ2000- Laboratory-Based Project

A 5,000 – 8,000 word project will have to be submitted. The student will be expected with the help of a supervisor to design a lab-based research project. The student is expected to engage in scientific literature review, experiment designing,laboratory work, data analysis and interpretation.

The work submitted should conform to the School's Project Guidelines.