

# **DIPLOMA IN BIOMEDICAL ENGINEERING**

Become proficient in biomedical device technologies and sharpen the tools of the medical profession. This course is designed to prepare you for an engineering career in the biomedical sector, where there is increasing demand for trained professionals as more international biomedical firms establish their bases in Singapore.

You will design and produce medical devices used by clinicians and patients; and at our Biomedical Engineering & Advanced Materials Hub, you will participate in collaborative projects with our many industry partners. This lets you experience real-life biomedical issues as you play a part in developing innovations to address and solve challenges. Upon graduation, you will be a technically competent, innovative and adaptable individual ready for a successful career in the expanding biomedical and healthcare sectors.

### WHY THIS DIPLOMA?

- Get practical and hands-on training with the latest engineering design tools, software, and advanced medical and biomedical systems and processes.
- Experience real-life, industry-based medical device design and development projects.
- Gain international exposure and experience through our Overseas Internship Programme in countries such as Australia, Canada, France, the UK and Japan.
- Be eligible for the Diploma Plus Programme, which prepares you for university studies, professional certifications and enhancements of your technical capabilities.

# IT WILL ENABLE YOU TO ...

- Become competent in the latest technologies for current and emerging biomedical needs.
- Design and develop medical devices and instruments.
- Provide support for medical technology companies, healthcare companies and research institutions.
- Enjoy advanced standing in Bioengineering or Biomedical Engineering Degree Programmes at local and overseas universities.

# DURATION

Three academic years on a full-time basis

### **FURTHER EDUCATION**

You get advanced standing or module exemptions for relevant or equivalent degree programmes at many reputable universities in Singapore and abroad such as the University of Sheffield, Queen Mary University of London, Newcastle University, University of Manchester, University of New South Wales, Monash University and University of Sydney.

# **CAREER PROSPECTS**

You will be highly sought-after in the biomedical and healthcare industries. You can expect to enjoy a dynamic and rewarding career with industry leaders, or join an academic or research institute, in positions such as:

- Medical product designer
- Assistant quality assurance engineer
- Assistant regulatory affairs officer
- Assistant GMP facilities & equipment engineer
- R&D technologist
- Research assistant

You can also enter the industry directly as an entrepreneur.

# **ENTRY REQUIREMENTS**

You must have obtained the following minimum GCE 'O' Level results:

- English Language (EL1) Grade 1–7
- Elementary/Additional Mathematics Grade 1–6
- A relevant Science subject Grade 1–6

# **COURSE STRUCTURE**

# YEAR 1 – SEMESTERS 1 & 2

# **Core Modules**

EGH101 Algebra EGH103 Electrical Principles and Circuits EGH104 3D CAD Modelling EGH105 Communication Skills EGH106 Physics EGH107 Calculus EGH108 Inorganic & Physical Chemistry EGH109 Mechanics - Statics EGH110 Biomaterials EGH111 Computer Programming EGH113 Introduction to Engineering EGH114 Introduction to Biomedical Manufacturing Processes General Studies\*

### YEAR 2 – SEMESTERS 1 & 2

#### **Core Modules**

EGH201 Mathematics 2A EGH202 Anatomy & Physiology EGH203 Biomedical Engineering Design EGH205 Microcontroller Applications EGH206 Biomedical Project 1 EGH207 Mathematics 2B EGH208 Biomedical Electronics EGH209 Thermofluids EGH212 Biomedical Project 2 EGH216 Good Manufacturing Practice General Studies\*

### **Elective Modules (Choose two)**

EGH204 Organic Chemistry EGH210 Biomaterials 2 EGH211 Medical Imaging EGH215 Automatic Control

### YEAR 3 – SEMESTERS 1 & 2

### **Elective Programmes (Select one)**

# **Biomedical Device Design**

#### **Core Modules**

EGH301 Medical Device Design EGH302 Biomedical Instrumentation EGH303 Biomedical Project 3 EGH304 Professional & Interpersonal Communication Skills EGH324 Full-Time Semestral Project\*\*

# General Studies\* Internship#

# **Elective Modules (Choose two)**

EGH305 Medical Device Validation EGH306 Biosignal Processing & Analysis EGH308 Diagnostic Image Processing & Visualisation EGH312 Healthcare Analytics

### **Quality System & Regulatory Compliance**

# **Core Modules**

EGH303 Biomedical Project 3 EGH304 Professional & Interpersonal Communication Skills EGH309 Quality Management System EGH311 Medical Device Regulatory Compliance EGH324 Full-Time Semestral Project\*\* General Studies\* Internship#

# **Elective Modules (Choose two)**

EGH302 Biomedical Instrumentation EGH305 Medical Device Validation EGH310 Biomedical Manufacturing Technology EGH312 Healthcare Analytics

#### **Biomedical Manufacturing Processes & Technology**

### **Core Modules**

EGH303 Biomedical Project 3 EGH304 Professional & Interpersonal Communication Skills EGH310 Biomedical Manufacturing Technology EGH314 Automation Control Technology EGH324 Full-Time Semestral Project\*\* General Studies\* Internship#

# **Elective Modules (Choose two)**

EGH302 Biomedical Instrumentation EGH305 Medical Device Validation EGH309 Quality Management System EGH311 Medical Device Regulatory Compliance

\* To complete 60 hours for General Studies Modules with the aim of promoting a holistic education and learning experience. Choose modules from clusters that include foreign languages, communication and interpersonal skills, leadership and teamwork, values and society, general knowledge and interests, and healthy and active lifestyle.

\*\* Students taking EGH325 or EGH326 would not need to do EGH324.

# Internship (Choose one)
EGH323 Internship Programme (12 weeks)
EGH325 Internship Programme (24 weeks)
EGH326 Overseas Internship Programme

### EGH101 Algebra [60 hours]

This module provides students with the basic mathematical principles and tools necessary to underpin their education in the engineering discipline. It will enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems. Topics covered include engineering functions, trigonometry, complex numbers, determinants, matrices and vectors. At the end of this module, students will be able to demonstrate understanding of and competence in the basic mathematics of engineering, such as vectors, matrices, exponential and logarithmic functions, and complex numbers.

### EGH103 Electrical Principles & Circuits [60 hours]

This module aims to familiarise students with the fundamentals of DC and AC electrical circuits. Students will learn the relevant electrical principles, electrical safety rules, DC and AC basic electrical quantifications as well as AC to DC conversion. At the end of the module, students will be able to select appropriate methods to solve electrical circuits and apply electrical safety rules relevant to electrical equipment and systems.

# EGH104 3D CAD Modelling [45 hours]

This module provides students the fundamental knowledge of basic 3D modelling and 2D drafting skills. Topics covered include Solid Modelling and Drafting and Documentation to equip the students with the necessary skills in communicating design ideas and concepts. The module equipped students with knowledge of the universal graphic language and documentation standards essential for engineering components and systems design used in engineering industry.

### EGH105 Communication Skills [30 hours]

This module aims to give students a broad understanding of the communication process and the interpersonal communication skills to interact effectively with others. Students will also practise oral presentation skills so that they can become effective presenters. In addition, students will recognise the various forms of writing skills – technical, proposal and report – required in a professional environment. Therefore by the end of the module, students will be able to demonstrate effective communication, interpersonal, presentation and writing skills in social and work environments.

#### EGH106 Physics [60 hours]

This module provides students with fundamental basic concepts of physics and covers how to apply physics in technology development such as biomedical and material science applications. The module covers measurement, kinematics, dynamics, energy, thermal physics, wave theory, solid-state devices and electromagnetism. By the end of this module, students will have a good grasp of basic physics science knowledge. Knowledge acquired also serves as a foundation for advanced modules in the field of biomedical engineering and material science.

#### EGH107 Calculus [60 hours]

This module provides students with the essential knowledge in calculus and analytical skills for solving engineering problems encountered in their course of study. It also serves as a foundation for advanced topics in the second year. Topics include concept of limits; derivatives of polynomial, trigonometric, inverse trigonometric, exponential and logarithmic functions; indefinite and definite integrals of common engineering functions; and differentiation and integration with engineering applications.

#### EGH108 Inorganic & Physical Chemistry [75 hours]

The module provides students with essential knowledge that covers the general chemistry involving ideal gas laws, thermochemistry, phase diagrams, the principles of physical chemistry and the

reactions and properties of inorganic compounds. Also included in the module are atomic structure and trends, chemical bonding, chemical equilibrium, kinetics, electrochemistry and reactions, and chemistry of solutions including acids and bases. By the end of this module, students should have firm understanding of the atomic structure and bonding of inorganic matter, the physical chemistry and reactions of inorganic compounds. The knowledge acquired serve as foundation for other advanced modules in nanotechnology, materials synthesis, advanced materials science and engineering.

### EGH109 Mechanics - Statics [60 hours]

This module provides students with basic knowledge of mechanics that includes Newton's 3 laws, statics of rigid bodies in 2-D, friction, stress and strain, moment of inertia, bending moments and shear forces in beams, and torsion of shafts. At the end of this module, students will be able to analyse and solve problems related to engineering statics applications.

### EGH110 Biomaterials [60 hours]

This module provides students with basic knowledge of biomaterials science. The module covers the basic requirements of biomaterials, their microstructures, chemical bonds and material properties. The different types of biomaterials including metals, polymers, ceramics and composites which are commonly used in the production of medical devices will be covered. The topics covered will provide students with the necessary knowledge that is pertinent to the selection of appropriate biomaterials for the design and development of biomedical devices.

#### EGH111 Computer Programming [60 hours]

This module focuses on providing students a firm foundation in computer programming. It teaches skills in designing algorithms/flowcharts, formatting variables for data processing and analysis, and carrying out structured and modular programming and software testing/debugging in C programming language. It provides the necessary knowhow to develop complete programs according to design requirements. The module serves as a foundation in areas of electronics & image processing.

### EGH113 Introduction to Engineering [60 hours]

This module is designed to develop students' interest in engineering. Topics covered include the purpose of engineering, the roles that engineers play in society, career possibilities, and basics in electronics and mechanical systems. Assignments and projects related to building basic biomedical devices will be given in this module, which will require the application of knowledge in these areas. Knowledge acquired serves as a foundation for advanced modules in the field of mechanical and electrical engineering.

#### EGH114 Introduction to Biomedical Manufacturing Processes [30 hours]

This module provides students with knowledge and skills of biomedical manufacturing technology. It covers manufacturing processes in medical devices, pharmaceutics and biotechnology. The knowledge and skills acquired will serve as a foundation for modules related to the biomedical manufacturing industry.

#### EGH201 Mathematics 2A [60 hours]

This module provides students with the basic theory of ordinary differential equations and Laplace transform. The module focuses on differential equations that arise in practice and the emphasis will be on solving these equations and understanding the possible behaviours of solutions. Topics covered include partial derivatives, first and second order differential equation and their applications, numerical approximation to solutions of differential equations, Laplace transform and

applications. At the end of the module, students will be able to demonstrate a sound knowledge of a range of techniques for solving linear ordinary differential equations and apply them to solve reallife problems in engineering.

# EGH202 Anatomy & Physiology [60 hours]

This module aims at introducing to students the basic structure and functions of the human body. It covers the organisation of functional systems of the human body as a whole, and the anatomy and physiology of individual systems such as the nervous, endocrine, blood, cardiovascular, respiratory, gastrointestinal, urinary, musculoskeletal, integumentary and immune systems. The knowledge acquired will serve as a tool to enable engineers to design or improve biomedical products.

# EGH203 Biomedical Engineering Design [60 hours]

This module provides students with the fundamentals of design engineering. The module covers topics like engineering design process, stress and strain analysis, calculating beam deflection, designing for static and fatigue strength, determining fits and tolerances, selection of commonly used machine elements and designing with plastics. Assignments and design projects related to biomedical devices will require the application of knowledge in these areas. Knowledge acquired serves as a foundation for advanced modules in the field of mechanical design in biomedical engineering.

# EGH204 Organic Chemistry [60 hours]

Students of this module will gain fundamental knowledge of organic chemistry. By understanding the bonding and geometry of the main functional chemical groups students will be able to predict reactions and specify reaction mechanisms. Laboratory classes will further enhance the key concepts and students will develop practical chemical skills. This module prepares students to apply chemical knowledge to biological and environmental systems and industry practices.

# EGH205 Microcontroller Applications [60 hours]

This module introduces the application design and development process for an embedded microcontroller system. Students will learn to develop microcontroller application programmes using high-level 'C' programming language. Concepts covered in microcontroller programming are I/O programming, peripherals programming and interrupt handlings. Case studies will be used to illustrate the fundamental building blocks of a microcontroller system and how they are interrelated. All illustrations through programming will be done in the 'C' language.

# EGH206 Biomedical Project 1 [30 hours]

This module provides students with a series of structured biomedical design project assignments. Students will learn to apply the knowledge, techniques, skills and modern tools appropriate to these structured biomedical design applications. Through this module, Students are able to identify, analyse, and solve engineering technology problems, function effectively and innovatively as a member of a project team, and communicating their ideas and solutions effectively through written, oral, and graphical presentations.

# EGH207 Mathematics 2B [60 hours]

This module provides students with the necessary mathematical training that will assist and expand their experiences within their discipline of study. The module contains two parts. The first part focuses on Fourier analysis and discusses how periodic signals in the time domain can be represented in the frequency domain. The aim of the second part is to give students a working knowledge of statistical concepts so that statistical reasoning can be correctly applied to experimental results and their statistical significance discussed. Topics include Fourier series, probability concepts, probability distribution (Binomial, Poisson and Normal), sampling distributions, estimation and linear regression. At the end of the module, students will be able to demonstrate a sound knowledge of the mathematical training and apply them to solve real-life problems in engineering.

### EGH208 Biomedical Electronics [60 hours]

This module provides students with knowledge of the principles of electronic devices. Students will learn to describe the basic functions and operational principles of electronic devices including transistors, amplifiers, digital circuits, digital-to-analogue and analogue-to-digital converters. Students will also learn to conduct standard tests and measurements of electronic devices. Through this module, students will apply their knowledge to conduct, analyse and interpret biomedical electronics experiments.

#### EGH209 Thermofluids [60 hours]

This module introduces the fundamentals of thermodynamics, heat transfer and fluid mechanics. In the topics of thermodynamics and heat transfer, the properties of pure substances and ideal gases, laws of thermodynamics and processes of heat transfer are introduced. In the topics of fluid mechanics, the properties of fluids, the concepts and basic equations of fluid statics and fluid flow are covered. At the end of the module, students will be able to appreciate and utilise their knowledge to analyse and solve problems relating to fluid statics, fluids in motion, heat transfer and laws of thermodynamics and properties of pure substances and ideal gases.

#### EGH210 Biomaterials 2 [60 hours]

This module provides students with knowledge of biomaterials syntheses, engineering and applications. Topics covered include the processes used to synthesise the various types of biomaterials, the manufacturing processes to convert the raw materials into finished medical products and the applications of the various types of materials in medicine. Other topics include the types of tests used to assess the biocompatibility of potential biomaterials, advanced applications of biomaterials, such as in the area of regenerative medicine. Such knowledge serves as a foundation for advanced modules in biomedical device design and manufacturing. This module will train students to able to choose relevant biomaterials for biomedical device/product in the industry.

#### EGH211 Medical Imaging [60 hours]

This module provides students with a comprehensive understanding of the current technology and applications available in medical imaging and imparts practical skills in image processing. This module covers major medical imaging modalities and image processing techniques. The medical imaging modalities includes: computerised tomography (CT), X-ray, ultrasound and magnetic resonance imaging (MRI), positron emission tomography (PET) and nuclear medicine. The processing techniques includes: image restoration, image enhancement, image compression and image segmentation. This module provides the students with the necessary knowledge that is pertinent to state-of-art medical imaging diagnostic equipment and image processing techniques.

#### EGH212 Biomedical Project 2 [30 hours]

This module is designed to develop students' development skills in applying Information Technology knowledge to design & develop solutions to perform data processing. It consists of tasks involving data processing for students to complete. By the end of this module, student will be able to construct software solutions to do perform data manipulation/processing.

### EGH215 Automatic Control [60 hours]

This module equips students with the application knowledge of pneumatics, electro-pneumatic control and basic circuit protection device and programmable logic controller. This module will train students to be able to design and develop electro-pneumatic circuit and ladder logic program for programmable logic controller which are widely used in the industry to control the automation equipment or system.

### EGH216 Good Manufacturing Practice [60 hours]

This module introduces the various aspects of Good Manufacturing Practice (GMP) in medical devices, biologics and pharmaceutical industry. Topics covered applications of GMP in manufacturing operations, documentation, requirements of production batch records, cleanroom monitoring, clean utilities, validation and GMP facility management. Practical experience in real-life working environment will also be provided. The focus of this module is on how GMP knowledge can be applied and integrated in the manufacturing processes of medical device, biologics and pharmaceutical industries in meeting various regulatory requirements.

# EGH301 Medical Device Design [60 hours]

This module equips the students with the skills and knowledge to design and develop medical and assistive devices. It enables students to apply their knowledge of engineering design and computer aided modelling skills to medical and assistive product design. Topics covered include the design methodology, computer-aided design, physical modelling and experimentation techniques. This module will enable the students to work as product design and development engineers in the industry, in particular, the biomedical and healthcare industries.

### EGH302 Biomedical Instrumentation [60 hours]

This module provides students with knowledge of the operational principles of common biomedical instruments. Topics covered include biomedical sensors, physiological signal processing & analysis measurement techniques and medical instrument development & certification. By the end of the module, students will be able to apply the knowledge and skills learnt to medical instrument design, development and testing to meet the needs of the industry.

#### EGH303 Biomedical Project 3 [60 hours]

This module is designed to develop the skills and knowledge in the various aspects of technopreneurship, where students are expected to complete an assignment, with special emphasis on biomedical engineering-related applications. Students will research on project engineering including emphasis on information gathering, usability, robustness of design, costing analysis, business entity and structure, business plan and its various components, and intellectual property protection. The focus is on applying the technopreneurship skills into the creation process for biomedical engineering-related applications. The student will be able to write a business plan and design an innovative product.

#### EGH304 Professional & Interpersonal Communication Skills [30 hours]

This module aims to help students understand and acquire communication skills for their entry into the job market as working professionals. It focuses on job search skills and includes resume and cover letter writing, as well as interview skills. Students will gain insight into change management, organisational structure and corporate culture. They will also learn about business correspondence. In all, students will gain competence in job search skills and adaptability to the work environment of the relevant industry.

#### EGH305 Medical Device Validation [60 hours]

This module is designed to foster an understanding of the design and process validation that is a requisite of all recognised Quality Systems. The module covers include an overview of regulations that guides the medical devices industry, product and process development with elements of verification and validation, validation of computerised equipment, test method development and change control. This enables students with a thorough grounding on the principles and techniques of medical device design and process validation for the medical device industry.

### EGH306 Biosignal Processing & Analysis [60 hours]

This module will introduce students to signal processing circuits such as signal conversion, signal amplification, isolation, buffering and filtering. Basic concepts of digital signal processing such as sampling and quantisation, discrete-time signals and systems, convolution, Fourier transform, spectral analysis and digital filter design are applied to the analysis of biomedical signals such as ECG (electrography), EMG (electromyography) and EEG (electroencephalography) are also covered. Students will be able to utilise their knowledge to design for removal of artefacts from ECG signals as case studies. These skills are needed in the biomedical industry.

### EGH308 Diagnostic Image Processing & Visualization [60 hours]

This module provides students with the essential knowledge of performing image analysis and visualization on 2D/3D medical images. This module covers major 2D and 3D medical image analysis algorithms and visualization techniques. The medical image analysis algorithms include: image segmentation, registration, enhancement and compression. The visualization techniques include: 3D surface rendering and ray casting volume rendering. This module will train students to be able to design and develop software solution to analyse and visualize 2D and 3D medical images in healthcare and biomedical research industry.

# EGH309 Quality Management System [60 hours]

This module provides students with the essential knowledge of quality management system. The module covers the fundamental of metrology, quality control activities, basic statistics, statistical quality control and quality management systems. By the end of the module, students should have a firm grasp of good measurement practices and apply appropriate statistical technique to verify product conformity against given specification. The focus is to applied suitable statistical process control method for critical process monitoring and analysis to solve problems in the biomedical industry.

# EGH310 Biomedical Manufacturing Technology [60 hours]

This module enables students with essential knowledge applicable for the biomedical manufacturing industry. It covers cleanroom technology, microengineering technology, distributed computer control system and automated manufacturing technology and processes. In addition, students will learn basic biomedical processes, such as passivation, sterilisation, chromatography and cell culture, and utilities in biopharmaceutical and life sciences applications. The aim is to apply the knowledge acquired in the biomedical and pharmaceutical industries.

# EGH311 Medical Device Regulatory Compliance [60 hours]

This module is designed to foster an understanding of key essential concepts on regulatory compliance for medical devices. The use of medical device is highly regulated and the understandings of various regulations provide a useful guide in product and process development. Coverage include various regulations and quality analytical techniques required by medical devices industry in the area of design & development, production, sterilization, distribution, product registration/submission, adverse reporting, and post market surveillance. This module provides

students with knowledge of various regulatory concepts and the use of various tools to ensure the safety of medical devices.

# EGH312 Healthcare Analytics [60 hours]

This module aims to provide a comprehensive understanding of the methods for analyzing data and how the analytical results are presented and used for making decisions in the healthcare industry. The module will cover the IT methodologies, tools and systems for gathering, analyzing and visualizing data in the healthcare context. Students will be equipped with essential IT knowledge in assisting decision making at various levels, including those of administrators, care providers and researchers, to leverage on the large volume of data flowing through healthcare information systems.

#### EGH314 Automation Control Technology [60 hours]

This module introduces the application design and development process for programmable logic controller system. Students with the knowledge of electro pneumatic, electrical control devices, sensors and programmable logic controller will learn to develop application programmes which are widely used in the industry to control the automation equipment or system.

#### EGH323 Internship Programme [12 weeks]

This module enables students to enhance their learning by relating and applying their knowledge and skills to practice in real-life work environments. This will allow students to gain work-centred knowledge and skills, and work-related experiences. In addition, they will acquire important work values which include being responsible and positive, and exercising integrity, work ethics and interpersonal communication skills. Through this work-based experiential program, they will be better prepared for entry into the workforce.

#### EGH324 Full-Time Semestral Project [12 weeks]

This module enables students to put into practice the knowledge and skills they have acquired from the course to develop solutions for real-life applications. Projects will be assigned to students who will work under staff supervision to develop and produce the desired project deliverables. In addition to equipping the students with technical and soft skills for project development, this module will enable students to develop problem-solving skills and instil the habit of lifelong learning to prepare them for entry into the workforce.

#### EGH325 Internship Programme [24 weeks]

This module enables students to put into practice the knowledge and skills that they have acquired from the course in real-life work environments. The students will be assigned work tasks or projects, with clear learning outcomes that are relevant to their courses and intended job roles, during the internship. The students will be guided by mentors from the industry and NYP to help them perform on the job and to achieve the learning outcomes. This will allow students to gain work-centred knowledge and skills, and work-related experiences. In addition, they will acquire important work values and ethics which include being responsible and positive, as well as taking initiative and exercising integrity. Through this work-based experiential programme, students will be better prepared for work and life.

#### EGH326 Overseas Internship Programme [24 weeks]

This module enables students to put into practice the knowledge and skills that they have acquired from the course in real-life work applications. During the overseas internship, students will be assigned work tasks or projects that are relevant to their courses and intended job roles. The students will be guided by mentors from the industry, company or institution to help them perform

on the projects or tasks. This will allow students to gain project- or task-related knowledge, skills, and experiences. In addition, they will acquire important work values and ethics which include being responsible and positive, as well as taking initiative and exercising integrity. This module will also enable students to develop problem-solving skills, instil the habit of lifelong learning and develop a global mindset to prepare them for entry into the workforce.

# **END OF DOCUMENT**