

BIOMEDICAL SCIENCE COURSE MODULES (YEAR 2)

Learn to integrate and apply biological and chemical sciences knowledge to solve problems that our world faces, including infectious diseases, cancer, neurodegenerative diseases and an increasing demand for better nutrition and safer foods. Our Diploma in Biomedical Science [BMS] combines knowledge from bioinformatics, chemistry, molecular biology, immunology, microbiology, and proteomics to offer innovative solutions to these challenges. BMS is a launch pad for you to embark on a diversity of careers in the manufacturing, research and development, regulatory affairs and clinical trials, and clinical diagnoses industries.

In your first year, you will take modules such as Anatomy & Physiology, Cell Biology & Genetics, Biostatistics, Chemistry and Microbiology that will give you a firm foundation in chemistry and bioscience. You can build upon this solid foundation and choose one of our two specialisation options in your second year.

SPECIALISATION OPTIONS

General Biomedical Science

Develop analytical, research and problem solving skills that are highly valued by the industry. You will acquire knowledge and skills in analytical chemistry, molecular biology, biopharmaceutical analysis, and biomanufacturing practices. This option includes a six-month local or overseas internship at biopharmaceutical or food manufacturing companies, laboratory testing and analysis companies, research institutes, and healthcare organisations.

Clinical Laboratory Technology

This option includes a two-year Integrated Clinical Laboratory Training Programme at NUH, where you will learn about clinical laboratory techniques and get trained alongside professionals such as doctors, nurses and medical technologists. You will also receive an additional certification in phlebotomy.

GENERAL BIOMEDICAL SCIENCE SPECIALISATION OPTION

LEVEL 2.1

Applied Microbiology

This is an advanced module in microbiology for second year students and is a continuation of the basic microbiology module. This module focuses on the importance of microorganisms as contaminating agents in the production of foods and pharmaceuticals. It focuses on the techniques and methodologies involved in the analyses and prevention of microbiological contamination. This module also provides a foundation in medical, food, environmental and industrial microbiology as well as skills and knowledge in Good Manufacturing Practices, food hygiene auditing and in the preparation of a HACCP plan.

Biochemistry

This module introduces fundamental biochemical concepts and practices. The subject integrates biological and chemical concepts as they relate to biochemistry and biochemical disorders. The module prepares students to work in biochemical industries and research institutions, and covers three major areas of protein chemistry, enzymology and metabolism.

Career & Professional Preparation II

This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their further career and/or education. In this module, students will explore basic job search strategies, practice writing of effective resumes and cover letters, and learn interview skills. Students will also learn professional and intercultural communication skills to prepare them for a dynamic and diverse workplace.

Molecular Biology & Bioinformatics

This module covers advanced topics in molecular biology. Topics include regulation of gene expression, gene mutation and DNA repair mechanisms. In the area of recombinant DNA technology and molecular techniques, students will learn about nucleic acid isolation, polymerase chain reaction (PCR), DNA cloning, identification of recombinant clones, DNA sequencing and microarrays. Students will also be introduced to computational approaches and bioinformatics tools that can be used for the analysis of nucleic acid and protein sequences, and for designing PCR primers.

ELECTIVES

Choose any 1

Biomanufacturing Practices

This module focuses on principles and practices in the manufacturing of biological agents such as vaccines, biologic drugs and antibodies by mammalian and microbial catalysts. Topics include an overview of kinetic and stoichiometric analysis of bioreactors, biomanufacturing process operations, bioreactor design principles, single use systems, agitation and mixing, heat transfer and temperature culture, process scale-up.

Food Science & Technology

This module covers key topics in modern food science, focusing on key issues which affect the import, production, testing and regulation of processed foods in Singapore. This module introduces students to local and international food standards, interpret data and information presented in the scientific and non-scientific literature. Laboratory classes will focus on the analyses of processed foods.

LEVEL 2.2

Applied Biostatistics

This module covers advanced statistical skills to analyse and interpret a wide range of biological, pre-clinical and clinical data, and preparation of data for scientific presentation. The statistical skills covered are biological experiment design, hypothesis testing, quantitative data analysis by parametric and non-parametric methods, qualitative data analysis by Chi-square and Fisher tests, and simple correlation & regression analysis for non-linear data. Students will perform statistical analysis using statistical software such as SPSS and Excel. The scientific presentation section covers how to organise data, prepare and incorporate statistical results on graphs and interpretation of results.

Analytical Chemistry

This module covers various instruments which are used in analytical chemistry/biochemistry with the emphasis on their practical use. Students will study the workings of the UV-Vis, HPLC (including IEX, gel filtration, affinity chromatography), capillary and gel electrophoresis. This module will also cover the interpretation of mass spectrometry as applied to small molecules and proteins; proton and ¹³C-NMR, infrared spectroscopy in the structural elucidation of organic molecules.

Cell Culture & Bioprocess Engineering

This module equips students with strong aseptic techniques and application of cell culture in bioprocess engineering. Topics include regulatory affairs, biologics, cell lines, media, maintenance of cell cultures, and understanding of bioprocessing. Students will also acquire practical and theoretical knowledge of developing fermentation processes and manufacturing biological products. This module also includes applying bioprocess technology principles to scale-up production, economics, and regulatory considerations of bio-products derived from recombinant organisms and animal cell culture.

Immunological Techniques

This module introduces the fundamentals of immunology and provides an understanding of how the immune system functions as an integrated defense system against disease. Topics include an overview of the innate and adaptive immunity, humoral and cell mediated immunity, immunisation and vaccination. Also covered are the applications and advancements of immunological techniques in clinical, healthcare and diagnostic laboratories.

World Issues: A Singapore Perspective[^]

This module develops a student's ability to think critically on world issues. Students will discuss a wide range of social, political and cultural issues from the Singapore perspective. It also looks at how city-state Singapore defied the odds and witnessed close to half a century of rapid economic growth, strong political ties and social harmony.

ELECTIVES

Choose any 1

Biopharmaceutical Analysis

This module is designed to equip students with knowledge and molecular techniques that are used to analyse raw materials and biological products. Topics include an overview on biologics production using microbial and mammalian systems, detection of adventitious agents in biological products using quantitative PCR (qPCR), endotoxin and pyrogen testing, bioburden test, and detection of residual host cell proteins using enzyme linked immunosorbent assay (HCP-ELISA). An overview on pharmaceutical law and regulatory landscape will also be covered.

Food Processing & Safety

This module covers principles and techniques used in food industry which include mass and energy balance and their application in food unit operations, size reduction, thermal processing, non-thermal processing and equipment. Under food safety, the proper handling, preparation and storage of food will be explored. Nature of contaminants, safety evaluation of food ingredients and food safety regulations (FDA, AVA) will also be covered.

CLINICAL LABORATORY TECHNOLOGY SPECIALISATION OPTION

Students undergo a two-year Integrated Clinical Laboratory Training Programme (ICLTP) conducted in collaboration with the National University Hospital. Students will receive additional certification in phlebotomy.

LEVEL 2.1

Career & Professional Preparation II

This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their further career and/or education. In this module, students will explore basic job search strategies, practice writing of effective resumes and cover letters, and learn interview skills. Students will also learn professional and intercultural communication skills to prepare them for a dynamic and diverse workplace.

Laboratory Techniques in Clinical Chemistry

This module covers the principles of protein separation techniques, immuno-nephelometry, immuno-turbidimetric analysis, chromatographic techniques, therapeutic drug analyses, immunochemical techniques, blood gas analysis and diagnostic procedures for hormonal testing. This module also covers aspects related to laboratory management, information technology in the laboratory and quality management.

Laboratory Techniques in Clinical Haematology

This is an introductory module with emphasis on basic instrumentation and diagnostic procedure performed in Blood Bank and Haematology laboratory. Students will learn about the principles, procedures and interpretation of manual and automated analyzer results.

Laboratory Techniques in Clinical Microbiology

This module aims to demonstrate the daily routines of a microbiology laboratory serving a public hospital. Students should take note of the essential skills such as aseptic techniques, medium preparation, urinalysis, diagnostics methods for parasitology and virology. This module also covers infectious disease management.

Molecular Biology & Bioinformatics

This module covers advanced topics in molecular biology. Topics include regulation of gene expression, gene mutation and DNA repair mechanisms. In the area of recombinant DNA technology and molecular techniques, students will learn about nucleic acid isolation, polymerase chain reaction (PCR), DNA cloning, identification of recombinant clones, DNA sequencing and microarrays. Students will also be introduced to computational approaches and bioinformatics tools that can be used for the analysis of nucleic acid and protein sequences, and for designing PCR primers.

LEVEL 2.2

Applied Biostatistics

This module covers advanced statistical skills to analyse and interpret a wide range of biological, pre-clinical and clinical data, and preparation of data for scientific presentation. The statistical skills covered are biological experiment design, hypothesis testing, quantitative data analysis by parametric and non-parametric methods, qualitative data analysis by Chi-square and Fisher tests, and simple correlation & regression analysis for non-linear data. Students will perform statistical analysis using statistical software such as SPSS and Excel. The scientific presentation section covers how to organise data, prepare and incorporate statistical results on graphs and interpretation of results.

Clinical Chemistry I

This module focuses on basic biochemical pathways such as glucose metabolism and diseases, water and ion metabolism, liver metabolism, plasma proteins as well as their related laboratory tests. Basic pathology and pathogenesis of diseases include cell injury, cell death, inflammation and neoplasia will also be covered.

Clinical Haematology I

This module covers the theory and principle of morphologic alterations in blood cells, various blood cell disorders, pediatrics haematology and antigen-antibody reactions as applied to blood-banking. Emphasis is given to cell-typing, cross-matching, compatibility problems and HLA-typing for organ and bone marrow transplants.

Clinical Microbiology I

This module aims to provide students with more in-depth microbiological knowledge. Students will also learn about tuberculosis diagnostic tests and non-culture based investigations such as serology. In terms of theoretical knowledge, students are expected to be familiar with pathogen laboratory characteristics and identification, as well as relating specific pathogens to clinically important diseases.

World Issues: A Singapore Perspective[^]

This module develops a student's ability to think critically on world issues. Students will discuss a wide range of social, political and cultural issues from the Singapore perspective. It also looks at how city-state Singapore defied the odds and witnessed close to half a century of rapid economic growth, strong political ties and social harmony.

COURSE CURRICULUM (YEAR 2)

Module Name	Credit Units
YEAR 2	
GENERAL BIOMEDICAL SCIENCE SPECIALISATION OPTION	
Level 2.1 (22 hours per week)	
Applied Microbiology	5
Biochemistry	4
Career & Professional Preparation II	2
Molecular Biology & Bioinformatics	5
Electives (Choose 1):	4
• Biomanufacturing Practices	
• Food Science & Technology	
Interdisciplinary Studies (IS) elective [^]	2
Level 2.2 (22 hours per week)	
Applied Biostatistics	3
Analytical Chemistry	4
Cell Culture & Bioprocess Engineering	5
Immunological Techniques	4

Electives (Choose 1):	4
• Biopharmaceutical Analysis	
• Food Processing & Safety	
World Issues: A Singapore Perspective ^	2

CLINICAL LABORATORY TECHNOLOGY SPECIALISATION OPTION

Level 2.1 (22 hours per week)

Career & Professional Preparation II	2
Laboratory Techniques in Clinical Chemistry	5
Laboratory Techniques in Clinical Haematology	5
Laboratory Techniques in Clinical Microbiology	5
Molecular Biology & Bioinformatics	5

Level 2.2 (20 hours per week)

Applied Biostatistics	3
Clinical Chemistry I	5
Clinical Haematology I	5
Clinical Microbiology I	5
World Issues: A Singapore Perspective ^	2

Notes:

^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

IS Modules

The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students' competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.