

BSc (Hons) Microbiology – A303

1. Objectives

This programme is designed to develop the necessary competence for a career as a microbiologist. The training is broad-based and prepares students for a wide range of employment opportunities in veterinary, clinical and public health fields, biotechnology, environment-related fields, and food and beverage industries. The programme also offers adequate background for specialisation through further studies/research at postgraduate level both locally and overseas.

Upon successful completion of this programme, learners will be able to:

- Demonstrate knowledge and understanding of microorganisms, their role and importance in the food/industrial, environment and health sectors;
- Apply knowledge and skills to control growth of microorganisms in different environments;
- Carry out laboratory procedures to isolate, detect and identify microorganisms present in food, environmental and clinical samples;
- Interpret data obtained from microbiological analyses and take action in consequence;
- Synthesise, evaluate or critically analyse microbiology-related information;
- Demonstrate transferable skills namely written and oral communication, team working, problem solving and IT skills;
- Carry out research in the field of microbiology;
- Embark on training programmes at postgraduate level.

2. General Entry Requirements

In accordance with General Entry Requirements for Admission to the University for Undergraduate Degrees.

3. Programme Requirements

SC: Credit in Mathematics and Chemistry

Preference will be given to candidates also holding an 'O' Level in Biology.

2 GCE 'A' Levels passes in related approved Science subjects.

Preference will be given to candidates also holding an 'A' Level in Biology and Chemistry.

4. Programme Duration

	Normal (Years)	Maximum (Years)
Degree	3	5

5. Credits per Year: Minimum 18 credits, Maximum 48 credits subject to Regulation 4.

6. Minimum Credits Required For Award of Undergraduate Degree: 103

Breakdown as follows:

	Credits from		
	Core Taught Modules	Project	GEM
Degree	88	9	6

The Practical Training Component and the “Scientific Communication Skills” module must be completed satisfactorily for the award of the degree.

Students may exit with

- (a) a Certificate after having earned 30 credits in core modules.
- (b) a Diploma after having earned 60 credits in core modules.

7. Assessment

Each module will be assessed over 100 marks (i.e. expressed as %) with details as follows (unless otherwise specified):

Assessment will be based on a Written Examination of 2-3 hour duration, carrying a weighting of 70%, and Continuous Assessment carrying 30% of total marks for AGRI modules. Modules from other Faculties/Departments/Centres will carry weighting in the Written Examination and the Continuous Assessment as specified by the concerned Faculties/Departments/Centres. Continuous Assessment will be based on laboratory/field works, and/or assignments, and should include at least 1 class test. Written examinations for all AGRI modules will normally be carried out at the end of the academic year.

An overall total of 40% for combined continuous assessment and written examination components would be required to pass a module, without minimum thresholds within the individual continuous assessment and written examination.

Modules will carry the weightings of 1, 3 or 5 depending on their status (Introductory, Intermediate or Advanced). Weighting for a particular module is indicated within parentheses in the module code.

Each module will carry credits ranging from 3 to 6 credits and the Project will carry 9 credits.

Students who do not have SC level pass in Biology will be required to follow the “structure and function of multicellular organisms and ecosystems” module in the first semester of the first year of the programme of study. Assessment will be based on a Written Examination carrying a weighting of 70%, and Continuous Assessment carrying 30% of total marks. The module carries no credits. For satisfactory completion of the module, a minimum of 40% should be attained.

Assessment of the “scientific communication skills module” will be based on continuous assessment of students throughout the module and/or submission of a portfolio. The module carries no credits. For satisfactory completion of the module, a minimum of 40% should be attained.

Assessment of practical training placement will be based on the on-site supervisor’s evaluation and the student’s portfolio. For satisfactory completion of the training placement, a minimum of 40% should be attained.

Written examinations for all the modules will be carried out at the end of the year.

8. Important Note

The rules as stipulated in this Programme Structure and Outline Syllabus will replace all other rules and regulations.

9. Academic Teaching in Case of an Emergency

To ensure minimal disruption of normal academic teaching in case of emergency (eg closure of the University for more than 2 weeks), the Moodle-e-Learning Platform of VCILT will be used to deliver Teaching and Learning content. Relevant learning resources will be posted on the Platform. Assignments (if any) will be submitted using the online submission box. Arrangements will be made to register students on the Moodle Platform at the beginning of the academic year.

10. List of Modules

CORE MODULES

Module Code	Module Name	Hr / Yr L+P	Credits
AGRI 1046Y (1)	Chemistry Fundamentals and Biochemistry	60+60	6
AGRI 1056Y (1)	Introductory Statistics	30+30	3
AGRI 1057Y (1)	Basic Microbiology and Techniques	60+60	6
AGRI 1058Y (1)	Cell Biology	60+30	5
AGRI 1059Y (1)	Animal, Human and Plant Physiology	60+60	6
AGRI 1060Y (1)	Genetics	45+30	4
AGRI 2066Y (3)	Immunology and Molecular Pathology	60+60	6
AGRI 2081Y (3)	Statistical Methods and Computational Biology	60+60	6
AGRI 2082Y (3)	Microbial Ecology and Evolution	45+30	4
AGRI 2083Y (3)	Microbial Physiology and Biochemistry	60+60	6
AGRI 2084Y (3)	Microorganisms and Diseases	60+60	6
AGRI 2085Y (3)	Molecular Biology and Biotechniques	60+60	6
AGRI 2100	Scientific Communication Skills	20+0	-
AGRI 3000Y (5)	Project	-	9
AGRI 3078Y (5)	Food and Industrial Microbiology	45+30	4
AGRI 3079Y (5)	Aquatic, Marine and Environmental Microbiology	45+30	4
AGRI 3080Y (5)	Medical and Veterinary Microbiology	60+30	5
AGRI 3081Y (5)	Microbial Genomics	45+30	4
AGRI 3082Y (5)	Recent Developments in Microbiology	45+0	3
AGRI 3091Y (5)	Bioinformatics and Applications	45+30	4
AGRI 2000	Practical Training can be undertaken either in Year 1 or in Year 2		
GEM (1)		-	6

Basic module in biology for students who do not have SC level Biology:

AGRI 1000	Structure and Function of Multicellular Organisms and Ecosystems	45+0	-
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Total Number of Credits: 103

11. Programme Plan – BSc (Hons) Microbiology

YEAR 1

Module Code	Module Name	Hr / Yr L+P	Credits
CORE			
AGRI 1046Y (1)	Chemistry Fundamentals and Biochemistry	60+60	6
AGRI 1056Y (1)	Introductory Statistics	30+30	3
AGRI 1057Y (1)	Basic Microbiology and Techniques	60+60	6
AGRI 1058Y (1)	Cell Biology	60+30	5
AGRI 1059Y (1)	Animal, Human and Plant Physiology	60+60	6
AGRI 1060Y (1)	Genetics	45+30	4
AGRI 1000	Structure and Function of Multicellular Organisms and Ecosystems	45+0	-
GEM (1)		-	6
AGRI 1000:	Only for students who <u>do not</u> have SC level Biology		

YEAR 2

Module Code	Module Name	Hr / Yr L+P	Credits
CORE			
AGRI 2066Y (3)	Immunology and Molecular Pathology	60+60	6
AGRI 2081Y (3)	Statistical Methods and Computational Biology	60+60	6
AGRI 2082Y (3)	Microbial Ecology and Evolution	45+30	4
AGRI 2083Y (3)	Microbial Physiology and Biochemistry	60+60	6
AGRI 2084Y (3)	Microorganisms and Diseases	60+60	6
AGRI 2085Y (3)	Molecular Biology and Biotechniques	60+60	6
AGRI 2100	Scientific Communication Skills	20+0	-
AGRI 2000	Practical Training can be undertaken either in Year 1 or in Year 2		

YEAR 3

Module Code	Module Name	Hr / Yr L+P	Credits
CORE			
AGRI 3000Y (5)	Project	-	9
AGRI 3078Y (5)	Food and Industrial Microbiology	45+30	4
AGRI 3079Y (5)	Aquatic, Marine and Environmental Microbiology	45+30	4
AGRI 3080Y (5)	Medical and Veterinary Microbiology	60+30	5
AGRI 3081Y (5)	Microbial Genomics	45+30	4
AGRI 3082Y (5)	Recent Developments in Microbiology	45+0	3
AGRI 3091Y (5)	Bioinformatics and Applications	45+30	4

Total Number of Credits: 103

12. Outline Syllabus

AGRI 1046Y(1) - CHEMISTRY FUNDAMENTALS AND BIOCHEMISTRY

Basics of organic, inorganic and physical chemistry. Structures of atoms, molecules, bonding, orbitals. Reactions and stoichiometry. Reaction rates and equilibrium. Acid/base redox reactions. Buffer solutions. Isomerism. Stereochemistry. Free radicals. Electrophilic, nucleophilic reactions. Spectroscopic techniques.

Biomolecules: Polysaccharides, sugars; storage polysaccharides; Lipids, classification and properties, biological membranes; Proteins, amino acids, covalent and three-D structure of proteins; Enzymes, properties and mechanism of actions, enzyme kinetics. Biochemical calculations.

AGRI 1056(1) – INTRODUCTORY STATISTICS

Introducing statistics in microbiology. Descriptive statistics – displaying and summarising data. Probability distributions. Point and interval estimation. Hypothesis testing. Analysis of categorical data. Correlation and regression analysis. Data entry and analysis using EXCEL and MINITAB.

AGRI 1057Y(1) – BASIC MICROBIOLOGY AND TECHNIQUES

Groups of microorganisms. Distribution of microorganisms in nature. Microbial classification, nomenclature and identification. Major characteristics of bacteria, fungi, algae, protozoa, nematodes, microhelminths, microarthropods and viruses. Microbial growth and survival. Control of microorganisms. Antimicrobial agents. Basic procedures and techniques in microbiology.

AGRI 1058Y(1) – CELL BIOLOGY

Plant, animal, prokaryotic cells. Structure, function and synthesis of cellular components: nucleus, genetic code and protein synthesis, cytoplasm, cytoplasmic membrane, cytoplasmic organelles, enzymes, nucleotides, carbohydrates, lipids. Membrane transport. Intracellular compartments and transport. Energy-producing pathways. Cell division and the cell cycle. Cell cycle control. Cell death.

AGRI 1059Y(1) – ANIMAL, HUMAN AND PLANT PHYSIOLOGY

Ruminant and non-ruminant of economic importance. Circulatory system. Digestion and Nutrition. Reproductive system. Muscular system. Lymphatic and Immune system.

Human physiology: Circulatory system. Respiratory System. Digestion and Nutrition. Nervous and Endocrine Systems. Sensory Structures. Excretory and Reproductive system. Muscular system. Lymphatic and Immune system.

Overview of economically important crops. Plant anatomy and structures. Water and plant mineral uptake. Assimilation of nutrients. Vegetative and reproductive growth. Plant growth analysis. Yield determination. Growth kinetics. Seed physiology.

AGRI 1060Y(1) – GENETICS

Bacterial genetics. Bacteriophage genetics. Mutagenesis. Mechanisms of genetic information transfer. Plasmids. Regulation of gene expression. Genetic adaptation. Genetic approaches to study complex cellular processes. Mendelian inheritance. Linkage and chromosome mapping. Sex linked and extranuclear inheritance. Quantitative and population genetics.

AGRI 1000 – STRUCTURE AND FUNCTION OF MULTICELLULAR ORGANISMS AND ECOSYSTEMS

Introduction to unity in biological sciences. The structures and processes common to all living things at the cellular and molecular levels are introduced in the first part of the course followed by genetic principles and processes, and an overview of evolutionary concepts. Finally basic concepts on evolution and the diversity of living things (including bacteria, plants, fungi and animals) will be explored. Ecosystems and the relationship of organisms to their environment will also be considered.

AGRI 2066Y(3) - IMMUNOLOGY AND MOLECULAR PATHOLOGY

Components of immune system; cells, organs, soluble mediators; humoral and cell-mediated immunity, Immunoglobulins; cell differentiation; complement system; inflammation. Immunity to bacterial, viral and fungal pathogens. Escape mechanisms. Immunological tolerance. Autoimmunity. Vaccines. Genomics of

bacterial, viral pathogens in humans, animals and plants. Molecular basis of virulence. Pathogen genetic diversity; strain differentiation; receptors for pathogen invasion. Drug resistance.

AGRI 2081Y(3) - STATISTICAL METHODS AND COMPUTATIONAL BIOLOGY

Design and analysis of experiments. Non-parametric methods. Sampling methods. Questionnaire development, design and administration. Data processing using EXCEL, MINITAB and SPSS. Elements of research methodology.

Programming in Python: Basic Commands, Flow Control, Input/Output, Files, Modules, Regular Expressions Lists. Storing Amino Acids, Genes and Protein Information. Pattern Matching.

AGRI 2082Y(3) – MICROBIAL ECOLOGY AND EVOLUTION

Overview of the physiological, phylogenetic and genomic diversity and ecology of microorganisms. Microbial interactions with their environment at the level of the individual, population and community, including associations with plants and animals. Current methods for studying microbial ecology and diversity in the environment. Experimental design, methods, and presentation of experimental results in the area of microbial ecology.

AGRI 2083Y(3) – MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Structure, functions and assembly of cell components. Physiological diversity. Bioenergetics. Aerobic and anaerobic energy production. Energy production by photosynthesis. ATP synthesis. Utilisation of energy: motility, transport of nutrients, biosynthesis. Metabolic pathways. Carbohydrate, amino acid and nucleotide metabolism and regulatory mechanisms. Bacterial secretion systems. Microbial enzymes. Environmental stress tolerance. Nutrition, growth and cellular differentiation. Experimental approaches to analysis of microbial structure, composition and metabolism. Structure and content of scientific reports.

AGRI 2084Y(3) – MICROORGANISMS AND DISEASES

Study of bacteria, fungi, protozoa, nematodes, microhelminths, microarthropods and virus causing diseases/disorders in living organisms. Vectors of diseases.

Bacterial pathogens and mechanisms of pathogenesis. Bacterial virulence. Host-defense mechanisms. Antibiotic therapy. Modern and classical techniques for the isolation, identification and characterisation of pathogenic bacteria.

Plant, animal and human diseases caused by fungi, prevention and control.

Biology of host-parasite relationships of major groups of plant, animal and human parasites -parasitic protozoa, microhelminths and microarthropods. Techniques of diagnosing and studying parasites. Prevention and control of parasitic diseases/disorders.

Human, animal and plant viruses. Bacteriophages. Molecular basis for viral pathogenesis. Prevention and treatment of viral diseases.

AGRI 2085Y(3) - MOLECULAR BIOLOGY AND BIOTECHNIQUES

Prokaryotic and Eukaryotic genome, Mechanism of genetic exchange, Structure and properties of DNA. Recombination. DNA repair. Mutation and mutagenesis, Gene regulation and gene expression. Protein synthesis. Techniques of DNA analysis. Recombinant DNA technology.

AGRI 2100 - SCIENTIFIC COMMUNICATION SKILLS

Avenues of communication in science. Scientific and technical writing. Oral and poster presentations. Ethics of scientific publishing.

The dissertation guidelines. Planning and managing the dissertation writing up process – effective literature search and review, introduction, methodology, results, discussion, conclusions, referencing rules and plagiarism.

This module does not carry any credit, but training must be completed satisfactorily for the award of the degree.

AGRI 2000 - PRACTICAL TRAINING

Students are required to undergo a full-time practical training of 6-8 week duration during the winter vacation either in year 1 or year 2. Training placement may take place in food and beverage industries, research institutions, and private or public laboratories. The aim is to expose the student to the real work environment, acquaint him/her of what employers would expect of a graduate. Students are required to submit a training placement portfolio.

This module does not carry any credit, but training must be completed satisfactorily for the award of the degree.

AGRI 3000Y(5) - PROJECT

This is a very important component of the programme, allowing students to develop high level skills and cognitive abilities. Every student will be allocated a research topic and the research work will be carried out under supervision. The student is required to investigate a topic/problem, plan and execute the research work as well as present and discuss the results. The student will have to submit a dissertation at the end of the final year. Students should demonstrate good practice in using skills and knowledge acquired and follow guidelines as laid down.

AGRI 3078Y(5) – FOOD AND INDUSTRIAL MICROBIOLOGY

Microorganisms of importance to the food industry. Factors affecting growth in foods. Microbial food spoilage. Microbial foodborne infections and intoxications. Emerging pathogens. Investigation of foodborne disease outbreaks. Probiotics. Microorganisms in food production. Control of microbiological hazards in the food industry. Microbiological Risk Assessment. Predictive Microbiology. Microbiological examination of foods.

Bioreactor design and operation, media composition, gas exchange and mass transfer, sterilization, bioreactor scale-up. Bioprocess engineering and instrumentation. Production and commercial applications of industrial products including amino and organic acids, biodegradable polymers and antibiotics. Modification of food through fermentation technology. Enzymes in industries. Genetic engineering of enzymes. Biofuels, biotransformation and biosensors. Downstream processing and product purification

AGRI 3079Y(5) – AQUATIC, MARINE AND ENVIRONMENTAL MICROBIOLOGY

Microorganisms and their relation to environment, with emphasis on water, marine and soil microbiology. Major groups of autotrophic and heterotrophic microorganisms and their roles in aquatic and wetland ecosystems. Role of microorganisms in the marine environment: ecology, physiology, biogeochemistry and diversity of marine microbes. Microorganisms in wastewater treatment. Microbial flora of soil. Biogeochemical role of soil microorganisms. Nutrient cycling. Hydrocarbon-oxidising microorganisms, biosurfactants, removal of organic and metallic pollutants from soil. Bioremediation. Biodesulphurisation, Biosensors in environmental applications. The plastics dilemma and biodegradable plastics. Microbes in clean production technology. Uses of microorganisms in agriculture (e.g. biofertilisers, mycorrhizas).

AGRI 3080Y(5) – MEDICAL AND VETERINARY MICROBIOLOGY

Infectious diseases including concept of virulence, resistance, prevention and control of microbial diseases in man and in the community. Epidemiology of infectious diseases. Animal pathogens: incidence, diagnosis, resistance, prevention and control.

Clinical diagnosis: principles of blood chemistry, urinalysis, hematology and other clinical parameters of disease and health. Clinical diagnosis methods.

AGRI 3081Y(5) – MICROBIAL GENOMICS

Features of microbial genomes. Genome organisation. Information flow in biology, DNA sequence data. Experimental approach to genome sequence data - genome information resources. Comparative genomics. Protein sequence and structural data, protein information resources and secondary data bases. High-throughput analysis of gene function - DNA microarrays, Molecular markers. Core and flexible genome. Horizontal gene transfer (HGT). Genomic islands. Microbial gene evolution. Computer applications for microbial genome comparison. Current techniques for understanding microbial genome diversity.

AGRI 3082Y(5) – RECENT DEVELOPMENTS IN MICROBIOLOGY

Reviews on current research and development in microbiology. Student seminars on defined research topics in microbiology.

AGRI 3091Y(5) – BIOINFORMATICS AND APPLICATIONS

Internet basics, biological data analysis and application, Sequence alignment and data base search. Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alignment. Multiple sequence alignment. Databases. Algorithms used in bioinformatics. Genome browsers. Phylogenetic analysis. Clustering. Motif searching. Structural proteomics.

15 August 2011