A unique diploma that SoE offers is the Diploma in Engineering Science which equips students with a strong foundation in applied sciences for academic progression, and multidisciplinary skillsets for career development. There is also the Engineering with Business Management Programme which is jointly run by SoE and the School of Business & Accountancy.

**COURSES OFFERED**

SoE offers a total of 12 full-time diplomas. They are:
- Aerospace Electronics (AE)
- Aerospace Technology (AT)
- Audio-visual Technology (AVT)
- Automation & Mechatronic Systems (AMS)
- Biomedical Engineering (BME)
- Clean Energy Management (CEM)
- Electrical Engineering (EE)
- Electronic & Computer Engineering (ECE)
- Engineering Science (ES)
- Marine & Offshore Technology (MOT)
- Mechanical Engineering (ME)
- Network Systems & Security (NSS)

An important aspect of Ngee Ann’s engineering diplomas is the option for graduating students to participate in either an internship or an in-house Project Design & Development (PDD) module.

Internships give our students invaluable experiential learning by providing them with the opportunity to apply the knowledge and skills they have gained in the classroom in real-world settings. This will better prepare them for their future careers. The PDD module offers intensive learning projects that require significant planning and implementation effort. It places emphasis on developing projects that lead to useful solutions for industry.

**ENGINEERING WITH BUSINESS MANAGEMENT PROGRAMME**

Students who are interested in both engineering and business studies can have the best of both worlds when they enrol in the Engineering with Business Management Programme (EBM).

Traditionally, students who wish to pursue an engineering diploma have to choose a specific engineering discipline during the application process. However, with EBM, students can choose their preferred engineering discipline towards the end of their first semester in Year 1. This allows them to gain a better understanding of the various disciplines before making a more informed decision.

Besides enjoying this flexibility, EBM students also take business management modules delivered by the School of Business & Accountancy. The broader curriculum is geared towards training students to be new age engineers with the vision for business leadership.

Under this EBM programme, students will have a choice of nine diplomas to graduate in:
- Aerospace Electronics
- Aerospace Technology
- Audio-visual Technology
- Automation & Mechatronic Systems
- Biomedical Engineering
- Electrical Engineering
- Electronic & Computer Engineering
- Marine & Offshore Technology
- Mechanical Engineering

The School of Engineering (SoE) is the largest academic school in Ngee Ann Polytechnic. It offers a total of 12 diplomas and one special programme.
All first-year students taking the above engineering courses, including those who opt for EBM, will share a common curriculum in the first semester. Towards the end of the first semester, EBM freshmen will choose their preferred engineering courses.

DIPLOMA PLUS PROGRAMME

The Diploma Plus Programme (DPP) is designed to help students with proficiency in a specific domain area, to either enhance their knowledge and skills in their main discipline of study, or equip them with additional professional knowledge that better prepares them for further studies and future careers.

SoE students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. The DPP clusters offered by SoE are:

- Advanced Engineering Mathematics
- Applied Physics
- Aviation Fundamentals
- Biomedical Engineering
- Computer-Aided Design Skills
- Computer & Communication Systems
- Industrial Control
- Mechatronics Application Skills
- Stage Management & Technology
- Workplace Safety & Health

For a description of the modules within each elective cluster, please refer to page 193. For details on the specific clusters available to different diplomas, please refer to the Course Modules Section of each diploma under the Diploma Plus Programme.

SoE students can also pursue Diploma Plus Certificates in Advanced Engineering Mathematics, Business, Innovation Management and Foreign Languages, which are offered by other academic schools in Ngee Ann.

MAJOR ACHIEVEMENTS

Staff from the Electrical Engineering Division secured about $280,000 in funding from the Ministry of Education (MOE) Translational R&D and Innovation Fund (TIF) for a project that explores turning grid-tied photovoltaic systems into an autonomous mini-grid power system. This keeps the solar power on during grid disturbances and maintains an uninterruptible flow of energy when the grid is down. They also received another grant of $130,000 from the Social Innovation Research Fund for developing a computerised portable test system to analyse the probability of falls among the elderly. The system will be jointly developed with Khoo Teck Puat Hospital’s senior consultants.

Two Biomedical Engineering students developed a unique exoskeleton system to improve the rehabilitation of stroke victims who are paralysed on one side of the body. Unlike conventional arm rehabilitation systems, where movements are limited to the machine’s programmes, the students’ exoskeleton system is more flexible as it is controlled by the patient himself. When a patient moves the good arm on his own, the exoskeleton automatically drives the paralysed arm to follow the action.

Mechanical Engineering students developed an unmanned solar-powered boat with sensors that monitor water quality. The vessel was designed to save manpower and time as only one person is required to operate it by wireless control and communication. It is used by the Waterways Watch Society to perform real-time in-situ measurement of the quality of water in the Marina Reservoir and surrounding catchment areas.

FACILITIES & STAFF

SoE students can look forward to a conducive and engaging learning environment. Depending on the course of study, students will get the opportunity to work in one or more technology and expertise areas such as:

- Aerospace
- Automation, Control & Instrumentation
- Audio-visual
- Automotive Technology & Motor Sports
- Bioengineering
- Design & Rapid Prototyping
- Digital Audio & Video Broadcast
- Electronics
- Energy Systems
- Green Building
- IT & Networking
- Marine & Offshore
- Micro-electromechanical Systems
- Photonics & Lasers
- Product & Industrial Design
- Robotics
- Solar Energy
- Wafer Fabrication
- Wind Technology
- Wireless Communication Systems

Students are involved in developing projects and applying state-of-the-art technologies. This is made possible by a pool of highly qualified and dedicated
lecturers and technical support staff who hold relevant post-graduate degrees and industry experience in their respective engineering fields. SoE strongly promotes the culture of continuous learning and collaborations with local and overseas partners so that staff can keep abreast of the latest technological developments. For example, SoE lecturers often work with their counterparts from local and overseas research and educational institutions to publish books, craft articles for journals and present papers at conferences. In doing so, we ensure that our curricula remain up-to-date and relevant.

To support our staff and students’ quest for excellence in technology capability development, SoE is equipped with some of the latest facilities, such as:

- Aerospace Hub
- Alpha Centre (for Robotics)
- Assistive Technology Centre
- Automation & Integrated System Centre
- Biomechanic Centre
- Biomedical Engineering Centre
- Bluetooth Laboratory
- Design & Rapid Prototyping Centre
- Digital Signal Processing Centre
- Energy & Environment Centre
- Frontline | AeroScout - Enterprise Visibility Solution Centre
- High Voltage Training Centre
- Instrumentation & Control Centre
- Internetworking Technology Laboratory
- Marine Technology Laboratory
- Microelectronics Design & Application Laboratory
- Centre for Applied Photonics & Laser Technology
- Power Quality Centre
- Radio Frequency Laboratory
- Solar Technology Centre
- Wind Technology Training Centre

**COLLABORATIONS**

SoE has forged numerous collaborations with various partners including educational institutions such as the National University of Singapore and Nanyang Technological University as well as overseas universities in the UK, Japan, Australia, China, South Korea and Malaysia.

SoE also boasts industry partners such as SingTel, SIA Engineering, Airbus Helicopters Southeast Asia, Keppel Corporation, Sembcorp Industries, Singapore Technologies Engineering, Tan Tock Seng Hospital, Cisco Systems, National Instruments and IBM, as well as government agencies. These partnerships provide opportunities for SoE staff and students to engage in joint research and consultancy projects, skills and technology transfer, training, and internships.

For example, the School of Engineering also sealed an agreement with Thales Solutions Asia Pte Ltd to enhance internship opportunities for Aerospace Electronics students. The memorandum of understanding (MOU) also facilitates project and research collaborations.

Students from the Diploma in Automation & Mechatronic Systems will be better equipped to meet the needs of the port industry, thanks to an MOU signed with PSA Corporation Ltd in March 2014. Under this agreement, new relevant engineering modules were developed. In addition, students from the diploma can also apply for scholarships and secure internship placements at PSA.

A collaboration between SoE and Alexandra Health has paved the way for Electrical Engineering students to work with the staff from Khoo Teck Puat Hospital to develop healthcare solutions for its patients.
With the Diploma in Aerospace Electronics (AE), students will acquire core engineering knowledge and skills with a specialisation in aviation electronics. This encompasses the knowledge and skill sets needed for Maintenance, Repair & Overhaul (MRO) work of modern commercial aircraft. AE involves the application of electronics to aviation. It deals with all the electronics on board modern aircraft including communication, navigation, surveillance, flight control, flight instruments, in-flight entertainment, microprocessor, sensor and electrical systems.

AE equips students with the knowledge and skills to excel in the fields of applied aerospace electronic engineering. Final-year students work in teams to design and build exciting and challenging aerospace and electronics projects such as remote control airships with GPS capabilities and smart electronic systems. With these projects, students can participate in national competitions organised by Singapore Science Centre and Civil Aviation Authority of Singapore (CAAS). Students may also work on collaborative industry-based projects with leading aerospace companies. Final-year students can also pursue a six-month internship with leading aerospace companies such as ST Aerospace, Airbus Helicopters South East Asia, Thales Solutions Asia, Rockwell Collins, the Republic of Singapore Air Force and SIA Engineering.

AE students learn about the theory of flight, as well as how modern aircraft navigate and communicate. AE students will also learn how to fly an aircraft using realistic flight simulators. For students who aspire to obtain their Aircraft Maintenance Engineer licences sooner, the AE curriculum is designed to keep pace with aerospace industry practices as well as meet the Singapore Airworthiness Requirements (SAR 66) standard, as stipulated by the CAAS. For those aspiring to have a good head-start in their flying career, the AE curriculum is also aligned with the Air Transport Pilot Licence (ATPL) ground theory examination requirements. The ATPL is the highest level of aircraft pilot licence, and those certified as airline transport pilots can become pilots-in-command of commercial aircraft.

AE also offers an alternative pathway for those who prefer to read more business modules. In Year 2, students can sign up for our Minor in Business Management. Taught by Ngee Ann Polytechnic’s School of Business & Accountancy, the Minor in Business Management modules cover topics such as financial management, marketing and entrepreneurship.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component)</td>
<td>1-6</td>
</tr>
<tr>
<td>or Biotechnology</td>
<td></td>
</tr>
<tr>
<td>or Computer Studies</td>
<td></td>
</tr>
<tr>
<td>or Design &amp; Technology</td>
<td></td>
</tr>
<tr>
<td>or Fundamentals of Electronics</td>
<td></td>
</tr>
</tbody>
</table>

You must also fulfill the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency including colour vision deficiency should not apply for the course.

CAREER PROSPECTS

With over 100 aerospace companies that serve global and regional markets based in Singapore, your job prospects are bright. Graduates can work in the aerospace and electronics industries, in areas such as engineering and maintenance support, research and development, and sales and marketing, to name a few.

AE curriculum’s alignment with SAR 66 requirements gives graduates a head start should they decide to become a Licenced Aircraft Maintenance Engineer. At the same time, by acquiring the basics of flying skills using the Cessna flight simulator, graduates will enjoy an advantage if they decide to pursue a career in flying. A number of AE graduates have joined the Republic of Singapore Air Force as trainee pilots.

Subject ‘O’ Level Grade

<table>
<thead>
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<tbody>
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<tr>
<td>or Biotechnology</td>
<td></td>
</tr>
<tr>
<td>or Computer Studies</td>
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</tr>
<tr>
<td>or Design &amp; Technology</td>
<td></td>
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<tr>
<td>or Fundamentals of Electronics</td>
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ACCREDITATION FOR FURTHER STUDIES

AE graduates can pursue an avionics or aerospace-related degree at the Singapore Institute of Technology, SIM University or one of the following overseas universities:

- Embry Riddle Aeronautical University (USA)
- Queensland University of Technology (Australia)
- University of Bath (UK)
- University of Bristol (UK)
- University of Glasgow (UK)

Alternatively, graduates can choose to pursue electrical, electronics, computer and other related engineering degrees with advanced standing at both local and overseas universities.

COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR 1</td>
<td></td>
</tr>
<tr>
<td>Level 1.1 (25 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Avionics Systems</td>
<td>3</td>
</tr>
<tr>
<td>Electrical Technology</td>
<td>4</td>
</tr>
<tr>
<td>Electronic Measurement &amp; Prototyping Skills</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Level 1.2 (25 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>Digital Logic</td>
<td>3</td>
</tr>
<tr>
<td>Discrete Analogue Electronics</td>
<td>6</td>
</tr>
<tr>
<td>Engineering Mathematics 2</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Aerospace Technology</td>
<td>3</td>
</tr>
<tr>
<td>Innovation Toolkit 2^</td>
<td>2</td>
</tr>
<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td>YEAR 2</td>
<td></td>
</tr>
<tr>
<td>Level 2.1 (24 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Aircraft Maintenance Practices</td>
<td>3</td>
</tr>
<tr>
<td>Applications Programming</td>
<td>4</td>
</tr>
<tr>
<td>Digital Electronics</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design Prototyping 1</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 3A</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Physics</td>
<td>3</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.2 (26 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Aircraft Materials</td>
<td>3</td>
</tr>
<tr>
<td>Analogue Circuit Design &amp; Applications</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design Prototyping 2</td>
<td>4</td>
</tr>
<tr>
<td>Human Factors</td>
<td>2</td>
</tr>
<tr>
<td>Microcontroller Programming &amp; Interfacing</td>
<td>5</td>
</tr>
<tr>
<td>Telecommunication Principles</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>YEAR 3 (Internship)</td>
<td></td>
</tr>
<tr>
<td>Level 3.1 (24 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Aircraft Electrical &amp; Instrumentation Systems</td>
<td>5</td>
</tr>
<tr>
<td>Aircraft Navigation &amp; Communication Systems</td>
<td>5</td>
</tr>
<tr>
<td>Avionics Project Design</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Level 3.2 (22 hours per week)</td>
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<tr>
<td>Six-month Internship</td>
<td>22</td>
</tr>
<tr>
<td>YEAR 3 (Non-Internship)</td>
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<tr>
<td>Level 3.1 (23 hours per week)</td>
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</tr>
<tr>
<td>Aerospace System Design</td>
<td>4</td>
</tr>
<tr>
<td>Aircraft Electrical &amp; Instrumentation Systems</td>
<td>5</td>
</tr>
<tr>
<td>Project Design &amp; Development 1</td>
<td>10</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Level 3.2 (22 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Six-month Internship</td>
<td>22</td>
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MINOR IN BUSINESS MANAGEMENT

Year 2

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td>Level 2.1 (24 hours per week)</td>
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<tr>
<td>Applications Programming</td>
<td>4</td>
</tr>
<tr>
<td>Digital Electronics</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design Prototyping 1</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 3A</td>
<td>4</td>
</tr>
<tr>
<td>Fundamentals of Financial Management</td>
<td>4</td>
</tr>
<tr>
<td>Human Factors</td>
<td>2</td>
</tr>
<tr>
<td>Business &amp; the Economy^</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.2 (25 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Analogue Circuit Design &amp; Applications</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design Prototyping 2</td>
<td>4</td>
</tr>
<tr>
<td>Marketing Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>Microcontroller Programming &amp; Interfacing</td>
<td>5</td>
</tr>
<tr>
<td>Telecommunication Principles</td>
<td>5</td>
</tr>
<tr>
<td>Effective People Management^</td>
<td>2</td>
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</tbody>
</table>

YEAR 3 (Internship)

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3.1 (26 hours per week)</td>
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<tr>
<td>Aerospace System Design</td>
<td>4</td>
</tr>
<tr>
<td>Aircraft Electrical &amp; Instrumentation Systems</td>
<td>5</td>
</tr>
<tr>
<td>Aircraft Navigation &amp; Communication Systems</td>
<td>5</td>
</tr>
<tr>
<td>Business Management Elective</td>
<td>4</td>
</tr>
<tr>
<td>Starting &amp; Managing an Enterprise</td>
<td>4</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Six-month Internship</td>
<td>22</td>
</tr>
</tbody>
</table>
**COURSE MODULES**

**LEVEL 1.1**

**Avionics Systems**
This module provides students with an appreciation of aircraft electronic systems. It includes topics such as cockpit instrumentation, aircraft navigation, communication, surveillance, control and lighting electronics. This module equips students with the knowledge required for the advanced modules on Aircraft Navigation and Communication Systems (ANCS) and Aircraft Electrical & Instrumentation Systems (AEIS).

**Electrical Technology**
This module introduces the necessary foundation for electrical circuit analysis covering electrical theorems and techniques for analysing and solving direct and alternating current circuit problems. Laboratory assignments include basic electrical measurement skills and concepts learnt in lectures and tutorials.

**Electronic Measurement & Prototyping Skills**
This module equips students with the necessary hands-on practical skills in electronic circuit construction and measurements. Students will be introduced basic practical skills such as soldering, identification of components and use of various electronic instruments.

**Engineering Mathematics 1**
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

**Engineering Mechanics**
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics of linear and rotational motion, and Kinetics of linear and rotational motion.

**LEVEL 1.2**

**Computer Programming**
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. Upon completion of the module, students will be able to explain and write C programs for simple engineering applications.

**Digital Logic**
This module provides students with the fundamental knowledge and skills in logic design. Students will learn about the combinational and sequential logics and how to design and use them to control digital systems. A project will be used to reinforce students’ learning and help them to relate their learning to real-life examples.

**Discrete Analogue Electronics**
The aim of this module is to lay a foundation in electronics. It will cover concepts pertaining to analogue devices. With the fundamentals of basic circuit theory frequently revisited, the module will deal with the operating characteristics, working principles and applications of discrete electronic devices such as the various types of diodes, MOSFETs and BJTs. Practical circuits will be used to enhance and strengthen...
the students’ knowledge so that they will acquire the relevant competencies to move on to more specialised modules. This module is the pre-requisite for the Analogue Circuit Design and Applications module.

**Engineering Mathematics 2**
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

**Fundamentals of Aerospace Technology**
This activity-based module introduces students to the basics of aerodynamics and principles of flight and traces the development of the aerospace technology. It highlights the nature and scope of the aerospace industry, and the broad technical training for the profession. The module aims to create professional awareness in students.

**LEVEL 2.1**

**Aircraft Maintenance Practices**
This module helps students become familiar with the workshop as well as inculcates good workshop practices. It covers various soldering methods such as welding, brazing, soldering and bonding, aircraft weight and balance, aircraft handling and storage, disassembly, inspection, repair and assembly techniques, and maintenance procedure.

**Applications Programming**
This practice-oriented module equips students with the fundamental knowledge and skills required to develop Windows applications. The students will develop conceptual understanding to design and develop applications to solve business and engineering problems. Main topics include branch and loop, array, data files accessing and methods.

**Digital Electronics**
This module covers the fundamentals of digital electronics. The basic principles and techniques of digital system and design are covered. It is also prepares students for subsequent modules that discuss microprocessors and microcomputers. The main topics covered are number systems, Boolean Algebra, combinational logic circuits and minisation techniques, flip-flops and multivibrators, IC counters, and data handling devices. Characteristics of standard TTL and high speed CMOS are also discussed.

**Electronic Design Prototyping 1**
This module builds upon the skills learned in the Electronic Measurement and Prototyping Skills module. The main objectives of this module are electronic circuit construction, measurement and simple troubleshooting techniques. Students will be introduced to Computer-aided design (CAD) tools to design printed circuit board (PCB) of simple circuits.

**Engineering Mathematics 3A**
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

**Engineering Physics**
This module provides understanding of engineering physics theories such as angular kinematics, universal gravitation and fluid mechanics. It also provides the laws and applications of thermodynamics. Moreover, it explains the kinetic theory of gases and introduces the fundamentals of heat engines.

**Fundamentals of Financial Management**
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

**Human Factors**
This module introduces students to human factors and how they affect performance at work. Topics include social psychology, physical environment, types of tasks, communication and human errors, with special reference to the aerospace industry.

**LEVEL 2.2**

**Aircraft Materials**
The module covers the family of common engineering materials comprising metals, ceramics, polymers and composites, with an emphasis on the structures, properties, performance and processing of such materials. Corrosion & various fasteners components are included. Learning is enhanced by laboratory work on microstructures and mechanical testing.

**Analogue Circuit Design & Applications**
This module introduces students to the operating principles of commonly used analogue devices and circuits, such as operational amplifiers, oscillators and filters. Applications in various practical circuits are also illustrated.

**Electronic Design Prototyping 2**
This module builds upon the skills learned in the module, Electronic Design Prototyping 1. The main objectives of this module are to introduce prototyping and testing techniques, fault simulation and fault finding used in electronic project design. Students will also use CAD tools to design PCB of more complex circuits.

**Human Factors**
This module introduces students to human factors and
how they affect performance at work. Topics include social psychology, physical environment, types of tasks, communication and human errors, with special reference to the aerospace industry.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

Microcontroller Programming & Interfacing
This module introduces students to the fundamentals of microcontroller programming and interfacing. C language programming is used to illustrate the operation of the microcontroller. Interfacing the microcontroller to basic input-output devices such as switches, LEDs, 7-segment displays and keypads help to demonstrate the behaviour of the application software running on a working system.

Telecommunication Principles
This module introduces students to radio communication. It builds an understanding of the basic concepts of analogue communication systems. The characteristics of a basic communication system and the environmental factors that affect communication will be discussed. The concepts that are necessary for an understanding of linear systems will be explained, with an emphasis on resonance and filters. Students will be taught the fundamental concepts of analogue modulation and demodulation techniques such as AM and FM and their applications.

LEVELS 3.1 & 3.2
Aircraft Electrical & Instrumentation Systems
This module examines the theory of operations and the functional description of aircraft instrument and electrical systems found in the modern aircraft. Students will also learn about the auto flight, flight control and management systems, emergency electronics, and cabin entertainment system.

Aircraft Navigation & Communication Systems
This module provides students with the theory of operations and the functional description of airborne navigation and communication systems found in modern aircraft. Systems covered include ADF, VOR, DME, IRS, HF & VHF. The standard digital data-bus communications protocol, such as ARINC 429 and ARINC 629 used by commercial aircraft and MIL-STD-1553B used by military aircraft, will also be discussed. Radio Frequency & Microwave Engineering Students are introduced to the basic principles, characteristics and applications of a wide range of commonly used RF and Microwave Integrated Passive and Active Circuit hardware.

Avionics Project Design
Using a Problem-based Learning (PBL) approach that combines the fundamental learning process and engineering problem-solving, this module is designed to impart pre-requisite skills and knowledge like problem analysis, defining and formulating a problem in engineering terms, and the use of software tools. Students will have the opportunity to apply these skills in real-life problem solving.

Fundamentals of Control Systems
This module provides students with a basic coverage of feedback control systems. The topics cover basic concepts of automatic control, components of control systems, simple analytical tools, and stability analysis of systems. Students are also introduced to the use of Matlab/Simulink as a computer tool in control systems analysis.

Project Design & Development 1
In this module, students will work in teams of three to design and implement a project that demonstrates their engineering skills as well as teamwork over a period of two semesters. The module is structured to encourage creativity and innovative thinking. This will also help students develop a positive work attitude and good team spirit.

Project Design & Development 2
This module follows on from Project Design and Development 1. Students are required to demonstrate their ability and resourcefulness in implementing their selected project design solution. The scope of work includes printed circuit board fabrication, wiring, assembly and testing of the final prototype according to the specifications and requirements defined in Project Design and Development 1. In addition, software based projects may require database coding, operating system implementation and testing, server and client system design, portable design field test and web-based integration.

Project Design & Business Application 1
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a year-long project in the field of Aerospace Electronics. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Project Design & Business Application 2
This module is a continuation of Project Design & Business Application 1 where students undertake a year-long project on a topic in the field of Aerospace
Electronics. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Starting & Managing an Enterprise
Through this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

Six-month Internship
In this module, students will be attached to sponsoring companies for a period of approximately six months. During their internships, they will undertake projects assigned by the company or be involved in operations or maintenance-related work. Student internships may be undertaken locally or overseas.

Business Management Electives
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

Supply Chain Management
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
• Applied Physics*
• Computer & Communication Systems

Other available Diploma Plus Certificates
• Advanced Engineering Mathematics*
• Language (French) Business**
• Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
AT’s integrated curriculum is grounded firmly in strong engineering fundamentals, supported by core aerospace modules such as aircraft structures and systems, aircraft propulsion systems, mechanics of flight, avionics systems, airworthiness legislation, aerospace materials and processes. Students are also taught design thinking and design practice to develop skills in creating innovative solutions or processes, or designing and manufacturing aerospace components. AT students are well-prepared for careers in the aerospace industry, in design and development, manufacturing, and MRO activities.

Students are assessed through a mix of examinations and coursework, including project-based learning. Final-year students go on a four-month internship with leading aerospace companies, as an important practical element of their total learning experience.

Final-year AT students can also pursue one of three exciting specialisations: Aerospace Design, Aviation Management or Maintenance, Repair & Overhaul. AT students also enjoy study trips to Aviation Australia in Brisbane, overseas immersion programmes in Tianjin and overseas internships in China.

In response to the increasing industry demand for engineering graduates to have skills in the area of business management, AT offers a Minor in Business Management. This Minor aims to nurture graduates who are technically competent and equipped with business knowledge to succeed in the changing industry environment.

Another salient feature of the course is its flexibility.

Students can choose to graduate with additional Diploma Plus and/or Enhancement Certificates depending on abilities and interests. These are optional programmes designed to broaden students’ knowledge and deepen their skills in specific areas in preparation for higher degree courses and specialisations including the basic ground school preparation for pilots. Unique to AT, the Diploma Plus Programme in Aviation Fundamentals, complemented by course modules, also gives students a head-start in getting the Air Transport Pilot Licence for commercial piloting.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component) or Biotechnology or Computer Studies or Design &amp; Technology or Fundamentals of Electronics</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must also fulfill the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency including colour vision deficiency should not apply for the course.
CAREER PROSPECTS

As Asia’s Aerospace Hub, Singapore is home to the regional headquarters of many leading multinational aerospace companies. These companies carry out a wide spectrum of value-added activities relating to product support, MRO, component manufacturing and design and airport and aviation services management. Besides MRO, leading aerospace original equipment manufacturers and suppliers also carry out a variety of manufacturing activities here.

These activities range from airframe maintenance and modification, to engine overhaul and component design for manufacturing and process development. The current development of the Seletar Aerospace Park as a business aviation centre will further enhance Singapore’s position as a global player in the aerospace industry.

Many lucrative and challenging job opportunities await AT graduates. With the AT curriculum aligned to the Singapore Airworthiness Requirements Part 66 (SAR-66), graduates can be placed on an accelerated programme towards a professional qualification as a Licenced Aircraft Maintenance Engineer. They also enjoy good employment prospects as Aerospace Technologists providing technical support for aerospace manufacturing, design, process development and aircraft services for leading aerospace companies.

Graduates who pursued the Aviation Management Specialisation can enjoy good job prospects in the growing airport and aviation services management sectors.

ACCREDITATION FOR FURTHER STUDIES

The AT course is well-recognised by both local and overseas universities, which grant advanced standing for their relevant degree programmes. Some of the university courses to which offer advanced standing are as follows:

- Nanyang Technological University: Bachelor of Engineering in Aerospace Engineering, Mechanical Engineering or Materials Engineering
- National University of Singapore: Bachelor of Engineering in Mechanical Engineering, Electrical Engineering or Computer Engineering
- Imperial College London (United Kingdom): Masters of Engineering in Aeronautical Engineering
- University of Manchester (United Kingdom): Bachelor of Engineering in Aerospace and Aeronautical Engineering
- University of Sheffield (United Kingdom): Bachelor of Engineering in Aerospace and Aeronautical Engineering
- University of New South Wales (Australia): Bachelor of Engineering in Aerospace Engineering or Bachelor of Aviation Management
- Massey University (New Zealand): Bachelor of Aviation Management

Module Name | Credit Units
---|---
Level 1.1 (26 hours per week) |  
Computer Programming | 4
Electrical Technology & Electronics | 6
Engineering Mathematics 1 | 5
Engineering Mechanics | 4
Fundamentals of Aerospace Technology | 3
Innovation Toolkit | 2
Sports & Wellness | 2

YEAR 2

Level 2.1 (27 hours per week) |  
Aircraft Structures & Systems | 5
Applied Mechanics | 5
Avionics Systems | 3
Engineering Design Thinking | 3
Engineering Materials | 4
Strength of Materials | 5
Interdisciplinary Studies (IS) elective | 2

Level 2.2 (27 hours per week) |  
Aerospace Design Practice | 3
Computer Aided Design & Manufacturing | 5
Engineering Design Analysis | 4
Engineering Mathematics 3 | 4
Mechanics of Flight | 4
Thermofluid 2 | 5
Interdisciplinary Studies (IS) elective | 2

YEAR 3

Level 3.1 (23 hours per week) |  
Aerospace Design Specialisation | 3
Aerospace Computational Analysis | 3
Aerospace Computational Design | 3

Aviation Management Specialisation |  
Airport Operations | 3
Aviation Business & Management | 3
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td>Maintenance, Repair &amp; Overhaul Specialisation</td>
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<td>Aerospace Materials &amp; Processes</td>
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<td>Airworthiness Legislation</td>
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<td><strong>Level 3.2 (21 hours per week)</strong></td>
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<tr>
<td>Four-month Internship</td>
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<tr>
<td>Human Factors</td>
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<tr>
<td>Aerospace Design Specialisation</td>
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<tr>
<td>Aerospace Computational Simulation</td>
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<tr>
<td>Aviation Management Specialisation</td>
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<tr>
<td>Aviation Safety &amp; Management</td>
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<tr>
<td>Maintenance, Repair &amp; Overhaul Specialisation</td>
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<tr>
<td>Quality System &amp; Manufacturing Management</td>
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<tr>
<td><strong>MINOR IN BUSINESS MANAGEMENT</strong></td>
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<td><strong>YEAR 1</strong></td>
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<td>Computer Programming</td>
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<tr>
<td>Electrical Technology</td>
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<td>Engineering Mathematics 1</td>
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<tr>
<td>Engineering Mechanics</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit 1^</td>
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<tr>
<td>Sports &amp; Wellness^</td>
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<td><strong>Level 1.2 (28 hours per week)</strong></td>
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<tr>
<td>Aircraft Manufacturing &amp; Maintenance Practices</td>
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<tr>
<td>Engineering Design Drafting</td>
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<tr>
<td>Engineering Mathematics 2</td>
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<tr>
<td>Fundamentals of Aerospace Technology</td>
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<tr>
<td>Thermofluid 1</td>
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<tr>
<td>Communication &amp; Contemporary Issues^</td>
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<tr>
<td>Innovation Toolkit 2^</td>
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<tr>
<td><strong>Level 2.1 (25 hours per week)</strong></td>
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<tr>
<td>Aircraft Structures &amp; Systems 1</td>
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<td>Applied Mechanics</td>
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<td>Engineering Materials</td>
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<td>Marketing Fundamentals</td>
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<td>Business &amp; the Economy^</td>
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<td>Aircraft Electronics</td>
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<td>Engineering Design Analysis</td>
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<td>Engineering Design Thinking &amp; Practice</td>
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<td>Engineering Mathematics 3</td>
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<tr>
<td>Fundamentals of Financial Management</td>
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<td>Mechanics of Flight</td>
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<td>Thermofluid 2</td>
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<tr>
<td>Effective People Management^</td>
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<td>Avionics Systems</td>
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<td>Human Factors</td>
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**YEAR 2**

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<th>Credit Units</th>
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<td><strong>Level 2.1 (25 hours per week)</strong></td>
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<tr>
<td>Aircraft Structures &amp; Systems 1</td>
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<td>Applied Mechanics</td>
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<td>Engineering Materials</td>
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<td>Marketing Fundamentals</td>
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<td>Strength of Materials</td>
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<tr>
<td>Business &amp; the Economy^</td>
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<tr>
<td><strong>Level 2.2 (28 hours per week)</strong></td>
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<tr>
<td>Aircraft Electronics</td>
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<td>Engineering Design Analysis</td>
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<td>Engineering Design Thinking &amp; Practice</td>
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<td>Engineering Mathematics 3</td>
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<td>Fundamentals of Financial Management</td>
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<td>Mechanics of Flight</td>
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<tr>
<td>Thermofluid 2</td>
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<td>Effective People Management^</td>
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**YEAR 3**

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<td>Aircraft Propulsion Systems</td>
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<td>Aircraft Structures &amp; Systems 2</td>
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<td>Business Management Elective</td>
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<tr>
<td>Starting &amp; Managing an Enterprise</td>
<td>4</td>
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<tr>
<td>World Issues: A Singapore Perspective^</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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<td><strong>Level 3.2 (21 hours per week)</strong></td>
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<td>Four-month Internship</td>
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<td>Avionics Systems</td>
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<tr>
<td>Human Factors</td>
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</tr>
</tbody>
</table>

**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.

**COURSE MODULES**

**LEVEL 1.1**

**Computer Programming**

This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programmes for simple engineering applications.

**Electrical Technology**

This module provides the foundation in electricity to prepare the students for more specialised subjects. It deals with the basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of the basic electrical circuit laws (Ohm's Law, Kirchhoff's Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics covered include
fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance, ac circuit theory and transformer fundamentals.

Electrical Technology & Electronics
This module equips students with fundamental electrical and electronics principles, and the necessary practical skills in handling basic test equipment, electrical circuits as well as electronic devices and circuits. Major topics include basic circuit elements, direct current circuits, Ohm's law, Kirchhoff's laws, transistors as well as common analogue and digital integrated circuits. This module provides the background knowledge for students to progress to the module Avionics Systems.

Engineering Mathematics 1
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Topics include algebra, trigonometry, logarithms, plane analytic geometry, matrices and complex numbers. Throughout the module, there is appropriate use of a Computer Algebra System.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultant, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear motion in two dimensions will be covered. Topics include kinematics and kinetics of linear motion.

Fundamentals of Aerospace Technology
This activity-based module introduces students to the principles of flight, and traces the historical development of aerospace technology, its impact on society, and economics, safety and environmental issues. It highlights the nature and scope of the aerospace industry in Singapore, and the broad technical training for the profession with specific reference to the structure of the course. The module aims to create professional awareness in students.

LEVEL 1.2
Aircraft Manufacturing & Maintenance Practices
The objective of this module is to provide students with a fundamental knowledge of aircraft maintenance practices and the safe handling of aircraft servicing on ground. It will fulfil both current and future requirements for a module in basic Aviation Maintenance Technology. Materials in the module are in accordance to Federal Aviation Administration (FAA) and our Civil Aviation Authority Singapore (CAAS).

Engineering Design Drafting
This module covers the basic principles of engineering drafting and the application of an industry-standard computer design drafting tool to produce detailed drawings of engineering parts. This practice-oriented module comprises short lectures complemented by hands-on exercises with emphasis on practical examples and industry practices. Topics include orthographic projection, sectioning, dimensioning, conventional representation and assembly drawing.

Engineering Mathematics 2
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include Trigonometry, differentiation and simple integration with applications.

Fundamentals of Aerospace Technology
This activity-based module introduces students to the principles of flight, and traces the historical development of aerospace technology, its impact on society, and economics, safety and environmental issues. It highlights the nature and scope of the aerospace industry in Singapore, and the broad technical training for the profession with specific reference to the structure of the course. The module aims to create professional awareness in students.

Thermofluid 1
Students will learn the basic laws governing the behaviour of fluids under the influence of energy transfer. Topics include systems concept, temperature and pressure, fluid statics, fluid in motion, continuity equation, laminar and turbulent flows, ideal incompressible flow, Bernoulli’s equation, flow measurement and Pitot tube, external flow and thermofluid applications in aircraft components and systems.

LEVEL 2.1
Aircraft Structures & Systems 1
The module provides a firm foundation in the design and operation of an aircraft. It introduces key aircraft design features that range from structures and construction to the various vital systems that make operation of a modern aircraft possible. Design philosophies and concepts; stress and strength analysis are also introduced to provide an analytical dimension to supplement the theoretical aspects of the module.

Applied Mechanics
This is a follow-on module from Engineering Mechanics. It aims to equip students with the further knowledge and
Skills to analyse problems of rigid bodies at rest and in motion. Topics include trusses, further friction principles, centre of gravity, relative motion, work-energy method, power and efficiency, and impulse-momentum method. The students will solve engineering problems using these mechanics principles.

**Avionics Systems**
This module covers the various avionics instruments and systems used in modern aircraft, the requirement for zero-visibility flying, the functions and operation of various cockpit instruments, flight environmental systems, sensing devices and electrical power systems used in aircraft. Due emphasis is given to electronics for navigation, communications, surveillance and control.

**Engineering Design Thinking**
This module aims to teach students the engineering design thinking process that designers adopt to define the problem, do relevant research to acquire information, analyse knowledge and provide creative solutions to the problem in the design and planning fields. With the thinking process, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen.

**Engineering Materials**
This module introduces students to the equilibrium phase diagrams, structures, and properties of common engineering materials with emphasis on mechanical testing methods, heat-treatment, international standard specifications, selection and applications of such materials. Topics include classification of materials, mechanical testing, alloying, steels, non-ferrous alloys, plastics, ceramics, composites, corrosion and selection of materials and shaping processes.

**Marketing Fundamentals**
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P's in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

**Strength of Materials**
This module aims to provide students with foundational knowledge of strength of materials with emphasis on applications and problem solving. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

**LEVEL 2.2**

**Aircraft Electronics**
This module equips students with fundamental electronics principles, and the necessary practical skills in handling basic test equipment and electronic devices and circuits. Major topics include common analogue and digital integrated circuits. This module provides the background knowledge of electronics for students to progress to the module Avionics Systems.

**Aerospace Design Practice**
The main aim of this module is for students to apply the knowledge and skills they have learnt from the various modules, into designing an aerospace product that complies with the provided system requirements and eventually illustrate how to integrate their product into the existing aircraft system. Each student takes responsibility for the design and analysis of part of the aerospace design team in a virtual industrial environment. This provides the students the opportunity to work as an integrated product team and prepares them well for project based careers in the aerospace industry.

**Computer-Aided Design & Manufacturing**
This practice-oriented module focuses on the application of CAD/CAM systems in modern manufacturing. Through hands-on projects and assignments, students develop the proficiency in using a parametric, feature-based solid modelling software for the design of engineering parts and assembly as well as the preparation of detailed manufacturing drawings. Simulation and verification of machining operations are carried out followed by the generation of numerically-controlled data.

**Engineering Design Analysis**
Students systematically apply engineering principles to the selection and design of mechanical elements and systems. Through short design projects and case studies, students learn the design process, the use of Computer-Aided Design (CAD) tools, code of practice and engineering judgment in design. Topics include the selection and design of common engineering elements and systems such as electric motor, coupling, gears, bearing, shaft, key and chain drives.

**Engineering Design Thinking & Practice**
This module takes a structured approach in the teaching of the use of the design thinking process to solve engineering and technical problems. Students experience an integrated approach to the learning of design concepts, applying design thinking skills in idea creation, prototyping and testing.

**Engineering Mathematics 3**
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Laplace Transform, Probability and Statistics.

**Fundamentals of Financial Management**
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and
Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

Mechanics of Flight
The module covers the fundamentals of aerodynamics and the principles governing flight and control. Topics include forces and moments acting on an aircraft, the behaviour of the aerfoil at subsonic speeds, aircraft thrust and propulsion, performance characteristics, and factors affecting range and endurance, takeoff and landing, flight manoeuvres, stability and control. Practical sessions include model construction projects, software simulation and wind tunnel experiments.

Thermofluid 2
This follow-on module of Thermofluid 1 covers the application of thermodynamics principles to flow and non-flow process as well as power cycles. Topics include perfect gases and perfect gas laws, the first and second laws, flow and non-flow processes, steady flow energy equation, gas cycles, combustion, rotary expanders and compressors, one-dimensional compressible flow, and dimensionless groups.

LEVELS 3.1 & 3.2
Aerospace Materials & Processes
A continuation of the earlier module, Engineering Materials, this module covers aerospace materials and processes as applied to aluminium, magnesium, titanium and nickel-based systems including super alloys, and select ceramics and composites. Topics include materials specific cations, design guidelines and choice of materials for aerospace components, fatigue and creep behaviour, materials degradation by corrosion and corrosion control, materials forming processes, selective surface hardening, surface modification techniques and surface integrity, and composite repair techniques.

Students will develop the knowledge and skills for the design and selection of materials, and the supporting key processes to optimise performance of aerospace components.

Aircraft Propulsion Systems
This module equips students with the basic principles of jet propulsion and a general understanding of the key design features of aircraft power plants. The module systematically provides the students with an insight into the evolution and importance of the propulsion system to the development of modern airliners. The topics include turbine cycles, various jet and rocket propulsion systems, design features of inlets, compressors, combustion chambers, turbines and other elements of propulsion systems.

Aircraft Structures & Systems 2
The module covers aircraft hydraulic components and their working principles, hydraulic circuits, operating characteristics, hydraulic drives and application circuits, control of landing gears and flight control surfaces. It also covers environmental control systems encompassing air-conditioning, cabin pressurisation, oxygen system and the various auxiliary systems such as fire and ice protection system, water and waste system, and rain removal.

Avionics Systems
This module covers the various avionics instruments and systems used in modern aircraft, the requirement for zero-visibility flying, the functions and operation of various cockpit instruments, flight environmental systems, sensing devices and electrical power systems used in aircraft. Due emphasis is given to electronics for navigation, communications, surveillance and control.

Four-month Internship
The four-month internship at an aerospace company provides students the opportunity to apply the knowledge acquired in the classroom to practical work situations and to associate work experience with classroom learning. Students learn to demonstrate their skills in problem solving and communication in an actual work environment. They will work independently and in a team, and have practitioners in the aerospace industry as mentors to enhance their learning process.

Human Factors
This module introduces students to human factors and how they affect performance at work. Topics include social psychology, physical environment, type of tasks, as well as communication and human errors, with special reference to the aerospace industry.

Starting & Managing an Enterprise
In this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

System Dynamics & Control
The module focuses on modelling the dynamic behaviour of systems including vibration in aircraft systems, and shaping the dynamic response through closed-loop control, with case studies on flight control surfaces and single-discipline systems and mixed systems, Laplace transform, s-plane, time-domain specifications, effects of control actions on system performance, frequency response analysis and introduction to statespace.
Aerospace Design Specialisation

Aerospace Computational Analysis
This module focuses on the basic engineering methods and tools for the design and development of aerospace components. It aims to equip students with a good understanding of the fundamental engineering principles of aerospace component design, and an appreciation of the elemental aspects of computational stress analysis using finite element methods.

Aerospace Computational Design
The mechanism design module equips students with computer-aided engineering skills to articulate and perform kinematics analysis of mechanisms. The students will be able to design, assemble and model behaviour of motion generating machine elements. Animated results and data obtained from the analysis will be used for design optimisation.

Aerospace Computational Simulation
This practice-oriented module enables students to perform basic computational fluid dynamic analyses of aerospace component design through the appropriate use of numerical methods and computer applications. In the process, students will hone their engineering analytical skills and apply knowledge acquired from the previous modules to work on interesting aerospace design projects.

Aviation Management Specialisation

Airport Operations
This module introduces the fundamental concepts and principles involved in the administration and operation of modern international airports. Also fundamentals of airside rules, regulations and operations around the airport parking apron of an airport. Topics covered include international governance and standards of airports, airfield layout design, airport terminal design and operations, apron layout design, arrival gate assignments, aircraft refuelling services as well as ramp operations and safety. Also air navigation services encompassing the key facilities and systems found at the airside of an airport will be taught. Topics covered include aircraft approach and landing aids, airfield lighting systems and aircraft pavement management.

Aviation Business & Management
This module introduces the fundamentals of airline business and management. Topics covered include economics of air transportation, airline organisational structures and business modelling, route planning and development, airline and route profitability, air transport agreements and the regulatory framework of the airline industry, airline alliances, fleet and facilities planning, airline financing, product development and acquisition, as well as key airline performance indicators. Fundamental of aviation logistics and cargo management will also be covered.

Aviation Safety & Management
This module provides students with a broad understanding of the elements of a safety management system, hazard identification and risk management. Topics cover safety management of aircraft operations, air traffic services and maintenance of aircraft and aerodrome operations, ICAO requirement, Safety Management System (SMS) planning and operation requirement.

Maintenance, Repair & Overhaul Specialisation

Aerospace Materials & Processes
A continuation of the earlier module, Engineering Materials, this module covers aerospace materials and processes as applied to aluminium, magnesium, titanium and nickel-based systems including super alloys, and select ceramics and composites. Topics include materials specifications, design guidelines and choice of materials for aerospace components, fatigue and creep behaviour, materials degradation by corrosion and corrosion control, materials forming processes, selective surface hardening, surface modification techniques and surface integrity, and composite repair techniques. Students will develop the knowledge and skills for the design and selection of materials, and the supporting key processes to optimise performance of aerospace components.

Airworthiness Legislation
The module provides students with basic knowledge of key aviation regulations and airworthiness requirements governing the aerospace industry. Students will gain an appreciation of the roles and organisation of aviation governing bodies responsible for safety standards and aviation regulations. These organisations include the International Civil Aviation Organisation (ICAO), US Federal Aviation Administration (FAA), European Joint Aviation Authorities (JAA), European Aviation Safety Agency (EASA) and in particular the Civil Aviation Authority of Singapore (CAAS). In the context of the local aerospace industry, the module covers in greater depth the Singapore Air Navigation Order (ANO), with a focus on the Singapore Airworthiness Requirements. The latter provides the students with an understanding of the rules and regulations governing the local aviation industry.

Quality System & Manufacturing Management
This module prepares students to apply quality system management techniques and principles in their future workplace. Topics include Quality Management Systems (ISO 9000) and Quality Audits for process compliance, Mistake Proofing, Hypothesis Testing, Gage Repeatability & Reproducibility and Design of Experiment. Minitab software is used to enhance students’ understanding and perform root cause analysis on troubleshooting and problem-solving systematically, scientifically, and statistically. Lean manufacturing to identify and eliminate wastes and six sigma initiatives in the aerospace industry will also be discussed.
Business Management Electives
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

Supply Chain Management
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics
- Aviation Fundamentals
- Computer-Aided Design Skills (World Skills Singapore)
- Workplace Safety & Health

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics
- Business
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
AVT focuses on training in audio-visual technology, multimedia communication technology such as video conferencing and streaming, live performance system integration and management, stage lighting and live sound control, and digital media applications. The course is also supported by studies in electrical, electronic and computer engineering. From the first year, there is strong hands-on training with leading industry players like Esplanade and MediaCorp. Students are also exposed to the British performing arts culture, show production practices and audio-visual technology updates on a UK study trip to the BBC TV station, West End theatres and University of Salford.

The Sound Design electives were launched to enhance students’ skills in arranging music, designing sound and composing music for live performances, advertising videos, moving images and entertainment industries.

In the final year, students can opt to work on a full-time project or take up an internship. Both options promote creativity and innovative thinking, inculcate adaptability, and enhance independent learning. Most importantly, they serve as a platform through which students express their passions, ideas and aspirations.

Corporations and associations like Esplanade, MediaCorp, Singapore Association of Convention & Exhibition Organisers & Suppliers (SACEOS), Suntec, EXPO and Event Production houses have demonstrated strong support for AVT.

AVT also offers an alternative pathway for those who prefer to read more business modules. In their second year, students can sign up for our Minor in Business Management. Taught by Ngee Ann Polytechnic’s School of Business & Accountancy, the Minor in Business Management modules cover topics such as financial management, marketing and entrepreneurship.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
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<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
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<tr>
<td>Science (with Physics, Chemistry or Biology component)</td>
<td>1-6</td>
</tr>
<tr>
<td>or Biotechnology</td>
<td></td>
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<tr>
<td>or Computer Studies</td>
<td></td>
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<tr>
<td>or Design &amp; Technology</td>
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<tr>
<td>or Fundamentals of Electronics</td>
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</table>

You must also fulfill the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.

CAREER PROSPECTS

AVT graduates are empowered to be audio-visual technologists and audio-video engineering professionals in MICE (Meetings, Incentive, Conventions and Exhibitions), arts and entertainment, audio video consumer electronics, broadcasting and multimedia industries. They are employed in sectors that require audio-visual professionals, such as hotels and resorts, audio video equipment supply, audio-visual consultancy services, advertising, education, and theme parks.
### ACCREDITATION FOR FURTHER STUDIES

AVT graduates receive rigorous training that allows them to pursue further studies in local or overseas universities. They can pursue degree programmes related to audio-visual, broadcast or digital media technology. As the course is supported by studies in electrical, electronic and computer engineering, graduates may also gain admission to degree courses in electrical, electronic and computer engineering disciplines.

### COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
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<tr>
<td><strong>Level 1.1 (27 hours per week)</strong></td>
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<tr>
<td>Multimedia Authoring</td>
<td>3</td>
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<tr>
<td>Web &amp; Creative Media Technology</td>
<td>3</td>
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<tr>
<td>Computer Programming</td>
<td>4</td>
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<tr>
<td>Electrical Technology</td>
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<tr>
<td>Engineering Mathematics 1</td>
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<tr>
<td>Engineering Mechanics</td>
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<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
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<tr>
<td>Sports &amp; Wellness^</td>
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<tr>
<td><strong>Level 1.2 (28 hours per week)</strong></td>
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<td>Music &amp; Music Technology</td>
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<tr>
<td>Fundamentals of Audio &amp; Acoustics</td>
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<td>Audio Electronics &amp; Electrical Practical Skills</td>
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<td>Analogue Electronics &amp; Applications</td>
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<td>Digital Electronics &amp; Practice</td>
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<td>Communication &amp; Contemporary Issues^</td>
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<td><strong>Level 2.1 (24 hours per week)</strong></td>
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<td>Audio Technology</td>
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<td>Digital Audio</td>
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<td>Interdisciplinary Studies (IS) elective^</td>
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<td><strong>Level 2.2 (24 hours per week)</strong></td>
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<td>Audio Video Mini Projects</td>
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<tr>
<td>Computer Aided Drawing</td>
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<td>Digital Photography &amp; Graphics</td>
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<td>Media Transmission Systems</td>
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<td>Video Production</td>
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<td>Video Technology</td>
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<td>Interdisciplinary Studies (IS) elective^</td>
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<tr>
<td>Sound Design Elective*</td>
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<td>Music Theory &amp; Synthesis</td>
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<th>Module Name</th>
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<tr>
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<td><strong>Level 3.1 (24 hours per week)</strong></td>
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<td>Live Sound Technology</td>
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<tr>
<td>Stage Lighting</td>
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<tr>
<td>Audio Effect Processing</td>
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<tr>
<td>Video Conferencing &amp; Streaming Technology</td>
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<tr>
<td>World Issues: A Singapore Perspective^</td>
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<td>Interdisciplinary Studies (IS) elective^</td>
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<td>Six-month Local/Overseas Internship</td>
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<td>or Project Design &amp; Development</td>
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<td>Fundamentals of Sound Design</td>
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<td>Sound Design for Live Performances</td>
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<tr>
<td><strong>MINOR IN BUSINESS MANAGEMENT^</strong></td>
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<td>Marketing Fundamentals</td>
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<td>Fundamentals of Financial Management</td>
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</table>
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.

* The Minor in Business Management has the same Year 1 curriculum.
* Denotes the Music Design Electives.

COURSE MODULES

LEVEL 1.1

Multimedia Authoring
This is a workshop-based module that covers the editing of animated pictures, audio and video, and the authoring of a multimedia package using computer technology such as digital cameras and recorders, soundcards, video cards, and DVD recorders. The module is hands-on in simple post-audio productions for different multimedia movies or animations. Students will be able to produce short DVD movies with sound, video, simple online text and narration effects.

Web & Creative Media Technology
This module provides students with talks or mini seminars with topics ranging from “Acoustic Drums”, “Introduction to Event Management”, “3D Face Construction”, “How to select professional Video Camera”, “Motion Graphics from Static Images”, “3D Stage Property Design” etc. At the end of each talk/mini seminar, students are required to submit a mini assignment or answer quiz related to each event topic.

Computer Programming
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programs for simple engineering applications.

Electrical Technology
This module builds the necessary foundation for electrical circuit analysis covering electrical theorems and techniques for analysing and solving direct and alternating current circuit problems. Laboratory assignments include basic electrical measurement skills and concepts learnt in lectures and tutorials.

Engineering Mathematics 1
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics of linear and rotational motion, and Kinetics of linear and rotational motion.

LEVEL 1.2

Music & Music Technology
The module will cover basic music theory and ear training, to build foundation for music and audio production. This is followed by an introduction to MIDI and music synthesis, complete with projects applying sequencing techniques to produce sequenced music based on synthesised sound and audio loops.

Fundamentals of Audio & Acoustics
The module will cover introduction to the application and physics of sound, sound reproduction systems, followed by sound production systems. Audio electronics, electroacoustic devices, analogue versus digital sound, acoustic and psychoacoustic will be introduced timely, with tight integration to specific applications and platforms.

Audio Electronics & Electrical Practical Skills
This workshop-based module equips students with practical skills in electronic component identification, correct wiring methods, and the building and testing of audio electronic circuits on breadboards and printed circuit boards. Students will learn to use various test and measurement equipment such as the digital multimeter, oscilloscope and function generator.
Analogue Electronics & Applications
The aim of this module is to introduce the fundamental concepts of analogue electronic devices and circuits. It covers semiconductor physics as well as the devices characteristics, operating principles and common applications of diodes and transistors. The module will equip students with a thorough understanding of transistor switching and dc biasing as well as ac operation of transistor amplifier circuits. This will be achieved through work examples, tutorials, laboratory sessions and e-learning material.

Digital Electronics & Practice
This module covers basic principles of digital electronics. Topics include Number Systems and Codes, Logic Gates and Boolean Algebra, Combinational Logic Circuits, Counters, Flip-flops and Data Handling Circuits. Students will be able to explain and analyse the workings of digital circuits through hands-on experiments in the laboratory.

Engineering Mathematics 2
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

LEVEL 2.1
Audio Technology
This module trains students in the principles of sound and hearing, audio signal analysis, audio processing and sound spectrum. Topics include structure and electronic principles of microphones, amplifiers, sound reproduction systems such as loud speakers, headphones, crossovers, low noise op-amps, solid state devices and thermionic valves, noise reduction techniques, signal enhancers and equalisers, as well as signal processors. Also included are digital audio, analogue-to-digital, and digital-to-analogue conversion for audio signals.

Digital Audio
The module will cover applied digital audio, providing fundamentals of digital audio know-how in audio production and reproduction, audio installation and digital audio design. Core topics include audio coding, CD technology, digital audio editing and effects, digital audio production and reproduction systems, digital audio interconnects and networking, to support AVT audio production modules.

Engineering Mathematics 3A
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P's in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

Music Production
In this module students learn how to apply reverb, treble, mid-tone and bass on to recorded music. Students get hands-on experience with recording studio equipment, music recording, and setting up recording devices for musical instruments such as the guitar, acoustic guitar, organ, piano and trumpet. Students will also learn about the functions and connections of the mixer the placement of mono and stereo microphones and music sensors.

PC Networking
Computer networks are essential to organisations. In this module, students will study PC Networking (PCN) with a focus on data networking knowledge. The Open System Interconnection (OSI) reference model and Transmission Control Protocol/Internet Protocol (TCP/IP) model will be used to explain important networking concepts. Standards and products associated with each OSI layer, and data flow in networking devices will be discussed. Premises structured cabling systems standards, media types and performance criteria, system design, and installation recommendations are also covered.

LEVEL 2.2
Audio Video Mini Projects
This workshop-based module provides students with extensive hands-on practice in building and troubleshooting audio and video circuits. Mini projects include audio amplifier, audio mixer, video preamplifier, audio/video switch, video modulator, VGA-to-video converter, and video-to-VGA converter. Students will learn to build and test audio and video circuits on breadboard and printed circuit board, and to use test and measurement equipment such as the distortion meter, function generator, oscilloscope, waveform monitor and pattern generator.

Computer-Aided Drawing
This workshop-based module introduces the basic concepts of engineering drawing such as the construction of basic lines and shapes, dimensioning, editing and drawing manipulation. Commonly used engineering drawing layouts are included.

Digital Photography & Graphics
This workshop-based module encompasses practical training in using digital cameras to shoot creative and artistic photos, including portrait, dawn, party and night scenes, and moving objects. Students will cover the use of digital imaging software including Flash, as well as how to use photographic effects, filter, hue control, advertisement, poster, movie flash, and flyer design to create digital arts beyond the imagination.
Media Transmission Systems
This module allows students to learn about media data communication, analogue and digital transmission systems that include AM, FM, cable TV, satellite TV, DAB, and DVB. For data communication, students will gain an understanding of the base-band concept, data encoder and decoder, error detection and correction, routing information, reconstruction and lock synchronisation. For wireless systems, students will study system configurations, transmitters and receivers, error performance, path loss, signal processing, bandwidth, data rate, relative complexity, advantages and disadvantages, and transmission standards.

Video Production
In this module, students are introduced to single and multiple camera film-style video production. This module provides students with a basic theoretical and practical introduction to video camera operations, basic production techniques and equipment, film arts, and how to plan and organise a video production.

Video Technology
In this module, students learn the characteristics of human vision, vision wavelength, video signals, saturation, luminance, display device standards, and colorimetric computer display. Electron gun deflection, fly-back, colour sub-carrier, NTSC and PAL TV system will also be discussed. For digital video and computer visual systems, the principles of pixels, display format (RGB) and HDTV will be covered. The module also teaches the operating principles of the LCD display and plasma TV, and video camera technologies like charge-coupled devices (CCD) and CMOS sensors and imagers.

Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

Sound Design Elective
Music Theory & Synthesis
The module will equip students’ with music theory skills to recognise, understand, and describe the materials and processes of music that are heard or presented in a score. This includes aural, analytical, and compositional skills using both listening and written exercises. This module will also introduce Music Synthesis in conjunction with MIDI for synthesizer control. Music synthesis is the core of all sound design work and MIDI is necessary for synthesizer programming.

LEVEL 3.1
Live Sound Technology
This hands-on module teaches students the concepts and technical skills required for live event sound reinforcement. Topics include the operation of a basic sound system using interconnected components such as consoles, amplifiers, speakers, processors and microphones. Upon completion of this module, students will be able to apply the concepts of live sound reinforcement to set up and operate a small to medium-scale sound system for a live event, and to customise a recording setup based on the ambience and multimedia requirements.

Stage Lighting
This module enables students to learn the technical and creative aspects of stage lighting. Topics include basic design, colour and exposure theory, types of lighting instruments, power distribution, control, safety, proper hanging, connection, focus, and control of instruments. Upon completion of this module, students will be able to perform creative lighting layout, install concert lighting, explain colour theory, integrate lighting control instrumentation, and set up a variety of motion lighting instruments.

Audio Effect Processing
This workshop-based module offers intensive hands-on sessions, where students learn to create, edit and mix music and special sound effects onto multiple audio tracks. It also provides theoretical and practical training on digital audio effects techniques that convert 2-channel stereo audio track to 5.1 surround-sound tracks, the professional use of AC-3, redirection to speakers through digital Dolby and surround sound decoders, and spatial enhancement in theatre and audio entertainment application.

Video Conferencing & Streaming Technology
This module provides training in streaming technologies that include local network, internet audio and video streaming technology, webcasing and voice over IP (VoIP). Students will acquire knowledge of hardware configurations, transmitters and receivers, quality of service, routing, re-sequence, signal processing and streaming standards. The module also includes an overview of the MPEG-4 data compression mechanism; and issues related to shooting video for streaming, editing, quality control, and the formatting of streaming audio and video to fit various applications such as video conferencing, web-casting, pod-casting and mobile entertainment systems.

Starting & Managing an Enterprise
In this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include
entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

**LEVEL 3.2**

**Six-month Local/Overseas Internship**
In this module, students will have the opportunity to apply the skills and knowledge acquired in the classroom in a real-time environment. Students are given on-the-job training in actual companies to develop skills in problem-solving, interpersonal communications, project planning, industrial liaisons and character building. Participating companies will also have the opportunity to assess prospective employees and secure the services of these students in advance.

**Project Design & Development**
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a six-month long project in the field of AVT. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

**Project Design & Business Application**
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a six-month long project in the field of Electrical Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

**Sound Design Electives**

**Fundamentals of Sound Design**
This module introduces applications of sound design and related tools. This include computer music soundscaping, theatrical sound design, jingles sound design (as introduction to film/TV sound design), animation/feature film Sound FX and animation/feature film music scoring. At the end of the module, students are able to perform simple sound design based on a small video (can be drama, advertising videos or parts of MTV) clip provided.

**Sound Design for Live Performances**
This module reinforces students’ skills on sound design. The concepts and tools to apply sound design coupled with basic music composition are then used to create music masterpieces to support live performances. Students are given assignments to produce completed portfolios work for samples of live performances. These portfolios will enable the students to showcase their skills and experience in sound design and basic music composition for not only live performances but also short advertisement and moving images upon completing their studies.

**Business Management Electives**
(Students to choose one of the four electives below)

**E-Business in Practice**
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

**Managing Service Operations**
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

**Supply Chain Management**
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

**Understanding Buyer Behaviour**
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

**Diploma Plus Programme**
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.
Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

**Engineering Clusters**
- Applied Physics
- Industrial Control (World Skills Singapore)
- Stage Management & Technology

**Other available Diploma Plus Certificates**
- Advanced Engineering Mathematics
- Business
- Innovation Management
- Foreign Languages

*The Applied Physics syllabus is aligned to the NTU's FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
The Diploma in Automation & Mechatronic Systems (AMS) offers students an exciting experience with modern-day computer-controlled intelligent automated and mechatronic systems and products. AMS offers mechanical, electronics and computer modules that work as an integrated whole, from aircraft fly-by-wire systems and automotive fuel injection, to robot surgeons and robot pets.

The course is a well-integrated programme that provides a balance between theory and practice, and systematically builds knowledge and skills. Students are assessed through a good mix of examinations and coursework, including project-based learning. In the final year, students can opt for a four-month internship, locally or overseas in countries such as Australia, China and Germany. Alternatively, students can choose to take the Mechatronic Design Project. In both the Internship and Mechatronic Design Project paths, students can choose a final-year specialisation either in Aerospace Systems, Marine & Offshore Systems or Industrial Systems.

AMS gives students the opportunity to apply the knowledge and skills they have acquired in designing and developing innovative automation and mechatronic products or processes.

Students are also taught design thinking and design practice to develop skills in creating innovative solutions or processes, or designing and manufacturing high-tech consumer products or industrial applications.

In response to the increasing industry demand for engineering graduates to have skills in the area of business management, AMS offers a Minor in Business Management. This Minor aims to nurture graduates who are technically competent and equipped with business knowledge to succeed in the changing industry environment.

A salient feature of the course is its flexibility. Students can choose to graduate with additional Diploma Plus and/or Enhancement Certificates depending on abilities and interests. These are optional programmes designed to broaden students’ knowledge and deepen their skills in specific areas.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component) or Biotechnology or Computer Studies or Design &amp; Technology or Fundamentals of Electronics</td>
<td>1-6</td>
</tr>
</tbody>
</table>

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.

CAREER PROSPECTS

With the nation’s emphasis on productivity and the growing need for integrating mechanical, electronics and computer technologies in products, machines, processes and systems, AMS graduates will enjoy good employment prospects in a wide range of industries such as precision engineering, electronics, chemicals and petrochemicals, biomedical science, information and communication, aerospace and marine & offshore.

New areas of growth in these sectors require highly-skilled manpower. As technologists, graduates will be involved in process development, process automation, engineering and product design, R&D and product development, engineering tests, as well as the maintenance and operation of high-tech equipment and facilities.
ACCREDITATION FOR FURTHER STUDIES

The AMS course is well-recognised by local and overseas universities. Students may further their studies in degree programmes in Mechatronic Engineering, Mechanical Engineering, Electrical or Electronic Engineering and Computer Engineering.

The Singapore Institute of Technology together with the University of Glasgow now offers AMS graduates the opportunity to pursue a Bachelor of Engineering with Honours in Mechatronics on Ngee Ann campus. Graduates also enjoy advanced standing and subsidised fees.

Some of the university courses to which AMS graduates enjoy advanced standing include:

- Nanyang Technological University: Bachelor of Engineering in Mechanical Engineering, Electrical & Electronic Engineering, Computer Engineering, Information Engineering and Media or Materials Engineering
- National University of Singapore: Bachelor of Engineering in Mechanical Engineering, Electrical Engineering or Computer Engineering
- Singapore Institute of Technology & the University of Glasgow: Bachelor of Engineering with Honours in Mechanical Design Engineering or Mechatronics
- University of Manchester (United Kingdom): Bachelor of Engineering in Mechatronic Engineering
- University of Sheffield (United Kingdom): Bachelor of Engineering in Mechatronic Engineering or Systems and Control Engineering
- University of New South Wales (Australia): Bachelor of Engineering in Mechatronic Engineering
- Monash University (Australia): Bachelor of Engineering in Mechatronic Engineering or IT & Systems

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<tr>
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<tr>
<td>Automation Systems Integration</td>
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</tr>
<tr>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>Systems Modelling &amp; Control</td>
<td>5</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
</tr>
<tr>
<td>Aerospace Systems Specialisation</td>
<td>4</td>
</tr>
<tr>
<td>Aircraft Propulsion Systems</td>
<td>4</td>
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<tr>
<td>Aircraft Structures &amp; Systems</td>
<td>4</td>
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<tr>
<td>Avionics Theory &amp; Systems</td>
<td>4</td>
</tr>
<tr>
<td>Marine &amp; Offshore Systems Specialisation</td>
<td>4</td>
</tr>
<tr>
<td>Marine Engineering Systems</td>
<td>4</td>
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<tr>
<td>Offshore Production Systems</td>
<td>4</td>
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<tr>
<td>Shipyard Production Systems</td>
<td>4</td>
</tr>
<tr>
<td>Industrial Systems Specialisation</td>
<td>4</td>
</tr>
<tr>
<td>Communication &amp; Vision Systems</td>
<td>4</td>
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<tr>
<td>Industrial Drive Systems</td>
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COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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</thead>
<tbody>
<tr>
<td>Year 1 Level 1.1 (21 hours per week)</td>
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</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>Electrical Technology</td>
<td>4</td>
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<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
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<tr>
<td>Engineering Mechanics</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit: Acquiring the Skills</td>
<td>2</td>
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<tr>
<td>Sports &amp; Wellness</td>
<td>2</td>
</tr>
<tr>
<td>Level 1.2 (26 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Automation in a Mechatronic World</td>
<td>3</td>
</tr>
<tr>
<td>Electronics Technology</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Materials</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Mathematics 2</td>
<td>5</td>
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<tr>
<td>Manufacturing Technology &amp; Practice</td>
<td>4</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit: Applying the Skills</td>
<td>2</td>
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<tr>
<td>Year 2 Level 2.1 (26 hours per week)</td>
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<tr>
<td>Computer-Aided Design &amp; Drafting</td>
<td>4</td>
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<tr>
<td>Engineering Design Analysis</td>
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<tr>
<td>Engineering Design Thinking</td>
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<tr>
<td>Engineering Mathematics 3B</td>
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<tr>
<td>Fluid Mechanics</td>
<td>4</td>
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<tr>
<td>Thermodynamics</td>
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<td>Level 2.2 (25 hours per week)</td>
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<tr>
<td>Applied Mechanics</td>
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<tr>
<td>Industrial Automation</td>
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<tr>
<td>Mechatronic Design Practice</td>
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<td>Microcontroller &amp; Interfacing</td>
<td>5</td>
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<tr>
<td>Strength of Materials</td>
<td>5</td>
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<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
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<tr>
<td>Year 3 (Internship) Level 3.1 (28 hours per week)</td>
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<tr>
<td>Automation Systems Integration</td>
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</table>
Module Name | Credit Units
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Industrial Systems Specialisation
Communication & Vision Systems | 4
Industrial Drive Systems | 4
Unmanned Systems | 4

Level 3.2 (24 hours per week)
Automation Systems Integration | 4
Emerging Mechatronic Technologies | 5
Mechatronic Design Project 2 | 7
Project Management | 3
Systems Modelling & Control | 5

MINOR IN BUSINESS MANAGEMENT#
YEAR 2
Level 2.1 (27 hours per week)
Computer-Aided Design & Drafting | 4
Engineering Design Analysis | 4
Engineering Design Thinking | 3
Microcontroller & Interfacing | 5
Marketing Fundamentals | 4
Strength of Materials | 5
Business & the Economy^ | 2

Level 2.2 (23 hours per week)
Applied Mechanics | 5
Engineering Mathematics 3B | 4
Fundamentals of Financial Management | 4
Industrial Automation | 5
Mechatronic Design Practice | 3
Effective People Management^ | 2

YEAR 3 (Internship)
Level 3.1 (25 hours per week)
Automation Systems Integration | 4
Business Management Elective | 4
Fluid Mechanics | 4
Starting & Managing an Enterprise | 4
Thermodynamics | 5
World Issues: A Singapore Perspective^ | 2
Interdisciplinary Studies (IS) elective^ | 2

Level 3.2 (20 hours per week)
Automation Systems Integration | 4
Fluid Mechanics | 4
Project Design & Business Application 2 | 7
Systems Modelling & Control | 5

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.

^ The Minor in Business Management has the same Year 1 curriculum.

COURSE MODULES
LEVEL 1.1

Computer Programming
This practice-oriented module equips students with basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programmes for simple engineering applications.

Electrical Technology
This module provides a foundation in electricity to prepare the students for more specialised subjects. It deals with the basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of the basic electrical circuit laws (Ohm’s Law, Kirchhoff’s Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics covered include fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance, ac circuit theory and transformer fundamentals.

Engineering Mathematics 1
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Topics include algebra, trigonometry, logarithms, plane analytic geometry, matrices and complex numbers. Throughout the module, there is appropriate use of a Computer Algebra System.
Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear motion in two dimensions will be covered. Topics include kinematics and kinetics of linear motion.

LEVEL 1.2
Automation in a Mechatronic World
This module consists of two main components: assembly and programming. Students will first learn the assembly of drive mechanisms and mechatronic products, such as NXT robots and various drive mechanisms. Through these practical exercises, students will learn about mechanical designs, assembly skills, commissioning, troubleshooting and diagnostic techniques of mechatronic systems. Students will then learn how to build and program robots to perform a number of automation-related tasks using tools such as Lego Mindstorms NXT and Logicator for PIC microcontroller. They will also learn interfacing of simple input and output devices to the microcontroller to simulate real-life applications in the field of automation control.

Electronics Technology
The aim of this module is to introduce the fundamental concepts of electronics, which include analogue and digital electronic devices and circuits. The first section covers concepts pertaining to analogue electronics. These include understanding the analogue electronic circuitry, diodes, transistors, and their applications. The second half of the module covers concepts on digital electronics. Topics include number systems, Boolean algebra, combinational logic design, applications of latches, flip-flops, counters and registers.

Engineering Materials
This module introduces students to the equilibrium phase diagrams, structures, and properties of common engineering materials with emphasis on mechanical testing methods, heat-treatment, international standard specifications, selection and applications of such materials. Topics include classification of materials, mechanical testing, alloying, steels, non-ferrous alloys, plastics, ceramics, composites, corrosion and selection of materials and shaping processes.

Engineering Mathematics 2
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include trigonometry, differentiation and simple integration with applications.

LEVEL 2.1
Computer-Aided Design & Drafting
This practice-oriented module is designed to give students an appreciation of the scope of computer graphics and hands-on practice in the applications of CAD (Computer-Aided Design) in engineering design. This module aims to help the students in the application of the drafting concepts and modelling techniques for development of product models in the design process. Students will learn the principles and capabilities of CAD through three dimensional (3D) solid modelling of engineering components and assembly. A project is used to consolidate the concepts and techniques learnt in CAD module and EDA (Engineering Design Analysis) module. An appreciation level of finite element analysis is also included in the module.

Engineering Design Analysis
Students systematically apply engineering principles to the selection and design of mechanical elements and systems. Through short design projects and case studies, students learn the design process, the use of Computer-Aided Design (CAD) tools, code of practice and engineering judgment in design. Topics include the selection and design of common engineering elements and systems such as electric motor, coupling, gears, bearing, shaft, key and chain drives.

Engineering Design Thinking
This module aims to teach students the engineering design thinking process that designers adopt to define the problem, do relevant research to acquire information, analyse knowledge and provide creative solutions to the problem in the design and planning fields. With the thinking process, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen.
Engineering Mathematics 3B
This module is a continuation of Engineering Mathematics 2. Topics include integration techniques & applications, first order differential equation, laplace transform, probability and statistics.

Fluid Mechanics
The module provides an introduction to the principles of fluid mechanics and their application in analysing systems in which fluid is the working medium. Topics include fluid statics, pressure measurement, hydrostatic forces on submerged surfaces, buoyancy, fluid in motion, Bernoulli Equation, flow measurement, piping system, pump performance, and system characteristics.

Thermodynamics
This module covers the properties of working fluids, the first law of thermodynamics and its application to both non-flow and flow processes. Topics include the first law of thermodynamics, properties of liquids and vapours, non-flow processes with steam, steady flow processes with steam, properties of perfect gases, and non-flow processes with perfect gases.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

LEVEL 2.2

Applied Mechanics
This is a follow-on module from Engineering Mechanics. It will equip students with the necessary skills to analyse problems of rigid bodies at rest and in motion. Topics include trusses, friction, work energy method, power and efficiency and impulse momentum method. This knowledge plays an important role in many diverse engineering applications of the modern world, such as the design of cars, structures, airplanes, and various types of machines. Students will be guided to solve engineering problems using these mechanics principles.

Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

Industrial Automation
Students will explore the concepts of logic and sequential control, and their applications in industrial automation. They are introduced to a spectrum of technologies, ranging from pneumatics and electro-pneumatics to programmable controllers with emphasis on component technology leading to circuit design and implementation. Topics include automated mechanisms, ladder diagrams, basic and advanced features of programmable controllers, design techniques and applications.

Mechatronic Design Practice
This is a hands-on module that aims to provide students with the opportunities to translate the knowledge and skills learnt from module Engineering Design Thinking into practice through the detailed design, fabrication and testing of an engineering application prototype. In the process, students will hone their design knowledge and skills required for their final-year project or internship.

Microcontroller & Interfacing
This practice-oriented module aims to equip students with a working knowledge on microcontroller applications and interfacing techniques as the backbone of typical industrial process control operations. Major topics include basic numbering system, microcontroller application and programming, sensor interfacing and motor control. Students will gain a practical insight on applying digital techniques over a wide range of automation and control applications.

Strength of Materials
This module aims to provide students with foundational knowledge of the strength of materials with emphasis on applications and problem solving. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

LEVELS 3.1 & 3.2

Automation Systems Integration
This project-based learning module focuses on the integration knowledge of discrete and continuous systems. This module equips students with system perspectives to implement automation solutions with IEC61131 process controllers and communications at different levels such as Fieldbus, PLC to PLC and PLC to PC levels. Supervisory Control and Data Acquisition (SCADA) is also used in the module to integrate, control, modify, analyse and report on the automated processes.

Emerging Mechatronic Technologies
The aim of the module is to provide students with a platform to keep abreast with recent advances and developments in the newly emerging areas of technology, as well as actual and potential applications to industrial and factory automation. Topics include Micro-electro Mechanical Systems (MEMS), Digital Image Processing and Applied Optics.
Four-month Internship
The four-month internship provides students with the opportunity to apply the knowledge acquired in the classroom to work situations, and demonstrate problem solving, communication and interpersonal skills in a work environment. The programme enables students to hone their ability to work independently and in teams, while they take on one or more practical projects under the supervision of industry practitioners. The objective is to develop a professional approach to work based on the relevant code of practice.

Mechatronic Design Project 1
In this module, students will work in teams to design and develop a product or system related to the final-year specialisation module. In the project, students learn to apply their knowledge and skills in creative problem solving, engineering and design, teamwork and project management. This module focuses on the identification of problem or need, research and design.

Mechatronic Design Project 2
This module follows on from Mechatronic Design Project 1. Based on the design prepared in the first semester, students are required to fabricate the prototype, assemble the parts, test and refine the prototype, prepare the refined design and a project report. The students are also required to do a final presentation to a panel of examiners.

Project Design & Business Application 1
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a year-long project in the field of Automation & Mechatronic Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Project Design & Business Application 2
This module is a continuation of Project Design & Business Application 1 where students undertake a year-long project on a topic in the field of Automation & Mechatronic Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Project Management
This module aims to provide students with a thorough understanding of Projects and Project Management techniques such as Project Planning, Scheduling and Controlling using network analysis such as Critical Path Method (CPM), Gannt Charts and Program Evaluation & Review Technique (PERT). The course is supplemented with tutorial assignments. Case studies are included to reinforce basic understanding and concepts which can be applied in practical situations.

Starting & Managing an Enterprise
Through this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies needed to set up a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

Systems Modelling & Control
The module focuses on modelling the dynamics of process and servo systems and shaping the dynamic response through closed-loop control. Students will learn the principles of systems modelling, simulation, analysis and control, and the application of these principles in systems analysis and synthesis. Major topics include modelling single-discipline systems and mixed systems, Laplace transform, s-plane, standard forms, time-domain specifications, effects of control actions on system performance, and frequency response analysis.

Aerospace Systems Specialisation
Aircraft Propulsion Systems
This module aims to provide students with fundamental knowledge of the aircraft power plant. Students will learn the basic principles of aircraft propulsion systems and a general understanding of the design features of some of the components and subsystems. Topics include gas turbine cycles, various jet and rocket propulsion systems, design features of inlets, compressors, combustion chambers, turbines and other elements of propulsion systems.

Aircraft Structures & Systems
This module aims to provide students with fundamental knowledge of aircraft structures and systems and design features of aircraft structures, general construction of the fuselage and main control surfaces. Auxiliary systems such as hydraulic systems, pneumatic systems, electrical systems, fuel systems, de-icing and anti-icing systems, auxiliary power units, environmental control, communications systems and weapon systems will be explained in this module.

Avionics Theory & Systems
This module covers the various avionics instruments and systems used in modern aircraft, the requirement for zero-visibility flying, the functions and operation...
of various cockpit instruments, flight environmental systems, sensing devices and electrical power systems used in aircraft. Due emphasis is given to electronics for navigation, communications, surveillance and control.

**Marine & Offshore Systems Specialisation**

**Marine Engineering Systems**
This module aims to equip students with knowledge of marine piping, pumping, heating and cooling, and auxiliary machinery that supports the diesel propulsion plant. Learning is reinforced through practical work involving common marine equipment. Topics include fluid flows, pipe design, pumping system, heat transfer and heat exchangers, prime movers, fuel system, cooling system and lubricating system.

**Offshore Production Systems**
This module aims to equip students with the knowledge of offshore oil and gas production systems that include the various offshore oil & gas platforms, marine exploration, well-drilling, and floating production systems. Students will be equipped with fundamental knowledge of automation principles about drilling, separation, gas and water treatment, gas flaring, enhanced recovery and utility systems. Subsea production systems, flow lines and risers dynamics, as well as the dynamics and control of remote-operated vehicles will also be covered.

**Shipyard Production Systems**
This module aims to equip students with the knowledge of the shipyard production systems involved in the design, engineering and commissioning found in shipbuilding, rig-building, ship repair and conversion. Practical hands-on work includes programming CNC machines, plasma-cutting machines and commissioning equipment. The module has a mini capstone project of designing a shipyard with state-of-the-art automation systems for the next generation shipyard.

**Industrial Systems Specialisation**

**Communication & Vision Systems**
This module seeks to broaden students’ abilities learned from automating simple industrial systems acquired at Level 2 to more complex and advanced automation systems involving communication and vision technologies. This module will cover both wired and wireless communication technologies based on the various industry standards, e.g. LAN 802.11 a/b/g/n, LAN Mesh, Mobile 3G/4G, CAN bus, DeviceNet, Profbus and Modbus. Through this module, students will also gain an appreciation of the practical applications of RFID technology, laser and computer vision used in real-world industrial systems.

**Industrial Drive Systems**
This module builds on the previous modules taught in Level 1 and 2 to equip students with knowledge of both electrical and mechanical drive systems which are the core manipulating and actuating systems of all machines. Topics covered in electrical drives include single and three phase systems, power packs, transformers, motors, amplifiers and variable speed controllers, while topics cover in mechanical drives include gears, belts and pulleys, ball screws, linear guides, wire ropes/ drum system and braking system. In addition, topics on engine, hydraulic system and mechanical structures will also be included.

**Unmanned Systems**
This module will cover generic knowledge and techniques of navigation and control of an unmanned vehicle system. Topics taught in this module include automated guided vehicle, robot technology, navigation sensors, control and navigation algorithms and artificial intelligence. Eventually, students will be required to apply and integrate the knowledge taught in the three Industrial Systems Specialisation modules to design, build and test an unmanned vehicle.

**Business Management Electives**
(Students to choose one of the four electives below)

**E-Business in Practice**
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

**Managing Service Operations**
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

**Supply Chain Management**
This module introduces students to the process of planning, implementing, controlling the operations of the
supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

**Engineering Clusters**
- Applied Physics*
- Computer-Aided Design Skills (World Skills Singapore)
- Mechatronics Application Skills (World Skills Singapore)
- Workplace Safety & Health

**Other available Diploma Plus Certificates**
- Advanced Engineering Mathematics*
- Business**
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

** The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
DIPLOMA IN BIOMEDICAL ENGINEERING (BME)

As the pioneering diploma in this field in Singapore, BME equips students with a strong grounding in engineering that complements the life sciences, in areas such as electronics, biophysics, medical instrumentation, cell and molecular biology, biomechanics and implants.

About 40 per cent of the curriculum is devoted to practical training through laboratory experiments, workshops, projects and internships. Students acquire knowledge and skills in the design and operation of medical devices and equipment.

Final-year students focus on specialised topics in clinical engineering, biomaterials and implants, diagnostic and therapeutic medical equipment, and medical imaging technology. They also work in teams to design and develop biomedical projects.

In addition, students can pursue a six-month internship in relevant local or overseas biomedical companies, or choose to do an in-house project. Some participating organisations, such as the BME Departments of local hospitals and a number of multinational corporations, prefer our BME students for internships.

BME also offers an alternative pathway for those who prefer to read more business modules. In their second year, students can sign up for our Minor in Business Management. Taught by Ngee Ann Polytechnic’s School of Business & Accountancy, the Minor in Business Management modules cover topics such as financial management, marketing and entrepreneurship.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component)</td>
<td>1-6</td>
</tr>
<tr>
<td>or Biotechnology</td>
<td></td>
</tr>
<tr>
<td>or Computer Studies</td>
<td></td>
</tr>
<tr>
<td>or Design &amp; Technology</td>
<td></td>
</tr>
<tr>
<td>or Fundamentals of Electronics</td>
<td></td>
</tr>
</tbody>
</table>

You must also fulfil the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.

CAREER PROSPECTS

BME graduates can look forward to many exciting careers in the medical and healthcare sectors. They can work in any of the three major areas such as Research & Development, Engineering Support and Medical Equipment Sales & Marketing. Our versatile graduates can also work in the electronics and computer industries.

BME graduates doing R&D are at the forefront of cutting-edge technologies. Their work can range from investigative clinical studies, analysis and synthesis, design and development, product prototyping, quality assurance and certification; to clinical trials and cutting-edge research leading to scientific publications.
Those who choose to work in a medical environment like hospitals will be involved in evaluating, purchasing, installing and commissioning medical equipment, as well as maintenance and service work. They will also instruct and train end-users in the principles and proper use and care of the equipment. Outside of hospitals, BME graduates may work in healthcare equipment companies, sales, marketing and technical support of medical instruments and devices.

ACCREDITATION FOR FURTHER STUDIES

Our BME diploma has been accredited by both local and overseas universities. Many of these institutions grant either credit exemptions or direct entry into the second year of their courses. BME graduates may further their studies at:

- Nanyang Technological University: Bioengineering, Electrical & Electronic Engineering, Computer Science / Engineering, Materials Engineering, Physics and Applied Physics, Biological Sciences, Information Engineering & Media or Mathematical Sciences
- National University of Singapore: Biomedical Engineering, Electrical Engineering, Mechanical Engineering, Computer Engineering, Science (Physics), Science (Life Sciences) or Science (Computational Biology)
- Singapore Management University: All programmes
- Singapore Institute of Technology: Mechanical Design & Manufacturing Engineering, Sustainable Infrastructure Engineering (Land), Information & Communications Technology (Software Engineering), Chemical Engineering, Electrical Engineering & Information Technology, Mechanical Design Engineering, Mechatronics, Computer Science in Real-Time Interactive Simulation, Computer Science & Game Design, Digital Art & Animation, Game Design, Accountancy, or Criminology & Security
- Singapore University of Technology and Design: All programmes
- SIM University: Biomedical Engineering or Electronics
- University of New South Wales (Australia): 1.5 years of advanced standing for Bachelor of Electrical Engineering or Bachelor of Telecommunications Engineering (pre-requisite for Master of Biomedical Engineering)
- University of Sheffield (UK): Two years of study to obtain a Bachelor of Engineering degree in Biomedical Engineering or Biomaterial Science

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1.1 (25 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Electrical Technology</td>
<td>4</td>
</tr>
<tr>
<td>Electronic Measurement &amp; Prototyping Skills</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Biomedical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Innovation Toolkit 1</td>
<td>2</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues</td>
<td>4</td>
</tr>
<tr>
<td>Level 1.2 (26 hours per week)</td>
<td></td>
</tr>
<tr>
<td>BioPhysics</td>
<td>4</td>
</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>Digital Logic</td>
<td>3</td>
</tr>
<tr>
<td>Discrete Analogue Electronics</td>
<td>6</td>
</tr>
<tr>
<td>Engineering Mathematics 2</td>
<td>5</td>
</tr>
<tr>
<td>Innovation Toolkit 2</td>
<td>2</td>
</tr>
<tr>
<td>Sports &amp; Wellness</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.1 (26 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Cell &amp; Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>Digital Electronics</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design Prototyping 1</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 3A</td>
<td>4</td>
</tr>
<tr>
<td>Healthcare IT</td>
<td>4</td>
</tr>
<tr>
<td>Medical Instrumentation</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.2 (24 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Applications Programming</td>
<td>4</td>
</tr>
<tr>
<td>Electronic Design Prototyping 2</td>
<td>4</td>
</tr>
<tr>
<td>Embedded System (ARM)</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
</tr>
<tr>
<td>Physiological Systems</td>
<td>4</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.3 (22 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Six-month Internship</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3.1 (21 hours per week)</td>
<td></td>
</tr>
<tr>
<td>BME Project Design</td>
<td>10</td>
</tr>
<tr>
<td>Clinical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Diagnostic, Therapeutic &amp; Laboratory Equipment</td>
<td>3</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
</tr>
<tr>
<td>Level 3.2 (22 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Biomechanics &amp; Rehabilitation Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Object-Oriented Programming</td>
<td>5</td>
</tr>
<tr>
<td>Project Design &amp; Development 1</td>
<td>10</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective</td>
<td>2</td>
</tr>
<tr>
<td>Level 3.3 (23 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Biomaterials &amp; Implants</td>
<td>4</td>
</tr>
<tr>
<td>Clinical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Diagnostic, Therapeutic &amp; Laboratory Equipment</td>
<td>3</td>
</tr>
<tr>
<td>Project Design &amp; Development 2</td>
<td>12</td>
</tr>
</tbody>
</table>

MINOR IN BUSINESS MANAGEMENT

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1.1 (23 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>Electrical Technology</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
</tbody>
</table>
Module Name | Credit Units
--- | ---
Innovation Toolkit 1^ | 2
Communication & Contemporary Issues^ | 4

**Level 1.2 (28 hours per week)**
- BioPhysics | 4
- Introduction to Biomedical Engineering | 3
- Electronic Measurement & Prototyping Skills | 3
- Digital Logic | 3
- Discrete Analogue Electronics | 6
- Engineering Mathematics 2 | 5
- Innovation Toolkit 2^ | 2
- Sports & Wellness^ | 2

**YEAR 1**
**Level 1.1 (27 hours per week)**
- Engineering Mathematics 1 | 5
- Engineering Mechanics | 5
- Electrical Technology | 5
- Electronic Measurement & Prototyping Skills | 3
- Laboratory | 2

**LEVEL 1.1**

**Engineering Mathematics 1**
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

**Engineering Mechanics**
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics of linear and rotational motion, and Kinetics of linear and rotational motion.

**Electrical Technology**
This module builds the necessary foundation for electrical circuit analysis covering electrical theorems and techniques for analysing and solving direct and alternating current circuit problems. Laboratory assignments include basic electrical measurement skills and concepts learnt in lectures and tutorials.

**COURSE MODULES**

**LEVEL 1.1**

**Level 3.2 (22 hours per week)**
- Six-month Internship | 22

**YEAR 3 (Non-Internship)**
**Level 3.1 (25 hours per week)**
- Biomechanics & Rehabilitation Engineering | 3
- Project Design & Business Application 1 | 10
- Starting & Managing an Enterprise | 4
- Business Management Elective | 4
- World Issues: A Singapore Perspective^ | 2
- Interdisciplinary Studies (IS) elective^ | 2

**Level 3.2 (23 hours per week)**
- Biomaterials & Implants | 4
- Clinical Engineering | 4
- Diagnostic, Therapeutic & Laboratory Equipment | 3
- Project Design & Business Application 2 | 12

**YEAR 3 (Internship)**
**Level 3.1 (22 hours per week)**
- Clinical Engineering | 4
- Diagnostic, Therapeutic & Laboratory Equipment | 3
- Medical Imaging Technology | 3
- Starting & Managing an Enterprise | 4
- Business Management Elective | 4
- World Issues: A Singapore Perspective^ | 2
- Interdisciplinary Studies (IS) elective^ | 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.
**Introduction to Biomedical Engineering**
This module aims to provide students with an understanding and appreciation of the field of Biomedical Engineering. Students will learn a list of common roots, prefixes and suffixes in order to have a strong foundation of medical terminology. They will be introduced to the wide range of medical devices & equipment. The functions and responsibilities of the biomedical technician/engineer will be explored. Basic concepts of medical instrumentation, which encompasses transducers and signal conditioning/processing, will be taught. Finally, students learn the types of medical device classes and the various safety standards.

**LEVEL 1.2**

**BioPhysics**
In this module, students are introduced to various principles of Physics as they apply to the human body. These include energy, work, power, heat, temperature, pressure and electricity within the body. They are also exposed to the use of Physics in medical applications such as hearing, sight and radiation. This module provides a strong foundation for subsequent Biomedical Engineering modules.

**Computer Programming**
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. Upon completion of the module, students will be able to explain and write C programs for simple engineering applications.

**Digital Logic**
This module provides students with the fundamental knowledge and skills in logic design. Students will learn about the combinational and sequential logics and how to design and use them to control digital systems. A project will be used to reinforce students’ learning and help them to relate their learning to real-life examples.

**Discrete Analogue Electronics**
This module lays a foundation in electronics. It will cover concepts pertaining to analogue devices. With the fundamentals of basic circuit theory frequently revisited, the module will deal with the operating characteristics, working principles and applications of discrete electronic devices such as the various types of diodes, MOSFETs and BJTs. Practical circuits will be used to enhance and strengthen the students’ knowledge so that they will acquire the relevant competencies to move on to more specialised modules.

**Engineering Mathematics 2**
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

**LEVEL 2.1**

**Cell & Molecular Biology**
This module provides a solid foundation in the area of cell and molecular biology. The topics covered include Eukaryotic cell structure and function, molecular biology, bioinformatics, cell communication and differentiation, and cancer.

**Digital Electronics**
This module covers the fundamentals of digital electronics. The basic principles and techniques of digital system and design are covered. It is also intended to prepare students for subsequent modules involving microprocessors and microcomputers. The main topics covered are number systems, Boolean Algebra, combinational logic circuits and minimisation techniques, flip-flops and multivibrators, IC counters, and data handling devices. Characteristics of standard TTL and high-speed CMOS are also discussed.

**Electronic Design Prototyping 1**
This module builds upon the skills learned in the Electronic Measurement and Prototyping Skills module. The main objectives of this module are electronic circuit construction, measurement, and simple troubleshooting techniques. Students will be introduced Computer-aided design (CAD) tools to design printed circuit board (PCB) of simple circuits.

**Engineering Mathematics 3A**
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

**Healthcare IT**
Students are introduced to the concept of networking in healthcare industry. Nowadays, most medical equipment are integrated with network capability. In this module, students will gain knowledge in the area of inter-networking in the healthcare environment such as hospitals. Students will learn to configure, examine and troubleshoot network systems. Extensive laboratory sessions provide hands-on experience for the students to acquire the skills to build and maintain flat, switched, routed and wireless networks. In addition, they will learn techniques to identify and isolate connectivity problems from equipment failures.

**Medical Instrumentation**
In this module, students will gain an understanding of electronic instrumentation and measurements with a focus on physiological signals. Topics covered include measurement errors, transduction of bioelectric signals, different types of amplifiers and filters, signals and noise, power supplies, batteries, oscillators, timers and ultrasound.
Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

LEVEL 2.2
Applications Programming
This practice-oriented module equips students with the fundamental knowledge and skills required to develop Windows applications. The students will develop conceptual understanding to design and develop applications to solve business and engineering problems. Main topics include branch and loop, array, data files accessing and methods.

Electronic Design Prototyping 2
This module builds upon the skills learned in the module, Electronic Design Prototyping 1. The main objectives of this module are to introduce prototyping and testing techniques, fault simulation and fault finding used in electronic project design. Students will also use CAD tools to design PCB of more complex circuits.

Embedded System (ARM)
This module introduces the fundamentals of a typical modern embedded system based on the 32-bit Advanced RISC Microprocessor (ARM). It presents the basic processor architecture together with the concept of System-On-Chip (SoC). It covers the use of C programming language in modern embedded systems and is supplemented by assembly language. The Motorola i.mx application processor is used to demonstrate the basic hardware interfacing architecture of a typical integrated ARM SoC.

Fundamentals of Control Systems
This module provides students with a basic coverage of feedback control systems. The topics cover basic concepts of automatic control, components of control systems, simple analytical tools, and stability analysis of systems. Students are also introduced to the use of Matlab/Simulink as a computer tool in control systems analysis.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

Physiological Systems
Students will study the anatomy and physiology of the human body. This module emphasises the importance of the cardiovascular and neurological systems in the integration of our physiological processes. The respiratory, endocrine, skeletal, muscular, digestive and excretory systems will also be studied.

LEVELS 3.1 & 3.2
Biomaterials & Implants
This module covers the types of biomaterials that can be used inside the human body, both for short and long-term implantations, and their composition, properties and applications in skeletal, cardiovascular, dental, facial and breast implants. Students will also find out how the host body may react to the implantation of these foreign bodies. Current research on tissue engineering, which is seen as the alternative to implants, will also be covered.

Biomechanics & Rehabilitation Engineering
This module introduces students to the application of engineering statics and dynamics to perform simple force analyses of the musculo-skeletal system. They will learn to appreciate the kinematics and kinetics of human motion. They will also learn about the role of an engineer in rehabilitation under different medical conditions.

BME Project Design
In this module, small groups of students will start project work during their Level 2.2 vacation (full-time over five weeks) and continue over the first semester in Level 3. Students will gain practical experience in the design and implementation of a project to demonstrate their engineering and presentation skills, and knowledge gained in the various academic modules, especially in medical devices and equipment. This module provides the opportunity for students to demonstrate their creativity and initiative.

Clinical Engineering
Students will be taught biomedical equipment procurement, management, operation, calibration, testing and maintenance in order to provide quality patient care. They will discover the physiological effects of electricity and study the application of various electrical safety devices in a hospital environment. The IEC601-1 Electrical Safety Test procedures and safety limits are emphasised. Patient and operator safety, including the handling of chemicals, lasers, X-rays and radio-isotopes are also taught. Other topics include inferential statistics and hypothesis testing.

Diagnostic, Therapeutic & Laboratory Equipment
In this module, students will learn the functions, features and limitations of the most important hospital diagnostic and therapeutic equipment, as well as clinical lab
instruments. Examples of diagnostic equipment are patient monitoring systems, respiratory measurement equipment and electroencephalography. Defibrillators, cardiac pacemakers and surgical equipment are some of the therapeutic equipment covered. The clinical lab instrumentation includes spectrophotometers, chromatographs and blood cell counters.

Medical Imaging Technology
This module aims to provide students with an understanding and appreciation of the field of Medical Imaging. Students will be taught the different types of medical imaging principles and their application in diagnostic therapy. Image processing theory and concepts are introduced before the various imaging technologies are taught. Specific areas of radiology include topics such as ultrasound imaging, radionuclide imaging, X-ray, Computer Tomography (CT) and Magnetic Resonance Imaging (MRI) are taught. This activity-based module helps students to learn through web research, assignment and exercises, and to identify themselves with their future profession in Biomedical Engineering.

Object-Oriented Programming
This module builds on the foundation of the Applications Programming module and introduces the concepts of Object-Oriented Programming to the students. It covers the area from the fundamental concepts of Object-Oriented Programming to Web forms, database access, and some graphics and animation.

Project Design & Business Application 1
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a year-long project in the field of Biomedical Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Project Design & Business Application 2
This module is a continuation of Project Design & Business Application 1 where students undertake a year-long project on a topic in the field of Biomedical Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Project Design & Development 1
In this module, students will work in teams of three to design and implement a project that demonstrates their engineering skills as well as teamwork over a period of two semesters. The module is structured to encourage creativity and innovative thinking. This will also help students develop a positive work attitude and good team spirit.

Project Design & Development 2
This module follows on from Project Design & Development 1. Students are required to demonstrate their ability and resourcefulness in implementing their selected project design solution. The scope of work includes printed circuit board fabrication, wiring, assembly and testing of the final prototype according to the specifications and requirements defined in Project Design and Development 1. In addition, software-based projects may require database coding, operating system implementation and testing, server and client system design, portable design field test and web-based integration.

Six-month Internship
In this module, students will be attached to sponsoring companies for a period of approximately six months. During their internships, students will undertake projects assigned by the company or be involved in operations or maintenance-related work. Student internships may be undertaken locally or overseas.

Starting & Managing an Enterprise
In this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

Business Management Electives
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.
Supply Chain Management
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics*
- Biomedical Engineering
- Computer & Communication Systems

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics*
- Business**
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
Climate change and high oil prices have galvanised policy makers the world over to find economically viable alternatives to fossil fuels and innovative solutions in efficient energy utilisation and energy conservation. The Singapore Government has committed $350 million to research and development, testing, and pilot projects in clean energy with the aim of creating a major industry worth $1.7 billion by 2015. The solar industry has been singled out as having the most potential due to Singapore’s existing strength in the semiconductor industry, and its strategic location among the sun-belt countries.

The diploma consists of two key components: clean energy and energy management. The former is a supply-side strategy that aims to ensure there is life after oil and other non-renewable energy sources, while the latter focuses on conserving energy in order to reduce energy costs and promoting economic, political and environmental sustainability.

A highlight of the course is the option for final-year students to participate in either a six-month Project Design and Development Programme or a local or overseas internship with leading companies in the clean energy or energy management sectors.

Students also have the opportunity to go on overseas study trips to Finland, China and other countries.

Our strong industry partnerships with leading companies enable us to constantly align CEM with ever-changing technologies. Our students enjoy the benefits of learning the latest technologies and working with the most advanced facilities & equipment.

CEM is strongly endorsed and supported by the Economic Development Board, Energy Market Authority, Building & Construction Authority, National Environment Agency and many companies in the industry.

Students may also apply for various prestigious scholarships that cover tuition fees and allowances including those from Energy Market Authority (EMA) and Building and Construction Authority.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
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<tbody>
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<td>English Language*</td>
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<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component)</td>
<td>1-6</td>
</tr>
<tr>
<td>or Biotechnology</td>
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<tr>
<td>or Computer Studies</td>
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<tr>
<td>or Design &amp; Technology</td>
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<tr>
<td>or Fundamentals of Electronics</td>
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</tbody>
</table>

* Candidates with English as a second language must have attained a minimum grade of 6.

You must also fulfi l the aggregate computation requirements.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.
CAREER PROSPECTS

As the clean energy industry is relatively new in Singapore, there is no formal training course available in this sector and few trained personnel. CEM graduates will be in demand as the sector experiences robust growth due to the various initiatives by the Singapore Government. One of the world’s largest solar integrated manufacturing plants by REC ASA was officially opened by Prime Minister Lee Hsien Loong in late 2010. It is projected to create 3,000 jobs, with an estimated 30 percent of these jobs for diploma holders. When fully completed, the $6.3 billion plant will put Singapore firmly on the world map for clean energy.

Not only is there an immediate demand for manpower for this new industry, technologists who are able to apply modern energy management technologies to reduce energy consumption will also be much sought-after by the energy, transport, building, manufacturing, and environmental and water resource industries.

Graduates will be readily employed as technologists in the upcoming manufacturing plants, Cleantech Parks, R&D institutes, and system integration companies related to solar and other clean energy technology. They may also work in commercial and industrial sectors dealing with energy audit, energy management and energy conservation consultation.

ACCREDITATION FOR FURTHER STUDIES

With a firm foundation in electrical and electronic engineering, graduates will be able to gain direct admission into engineering courses offered by Nanyang Technological University, National University of Singapore, Singapore University of Technology & Design and Singapore Institute of Technology.

Graduates may also pursue a solar or clean energy-related degree at the following overseas universities and be granted credit exemptions or direct entry into the second or third year (depending on final grades achieved). These universities include:
- Murdoch University (Australia): Bachelor of Engineering in Electrical Power Engineering, Bachelor of Engineering in Renewable Energy Engineering, Bachelor of Engineering in Instrumentation & Control Engineering, Bachelor of Engineering in Industrial Computer Systems Engineering
- University of New South Wales (Australia): Bachelor of Engineering in Photovoltaic & Solar Energy, Bachelor of Engineering in Renewable Energy Engineering
- University of Adelaide (Australia): Bachelor of Engineering in Sustainable Energy Engineering
- University of Dundee (UK): Bachelor of Science in Renewable Energy
- Oregon Institute of Technology (US): Bachelor of Science in Renewable Energy Engineering

COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<td>Level 1.1 (24 hours per week)</td>
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<td>Clean Energy &amp; Sustainable Environment</td>
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<tr>
<td>Computer Programming</td>
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<tr>
<td>Electrical Technology</td>
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<tr>
<td>Engineering Mathematics 1</td>
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<tr>
<td>Engineering Mechanics</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
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<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td>Level 1.2 (26 hours per week)</td>
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<tr>
<td>AC Circuits</td>
<td>4</td>
</tr>
<tr>
<td>Analogue Electronics &amp; Applications</td>
<td>5</td>
</tr>
</tbody>
</table>

YEAR 2

Level 2.1 (26 hours per week)
- Clean Energy Mini Projects 1
- Wind, Hydro & Fuel Cell Technologies
- Electric Circuit Analysis & Measurement
- Electrical Installation Design
- Power Electronics & Applications
- Interdisciplinary Studies (IS) elective^ 2
- Interdisciplinary Studies (IS) elective^ 2

Level 2.2 (26 hours per week)
- Clean Energy Mini Projects 2
- Energy Management in Electrical & Mechanical Systems
- Photovoltaic & Cell Fabrication Technology
- Electrical Controls & Drives Practices
- Engineering Mathematics 3A
- Computer-Aided Drawing
- Interdisciplinary Studies (IS) elective^ 2
- Interdisciplinary Studies (IS) elective^ 2

YEAR 3

Level 3.1 (23 hours per week)
- Building Energy Studies
- Clean Energy System Integration & Protection
- Design & Operation of PV Systems
- Energy Audit & Measurement
- World Issues: A Singapore Perspective^ 2
- Interdisciplinary Studies (IS) elective^ 2

Level 3.2 (22 hours per week)
- Six-month Local/Overseas Internship 22
- Project Design & Development 22
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.

COURSE MODULES
LEVEL 1.1

Clean Energy & Sustainable Environment
This module introduces students to the causes and impacts of global warming and climate change, and the urgency for clean energy alternatives to current sources of energy. It covers fundamental knowledge on energy, environmental sustainability and the interrelations among energy, environment and society.

Computer Programming
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. Upon completion of the module, students will be able to explain and write C programmes for simple engineering applications.

Electrical Technology
This module builds a foundation in electricity to prepare the students for more specialised subjects. It deals with the basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of the basic electrical circuit laws (Ohm’s Law, Kirchhoff’s Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics covered include fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance, AC circuit theory and transformer fundamentals.

Engineering Mathematics 1
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include algebra, trigonometry, logarithms, matrices and complex numbers.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest and at simple linear motion. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, plane friction, kinematics and kinetics of linear motion.

Level 1.2

AC Circuits
Students will learn the basic principles of electrostatics, capacitance, electromagnetic inductance and the transient behaviours of R-C and R-L circuits. This module also covers basic principles of alternating current voltage generation, the characteristics of an A.C. sine wave and its mathematical representation, and the basic theory of alternating current applied to R, L and C series, parallel and series-parallel circuits. Concepts on AC power, power triangle and power factor will also be discussed.

Analogue Electronics & Applications
This module expounds on the fundamental concepts of analogue electronic devices and circuits. It covers semiconductor physics as well as the device characteristics, operating principles and common applications of diodes and transistors. The module will equip students with a thorough understanding of DC biasing and AC operation of transistor amplifier circuits. This will be achieved through worked examples, tutorials, laboratory sessions and e-learning materials.

Digital Electronics & Practice
This module covers basic principles of digital electronics. Topics include Number Systems and Codes, Logic Gates and Boolean Algebra, Combinational Logic Circuits, Counters, Flip-flops and Data Handling Circuits. Students will be able to explain and analyse the workings of digital circuits through hands-on experiments in the laboratory.

Electrical & Electronic Practical Skills
This module equips students with hands-on practical skills in basic electrical wiring and installation, industrial control using relays, sensors and programmable logic controllers. They learn to assemble, solder and test electronic circuits on breadboard, strip-board, and printed circuit board, and use test and measurement equipment such as the oscilloscope, function generator and digital multi-meter.
Engineering Mathematics 2
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

LEVEL 2.1
Clean Energy Mini Projects 1
The module aims to guide students to build an electrical or electronic application using clean energy at the end of the module. Students are guided in each lab to learn about various practical electronics and electrical circuits, batteries and their charging circuits, microcontroller and microcontroller interfacing with sensors, relays, switches and serial and network devices.

Wind, Hydro & Fuel Cell Technologies
This module provides students with fundamental knowledge on the characteristics of wind, hydropower and fuel cell systems. Topics include the principle of operation and energy conversion of fuel cells, types of fuel cells, wind and hydropower sources, turbines characteristics and aerodynamics of wind turbines, operations of wind and hydro power systems.

Electric Circuit Analysis & Measurement
This module covers the concepts, theorems and measurement techniques needed in electrical engineering, which includes three phase system analysis, power measurement and power factor correction, harmonics, transient and steady-state analysis, and measurement procedures and techniques.

Electrical Installation Design
Students will learn how to design electrical systems for residential, commercial and industrial installations. Topics include the design of artificial lighting systems, selection of protective devices for various distribution networks, sizing of cables and circuit protective conductors, and estimation of load requirements for large buildings. On completion of the module, students will be able to design electrical distribution systems in compliance with statutory requirements.

Power Electronics & Applications
This module covers principles of operation and analysis of power conversion circuits such as AC to DC converters, DC to DC converters, DC to AC converters and AC power controllers. Students learn to apply their knowledge in power semiconductor applications to the control and conversion of electric power.

LEVEL 2.2
Clean Energy Mini Projects 2
Students would deepen their knowledge and skills in developing a clean energy application or an energy management system. Students work on mini-projects using skill-sets learnt in Clean Energy Mini Projects 1 to gain hands-on experience and understand how different clean energy technologies are deployed and managed to convert clean energy sources to electrical power.

Energy Management in Electrical & Mechanical Systems
This module covers the working principles and energy management of common electrical and mechanical systems in commercial and industrial enterprises. Students learn how to define energy conservation measures and assess the economic benefits of such measures. They also learn about practical issues in energy management such as improvement in energy utilisation of power distribution system, drive systems, compressor air system, boilers, fans and blowers, and HVAC & refrigeration system.

Photovoltaic & Cell Fabrication Technology
This module provides students with fundamental knowledge on the operation principles and behaviour of solar cells and modules including spectral response, effect of temperature and cell efficiency. Students learn about PV cells interconnection, module fabrication and circuit design. This module also provides hands-on training for students in the NP cleanroom as well as the opportunity to learn how to fabricate solar cells in the laboratory.

Electrical Controls & Drives Practices
This module focuses on the operation, control and other practical aspects of motor controls and drives. As motors and drives are the main energy-using components in most electrical and mechanical systems, this module will provide students with the required foundation for understanding how the proper design and operation of electrical controls and drives are essential for efficient energy usage in electrical and mechanical systems.

Engineering Mathematics 3A
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

Computer-Aided Drawing
This workshop-based module introduces the basic concepts of engineering drawing such as the construction of basic lines and shapes, dimensioning, editing and drawing manipulation. Commonly used engineering drawing layouts are included.

LEVEL 3.1
Building Energy Studies
This module will introduce the students to the subject of building energy modelling and simulation, and will cover the rationales behind the need for energy modelling, be it for environmental or legislation/industrial needs. The module will also detail the measurable quantities involved.
in the quantitative analysis during the energy modelling simulations.

Clean Energy System Integration & Protection
This module equips the students with the knowledge in the technical and economical concept of clean energy system integration. It covers basic fundamentals of power system. Furthermore, students will learn power flow and fault studies pertaining to distributed generation. In addition, case studies will be used to demonstrate the concept of clean energy system modelling, simulation, optimisation and sensitivity analysis for both stand-alone and grid-connected micropower system. Students will also learn the integration of photovoltaic and wind-turbine grid-connected systems.

Design & Operation of PV Systems
This module takes students through the design process of a photovoltaic (PV) system and operation, identifying appropriate PV applications in power systems and undertaking simple PV system design. Topics include the concept of PV stand-alone and on-grid systems, sizing of cables and batteries, lightning protection, power protection and power quality issues.

Energy Audit & Measurement
This module introduces students to the energy audit process and measurement techniques. Students learn to use modern energy measuring equipment and software tools to conduct the audit. Utility data analysis, energy performance profiling, development of benchmarking system, environment management standards ISO 14000, and financial analysis for predicted savings will be covered.

LEVEL 3.2
Six-month Local/Overseas Internship
Students have the opportunity to apply the skills and knowledge acquired in the classroom in a real-life environment via on-the job training. This programme allows students to hone skills in the areas of problem-solving, interpersonal communications, project planning and implementation, industrial liaisons and character building. Participating companies will have the opportunity to assess prospective employees and secure the services of these students in advance.

Project Design & Development
Working on a design project, students will develop essential traits like leadership, team spirit, positive work attitude, independence, good presentation and management skills, and an innovative spirit. It promotes project management capabilities through project planning, scheduling, group discussions, project load balancing and planning project milestones. Students get to practise and improve their oral and written communication skills by submitting reports and making presentations.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics
- Electrical Control & Measurement
- Industrial Control (World Skills Singapore)

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics
- Business
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

For detailed module descriptions under each cluster, please refer to page 193.
DIPLOMA IN ELECTRICAL ENGINEERING (EE)

The Diploma in Electrical Engineering (EE) offers a broad-based curriculum to prepare students for exciting careers in major industries such as power engineering, clean energy, electrical monitoring and control systems, automation and motion systems, engineering design and project management, electronics, audio-visual technology, robotics, engineering product design, marine and offshore electrical systems, and electric transportation.

In the first and second years, students will pick up technical skills in the core fields of electrical, electronic and computer applications, and related skills in areas such as management, entrepreneurship, communication and innovation.

In the final year, students will be given the flexibility to specialise in areas such as Electric Transportation, Marine & Offshore Electrical Systems, Power Engineering, Solar Technology, Electronics, Engineering Management, Audio-visual Technology and Engineering Product Development. To make learning more interesting and challenging, students have the option to either work on a project or take up an internship with industry leaders such as PowerGrid Ltd, SMRT Corporation, Keppel Offshore & Marine, Singapore Technologies Aerospace and Resorts World Sentosa.

Students also have the opportunity to go on overseas study trips to the UK, Finland, China and other countries.

The full-time design and development project enables students to acquire research and product development skills, and provides a platform for enterprising students to come up with their own products and patents. Students are also given ample opportunities to take part in competitions to showcase their talents and innovativeness.

EE forges strong partnerships with many leading companies such as National Instruments, Fluke Networks, Tyco Electronics Singapore and Omron Asia Pacific to keep abreast of cutting-edge technologies. Our students enjoy the benefits of learning the latest technologies and working with the most advanced facilities and equipment.

Strategic industry collaborations have also spawned many specialised training areas. The Electrical Engineering (EE) Division boasts of a host of excellent facilities, including the only High Voltage Training Centre in Singapore, Instrumentation & Control Centre, Power Electronics & Drives Centre and Solar Technology Centre.

EE also offers an alternative pathway for those who prefer to read more business modules. In Year 2, students can sign up for our Minor in Business Management. Taught by Ngee Ann Polytechnic’s School of Business & Accountancy, the Minor in Business Management modules cover topics such as financial management, marketing and entrepreneurship.

Students may apply for various prestigious scholarships that cover tuition fees and allowances including those from Energy Market Authority (EMA), Singapore Power, Association of Singapore Marine Industries (ASMI), and Building and Construction Authority.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

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</tr>
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</table>

You must also fulfill the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.
**CAREER PROSPECTS**

EE graduates have an excellent track record of being snapped up by various industries upon graduation. Many graduates have also moved up the corporate ladder to managerial positions, and a number have started their own businesses.

Armed with the Diploma in Electrical Engineering, graduates can look forward to a wide range of challenging and rewarding careers in numerous industries, such as electrical consultancy and contracting, electronics, aerospace, biomedical, communications, process control, high-tech manufacturing, computer networking, and world-class resorts, just to name a few.

EE graduates are recognised by the Energy Market Authority in the application for the Electrical Technician Licence. The licence is an asset if they intend to start an electrical contracting business or work in one.

**ACCREDITATION FOR FURTHER STUDIES**

Our graduates are granted credit exemptions or direct entry into the second or third year in local and overseas universities. The diploma will also enable our graduates to apply for other degree programmes in the areas of business, accountancy, and arts and sciences at local universities. Some of the universities are:

- National University of Singapore
- Nanyang Technological University
- Singapore Institute of Technology
- Singapore Management University
- Singapore University of Technology and Design
- University of Manchester (UK)
- University of Sheffield (UK)
- University of New South Wales (Australia)
- Queensland University of Technology (Australia)

### COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tr>
<td>Computer Programming</td>
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<td>Electrical Technology</td>
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<td>Computer-Aided Drawing</td>
<td>2</td>
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<td>Engineering Mathematics 1</td>
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<td>Digital Systems &amp; Applications</td>
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### MODULES

**YEAR 3 (Common Modules)**

- World Issues: A Singapore Perspective (24 hours per week)
- Interdisciplinary Studies (IS) elective (24 hours per week)
- Electric Transportation Specialisation (24 hours per week)
- Electric Vehicle & Charging Systems
- Fuel Cell Vehicle
- Mass Transit & Light Rail Systems
- Control & Automation

**Marine & Offshore Electrical Systems Specialisation (24 hours per week)**

- Electrical Power & Machinery Systems
- Design of Marine Electrical Systems
- Instrumentation & Auxiliary Systems
- Control & Automation

**Audio-visual Technology Specialisation (24 hours per week)**

- Audio Video Systems Integration
- Stage Lighting
- Video Conferencing & Streaming Technology
- Electrond Discipline Module (Electrical Installation Design, Electronic System Design or Media Transmission System)

**Electronics Specialisation (24 hours per week)**

- Electronic System Design
- Embedded System Design
- Power Electronics
- Electrond Discipline Module (Engineering Contract & Project Management, Electrical Installation Design or Photovoltaic & Cell Fabrication Technology)
### Module Name | Credit Units
---|---
**Engineering Management Specialisation** (24 hours per week)
  - Electrical Installation Design 5
  - Engineering Contract & Project Management 5
  - Power System Economics & Energy Market 5
  - Elective Discipline Module (Power Distribution & Protection, Design & Operation of Photovoltaic Systems or E-Commerce Technology & Applications) 5
**Engineering Product Development Specialisation** (24 hours per week)
  - Embedded System Design 5
  - Motion Control 5
  - User-Centred Design 5
  - Elective Discipline Module (Electronic System Design, Control & Automation or Electrical Installation Design) 5
**Power Engineering Specialisation** (24 hours per week)
  - Control & Automation 5
  - Electrical Installation Design 5
  - Power Distribution & Protection 5
**Solar Technology Specialisation** (24 hours per week)
  - Building Energy Studies 5
  - Design & Operation of Photovoltaic Systems 5
  - Photovoltaic & Cell Fabrication Technology 5
  - Elective Discipline Module (Electrical Installation Design, Power Distribution & Protection or Engineering Contract & Project Management) 5
**Level 3.2 (22 hours per week)**
  - Six-month Local/Overseas Internship 22
  - Or
  - Project Design & Development 22

### Module Name | Credit Units
---|---
**MINOR IN BUSINESS MANAGEMENT***
**YEAR 2**
**Level 2.1 (26 hours per week)**
  - Electric Circuit Analysis & Measurement 6
  - Electrical Machines & Drives 6
  - Marketing Fundamentals 4
  - PLC & Applications 3
  - Sensors & Instrumentation 3
  - Business & the Economy* 2
  - Interdisciplinary Studies (IS) elective* 2
**Level 2.2 (28 hours per week)**
  - Advanced PLC & Networking 2
  - Electronic Devices & Circuits 6
  - Engineering Mathematics 3A 4
  - Fundamentals of Financial Management 4
  - PC Networking 3
  - Power Electronics & Applications 5
  - Effective People Management* 2
  - Interdisciplinary Studies (IS) elective* 2
**YEAR 3**
**Level 3.1 (22 hours per week)**
  - Business Management Elective 4
  - Engineering Contract & Project Management 5
  - Starting & Managing an Enterprise 4
  - World Issues: A Singapore Perspective* 2
  - Interdisciplinary Studies (IS) elective* 2
**Level 3.2 (22 hours per week)**
  - Six-month Local/Overseas Internship 22
  - Or
  - Project Design & Business Application 22

### 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.

*The Minor in Business Management has the same Year 1 curriculum.*

### COURSE MODULES
#### LEVEL 1.1

**Computer Programming**
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programs for simple engineering applications.

**Electrical Technology**
This module introduces the necessary foundation for electrical circuit analysis covering electrical theorems and techniques for analysing and solving direct and alternating current circuit problems. Laboratory assignments include basic electrical measurement skills and concepts learnt in lectures and tutorials.
Computer-Aided Drawing
This workshop-based module introduces the basic concepts of engineering drawing such as the construction of basic lines and shapes, dimensioning, editing and drawing manipulation. Commonly used engineering drawing layouts are included.

Engineering Mathematics 1
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics of linear and rotational motion, and Kinetics of linear and rotational motion.

LEVEL 1.2
AC Circuits
Students will learn the basic principles of electrostatics, capacitance, electromagnetic inductance and the transient behaviours of R-C and R-L circuits. This module also covers basic principles of alternating current voltage generation, the characteristics of an A.C. sine wave and its mathematical representation, and the basic theory of alternating current applied to R, L and C series, parallel and series-parallel circuits. Concepts on AC power, power triangle and power factor will also be discussed.

Analogue Electronics & Applications
This module expounds on the fundamental concepts of analogue electronic devices and circuits. It covers semiconductor physics as well as the device characteristics, operating principles and common applications of diodes and transistors. The module will equip students with a thorough understanding of DC biasing and AC operation of transistor amplifier circuits. This will be achieved through worked examples, tutorials, laboratory sessions and e-learning materials.

Digital Electronics & Practice
This module covers basic principles of digital electronics. Topics include Number Systems and Codes, Logic Gates and Boolean Algebra, Combinational Logic Circuits, Counters, Flip-flops and Data Handling Circuits. Students will be able to explain and analyse the workings of digital circuits through hands-on experiments in the laboratory.

Electrical & Electronic Practical Skills
This module equips students with an understanding of the conceptual and operational aspects of a microcontroller embedded system. Students will learn about the hardware and software design of a general purpose computer system, the fundamental concepts of microcontrollers and the interfacing with external applications. Intel’s 8051 microcontroller series will be used as a reference example. Assembly and C language will be used in solving engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

LEVEL 2.1
Electric Circuit Analysis & Measurement
This module covers the concepts, theorems and measurement techniques needed in electrical engineering including three phase system analysis, power measurement and power factor correction, harmonics, transient and steady-state analysis, and measurement procedures and techniques.

Electrical Machines & Drives
This module provides students with the basic concepts and working principles of common types of electrical machines and motor drives. They will be introduced to the construction, working principles, performance characteristics of transformers, dc motors, induction motors, synchronous generators and stepper motors, and their applications in the industry. Students will also be introduced to motor drive systems and their applications.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

Microcontroller & Applications
This practice-oriented module is designed to equip students with an understanding of the conceptual and operational aspects of a microcontroller embedded system. Students will learn about the hardware and software design of a general purpose computer system, the fundamental concepts of microcontrollers and the interfacing with external applications. Intel’s 8051 microcontroller series will be used as a reference example. Assembly and C language will be used in...
project-based exercises. Students will also learn to use microcontrollers for engineering applications.

**PLC & Applications**
This module introduces students to electrical control systems, which cover sequential motor control circuits, direct-on-line and star-delta motor starter circuits. Students will then be taught the PLC (programmable logic controller) theory of operation, basic functions, the I/O addressing and interfacing, and the design of ladder logic programs. Students will design PLC-based systems related to industrial applications through numerous hands-on exercises.

**Sensors & Instrumentation**
The module provides students with graphical programming skills using LabVIEW and the knowledge to develop virtual instrumentation systems. Students learn the concept of virtual instrumentation, sensor technologies, data acquisition devices, and computer interfaces such as RS232, GPIB and USB.

**LEVEL 2.2**

**Advanced PLC & Networking**
This is a follow-on module of PLC and Applications. This module provides more programming functions of PLC such as data movement, conversion and logic instructions as well as the control of the variable speed drive. Students will also be introduced DeviceNet, a network system that interconnects control devices for data exchange. Students will learn about the DeviceNet cable system, configuration of the driver, the scanner module and the network devices through hands-on experiments.

**Digital Systems & Applications**
This module builds on basic material covered in Level 1 Digital Electronics & Applications with topics such as flip-flops, adders, multiplexers/de-multiplexers, encoders/decoders, shift registers and counters. Students will have plenty of practice-oriented training in the design of digital system with real-life applications. Testing and verification of the digital circuits developed will be done using a hardware description language.

**Electronic Devices & Circuits**
This module aims to provide students with a general understanding of some commonly used analogue and digital electronic devices. The module covers the operating principles, characteristics and applications of operational amplifiers, digital-to-analogue and analogue-to-digital converters, integrated-circuit logic families and memory devices.

**Engineering Mathematics 3A**
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

**Fundamentals of Financial Management**
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

**PC Networking**
Computer networks are essential to organisations. In this module, students will study PC Networking (PCN) that focuses on data networking knowledge. The Open System Interconnection (OSI) reference model and Transmission Control Protocol/Internet Protocol (TCP/IP) model will be used to explain important networking concepts. Standards and products associated with each OSI layer and data flow in networking devices will be discussed. Premises structured cabling systems standards, media types and performance criteria, system design and installation recommendations are also covered.

**Power Electronics & Applications**
This module provides students with a broad-based understanding of power semiconductor devices (e.g. BJT, IGBT, thyristors, MOSFETs) and the use of such devices for the control of electrical power. Rectifiers, inverters, DC-to-DC power converters, variable speed drives for DC and AC motors will be covered in this module.

**LEVEL 3.1**

**Electric Transportation Specialisation**

**Electric Vehicle & Charging Systems**
This module covers the working principles of electric vehicle (EV), electric motors and controllers, the charger and electrical system, the battery storage and management system. The vehicle charging processes (different modes of charging) and the safety requirements will be introduced. The infrastructure for the charging stations, the impact of EV charging on the power network and the use of EV as energy storage for the power system will be examined.

**Fuel Cell Vehicle**
This module aims to provide the students with an appreciation on the use of fuel cell in various mode of transportation. The working principles of Proton Exchange Membrane (PEM) fuel cell and electronic system for fuel cell vehicle will be introduced. The module covers the application of fuel cell for fuel cell car/bus, fuel cell forklifts and fuel cell powered airplane (unmanned aerial vehicles).

**Mass Transit & Light Rail Systems**
This module gives a broad overview of the mass transit systems such as MRT (or subway) and electric light rail
system for major cities. The topics include the operation of the electric traction motors, the propulsion system, automatic train control system (ATC), regenerative braking, the auxiliary equipment for the train, the power supply and distribution systems. The students will be introduced to the working principles of high-speed train, such as Japanese bullet train (Shinkansen) and Taiwan high-speed train.

**Marine & Offshore Electrical Systems Specialisation**

**Electrical Power & Machinery Systems**
This module covers the design and operation of electrical power generation plant and emergency power systems for marine and offshore industries. Topics include the design criteria, construction and selection of generators, excitation methods, automatic voltage regulators, as well as synchronisation of generators for parallel operation and load sharing. The operating principles of low voltage and medium voltage DC and AC machines and drives for marine and offshore applications will also be taught.

**Design of Marine Electrical Systems**
This module covers the design of electrical distribution network for ships and oil rigs. Students will learn the estimation of load requirements, selection of protective devices, sizing of cables, design of switchboards and bus bar systems. Harmonic filtering, EM disturbances and counter measures, reserve (standby) and alternative power sources, surge protection, batteries systems will be covered in this module.

**Instrumentation & Auxiliary Systems**
This module covers the fundamentals of instrumentation, method of measurement, process control and their applications in marine and offshore industries. Topics include operating principles of measuring instruments, instrumentation standards, working principles of Supervisory and Data Acquisition (SCADA) system, cathodic protection system, fire and gas detection and alarm systems.

**Audio-video Technology Specialisation**

**Audio Video Systems Integration**
In this module, students will study the standards, characteristic and specifications of audio video devices such as DVD player, surround sound speakers, MP3/MP4 players, HDTV (LCD/Plasma) and HDMI cables & connectors etc. Students will learn how to design integrated audio video systems which covers equipment selection, acoustic & sound proofing, speaker selection and placement and also cable selection and wiring. Module will also introduce students to the latest development in the Digital Living Network Alliance (DLNA) software and devices.

**Stage Lighting**
This module enables students to learn the technical and creative aspects of stage lighting. Topics include basic design, colour and exposure theory, types of lighting instruments, power distribution, control, safety, proper hanging, connection, focus, and control of instruments. Upon completion of this module, students will be able to perform creative lighting layout, install concert lighting, explain colour theory, integrate lighting control instrumentation, and set up a variety of motion lighting instruments.

**Video Conferencing & Streaming Technology**
This module provides training in streaming technologies that include local network, internet audio and video streaming technology, web-casting and voice over IP (VoIP). Students will acquire knowledge of hardware configurations, transmitters and receivers, quality of service, routing, re-sequence, signal processing and streaming standards. The module also includes an overview of the MPEG-4 data compression mechanism; and issues related to shooting video for streaming, editing, quality control, and the formatting of streaming audio and video to fit various applications such as video conferencing, web-casting, pod-casting and mobile entertainment systems.

**Media Transmission System**
This module allows students to learn about media data communication, analogue and digital transmission systems that include AM, FM, cable TV, satellite TV, DAB, and DVB. For data communication, students will gain an understanding of the base-band concept, data encoder and decoder, error detection and correction, routing information, reconstruction and lock synchronisation. For wireless systems, students will study system configurations, transmitters and receivers, error performance, path loss, signal processing, bandwidth, data rate, relative complexity, advantages and disadvantages, and transmission standards.

**Engineering Product Development Specialisation**

**Motion Control**
This module covers the operation and design of motion control components and systems. Students will learn to develop and practical skills in application of components to implement simple and complex movement patterns, involving control in speed, position, acceleration profile and loading conditions, using servo and stepper motors. They will also learn about the signal and power drive circuitries to control these components when configured into a HMI control system.

**User-Centred Design**
This module covers the principles of user-centred design, its applications in engineering product design, its influence on users’ preference for a particular design. It covers anthropometrics, design of displays and controls, and design of human-machine interface. Case studies, exercises on specific topics, group discussions, assignments and a project will make learning in a practice-oriented manner. The students will apply the design principles, skills and knowledge from other modules, in designing engineering products and systems in the assignments and the project.
SCHOOL OF ENGINEERING

DIPLOMA IN ELECTRICAL ENGINEERING (EE)

Common Module
Audio-visual Technology, Electronics & Engineering Product Development Specialisations

Electronic System Design
In this module, students will learn how to design a basic electronic system in the control of electrical equipment and drive systems. The practical considerations will be emphasised through design examples and case studies. The topics covered include the selection of a wide range of electronic devices such as passive and active discrete devices, op amps for specific applications and the interpretation of manufacturers’ datasheets. There will be hands-on laboratory work and the introduction of software design aids to carry out the electronic design tasks.

Common Module
Engineering Management Specialisation & Minor in Business Management

Power System Economics & Energy Market
This module aims to equip students with a basic understanding of the economic principles underlying the introduction of competition in the electricity industry. Students will explore the structure, operation and regulations of Singapore’s electricity market, which was introduced to promote the efficient supply of competitively priced electricity and open up the wholesale and retail market for full competition.

Common Module
Engineering Management, Power Engineering & Solar Technology Specialisations

Power Distribution & Protection
In this module, students will gain a basic knowledge of high voltage and low voltage distribution systems, related equipment and protection devices. Topics

Common Module
Electronics & Engineering Product Development Specialisations

Embedded System Design
This module focuses on the fundamentals of embedded system design and will give students hands-on experience in both hardware and firmware. Students will be taught real time control strategies, as well as techniques to interface between the embedded system and the real world. Various components of embedded systems will be introduced together with data acquisition concepts. Serial interface using the I2C bus is also discussed.

Common Module
Engineering Management Specialisation & Minor in Business Management

E-Commerce Technology & Applications
This module begins with a brief history of the Internet and e-commerce, and goes on to cover the planning aspects of setting up an e-commerce site and the factors that attract surfers to return to it. Technical e-commerce topics include Hypertext Markup Language (HTML), VBScript, Structured Query Language (SQL), Active Server Pages (ASP .NET) and mobile Web applications (.NET Mobile). These technologies allow an e-commerce site to be data-driven - a dynamic site that provides relevant and up-to-date information with powerful search capability.

Common Module
Electronics & Solar Technology Specialisations

Photovoltaic & Cell Fabrication Technology
This module provides students with fundamental knowledge on the operation principles and behaviour of solar cells and modules including spectral response, effect of temperature, parasitic resistance and cell efficiency. Students learn about PV cells interconnection, module fabrication and circuit design. This module also provides hands-on training for students in the NP cleanroom as well as the opportunity to learn how to fabricate solar cells in the laboratory.
include fault calculation, principles of operation of switching devices, switchboards, transformers and cables, and the economic aspects of power distribution systems. Laboratory sessions include the testing of protection devices, operation of electrical equipment, and familiarisation with the safety requirements and precautions to be taken in the operation and maintenance of electrical apparatus.

**Common Module**
*Electric Transportation, Marine & Offshore Electrical Systems, Engineering Product Development & Power Engineering Specialisations*

**Control & Automation**
This module examines the characteristics and designs of the industrial automation process. Two main areas will be covered - continuous feedback control and discrete sequential control. Topics in continuous feedback control include system concept and applications, process characteristics, control strategies, system performance, design of controllers/ compensators, and modern digital control systems. Topics in discrete sequential control include system concept and applications, and design tools.

**Common Module**
*Engineering Management, Power Engineering & Solar Technology Specialisations, and Minor in Business Management*

**Design & Operation of Photovoltaic Systems**
This module takes students through the design process of photovoltaic (PV) system and operation, identifying appropriate PV applications in power systems and undertaking simple PV system design. Topics include concept of PV standalone and on-grid systems, sizing of cables and batteries, lightning protection, power protection and power quality issues.

**Common Module**
*Electronics, Engineering Management, Power Engineering & Solar Technology Specialisations, and Minor in Business Management*

**Engineering Contract & Project Management**
This module provides students with an understanding of the various aspects of electrical contracting and management procedures. Upon completion of this module, they will be able to prepare competitive bids for submission of tenders for projects pertaining to electrical services. They will also be able to apply the knowledge gained in project/contract management. Topics covered include contract arrangements and condition of contracts, cost planning, tendering procedures, specification writing, interim certificates and payments, completion and final payment, as well as variations and their valuation.

**Common Module**

**Electrical Installation Design**
Students will learn how to design electrical systems for residential, commercial and industrial installations. Topics include the design of artificial lighting systems, selection of protective devices for various distribution networks, sizing of cables and circuit protective conductors, and estimation of load requirements for large buildings. On completion of the module, students will be able to design electrical distribution systems in compliance with statutory requirements.

**Minor in Business Management**

**Starting & Managing an Enterprise**
Through this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

**LEVEL 3.2**

**Six-month Local/Overseas Internship**
Students have the opportunity to apply the skills and knowledge acquired in the classroom in a real-life environment via on-the-job training. This programme allows students to hone skills in the areas of problem-solving, interpersonal communications, project planning and implementation, industrial liaisons and character building. Participating companies will have the opportunity to assess prospective employees and secure the services of these students in advance.

**Project Design & Development**
Students will work full-time on a group project and have the flexibility to choose from a wide range of topics related to system design and integration, research and development, computer applications or other engineering areas. Students are required to carry out research, design, implementation, testing and troubleshooting processes from a prototype to a final product or system under supervision. Students will also learn to apply project management and scheduling skills to enable them to complete their project in time. They will be required to document their project development process and present their projects at regular intervals.
Project Design & Business Application
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a six-month long project in the field of Electrical Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

Business Management Electives
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

Supply Chain Management
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics*
- Electrical Control & Measurement
- Industrial Control (World Skills Singapore)
- Stage Management & Technology

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics*
- Business**
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

** The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
The electronics industry remains one of the major industries behind Singapore's economic growth. It has transformed itself over the years into a world-class player by producing higher value-added products and providing end-to-end Research & Development (R&D) services. To meet market demand, the curriculum of the Diploma in Electronic & Computer Engineering (ECE) is continuously revised to support new industry developments. Business knowledge and a global perspective have also been incorporated into the course to prepare students for the changing landscape of the electronics industry.

ECE also offers an alternative pathway for those who prefer to read more business modules. In Year 2, students can sign up for our Minor in Business Management. Taught by Ngee Ann Polytechnic's School of Business & Accountancy, the Minor in Business Management modules cover topics such as financial management, marketing and entrepreneurship.

Six-month local and overseas internships with established universities, research institutes and leading companies such as University of Applied Sciences Mannheim (Germany), A*STAR Research Institutes, GlobalFoundries, Xilinx and ST Kinetics are offered to students taking Microelectronics, Computer & Mobile Technology, Digital Media & Communication, Network Systems & Security specialisations, and Minor in Business Management.

**ENTRY REQUIREMENTS**

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

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<tr>
<th>Subject</th>
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<td>English Language*</td>
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<tr>
<td>Science (with Physics, Chemistry or Biology component) or Biotechnology or Computer Studies or Design &amp; Technology or Fundamentals of Electronics</td>
<td>1-6</td>
</tr>
</tbody>
</table>

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.

**CAREER PROSPECTS**

Electronics is the world’s largest industry, and this means that ECE graduates will enjoy diverse and exciting career opportunities. Graduates can choose to be an electronics engineer, product specialist or sales and marketing specialist. They can also provide engineering support in the aerospace industries or work in the manufacturing sector.

As demand for manpower surges in the areas of networking, mobile computing and digital media, they will also be able to head start their career as a network support engineer, mobile app developer and communications engineer.
ACREDITATION FOR FURTHER STUDIES

ECE graduates enjoy advanced standing in local and overseas universities when they apply for admission to relevant courses. Many universities offer credit exemption equivalent to almost a year of study or more.

For example, ECE graduates may further their studies at the following universities:

- Nanyang Technological University: Electrical & Electronic Engineering, Information Engineering & Media, Computer Engineering, Computer Science, Physics / Applied Physics or Mathematical Sciences
- National University of Singapore: Electrical Engineering, Computer Engineering, Computing (Computer Science Courses) or Computing (Information System Courses)
- Singapore Management University: Information Systems Management
- Singapore Institute of Technology: Electrical Engineering & Information Technology or Mechatronics
- SIM University: Aerospace Systems or Electronics
- University of New South Wales (Australia): 1.5 to 2 years of advanced standing for Bachelor of Computer Engineering or Bachelor of Electrical Engineering
- University of Edinburgh (UK): 1 year of advanced standing for Bachelor of Engineering (Electronics and Electrical Engineering)

Many of our graduates have successfully enrolled in local and overseas universities. Some have even received scholarships and progressed beyond the basic degree to attain their masters and doctorates.
<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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</thead>
<tbody>
<tr>
<td>Network Systems &amp; Security Specialisation</td>
<td></td>
</tr>
<tr>
<td>Basic Routing &amp; Switching</td>
<td>6</td>
</tr>
<tr>
<td>Cloud Computing &amp; Data Centres</td>
<td>5</td>
</tr>
<tr>
<td>Linux Servers</td>
<td>4</td>
</tr>
<tr>
<td><strong>Level 3.2 (22 hours per week)</strong></td>
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</tr>
<tr>
<td>Six-month Internship</td>
<td>22</td>
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<tr>
<td><strong>YEAR 3 (Non-Internship)</strong></td>
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<tr>
<td><strong>Level 3.1 (22 to 25 hours per week)</strong></td>
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<tr>
<td>Common Modules</td>
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<tr>
<td>Project Design &amp; Development 1</td>
<td>10</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
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<tr>
<td>Interdisciplinary Studies (IS) module^</td>
<td>2</td>
</tr>
<tr>
<td>Aerospace Electronics Specialisation</td>
<td></td>
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<tr>
<td>Aerospace System Design</td>
<td>4</td>
</tr>
<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
</tr>
<tr>
<td><strong>Microelectronics Specialisation</strong></td>
<td></td>
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<tr>
<td>Data Communications</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
</tr>
<tr>
<td>Integrated Circuit Packaging, Assembly &amp; Test</td>
<td>3</td>
</tr>
<tr>
<td><strong>Digital Media &amp; Communication Specialisation</strong></td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
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<tr>
<td>Linux Servers</td>
<td>4</td>
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<tr>
<td><strong>MINOR IN BUSINESS MANAGEMENT</strong></td>
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<td><strong>YEAR 1</strong></td>
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<tr>
<td>Level 1.1 (23 hours per week)</td>
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<tr>
<td>Computer Programming</td>
<td>4</td>
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<tr>
<td>Electrical Technology</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
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<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Level 1.2 (25 hours per week)</td>
<td></td>
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<tr>
<td>Applications Programming</td>
<td>4</td>
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<tr>
<td>Digital Logic</td>
<td>3</td>
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<tr>
<td>Discrete Analogue Electronics</td>
<td>6</td>
</tr>
<tr>
<td>Electronic Measurement &amp; Prototyping Skills</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 2</td>
<td>5</td>
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<tr>
<td>Innovation Toolkit 2^</td>
<td>2</td>
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<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
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<tr>
<td><strong>YEAR 2</strong></td>
<td></td>
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<tr>
<td>Level 2.1 (23 hours per week)</td>
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<tr>
<td>Analogue Circuit Design &amp; Applications</td>
<td>5</td>
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<tr>
<td>Digital Electronics</td>
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<tr>
<td>Electronic Design Prototyping 1</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 3A</td>
<td>4</td>
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<tr>
<td><strong>Level 2.2 (23 hours per week)</strong></td>
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<tr>
<td><strong>Level 3.2 (22 hours per week)</strong></td>
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<tr>
<td>Six-month Internship</td>
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<td><strong>YEAR 3 (Internship)</strong></td>
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<tr>
<td><strong>Level 3.1 (28 hours per week)</strong></td>
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<tr>
<td><strong>Business Management Elective</strong></td>
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</tr>
<tr>
<td>Computer Systems Architecture &amp; Administration</td>
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<tr>
<td>Data Communications</td>
<td>3</td>
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<tr>
<td>Digital Communications</td>
<td>3</td>
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<tr>
<td>Fundamentals of Control Systems</td>
<td>5</td>
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<tr>
<td>Starting &amp; Managing an Enterprise</td>
<td>4</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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<td>Fundamentals of Control Systems</td>
<td>5</td>
</tr>
<tr>
<td>Project Design &amp; Business Application 2</td>
<td>12</td>
</tr>
</tbody>
</table>
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.

COURSE MODULES

LEVEL 1.1

Computer Programming
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programs for simple engineering applications.

Electrical Technology
This module introduces the necessary foundation for electrical circuit analysis, covering electrical theorems and techniques for analysing and solving direct and alternating current circuit problems. Laboratory assignments include basic electrical measurement skills and concepts learnt in lectures and tutorials.

Electronic Measurement & Prototyping Skills
This module equips students with the necessary hands-on practical skills in electronic circuit construction and measurements. Students will be introduced basic practical skills such as soldering, identification of components and use of various electronic instruments.

Engineering Mathematics 1
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics of linear and rotational motion, and Kinetics of linear and rotational motion.

LEVEL 1.2

Applications Programming
This practice-oriented module equips students with the fundamental knowledge and skills required to develop Windows applications. The students will develop conceptual understanding to design and develop applications to solve business and engineering problems. Main topics include branch and loop, array, data files accessing and methods.

Digital Logic
This module provides students with the fundamental knowledge and skills in logic design. Students will learn about the combinational and sequential logics and how to design and use them to control digital systems. A project will be used to reinforce students’ learning and help them to relate their learning to real-life examples.

Discrete Analogue Electronics
The aim of this module is to lay a foundation in electronics. It will cover concepts pertaining to analogue devices. With the fundamentals of basic circuit theory frequently revisited, the module will deal with the operating characteristics, working principles and applications of discrete electronic devices such as the various types of diodes, MOSFETs and BJTs. Practical circuits will be used to enhance and strengthen the students’ knowledge so that they will acquire the relevant competencies to move on to more specialised modules. This module is the pre-requisite for the Analogue Circuit Design and Applications module.

Electronic Design Prototyping 1
This module builds upon the skills learned in the Electronic Measurement and Prototyping Skills module. The main objectives of this module are electronic circuit construction, measurement and simple troubleshooting techniques. Students will be introduced Computer-Aided Design (CAD) tools to design Printed Circuit Board (PCB) of simple circuits.

Engineering Mathematics 2
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane
analytic geometry, differentiation with applications, and integration with applications.

LEVEL 2.1

Common Modules

Analogue Circuit Design & Applications
This module introduces students to the operating principles of commonly used analogue devices and circuits, such as operational amplifiers, oscillators and filters. Applications in various practical circuits are also illustrated.

Digital Electronics
This module covers the fundamentals of digital electronics. The basic principles and techniques of digital system and design are covered. It prepares the students for subsequent modules that discuss microprocessors and microcomputers. The main topics covered are number systems, Boolean Algebra, combinational logic circuits and minimisation techniques, flip-flops and multivibrators, IC counters, and data handling devices. Characteristics of standard TTL and high speed CMOS are also discussed.

Electronic Design Prototyping 2
This module builds upon the skills learned in the module, Electronic Design Prototyping 1. The main objectives of this module are to introduce prototyping and testing techniques, fault simulation and fault finding used in electronic project design. Students will also use CAD tools to design PCB of more complex circuits.

Engineering Mathematics 3A
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

Object-Oriented Programming
This module builds on the foundation of the Applications Programming module and introduces the concepts of Object-Oriented Programming to the students. It covers the area from the fundamental concepts of Object-Oriented Programming to Web forms, database access, and some graphics and animation.

Common Module except for Minor in Business Management

Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

LEVEL 2.2

Common Modules

Microcontroller Programming & Interfacing
This module introduces students to the fundamentals of microcontroller programming and interfacing. C language programming is used to illustrate the operation of the microcontroller. Interfacing the microcontroller to basic input-output devices such as switches, LEDs, 7-segment displays and keypads help to demonstrate the behaviour of the application software running on a working system.

Telecommunication Principles
This module introduces students to radio communication. It builds an understanding of the basic concepts of analogue communication systems. The characteristics of a basic communication system and the environmental factors that affect communication will be discussed. The concepts that are necessary for an understanding of linear systems will be explained, with an emphasis on resonance and filters. Students will be taught the fundamental concepts of analogue modulation and demodulation techniques such as AM and FM and their applications.

Common Module except for Minor in Business Management

Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

Electronic Design Prototyping & Manufacturing
This module builds upon the skills learned in the module, Electronic Design Prototyping 2. The main objective of this module is to learn the necessary skills to undertake electronics project. Students will learn the complete process from prototyping to PCB design and CAM (computer-aided manufacturing) of more complex circuits. Students will also use CAD tools to design PCB of more complex circuits and to use these tools to produce files and libraries for circuit re-use and CAM of PCB.

Aerospace Electronics Specialisation

Avionics Systems
This module provides students with an appreciation of aircraft electronic systems. It includes topics such as cockpit instrumentation, aircraft navigation, communication, surveillance, control and lighting electronics. This module equips students with the knowledge required for the advanced module such as Aircraft Navigation & Communication Systems (ANCS).
Fundamentals of Aerospace Technology
This activity-based module introduces students to the basics of aerodynamics and principles of flight and traces the development of the aerospace technology. It highlights the nature and scope of the aerospace industry, and the broad technical training for the profession. The module aims to create professional awareness in students.

Computer & Mobile Technology Specialisation
Mobile Application Programming
This module will train student to develop applications for consumer mobile device platforms. Types of applications covered include those which are standalone, web-enabled, location-aware and client-server in nature. Students will also learn to develop and deploy interactive mobile applications using both client-side and server-side programming techniques with database integration.

Digital Media & Communication and Network Systems & Security Specialisations
Data Communications
This module will train students to understand and apply key concepts and processes associated with data transmission of information, transmission media, the OSI reference model, network topologies, protocols and TCP/IP protocol suite. This module provides the foundation for understanding principles in data communications and networking.

Digital Communications
This module introduces students to the fundamental concepts of digital communications. Students will be taught the various coding and digital modulation techniques. The concept of error control coding techniques for reliable communications and spread spectrum modulation schemes will be taught.

Microelectronics Specialisation
Integrated Circuit Design & Technology
This is a core module taken by Microelectronics Option students in Level 2. It introduces students to various Integrated Circuit (IC) technologies and provides students with basic integrated circuit design concepts using Metal-Oxide-Semiconductor (MOS) technology. The module equips students with the basic practical skills that are needed to design and layout simple digital circuits on silicon.

Wafer Fabrication Fundamentals
This is a core module taken by Microelectronics Option students in Level 2. It provides students with basic knowledge of IC fabrication. The processes that are required to convert a blank wafer to one that is covered with complex circuits are covered. It covers silicon ingot growth, wafer preparation, photolithography and etching. Yield and reliability as they pertain to IC fabrication are also covered. In addition, it will provide students with fundamental knowledge of various supporting technologies required in the wafer fabrication industry such as vacuum and pressure measurement systems. Finally, process and device simulations are covered with students undertaking a simulation exercise building and operating their own virtual transistors.

Minor in Business Management
Internet Technology
The module covers the concept of the Web operations and also the tools used for developing Web-based applications. Students will learn the basics of HTML, Java language, JSP, JDBC and JavaScript so that they are able to develop multiple-tier Web-based database applications.

Marketing Fundamentals
The module introduces concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

LEVELS 3.1 & 3.2
Common Modules
Fundamentals of Control Systems
This module provides students with a basic coverage of feedback control systems. The topics cover basic concepts of automatic control, components of control systems, simple analytical tools, and stability analysis of systems. Students are also introduced to the use of Matlab/Simulink as a computer tool in control systems analysis.

Common Modules
Six-month Internship
In this module, students will be attached to sponsoring companies for a period of approximately six months. During their internships, students will undertake projects
assigned by the company or be involved in operations or maintenance-related work. Student internships may be undertaken locally or overseas.

**Common Modules**

**Project Design & Development 1**
In this module, students will work in teams of three to design and implement a project that demonstrates their engineering skills as well as teamwork over a period of two semesters. The module is structured to encourage creativity and innovative thinking. This will also help students develop a positive work attitude and good team spirit.

**Project Design & Development 2**
This module follows on from Project Design and Development 1. Students are required to demonstrate their ability and resourcefulness in implementing their selected project design solution. The scope of work includes printed circuit board fabrication, wiring, assembly and testing of the final prototype according to the specifications and requirements defined in Project Design and Development 1. In addition, software based projects may require database coding, operating system implementation and testing, server and client system design, portable design field test and Web-based integration.

**Data Communications**
This module will train students to understand and apply key concepts and processes associated with data transmission of information, transmission media, the OSI reference model, network topologies, protocols and TCP/IP protocol suite. This module provides the foundation for understanding principles in data communications and networking.

**Digital Communications**
This module introduces students to the fundamental concepts of digital communications. Students will be taught the various coding and digital modulation techniques. The concept of error control coding techniques for reliable communications and spread spectrum modulation schemes will be taught.

**Aerospace Electronics Specialisation**
- **Aerospace System Design**
  Using a problem-based learning approach that combines the fundamental learning process and engineering problem-solving, this module is designed to impart prerequisite skills and knowledge like problem analysis, defining and formulating a problem in engineering terms, and the use of software tools. Students will have the opportunity to apply these skills in real-life problem solving.

- **Aircraft Navigation & Communication Systems**
  This module provides students with the theory of operations and the functional description of airborne navigation and communication systems found in modern aircraft. Systems covered include ADF, VOR, DME, IRS, HF & VHF. The standard digital data-bus communications protocol, such as ARINC 429 and ARINC 629 used by commercial aircraft and MIL-STD-1553B used by military aircraft, will also be discussed.

**Computer & Mobile Technology Specialisation**
- **Computer Systems Architecture & Administration**
  This module will equip students with competencies to describe the architecture of a general purpose computer system, explain the function of its hardware and be able to administer the software to operate it in a server-based computing environment.

- **Mobile Device Technology**
  This module introduces the essential elements of a mobile computing platform. These include single-board computers, high-performance embedded systems, mobile operating systems, sensory devices (such as GPS, accelerometer, compass and camera), and wireless sensor networks. Students will apply the knowledge to integrate the various elements and develop different real-life applications.

**Digital Media & Communication Specialisation**
- **Digital Audio, Video Processing & Applications**
  This module covers the fundamentals of human hearing and visual systems in relation to the development of digital audio, image and video processing techniques. A detailed coverage of audio, image and video compression techniques and standards is included. Examples of applications in digital audio and video storage and processing standard used in digital radio and TV, portable media devices e.g. MP3 players and home digital entertainment systems will also be included.

- **Digital Media Technologies & Communication**
  This module gives an overview of digital media technologies (online & mobile media, print & publishing, film & video, interactive media, etc.), and techniques for transmission of digital media contents. Students will
also learn the application of these techniques in various multimedia systems, such as radio & TV system, satellite communications and mobile media technologies.

Digital Signal Processing
This module provides students with knowledge of Digital Signal Processing (DSP) technology and equips them with practical skills in DSP software and hardware implementation. It will also provide students with the ability to work on various advanced digital signal processors.

**Microelectronics Specialisation**

Advanced Wafer Fabrication Technology
This module focuses on the silicon wafer fabrication process with emphasis on practice-oriented training in the cleanroom. Liquid Crystal Display Technology will also be covered.

Integrated Circuit Packaging, Assembly & Test
This is a core module taken by Microelectronics Option students in Level 3. It aims at providing students with an introductory knowledge in Integrated Circuit (IC) Assembly and Testing technology so as to prepare them for the semiconductor manufacturing environment in their careers. It covers basic IC packaging, surface-mount board assembly, statistical process control, IC testing methodology and reliability as well as failure analysis of IC.

Network Systems & Security Specialisation

Basic Routing & Switching
This module covers the architecture, components, and operations of routers and switches in a small network. Students learn how to configure a router and a switch for basic functionality. At the end of this module, students will be able to configure and troubleshoot routers and switches and resolve common issues with RIPv1, RIPvng, single-area OSPF, virtual LANs, and inter-VLAN routing in both IPv4 and IPv6 networks, access control lists, DHCP and NAT.

Cloud Computing & Data Centres
This module provides an overview of cloud computing and data centres. Concepts include virtualisation as a foundation for cloud computing, issues related to implementation of cloud computing and data centres, cloud services like Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). It also covers simple architecture, design, implementation, management and security of public and private clouds.

Linux Servers
This module covers the basics of Linux operating system and server. Concepts include the use of Linux commands to access and manage directories, files, setting of file security and access rights and basic servers’ implementation such as DNS and DHCP in a network.

Minor in Business Management

Computer Systems Architecture & Administration
This module aims to equip students with the competencies to describe the architecture of a general purpose computer system, explain the function of its hardware and be able to administer the software to operate it in a server-based computing environment.

Starting & Managing an Enterprise
Through this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

**Project Design & Business Application 1**
In this module, students are expected to integrate the knowledge they gained during the first two years of study and undertake a year-long project in the field of Electronic and Computer Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

**Project Design & Business Application 2**
This module is a continuation of Project Design & Business Application 1 where students undertake a year-long project on a topic in the field of Electronic and Computer Engineering. They will also be required to develop a business proposal/plan which forms an integral part of the whole project.

**Business Management Electives**
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.
Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

Supply Chain Management
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student's knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics*
- Computer & Communication Systems

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics*
- Business**
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
ES, the first diploma of its kind among the local polytechnics, has a strong emphasis on engineering fundamentals and relevant domain knowledge, which include mathematics, computing, applied sciences and research. This provides its graduates with a solid foundation for academic progression and multidisciplinary skillsets for future career development.

An Engineering Induction Programme gives students further exposure to various fields through industry visits, distinguished guest lectures, overseas study visits and short stints with research establishments. In the final year, students will have the opportunity to spend about one and half days a week in Nanyang Technological University (NTU), National University of Singapore (NUS), and Singapore University of Technology and Design (SUTD) where they take on projects supervised by professors in areas such as nanotechnology, integrated circuit design, materials science, photonics and biomedical engineering. Other local collaborators include DSO and A*STAR.

ES also has external collaborators in supervision of final-year projects/R&D immersion projects and in hosting study visits. They include Tokyo Metropolitan College of Industrial Technology/Tokyo Metropolitan University (Japan), Chiba University (Japan), Osaka Electro-Communication University (Japan), University of Applied Sciences Western Switzerland, Zhejiang University (China) and Imperial College (UK).

All ES students will be invited to join a study visit to prestigious institutions in Japan, China, or Europe. During the study visit, they will interact with local students and professors, and be exposed to the latest developments in technology and culture of engineering innovation.

One in four ES students may also be offered the NP Engineering Scholarship (NPES), a prestigious scholarship that covers tuition fees and notebook allowances. All NPES scholars will be placed on TCP talent development track.

**ENTRY REQUIREMENTS**

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
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</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
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<tr>
<td>Science (with Physics, Chemistry or Biology component)</td>
<td>1-6</td>
</tr>
<tr>
<td>or Biotechnology</td>
<td></td>
</tr>
<tr>
<td>or Computer Studies</td>
<td></td>
</tr>
<tr>
<td>or Design &amp; Technology</td>
<td></td>
</tr>
<tr>
<td>or Fundamentals of Electronics</td>
<td></td>
</tr>
</tbody>
</table>

You must also fulfill the aggregate computation requirements.

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to an in-house test.

**CAREER PROSPECTS**

ES graduates are well prepared for pursuing further studies in both local and foreign universities. They are also work-ready for careers in research & development, product design & innovation and manufacturing & services. ES graduates are equipped with solid foundation for academic progression as well as the relevant skills and knowledge to become leaders at the engineering workplace. The industry fully supports this diploma and they welcome ES graduates to join their workforce.
ACCREDITATION FOR FURTHER STUDIES

Both NTU and NUS have accredited ES for a wide range of their degree programmes.

With strong foundation, ES graduates may also apply for a wide range of overseas degree programmes. In particular, foreign universities offering degree course in engineering science include The University of Toronto (Canada), The University of Oxford (UK), The University of Hong Kong, The Pennsylvania State University (USA) and The University of Auckland (New Zealand).

COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Level 1.1 (25 hours per week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Technology</td>
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<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
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<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
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<tr>
<td>Engineering Skills &amp; Practice</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
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<tr>
<td>Sports &amp; Wellness^</td>
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<table>
<thead>
<tr>
<th>Level 1.2 (26 hours per week)</th>
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<tbody>
<tr>
<td>Strength of Materials</td>
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<tr>
<td>Discrete Analogue Electronics</td>
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<tr>
<td>Engineering Mathematics 2</td>
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<tr>
<td>Fundamentals of Object Oriented Programming</td>
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<tr>
<td>Critical Thinking &amp; Communication^</td>
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<td>Innovation Toolkit 2^</td>
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<table>
<thead>
<tr>
<th>Module Name</th>
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<tr>
<td>Digital Electronic Circuits</td>
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<tr>
<td>Thermodynamics</td>
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<tr>
<td>Engineering Mathematics 3A</td>
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<tr>
<td>Data Structures &amp; Algorithms</td>
<td>4</td>
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<tr>
<td>Physics 1</td>
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<table>
<thead>
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<td>Analogue Circuit Design &amp; Applications</td>
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<tr>
<td>Fluid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Microcontroller Programming &amp; Interfacing</td>
<td>5</td>
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<td>Engineering Design</td>
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<tr>
<td>Physics 2</td>
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<table>
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<th>Module Name</th>
<th>Level 3.1 (27 hours per week)</th>
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<tr>
<td>Nanotechnology Fundamentals &amp; Applications</td>
<td>5</td>
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<tr>
<td>Project Design &amp; Development 1</td>
<td>8</td>
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<tr>
<td>World Issues: A Singapore Perspective^</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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YEAR 3

Level 3.2 (22 hours per week)

<table>
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<th>Module Name</th>
<th>Level 3.2 (22 hours per week)</th>
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<tbody>
<tr>
<td>Project Design &amp; Development 2</td>
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<tr>
<td>Automation &amp; Mechatronic Technologies</td>
<td>5</td>
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<tr>
<td>Emerging Mechatronic Technologies</td>
<td>5</td>
</tr>
<tr>
<td>System Modelling &amp; Control</td>
<td>5</td>
</tr>
</tbody>
</table>

COURSE MODULES

LEVEL 1.1

Computer Programming
This practice-oriented module equips students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programs for simple engineering applications.

Electrical Technology
This module provides a foundation in electricity to prepare the students for more specialised subjects. It deals with the basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of the basic electrical circuit laws (Ohm’s Law, Kirchhoff’s Voltage and Current Laws) and network theorems, and their application.
to electrical network analysis. Topics covered include fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance, ac circuit theory and transformer fundamentals.

**Engineering Mathematics 1**
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include algebra, trigonometry, logarithms, matrices and complex numbers.

**Engineering Mechanics**
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest and at simple linear motion. Students learn the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, plane friction, kinematics and kinetics of linear motion.

**Engineering Skills & Practice**
This module aims to provide students with the necessary practical knowledge and engineering skills. Topics covered include computer-aided drafting (AutoCAD), mechanical skills in milling, turning & sheet metal work, electrical & electronic measurement & test instrumentation as well as breadboard fabrication & testing.

**LEVEL 1.2**
**Discrete Analogue Electronics**
The aim of this module is to lay the foundations in electronics. It will cover concepts pertaining to analogue devices. With the fundamentals of basic circuit theory frequently revisited, the module will deal with the operating characteristics, working principles and applications of discrete electronic devices such as the various types of diodes, MOSFETs and BJTs. Practical circuits will be used to enhance and strengthen the students’ knowledge so that they will acquire the relevant competencies to move on to more specialised modules. This module is the pre-requisite for the Analogue Circuit Design and Applications module.

**Engineering Mathematics 2**
This module equips students with further mathematical skills to solve engineering problems. Topics include trigonometry, coordinate geometry, differentiation and integration with applications.

**Fundamentals of Object Oriented Programming**
This module builds on the basis of the earlier module (Computer Programming) and brings students into the realm of Object Oriented Programming. Students learn how to encapsulate data and behaviour, apply polymorphism, and re-use codes through inheritance mechanism.

**Strength of Materials**
This module aims to provide students with the foundational knowledge of strength of materials with emphasis on applications and problem solving. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

**LEVEL 2.1**
**Data Structures & Algorithms**
This module introduces the basics of data structures including linked-list, binary search tree and sorting algorithms. Various sorting algorithms will be discussed and compared.

**Digital Electronic Circuits**
This module covers the fundamentals of digital electronics. The basic principles and techniques of digital system and design are covered. It is also intended to prepare students for higher level modules involving microprocessors and microcomputers. The main topics covered are number systems, Boolean algebra, combinational logic circuits and minimization techniques, flip-flops and multi-vibrators, Integrated Circuit (IC) counters, and data handling devices. IC electrical characteristic including TTL & CMOS devices and application of IC buffer/driver will also be covered.

**Engineering Mathematics 3A**
This module is a continuation of Engineering Mathematics 2. Topics include integration with applications, differential equations, Laplace transform and Fourier Series.

**Physics 1**
This module covers the topics of Classical Mechanics. Students learn the laws of motion in both one and two dimensions. They also study concepts of work and energy for linear systems including linear momentum and collision. The practical sessions will introduce students to system modelling and simulation using MATLAB.

**Thermodynamics**
This module covers the properties of working fluids, the first law of thermodynamics and its application to both non-flow and flow processes. Topics include the first law of thermodynamics, properties of liquids and vapours, non-flow processes with steam, steady flow processes with steam, properties of perfect gases, and non-flow processes with perfect gases.

**LEVEL 2.2**
**Analogue Circuit Design & Applications**
This module introduces students to the operating principles of commonly used analogue devices and
circuits, such as operational amplifiers, oscillators and filters. Applications in various practical circuits are also illustrated.

**Engineering Design**
This module will guide students to integrate various domain knowledge acquired to develop working models of engineering systems (e.g. two-arm robots, autonomous vehicles and DSP-based control systems). Students will work on mini-projects in teams under supervision and formulate and present solutions to the review panel at the end of the semester. The module serves as a step stone to prepare students for their Final-Year Projects.

**Fluid Mechanics**
This module provides an introduction to the principles of fluid mechanics and their application in analysing systems in which fluid is the working medium. Topics include fluid statics, pressure measurement, hydrostatic forces on submerged surfaces, buoyancy, fluid in motion, Bernoulli Equation, flow measurement, piping systems, pump performance and system characteristics.

**Microcontroller Programming & Interfacing**
This module introduces students to the fundamentals of microcontroller programming and interfacing. C language programming is used to illustrate the operation of the microcontroller. Interfacing the microcontroller to basic input-output devices such as switches, LEDs, 7-segment display and keypads helps to demonstrate the behaviour of the application software running on a working system.

**Physics 2**
This module builds on the Physics 1 and extends the coverage into other aspects of Physics such as Angular Kinematics, Universal Gravitation, Fluid Mechanics, Thermodynamics, Electricity and Magnetism.

**LEVEL 3.1**

**Common Modules**

**Nanotechnology Fundamentals & Applications**
Conventionally, nanotechnology education has been limited to postgraduate students working in specially settings, such as cleanrooms, within research-based universities. This module aims to take nanotechnology education out of these settings and infuse it into a diploma curriculum using desktop-based nanotechnology instruments/in-house case studies. It provides an opportunity for students to experience nanotechnology in a hands-on learning environment and understand the sciences, intricacies, and instruments necessary to work at the nanoscale. The module aims to equip students with a suit of skill sets that are relevant to industries such as semiconductors, imprint, solar cells, aerospace and biomedical engineering in Singapore. The same skill sets also provide students a level of competency required in universities should they decide to pursue further studies.

**Project Design & Development 1**
In this module, students will work together in teams of three to design and implement a project that demonstrates their engineering skills as well as teamwork over a period of two semesters. The module is structured to encourage creativity and innovative thinking. This will also help students develop a positive work attitude and good team spirit.

**Modules under the Specialisations**

**Digital Signal Processing**
This module provides students with knowledge of Digital Signal Processing (DSP) technology and equips them with practical skills in DSP software and hardware implementation. It will also provide students with the ability to work on various advanced digital signal processors.

**Fundamentals of Control Systems**
This module provides students with a basic coverage of feedback control systems. The topics cover the basic concepts of automatic control, the components of control systems, simple analytical tools, and stability analysis of systems. Students are also introduced to the use of MATLAB/Simulink as a computer tool in control systems analysis.

**Industrial Automation**
In this module, students will first be introduced electrical control systems, which cover sequential motor control circuits, direct-on-line and star-delta motor starter circuits. Students will then be taught the PLC (programmable logic controller) theory of operation, basic functions, the I/O addressing and interfacing, and the design of ladder logic programs. Students will design PLC-based systems related to industrial applications through numerous hands-on exercises.

**Mechanics of Machines & Materials**
This module provides students the experience of solving engineering problems based on the principles and theories covered in the earlier Mechanics modules. Topics include velocity and acceleration diagrams, effects of the mass of members of mechanism, friction mechanisms and the effects of friction on screw threads and belt drives, balancing of shafts and its application to gears and pulleys, and the causes and control of machinery vibration.
LEVEL 3.2

Common Modules

Project Design & Development 2
This module follows on from Project Design & Development 1. Students are required to demonstrate their ability and resourcefulness in implementing their selected project design solution. The scope of work includes printed circuit board fabrication, wiring, assembly and testing of the final prototype according to the specifications and requirements defined in Project Design and Development 1. In addition, software based projects may require database coding, operating system implementation and testing, server and client system design, portable design field test and web-based integration.

Modules under the Specialisations

Applied Thermodynamics
Students will learn the applications of principles of Thermodynamics to energy conversion, energy transformation and energy management. Topics include thermodynamic processes, the second law of thermodynamics, gas power cycles, engine performance testing, nozzles, steam power plant, basic heat transfer and introductory of thermal management.

Circuit Analysis & Design
This module aims to provide students with a sound grounding of the concepts and methods in circuit analysis and design. Topics covered include impedance, transient behaviours of RLC circuits, frequency response, spectrum & resonance, filters and two ports network functions. The practical sessions will introduce students to circuit design and simulation.

Emerging Mechatronic Technologies
The aim of the module is to provide the students with a platform to keep abreast with recent advances and developments in the newly emerging areas of technology, as well as actual and potential applications to industrial and factory automation. Topics include Micro-electro Mechanical Systems (MEMS), Nanotechnology, Photonics, and wireless & web-enabled automation systems.

Fundamentals of Control Systems
This module provides students with a basic coverage of feedback control systems. The topics cover the basic concepts of automatic control, the components of control systems, simple analytical tools, and stability analysis of systems. Students are also introduced to the use of MATLAB/Simulink as a computer tool in control systems analysis.

System Modelling & Control
The module focuses on modelling the dynamics of process and servo systems and shaping the dynamic response through closed-loop control. Students will learn the principles of systems modelling, simulation, analysis and control, and the application of these principles in systems analysis and synthesis. Major topics include modelling single-discipline systems and mixed systems, Laplace transform, s-plane, standard forms, time domain specifications, effects of control actions on system performance, and frequency response analysis.

Telecommunication Principles
This module introduces students to radio communication. It builds an understanding of the basic concepts of analogue communication systems. The characteristics of a basic communication system and the environmental factors that affect communication will be discussed. The concepts that are necessary for an understanding of linear systems will be explained, with an emphasis on resonance and filters. Students will be taught the fundamental concepts of analogue modulation and demodulation techniques such as AM and FM and their applications.

Diploma Plus Programme

The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics*
- Business
- Foreign Languages

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

For detailed module descriptions under each cluster, please refer to page 193.
Diploma in Marine & Offshore Technology (MOT)

As the world’s busiest port, a leading ship conversion centre, the largest base of oil and gas equipment manufacturing companies in Asia, and home to over 3,400 marine companies, Singapore is a leader in the international marine and offshore industry.

The Diploma in Marine & Offshore Technology (MOT) is designed to meet the buoyant marine industry’s demand for skilled professionals in sectors such as ship design and production, ship conversion, offshore engineering, and offshore oil and gas. MOT gives graduates a qualification in naval architecture and offshore technology, one of the most sought-after special skills in Singapore’s maritime industry.

MOT focuses on the three main sectors of the industry – ship design and production, ship conversion, and offshore engineering. In the final year, students can specialise in design or oil & gas. In the design specialisation, students will learn to design and analyse various marine platforms. In the oil & gas specialisation, students will learn about the design and construction of offshore oil rigs as well as offshore drilling, topsides and subsea systems.

Our close relationship with industry partners, especially the Association of Singapore Marine Industries (ASMI), ensures that the curriculum reflects the latest industry practices. Students will work with leading organisations such as Keppel Offshore & Marine, ST Marine and Sembcorp Marine when they undergo their internships. There will be frequent off-campus lessons and study visits for enhanced learning and exposure, and the opportunity to build and test ship models in Singapore’s only towing tank, located within the Ngee Ann Polytechnic (NP) campus.

Students are also taught design thinking and design practice to develop skills in creating innovative solutions or processes, or designing and building marine vessels and offshore structures.

In response to the increasing industry demand for engineering graduates to have skills in the area of business management, MOT offers a Minor in Business Management. This Minor aims to nurture graduates who are technically competent and equipped with business knowledge to succeed in the changing industry environment.

A salient feature of the course is its flexibility. Students can choose to graduate with additional Diploma Plus and/or Enhancement Certificates depending on their abilities and interests. These are optional programmes designed to broaden students’ knowledge and deepen their skills in specific areas.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

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<thead>
<tr>
<th>Subject</th>
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<tbody>
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<td></td>
</tr>
<tr>
<td>or Fundamentals of Electronics</td>
<td></td>
</tr>
</tbody>
</table>

* Candidates with English as a second language must have attained a minimum grade of 6.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course.

You must also fulfil the aggregate computation requirements.
CAREER PROSPECTS

MOT graduates enjoy excellent employment prospects as project supervisors, designers, assistant engineers, planners, commercial officers, quality control inspectors, assistant project managers and safety officers as starting positions. Positions are also available in the oil and gas sector for technical support, sales or commissioning services. As the marine industry moves into higher value-added activities, career options in the industry are also growing for graduates in areas such as design, marketing, procurement, planning, safety and human resource.

ACCREDITATION FOR FURTHER STUDIES

Together with Newcastle University, the Singapore Institute of Technology offers our MOT graduates the chance to pursue a two-year degree programme right here on NP’s campus. What’s more, this programme is highly affordable as it is subsidised by the Singapore government!

The degree programmes MOT graduates can pursue are:

- Bachelor of Engineering with Honours in Naval Architecture
- Bachelor of Engineering with Honours in Offshore Engineering
- Bachelor of Engineering with Honours in Marine Engineering

The MOT course is well-recognised by both local and overseas universities, which grant advanced standing for their relevant degree programmes. Some examples include:

- Nanyang Technological University: Bachelor of Engineering in Mechanical Engineering or Materials Engineering
- National University of Singapore: Bachelor of Engineering in Civil Engineering or Mechanical Engineering
- Newcastle University (United Kingdom): Bachelor of Engineering in Naval Architecture
- University of Strathclyde (United Kingdom): Bachelor of Engineering in Naval Architecture
- University of Sydney (Australia): Bachelor of Engineering in Mechanical Engineering
- University of Tasmania (Australia): Bachelor of Engineering in Naval Architecture or Ocean Engineering or Marine & Offshore Systems

SCHOLARSHIPS

Unique to MOT is the number of scholarships available to students. These include the prestigious ASMI-MOT scholarship, where students are groomed for top management positions. Other scholarships include ASMI and Keppel Offshore & Marine scholarships.

ASMI-MOT Scholarships

To maintain its international leadership position in the new economy, members of the Association of Singapore Marine Industries (ASMI) are offering scholarships to bright, dynamic and capable ‘O’ Level holders. Scholarships, inclusive of tuition and all other compulsory fees, are offered to Singapore citizens and Permanent Residents. Recipients also get a monthly allowance of $600 and a notebook computer allowance of $1,500. Successful applicants will work with their sponsor companies for three years. The total value of this scholarship is $30,000.

ASMI Scholarships

About 30 ASMI scholarships are sponsored by members each year. Each scholarship has a value of $5,000 for each year of study. Recipients of these scholarships are guaranteed jobs in sponsoring organisations such as Sembcorp Marine, ST Marine and Keppel Offshore & Marine.

K C Lee Scholarships and Bursaries

Each year, the K C Lee Scholarship Fund awards scholarships of $2,000 and bursaries of $1,000 to selected MOT students.

COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td>YEAR 1</td>
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<tr>
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<td>Engineering Mathematics 1</td>
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<tr>
<td>Engineering Mechanics</td>
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<tr>
<td>Fundamentals of Naval Architecture 1</td>
<td>4</td>
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<tr>
<td>Manufacturing Technology &amp; Practice</td>
<td>4</td>
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<tr>
<td>Programming for Marine Applications</td>
<td>4</td>
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<tr>
<td>Sports &amp; Wellness</td>
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<td>Innovation Toolkit 1</td>
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<tr>
<td>Level 1.2 (24 hours per week)</td>
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<td>YEAR 2</td>
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<td>Marine Auxiliary Systems</td>
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<tr>
<td>Marine Design Drafting</td>
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<td>Offshore Drilling &amp; Production</td>
<td>3</td>
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<td>Thermodynamics</td>
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<td>Marine Design Practice</td>
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<td>Marine CAD</td>
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<td>Marine Production Technology</td>
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<td>Marine Industry Safety</td>
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<tr>
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</table>
## Module Name | Credit Units
---|---
### YEAR 3: Oil & Gas Specialisation
#### Level 3.1 (22 hours per week)
- Marine Propulsion Systems 5
- Drilling Engineering 3
- Offshore Topsides Systems 3
- Subsea Technology 3
- Marine Design Project 4
- World Issues: A Singapore Perspective\(^\wedge\) 2
- Interdisciplinary Studies (IS) elective\(^\wedge\) 2

#### Level 3.2 (22 hours per week)
- Internship 22

### YEAR 3: Design Specialisation
#### Level 3.1 (22 hours per week)
- Marine Propulsion Systems 5
- Marine & Offshore Design 3
- Marine Design Applications 3
- Offshore Dynamics 3
- Marine Design Project 4
- World Issues: A Singapore Perspective\(^\wedge\) 2
- Interdisciplinary Studies (IS) elective\(^\wedge\) 2

#### Level 3.2 (22 hours per week)
- Internship 22

### MINOR IN BUSINESS MANAGEMENT
#### YEAR 1
##### Level 1.1 (21 hours per week)
- Computer Programming 4
- Electrical Technology 4
- Engineering Mathematics 1 5
- Engineering Mechanics 4
- Sports & Wellness\(^\wedge\) 2
- Innovation Toolkit 1\(^\wedge\) 2

##### LEVELS 1.1 & 1.2

### COURSE MODULES
#### LEVELS 1.1 & 1.2

**Computer Programming**
This practice-oriented module will equip students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programmes for simple engineering applications.

**Electrical Technology**
This module provides the foundation in electricity to prepare the students for more specialised subjects. It deals with the basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of basic electrical circuit laws (Ohm's...
Law, Kirchhoff's Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics covered include fundamentals of electricity, network theorems and capacitance.

Engineering Materials
This module introduces students to the equilibrium phase diagrams, structures, and properties of common engineering materials with emphasis on mechanical testing methods, heat-treatment, international standard specifications, selection and applications of such materials. Topics include classification of materials, mechanical testing, alloying, steels, non-ferrous alloys, plastics, ceramics, composites, corrosion and selection of materials and shaping processes.

Engineering Mathematics 1
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Topics include algebra, trigonometry, logarithms, plane analytic geometry, matrices and complex numbers. Throughout the module, there is appropriate use of a Computer Algebra System.

Engineering Mathematics 2
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics are introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic is on simple applications and problem solving. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include Trigonometry, differentiation and simple integration with applications.

Engineering Mechanics
This module introduces students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students develop the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear and rotational motion in two dimensions will be covered. Topics include Kinematics and kinetics of linear motion.

Fundamentals of Naval Architecture 1
This module introduces the world of marine & offshore technology and students learn the basic principles of ship construction and floatation. Students would be inducted into the industry with a strong emphasis on pastoral care and career guidance, infused with NP core values, through exciting and engaging action-learning experiences such as team-building-team-learning (TBTL) sessions, off-campus visits and career and alumni talks.

Fundamentals of Naval Architecture 2
This module aims to provide students with the basic principles of marine hydrostatics which include the knowledge and understanding of intact stability, large angle stability, trim and damaged stability of a ship. Principles and analysis of centroids on areas, volumes and mass for various types of floating platforms and ships would be covered to enable the learning of marine hydrostatics.

Manufacturing Technology & Practice
Students will acquire the basic knowledge and skills of manufacturing processes, including drilling, turning, milling, grinding, non-conventional machining, welding and assembly. The module is practice-oriented with classroom lectures complemented by practical sessions involving the creation of specially-designed work pieces.

Programming for Marine Applications
This practical-oriented module equips students with basic knowledge and skills in computer programming using Visual Basic.Net language. The main topics include basic computing concepts such as data types, variables, conditional logic, loops, procedures, event handlers and object oriented programming. Upon completion of the module, students will be able to explain and write VB.Net programmes for simple engineering applications.

LEVELS 2.1 & 2.2
Engineering Design Thinking
This module aims to teach students the engineering design thinking process that designers adopt to define the problem, do relevant research to acquire information, analyse knowledge and provide creative solutions to the problem in the design and planning fields. With the thinking process, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen.

Engineering Mathematics 3B
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Laplace Transform, Probability and Statistics.

Fundamentals of Financial Management
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

Fundamentals of Naval Architecture 2
This module aims to provide students with the basic principles of marine hydrostatics which include the knowledge and understanding of intact stability, large angle...
stability, trim and damaged stability of a ship. Principles and analysis of centroids on areas, volumes and mass for various types of floating platforms and ships would be covered to enable the learning of marine hydrostatics.

**Fundamentals of Naval Architecture 3**
This module aims to provide students with the principles of the ship/oil-rig launching process, the principles and analysis of vessel resistance and propulsion. Strength of ships using the simple beam theory analogy would be analysed. Problems related to vibration and manoeuvrability would be discussed. In addition, elements of marine design would be discussed such as tonnage, load line assignment and roles of statutory bodies and classification societies.

**Marine Auxiliary Systems**
The module aims to provide students with a broad understanding of marine piping, pumps, cooling and heating systems; auxiliary machineries on-board ships through hands-on practices on common marine equipment such as valves, strainers, pumps, heat exchangers and diesel engines; and their applications in marine systems design and operations.

**Marine CAD**
Students apply Marine CADCAM software to complete the full procedure of hull design and production, including hull form generation, lines fairing, curved surface modelling, planar structure modelling, and generation of production information. They will also carry out 2-D drafting, and then proceed to create marine components as 3-D objects. The module also covers piping programme for pipe routing and pipe assemblies.

**Marine Design Practice**
This module introduces students to various computer-aided design and manufacturing work processes commonly used in the marine and offshore industry. Students will also carry out hands-on computer and lab practices associated with computer aided design and manufacturing. This module would integrate design thinking concepts and prepare the students for their final-year projects.

**Engineering Design Thinking & Practice**
This module equips students with the engineering design thinking process that designers adopt to define the problem, do relevant research to acquire information, analyse knowledge and provide creative solutions to the problem in the design and planning fields in the marine and offshore domain. Students have to carry out hands-on computer and lab practices associated with computer aided design and manufacturing to build mock-ups and prototypes. Basic shipyard processes, marine safety and project management skills will be highlighted as an induction and overview for the internship experience.

**Marine Design Drafting**
The module gives students fundamental training in the principles and practices of the international graphic language for engineering that is based on the International Standard Organisation (ISO) and the Singapore Standards (SS) guidelines. The module comprises short lectures and numerous hands-on exercises in creating design and drafting using various principles and techniques applied on marine design. AutoCAD is taught and used as the tool for design and drafting practical marine examples.

**Fundamentals of Marine Engineering**
This module will provide students with a fundamental knowledge and understanding of marine propulsion systems, the marine auxiliary systems and electrical systems through hands-on practices on common marine equipment such as valves, strainers, pumps, heat exchangers and diesel engines; and their applications in marine systems design and operations.

**Marine Production Technology**
This module aims to help students understand and equip them with basic knowledge of yard operations and production processes carried out in the various types of yard, from new build to repair and conversion. This module will also impart essential knowledge of welding and various manufacturing processes carried out during different stages of the production process, including weld quality control and various types of non-destructive testing to identify the distortion and defects during production.

**Marine Industry Safety**
This module introduces students to the various important aspects of marine industry safety and legislation governing occupational safety in workplaces. Topics include identification, evaluation and analysis of hazards, control measures and risk assessment.

**Marketing Fundamentals**
The basic concepts and principles of marketing are introduced. This module enables students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

**Offshore Drilling & Production**
Students will be introduced to offshore oil production covering marine well-drilling, types of drilling rigs and floating production systems. Topics include separators, gas-treatment, gas flaring, enhanced recovery using water and gas injection, produced water treatment, utility systems, mooring arrangements, storage and export systems. Technical consideration of FPSO conversions, subsea product on systems flow lines and risers, as well as remote-operated vehicles will also be covered.
**Strength of Materials**
This module aims to provide students with the foundational knowledge of strength of materials with an emphasis on applications and problem solving. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

**Thermodynamics**
This module covers the properties of working fluids, the first law of thermodynamics and its application to both non-flow and flow processes. Topics include the first law of thermodynamics, properties of liquids and vapours, non-flow processes with steam, steady flow processes with steam, properties of perfect gases, and non-flow processes with perfect gases.

**LEVELS 3.1 & 3.2**

**Common Modules**

**Internship**
The Internship aims to provide practice-oriented training to equip students with the appropriate knowledge, management and communication skills imbued with the right values to work as technologists in marine production. Students will get the chance to appreciate the organisational structure, company product and go through the production flow or project cycle with company mentors. Assessment of students’ performance will be carried out jointly by both industry as well as NP supervisors.

**Marine Design Project**
The module will equip students with design, planning and implementation knowledge through projects assigned based on the particular option chosen, either “Design” or “Oil & Gas”. Students will apply their knowledge to solve a real design problem related to the marine industry. The module will take students, working in groups, through the entire design life cycle.

**Marine Propulsion Systems**
Students will attain a fundamental knowledge and understanding of marine propulsion systems, matching of engine and propeller, compressed air system for starting, steering gear systems, reliability concepts applied to machinery design, and marine pollution control.

**Oil & Gas Specialisation**

**Drilling Engineering**
This module provides students with an overview of the drilling operations, from planning to completion for production. It develops a functional understanding of the operation and commissioning of various equipment processes and systems involved in the drilling and completion operations. Students are also introduced to analytical methods to select various components of drilling operations, and the demonstration of some design problems.

**Offshore Topsides Systems**
This module provides students with a deeper understanding on the working principles of the offshore topsides systems in the oil and gas upstream process, fundamental organic chemistry, basic production, process plant, equipment and utilities to support the processing of oil and gas. Learning is enhanced through practical sessions on industrial standard software investigating well and flow behaviour.

**Subsea Technology**
This module provides students with a deeper understanding in the subsea systems engineering in offshore oil and gas production. It covers subsea systems, equipment and their architecture, offshore exploration, Remote-Operated Vehicles, subsea processing of oil & gas, subsea control systems, flowline, pipeline and risers, and so on.

**Design Specialisation**

**Marine & Offshore Design**
This module aims to provide students with theoretical and analytical knowledge in marine and offshore design. Students will have the opportunity to apply the naval architecture knowledge learnt previously in the conduct of marine & offshore design process. The process includes identifying design requirements, data collection, estimation of dimensions, choice of design ratios and hull form. Capacities, weight & centre of gravity (CG) calculations are also included together with stability checks and speed-power estimates.

**Marine Design Applications**
This module aims to equip students with knowledge and skills of computer software applications in marine design. The emphasis will be placed on carrying out student group work in various preliminary marine designs (e.g. design of container, tanker, bulk carrier, general cargo vessels, offshore oil-rigs, etc.). Advanced marine design and simulation analysis software would also be used in the students’ design work. The students would be required to ascertain their design feasibility through the classification rules and a critique panel made up of industry partners would share their experiences with the students and also conduct joint assessment with the polytechnic lecturers in a student forum.

**Offshore Dynamics**
The module aims to help students understand the design considerations for offshore structures. In the analysis and design of offshore structures, students would be introduced to the API RP and ISO 19900 standards for offshore platform design. Topics covered range from various wave theories and diffraction theory, to Morison’s theory and spectral modelling approaches. The module will
also provide opportunities to explore the capabilities of a software package for offshore dynamics. Overall, students will be exposed to the latest engineering concepts and practices in offshore design, construction and installation.

**Minor in Business Management**

*Marine Business Project*
This module is designed for MOT-EBM students to help them apply the knowledge they have learned previously in engineering as well as in business to undertake business-related projects relevant to the marine industry. The module will take students, working in groups, through an entire project cycle.

*Starting & Managing an Enterprise*
Through this module, students generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics covered include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

**Business Management Electives**
*(Students to choose one of the four electives below)*

*E-Business in Practice*
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

*Managing Service Operations*
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing and facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

*Supply Chain Management*
This module introduces students to the process of planning, implementing, controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

*Understanding Buyer Behaviour*
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

**Diploma Plus Programme**
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

**Engineering Clusters**
- Applied Physics*
- Computer-Aided Design Skills (World Skills Singapore)
- Workplace Safety & Health

**Other available Diploma Plus Certificates**
- Advanced Engineering Mathematics*
- Business**
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

** The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
Mechanical Engineering is a very important and pervasive branch of engineering. The fact that most products and systems consist of mechanically-engineered components highlights its importance. The Diploma in Mechanical Engineering (ME) is a broad-based programme with exciting specialisation options that give students a firm foundation to work at the forefront of changing and emerging technologies. It trains students to solve problems with practical and innovative solutions.

ME’s strong emphasis on design gives students a competitive edge in a field that requires professionals for the design and manufacture of products, ranging from home appliances to biomedical devices. Students are also trained in areas such as automotive technology & motorsports, as well as the generation and use of energy.

First-year modules focus on engineering basics such as mechanics, electrical technology and computing as well as mathematical skills and computing tools. This gives students a firm grounding in solving engineering problems. As they progress, students are systematically introduced to the core mechanical engineering modules such as thermodynamics, fluid mechanics, computer-aided design, strength of materials and engineering design.

ME students are also taught design thinking and design practice to develop creative thinking and hands-on skills in creating innovative solutions and processes.

In their final year, students can opt for a four-month internship with established local or overseas companies. Alternatively, students can choose to undertake the Mechanical Design Project and specialise in a final-year discipline-specific option, such as Automotive Technology & Motorsports, Biomedical Applications, Design Innovation and Environment & Energy Systems.

In response to the increasing industry demand for engineering graduates with skills in the area of business management, ME also offers a Minor in Business Management. The Minor aims to nurture graduates who are technically competent and equipped with business knowledge to succeed in the changing industry environment.

A salient feature of the ME course is its flexibility. Students can choose to graduate with additional Diploma Plus and/or Enhancement Certificates, depending on their abilities and interests. These are optional programmes designed to broaden students’ knowledge and deepen their skills in specific areas.

**ENTRY REQUIREMENTS**

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language*</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Science (with Physics, Chemistry or Biology component) or Biotechnology or Computer Studies or Design &amp; Technology or Fundamentals of Electronics</td>
<td>1-6</td>
</tr>
</tbody>
</table>

* Candidates with English as a second language must have attained a minimum grade of 6.

You must also fulfill the aggregate computation requirements.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course.

**CAREER PROSPECTS**

Due to the pervasive nature of Mechanical Engineering, students will have one of the most versatile professional qualifications upon completion of the course. ME graduates are in demand to fill a wide variety of interesting and challenging positions in both the public and private sectors.
Many career opportunities are found at the technologist and middle management levels in the design, manufacturing, aerospace, marine, oil and gas, facilities management and engineering services industries. The chemical processing, pharmaceutical and life sciences industries also offer career opportunities.

**ACCREDITATION FOR FURTHER STUDIES**

As Mechanical Engineering is one of the fundamental fields of engineering, ME gives graduates an excellent opportunity to pursue a degree. Most international universities have a degree programme in Mechanical Engineering, while many other degree programmes also recognise the ME diploma. Some examples are Material Engineering, Aerospace Engineering, Marine Engineering, Mechatronic Engineering, Biomedical Engineering and Computer Engineering. The Singapore Institute of Technology, together with the University of Glasgow, now offers ME graduates the opportunity to pursue a Bachelor of Engineering with Honours in Mechanical Design Engineering on the Ngee Ann campus. Graduates also enjoy advanced standing and subsidised fees.

The ME course is well-recognised by both local and overseas universities, which grant advanced standing for their relevant degree programmes. Some of the university courses to which ME graduates gain advanced standing are:

- Nanyang Technological University: Bachelor of Engineering in Mechanical Engineering, Aerospace Engineering, Bioengineering or Materials Engineering
- National University of Singapore: Bachelor of Engineering in Mechanical Engineering
- Singapore Institute of Technology & the University of Glasgow: Bachelor of Engineering with Honours in Mechanical Design Engineering or Mechatronics

### COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 1.1 (25 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>Electrical Technology</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Mathematics 1</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Materials</td>
<td>4</td>
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<tr>
<td>Innovation Toolkit 1^</td>
<td>2</td>
</tr>
<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td><strong>Level 1.2 (27 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Composite Materials</td>
<td>3</td>
</tr>
<tr>
<td>Electronics Technology</td>
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</tr>
<tr>
<td>Engineering Design Drafting</td>
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<tr>
<td>Manufacturing Technology &amp; Practice</td>
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</tr>
<tr>
<td>Engineering Mathematics 2</td>
<td>5</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Innovation Toolkit 2^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 2</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 2.1 (24 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Applied Mechanics</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Design Thinking</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Mathematics 3</td>
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<tr>
<td>Industrial Automation</td>
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</tr>
<tr>
<td>Thermodynamics</td>
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</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
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<tr>
<td><strong>Level 2.2 (26 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Computer-Aided Design &amp; Analysis</td>
<td>4</td>
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<tr>
<td>Computer-Aided Manufacturing</td>
<td>4</td>
</tr>
<tr>
<td>Engineering System Design 1</td>
<td>4</td>
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<tr>
<td>Fluid Mechanics</td>
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</tr>
<tr>
<td>Mechanical Design Practice</td>
<td>3</td>
</tr>
<tr>
<td>Strength of Materials</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 3 (Internship)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 3.1 (27 hours per week)</strong></td>
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<tr>
<td>Applied Thermodynamics</td>
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<tr>
<td>Engineering System Design 2</td>
<td>5</td>
</tr>
<tr>
<td>Instrumentation &amp; Control</td>
<td>5</td>
</tr>
<tr>
<td>Mechanics of Machines &amp; Materials</td>
<td>5</td>
</tr>
<tr>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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</tr>
<tr>
<td><strong>Level 3.2 (16 hours per week)</strong></td>
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<tr>
<td>Four-month Internship</td>
<td>16</td>
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<tr>
<td><strong>YEAR 3 (Non-Internship)</strong></td>
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<tr>
<td><strong>Level 3.1 (23 hours per week)</strong></td>
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</tr>
<tr>
<td>Instrumentation &amp; Control</td>
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</tr>
<tr>
<td>Mechanical Design Project 1</td>
<td>5</td>
</tr>
<tr>
<td>(in the specific specialisation)</td>
<td>4</td>
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<tr>
<td>Mechanics of Machines &amp; Materials</td>
<td>5</td>
</tr>
<tr>
<td>Specialisation Module (Automotive Technology &amp; Motorsports, Biomedical Applications, Design Innovation, or Environment &amp; Energy Systems)</td>
<td>5</td>
</tr>
<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
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<tr>
<td><strong>Level 3.2 (20 hours per week)</strong></td>
<td></td>
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<tr>
<td>Applied Thermodynamics</td>
<td>5</td>
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<tr>
<td>Engineering System Design 2</td>
<td>5</td>
</tr>
<tr>
<td>Mechanical Design Project 2</td>
<td>7</td>
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<tr>
<td>(in the specific option)</td>
<td>7</td>
</tr>
<tr>
<td>Project Management</td>
<td>3</td>
</tr>
</tbody>
</table>
### Module Name | Credit Units
---|---
**MINOR IN BUSINESS MANAGEMENT**

**YEAR 2**

**Level 2.1 (26 hours per week)**
- Applied Mechanics 5
- Computer-Aided Design & Analysis 4
- Engineering Design Thinking 3
- Engineering Mathematics 3
- Engineering System Design 1
- Marketing Fundamentals 4
- Business & the Economy\(^\wedge\) 2

**Level 2.2 (24 hours per week)**
- Fundamentals of Financial Management 4
- Industrial Automation 5
- Mechanical Design Practice 3
- Strength of Materials 5
- Thermodynamics 5
- Effective People Management\(^\wedge\) 2

**YEAR 3 (Internship)**

**Level 3.1 (26 hours per week)**
- Business Management Elective 4
- Engineering System Design 2 5
- Fluid Mechanics 4
- Mechanics of Machines & Materials 5
- Starting & Managing an Enterprise 4
- World Issues: A Singapore Perspective\(^\wedge\) 2
- Interdisciplinary Studies (IS) elective\(^\wedge\) 2

**Level 3.2 (16 hours per week)**
- Four-month Internship 16

**YEAR 3 (Non-Internship)**

**Level 3.1 (21 hours per week)**
- Business Management Elective 4
- Mechanics of Machines & Materials 5
- Project Design & Business Application 1 4
- Starting & Managing an Enterprise 4
- World Issues: A Singapore Perspective\(^\wedge\) 2
- Interdisciplinary Studies (IS) elective\(^\wedge\) 2

**Level 3.2 (21 hours per week)**
- Applied Thermodynamics 5
- Engineering System Design 2 5
- Fluid Mechanics 4
- Project Design & Business Application 2 7

**Notes:**
\(^\wedge\) 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.

\(^\wedge\) The Minor in Business Management has the same Year 1 curriculum except for Composite Materials.

### COURSE MODULES

#### LEVEL 1.1

**Computer Programming**
This practice-oriented module will equip students with the basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programmes for simple engineering applications.

**Electrical Technology**
This module will provide the foundation in electricity to prepare students for more specialised subjects. It will deal with basic concepts of electrical circuits and the methods used to analyse them. The module will emphasise the understanding of basic electrical circuit laws (Ohm’s Law, Kirchhoff’s Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics include fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance, AC circuit theory and transformer fundamentals.

**Engineering Mathematics 1**
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics will be introduced in an order that is intended to keep abreast with the application requirements in engineering modules. The emphasis in each topic will be on simple applications and problem solving. Topics include algebra, trigonometry, logarithms, plane analytic geometry, matrices and complex numbers. Throughout the module, there will be an appropriate use of a Computer Algebra System.

**Engineering Mechanics**
This module will introduce students to the study of external forces in two dimensions and their effect on particles and rigid bodies that are at rest. Students will acquire the skills to analyse the forces acting on the bodies by drawing free-body diagrams and applying the conditions of equilibrium. Topics include forces and resultants, moments and couples, equilibrium, and the concepts of plane friction. This module will also aim to equip students with the skills to analyse problems of rigid bodies in motion. Only linear motion in two dimensions will be covered. Topics include kinematics and kinetics of linear motion.
Engineering Materials
This module will introduce students to the equilibrium phase diagrams, structures, and properties of common engineering materials with emphasis on mechanical testing methods, heat-treatment, international standard specifications, selection and applications of such materials. Topics include classification of materials, mechanical testing, alloying, steels, non-ferrous alloys, plastics, ceramics, composites, corrosion and selection of materials and shaping processes.

LEVEL 1.2
Composite Materials
This module aims to provide students with knowledge of the design, analysis and fabrication of composites materials used in engineering design applications. Topics include basic principles of the design, characterisation, fabrication and repair of composites materials.

Electronics Technology
This module will introduce the fundamental concepts of electronics which include analogue and digital electronic devices and circuits. The first section covers concepts pertaining to analogue electronics. These include understanding the analogue electronic circuitry, diodes, transistors and their applications. The second half of the module covers concepts on digital electronics. Topics include number systems, Boolean algebra, combinational logic design, applications of latches, flip-flops, counters and registers.

Engineering Design Drafting
This module will cover the basic principles of engineering drafting and the application of an industry-standard Computer-Aided Design & Drafting tool to produce detailed drawings of engineering parts. This practice-oriented module will comprise short lectures complemented by hands-on exercises with emphasis on practical examples and industry practices. Topics include orthographic projection, sectioning, dimensioning, conventional representation and assembly drawing.

Manufacturing Technology & Practice
This module will allow students to acquire the basic knowledge and skills of manufacturing processes, including drilling, turning, milling, grinding, nonconventional machining, welding and assembly. The module will be practice-oriented with classroom lectures complemented by practical sessions involving the making of specially-designed work pieces.

Engineering Mathematics 2
This module is designed to provide students with the fundamental skills in mathematics required to solve basic engineering problems. Topics will be introduced in an order that is intended to keep abreast of the application requirements in engineering modules. The emphasis in each topic will be on simple applications and problem solving. Throughout the module, there will be appropriate use of a Computer Algebra System. Topics include Trigonometry, differentiation and simple integration with applications.

LEVEL 2.1
Applied Mechanics
This is a follow-on module of Engineering Mechanics. It will equip students with the necessary skills to analyse problems of rigid bodies at rest and in motion. Topics include trusses, friction, work energy method, power and efficiency & Impulse momentum method. This knowledge plays an important role in many diverse engineering applications of the modern world, such as the design of cars, structures, airplanes, and various types of machines. Students will be guided to solve engineering problems using these mechanics principles.

Engineering Design Thinking
This module aims to teach students the engineering design thinking process that designers adopt to define the problem, do relevant research to acquire information, analyse knowledge and provide creative solutions to the problem in the design and planning fields. With the thinking process, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen.

Engineering Mathematics 3
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Laplace Transform, Probability and Statistics.

Industrial Automation
This module will allow students to explore the concepts of logic and sequential control, and their applications in industrial automation. They will be introduced to a spectrum of technologies, ranging from pneumatics and electro-pneumatics to programmable controllers, with emphasis on component technology leading to circuit design and implementation. Topics include automated mechanisms, ladder diagrams, basic and advanced features of programmable controllers, design techniques and applications.

Marketing Fundamentals
This module will introduce concepts and principles of the marketing of goods and services to enable students to better understand and evaluate the marketing system in which products and services are planned, priced, promoted and distributed. Apart from the four P’s in marketing, topics covered also include segmentation, targeting and positioning, product mix, service marketing, channel decisions and branding.

Thermodynamics
This module covers the properties of working fluids, the first law of thermodynamics and its application to both
non-flow and flow processes. Topics include the first law of thermodynamics, properties of liquids and vapours, non-flow processes with steam, steady flow processes with steam, properties of perfect gases, and non-flow processes with perfect gases.

**LEVEL 2.2**

**Computer-Aided Design & Analysis**
This practice-oriented module is designed to give students an appreciation of the scope of computer graphics and hands-on practice on the applications of CAD (Computer-Aided Design) in engineering design. This module aims to help the students in the application of the drafting concepts and modelling techniques for development of product models in the design process. Students will learn the principles and capabilities of CAD through three dimensional (3D) solid modelling of engineering components and assembly. A project is used to consolidate the concepts and techniques learnt in the CAD module and CAM (Computer-Aided Manufacturing) module. Another project is used to consolidate the concepts and techniques learnt in the CAD module and ESD1 (Engineering System Design 1) module.

**Computer-Aided Manufacturing**
This module will allow students to acquire the basic knowledge and skills in handling modern manufacturing processes. The module is practice-oriented with classroom lectures complemented by practical sessions on computer-numerical-control (CNC) turning and milling, PRO/NC, reverse engineering, coordinate measuring machines, automation and assembly. There is also coverage on electronics manufacturing and automatic assembly processes. Safety and a positive work attitude form an integral part of the module.

**Engineering System Design 1**
This module will equip students with the fundamental knowledge and practice of proper engineering design process and the applications of engineering principles and analysis in the design, sizing and selection of components such as electric motor, coupling, gears, bearing, chain drives, and fastener and compression spring. Case studies of existing machines and systems, guided tutorials, quizzes, assignments and a practical project will be used to reinforce the theoretical aspects.

**Fluid Mechanics**
This module will provide an introduction to the principles of fluid mechanics and their application in analysing systems in which fluid is the working medium. Topics include fluid statics, pressure measurement, hydrostatic forces on submerged surfaces, buoyancy, fluid in motion, Bernoulli Equation, flow measurement, piping system, pump performance, and system characteristics.

**Fundamentals of Financial Management**
This module covers basic accounting and financial concepts and principles to enable students to understand and interpret financial statements and reports. Students will also have an understanding of costing concepts and the financial techniques used in making financial decisions and evaluating capital investment projects.

**Mechanical Design Practice**
This is a hands-on module that aims to provide students with the opportunities to translate the knowledge and skills learnt from module Engineering Design Thinking into practice through the detailed design, fabrication and testing of an engineering application prototype. In the process, students will hone their design knowledge and skills required for their final-year project or internship.

**Strength of Materials**
This module aims to provide students with the foundational knowledge of strength of materials with emphasis on applications and problem solving. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

**LEVELS 3.1 & 3.2**

**Applied Thermodynamics**
This module will allow students to learn the application of thermodynamics principles to energy conversion, transformation and management. Topics include thermodynamics processes, the second law of thermodynamics, gas power cycles, engine performance testing, nozzles, steam power plant, heat transfer and introductory thermal management.

**Engineering System Design 2**
This module will equip students with the fundamental knowledge and practice for the design of multiple discipline projects. Case studies where working examples are used to introduce and reinforce the knowledge acquired by students through lectures. A project is used to enhance and cultivate analytical thinking and independent learning in the design environment.

**Four-month Internship**
The four-month internship will provide students with the opportunity to apply the knowledge acquired in the classroom to work situations, and demonstrate problem solving, communication and interpersonal skills in a work environment. The programme enables students to hone their ability to work independently and in teams, while they take on one or more practical projects under the supervision of industry practitioners. The objective is to develop a professional approach to work based on the relevant code of practice.
Instrumentation & Control
This module will cover instruments, feedback control systems, control components, system performance and stability. Topics include concepts of feedback control, principles and application of measuring sensors, control valves, control modes, use of analytical tools for system performance and stability analysis, servo control systems, and process control applications.

Mechanical Design Project 1
This module will allow students to work in teams to design and develop a product or system related to their final-year option module. In the project, students will learn to apply their knowledge and skills in creative problem solving, engineering and design, teamwork and project management. This module focuses on the identification of problem or need, research and design.

Mechanical Design Project 2
This module follows on from Mechanical Design Project 1. Based on the design prepared in the first semester, students will be required to fabricate the prototype, assemble the parts, test and refine the prototype, prepare the refined design and a project report. The students will also be required to do a final presentation to a panel of examiners.

Mechanics of Machines & Materials
This module will provide students with the experience of solving engineering problems based on the principles and theories covered in the earlier Mechanics modules. Topics include velocity and acceleration diagrams, effects of the mass of members of mechanism, friction mechanisms and the effects of friction on screw threads and belt drives, balancing of shafts and its application to gears and pulleys, and the causes and control of machinery vibration.

Project Design & Business Application 1
This module will allow students to integrate the business and engineering knowledge they gained during the first two years of study and undertake a year-long project in the field of Mechanical Engineering. They will be required to conduct a market survey for a particular product need, conceptualise the product and develop a business proposal/plan for the product.

Project Design & Business Application 2
This module is a continuation of Project Design & Business Application 1 where students will develop their product into a working prototype. They will also be required to document their design and fabrication process in a project report and present their work to a panel of examiners.

Project Management
This module aims to provide students with a thorough understanding of projects and project management techniques such as project planning, scheduling and controlling using network analysis such as Critical Path Method (CPM), Gantt Charts and Program Evaluation & Review Technique (PERT). The major topics include Introduction to Projects and Project Management, CPM, Resource Scheduling, Project Costs, Project Control and PERT. The module is supplemented with tutorial assignments. Case studies are included to reinforce basic understanding and concepts which can be applied in practical situations.

Starting & Managing an Enterprise
This module will allow students to generate business ideas and propose how these ideas can be developed into a business plan incorporating operational and financial requirements and marketing strategies for a new enterprise. In addition, students will learn how the principles of management can be applied to organise and develop the enterprise. Topics include entrepreneurial concepts and issues, business entry and exit strategies, types of business ownership, sources of business financing, venture launch and management principles.

Final-year Specialisation Modules

Automotive Technology & Motorsports
This activity-based module covers the structures, functions, main components and operations of land vehicles and motorsports, including recent development of ‘green’ vehicles. The module will prepare students to undertake an automotive project, which takes them through the complete cycle of idea generation, design, manufacturing, testing and presentation.

Biomedical Applications
This activity-based module covers biomechanics and rehabilitation engineering, biomaterials and implant, and medical imaging with rapid prototype. The module will prepare students to undertake a biomedical application project, which involves the complete cycle of idea generation, design, manufacturing, prototype testing, report and presentation.

Design Innovation
This activity-based module covers the design, innovation and development process involving problem research and definition, target user group and product design specifications, aesthetic and ergonomic requirements. The module will prepare students to undertake a design innovation project, which involves the complete cycle of idea generation, design, manufacturing, prototype testing, report and presentation.

Environment & Energy Systems
This activity-based module covers environmental issues and energy saving in mechanical systems, alternative
and renewable energy sources, and the heat transfer principles and design requirements and applications of air-conditioning systems. The module will prepare students to undertake an environment and energy system project, which involves the complete cycle of idea generation, design, manufacturing, prototype testing, report and presentation.

Business Management Electives
(Students to choose one of the four electives below)

E-Business in Practice
The module introduces database concepts, information systems, value chains and the integrated enterprise systems. Students will develop multi-table database applications for e-business, incorporating interactive digital media functionalities and also gain exposure in buying and selling on the Web using auction sites with payment settlement functions. They will learn business workflow modelling through the business value chain to improve business processes using IT systems and tools within an integrated enterprise system.

Managing Service Operations
This module introduces the operations in service organisations and the use of techniques for designing, planning, organising and controlling resources for the delivery of goods and services to meet customers’ needs and organisational objectives. Concepts covered include service facility, managing and facilitating goods, forecasting demand, managing waiting lines, process improvement, inventory management, service supply relationship and service quality.

Supply Chain Management
This module introduces students to the process of planning, implementing, and controlling the operations of the supply chain. It will cover the movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption. The module also emphasises the effect supply chain management has on the success and profitability of the organisation.

Understanding Buyer Behaviour
The module provides students with a basic understanding of buyer behaviour concepts. It explores the different types of buying decision processes and the various influencing factors that affect buyer decisions. Buyers could be consumers or corporate buyers. Topics covered include consumer decision-making processes, perceptions and attitudes, consumer demographics and lifestyles, and cultural and group influences.

Diploma Plus Programme
The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student’s knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

Engineering Clusters
- Applied Physics*
- Computer-Aided Design Skills (World Skills Singapore)
- Workplace Safety & Health

Other available Diploma Plus Certificates
- Advanced Engineering Mathematics*
- Business**
- Innovation Management
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

** The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

** Students pursuing the Minor in Business Management cannot take the DPP Certificate in Business (CIB).

For detailed module descriptions under each cluster, please refer to page 193.
The unique Diploma in Network Systems & Security (NSS), the result of an industry-academia partnership between Ngee Ann Polytechnic and Cisco Systems (USA), provides world-class infocomm training to students, in areas such as design, implementation, security and maintenance of network infrastructure and data centres to support server farms & cloud computing.

The recent partnership with IBM in the area of Cloud Computing saw the setting up of NP-IBM Cloud Computing Centre of Excellence. With these two global industry partners, as well as others like SuperInternet, Global Cloud Xchange and Westcon Group, students will learn from industry experts and work on real-life projects.

NSS offers final-year specialisations in Network & Cloud Architecture and Data Security & Forensics. Students who pursue the Network & Cloud Architecture specialisation will enhance their skills and knowledge in the areas of network infrastructure and cloud technology. Students who opt for the Data Security & Forensics specialisation will learn more about the vulnerabilities of networks and servers as well as how to protect them.

Final-year students will also, as part of the course curriculum, go on a 22-week internship that gives them practice-oriented exposure in one of the following areas - design, implementation, security and maintenance of enterprise-level corporate network projects or involvement in research projects with national research organisations such as A*STAR Institute for Infocomm Research, A*STAR Data Storage Institute and DSO National Laboratories or with the Ministry of Home Affairs’ Singapore Infocomm Technology Security Authority.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
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</thead>
<tbody>
<tr>
<td>English Language as a First Language</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Any two other subjects</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Design & Technology or Food & Nutrition or a relevant OSIJE / Applied Subject and fulfill the aggregate computation requirements.

Candidates with severe vision deficiency should not apply for the course.

CAREER PROSPECTS

NSS graduates are equipped with the knowledge and practical skills to sit for the globally recognised Cisco Certifications (Cisco Certified Network Associate and Cisco Certified Network Professional) as well as other internationally recognised professional certifications such as IPv6 Forum Certified Network Engineer, Linux Professional Institute Certifications, ITIL, EC Council Certifications and Cloud Certifications. These certifications will enhance their market value.
Graduates can look forward to a spectrum of exciting and challenging infocomm-related careers in network systems or architecture, network security, wired and wireless network solutions, convergence networks, system administration and support, security risks assessment, data centre administration and support, and sales and marketing.

For more information on infocomm manpower requirements and careers, visit http://www.ida.gov.sg

ACCREDITATION FOR FURTHER STUDIES

NSS graduates can apply to National University of Singapore and Nanyang Technological University to pursue degree courses in Computing, Computer Science, Computer Engineering and Business & Computing. The Singapore Management University recognises the Diploma as fulfilling its entry requirements for the Bachelor of Science (Information Systems Management).

Most Australian universities recognise NSS as an entry requirement for their related undergraduate degree courses with advanced standing. The following are some examples:

- Australian National University
- Queensland University of Technology
- University of Adelaide
- University of Melbourne
- University of Queensland
- University of Western Australia

NSS graduates can also pursue the Information Technology Bachelor–Master Package Programme with The University of Queensland. Students will obtain both a Bachelors and a Masters degrees in five semesters and pay for only four semesters if they are eligible for the scholarship.

<table>
<thead>
<tr>
<th>COURSE CURRICULUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name</td>
</tr>
<tr>
<td>YEAR 1</td>
</tr>
<tr>
<td>Level 1.1 (26 hours per week)</td>
</tr>
</tbody>
</table>
Computer Programming | 4 |
Engineering Mathematics 1 | 5 |
IT Service Management | 3 |
Network Fundamentals | 6 |
Linux Servers | 4 |
Innovation Toolkit 1^ | 2 |
Sports & Wellness^ | 2 |

| Level 1.2 (28 hours per week) |
Applications Programming | 4 |
Digital Logic | 3 |
Engineering Mathematics 2 | 5 |
Basic Routing & Switching | 6 |
Windows Servers | 4 |
Innovation Toolkit 2^ | 2 |
Communication & Contemporary Issues^ | 4 |

| YEAR 2            |
| Level 2.1 (23 hours per week) |
Engineering Mathematics 3A | 4 |
Information Security | 4 |
Intermediate Routing & Switching | 5 |
Object-Oriented Programming | 5 |
Project Management | 3 |
Interdisciplinary Studies (IS) elective^ | 2 |

| Level 2.2 (22 hours per week) |
Cloud Computing & Data Centres | 5 |
Wide Area Networks | 5 |
Network Security | 5 |
Interdisciplinary Studies (IS) module^ | 2 |

| Network & Cloud Architecture Specialisation |
Internet of Everything | 5 |

| Data Security & Forensics Specialisation |
Server Administration & Security | 5 |

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR 3</td>
<td></td>
</tr>
<tr>
<td>Level 3.1 (24 hours per week)</td>
<td></td>
</tr>
</tbody>
</table>
Common Modules |
Cloud Architecture & Security | 5 |
Network & Cloud Design | 5 |
World Issues: A Singapore Perspective^ | 2 |
Interdisciplinary Studies (IS) module^ | 2 |

| Network & Cloud Architecture Specialisation |
Advanced Routings | 5 |
Advanced Switching | 5 |

| Data Security & Forensics Specialisation |
Computer & Network Forensics | 5 |
Ethical Hacking & Countermeasures | 5 |

| Level 3.2 (22 hours per week) |
Six-month Internship | 22 |

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.
COURSE MODULES

LEVEL 1.1

Computer Programming
This practice-oriented module equips students with basic knowledge and skills in computer programming using C language. The main topics include basic computing concepts, fundamentals of C, branching, loops, and C functions. On completion of the module, students will be able to explain and write C programmes for simple engineering applications.

Engineering Mathematics 1
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

IT Service Management
This module covers organisation of IT resources to deliver business value, documenting the processes, functions and roles of IT Service Management (ITSM) in the context of project management. Concepts include detailed descriptions of important IT practices with comprehensive checklists, tasks and procedures IT organisations can use to meet their business needs.

Network Fundamentals**
This module covers theoretical concepts and practical applications needed to design networks in small-to-medium businesses. Key concepts include the data networks, protocols in communications, OSI model, TCP/IP model, addressing & naming schemes in network communication.

Linux Servers
This module covers the basics of Linux operating system and server. Concepts include the use of Linux commands to access and manage directories, files, setting of file security and access rights and basic servers’ implementation, such as DNS and DHCP in a network.

LEVEL 1.2

Applications Programming
This practice-oriented module equips students with the knowledge and skills required to develop Windows applications. Students will acquire the conceptual understanding to design and develop applications to solve business and engineering problems. Main topics include branch and loop, array, data files accessing and methods.

Digital Logic
This module provides students with fundamental knowledge and skills in logic design. Students will learn about the combinational and sequential logics and how to design and use them to control digital systems. A project will be used to reinforce students’ learning and help them to relate their learning to real-life examples.

Engineering Mathematics 2
This module equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

Basic Routing & Switching**
This module covers the architecture, components, and operations of routers and switches in a small network. Students learn how to configure a router and a switch for basic functionality. By the end of this module, students will be able to configure and troubleshoot routers and switches and resolve common issues with RIPv1, RIPng, single-area OSPF, virtual LANs, and inter-VLAN routing in both IPv4 and IPv6 networks, access control lists, DHCP and NAT.

LEVEL 2.1

Engineering Mathematics 3A
This module is a continuation of Engineering Mathematics 2. Topics include Integration Techniques & Applications, First Order Differential Equation, Fourier series and Laplace Transform.

Information Security
This module covers management and administration of Information Security. Concepts include security threats, security incidents, risk assessment and mitigation, information security policy, procedures, guidelines and standards, security administration, physical security and configurations and administrations of current OS systems. Relevant Singapore IT Law and governance issues will also be covered.

Intermediate Routing & Switching**
This module covers the architecture, components and operations of routers and switches in larger and more complex networks. Students learn how to configure routers and switches for advanced functionality. By the end of this module, students will be able to configure and troubleshoot routers and switches and resolve common issues with OSPF, EIGRP, STP and HSRP in both IPv4 and IPv6 networks. Students will also gain the knowledge and skills needed to implement a WLAN in a small-to-medium network.
Object-Oriented Programming
This module builds on the foundation of the Applications Programming module and introduces the concepts of Object-Oriented Programming to the students. It covers the area from the fundamental concepts of Object-Oriented Programming to Web forms, database access, and some graphics and animation.

Project Management
This module uses case studies to teach project management principles, strategies & tools, planning the project, estimating project costs, developing the project schedule, executing the project, justifying project costs, managing project quality, managing project risk, software configuration management, interacting with project stakeholders and outsourcing the project.

LEVEL 2.2
Cloud Computing & Data Centres
This module provides an overview of cloud computing and data centres. Concepts include virtualisation as a foundation for cloud computing, issues related to implementation of cloud computing and data centres, cloud services like Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). It also covers simple architecture, design, implementation, management and security of public and private clouds.

Wide Area Networks**
This module covers implementation and configuration of common data link protocols and application of WAN security concepts, principles of traffic, access control, and addressing services. Concepts include PPP, Frame Relay, NAT & PAT, DHCP and IPv6.

Network Security
This module covers network security, intrusion detection, securing an organisation’s wired and wireless network infrastructure. Concepts include network security threats and attacks, designing resilient networks, configuring network components such as firewall, setting up Virtual Private Network (VPN) and securing wireless connections.

Network & Cloud Architecture Specialisation

Internet of Everything
This module covers IP communications used in voice, music, video and data in order to implement solutions that are best suited for their storage and transmission. Concepts include sampling theorem, analog & digital communications, aliasing, codecs, QoS, digital media and IP routing in IoE.

Data Security & Forensics Specialisation

Servers Administration & Security
This module covers provisioning and management of secured server systems, software services and hosting environment. Concepts include secured configuration, system hardening, access and activity authentication, authorisation and monitoring of DNS server, Web server & security, SSL, DHCP, Mail server, Samba server, Proxy server, SSH server and FTP server.

LEVEL 3.1
Common Modules

Cloud Architecture & Security
This module covers the design, implementation, management and security of public and private clouds. Concepts include the architecture of cloud and establishment of data integrity and privacy for Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

Network & Cloud Design
This module equips students with the skill-sets needed to design high availability secure enterprise networks with server farms, data centres and remote access to all these servers to deliver cloud services.
detection of SYN and spoofing attacks using various network tools.

**LEVEL 3.2**

*Six-month Internship*

In this module, students will be attached to sponsoring companies for a period of approximately six months. During their internships, they will undertake projects assigned by the company or be involved in operations or maintenance-related work. Student internships may be undertaken locally or overseas.

“Network Fundamentals, Basic Routing & Switching, Intermediate Routing & Switching and Wide Area Networks will help students prepare for CCNA:R&S certification while Advanced Routing and Advanced Switching will prepare them for CCNP:Route & CCNP:Switch certifications respectively (provided by external test centres).

**Diploma Plus Programme**

The Diploma Plus Programme (DPP) is designed to provide students with proficiency in a selected domain area, either to broaden or deepen a student's knowledge/skills in his/her main discipline of study, or to equip a student with additional professional knowledge that would better prepare him/her for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

Students can choose the DPP clusters from the list below. The offer of a DPP cluster is subject to the condition that the minimum class size is met and based on available vacancies.

**Engineering Clusters**

- Applied Physics*
- Computer & Communication Systems

**Other available Diploma Plus Certificates**

- Advanced Engineering Mathematics*
- Business
- Foreign Languages

* The Applied Physics syllabus is aligned to the NTU’s FE1012: Physics A module. NP students who obtain good grades in the Applied Physics modules will be granted exemption from the FE1012: Physics A module.

* The CAEM syllabus is aligned with the ‘A’ Level H2 Pure Mathematics syllabus. NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

For detailed module descriptions under each cluster, please refer to page 193.
DIPLOMA PLUS PROGRAMMES
ELECTIVE MODULES

**APPLIED PHYSICS CLUSTER**

Designed in collaboration with the College of Engineering, Nanyang Technological University, this cluster helps to prepare students for university-level physics modules. The three modules in the cluster enhance the students' knowledge and bridge the gaps to university physics modules.

**Physics 1A – Mechanics**
This module provides an understanding of the fundamentals of physics. Topics include measurements, vectors, mechanical motions in one and two dimensions, Newton's laws of motion, energy of a system, linear momentum and collisions.

**Physics 2A - Mechanics and Heat**
This module focuses on Mechanics and Heat. Topics include angular kinematics, universal gravitation, fluid mechanics, temperature, heat and the law of thermodynamics, and kinetic theory of gases.

**Physics 3A - Electricity and Magnetism**
This module focuses on Electricity and Magnetism. Topics include electric and magnetic fields, Gauss's Law, Faraday's Law, capacitance and dielectrics, current and resistance, direct and alternating current circuits.

**AVIATION FUNDAMENTALS CLUSTER**

Based on the ground school examinations curriculum of the Private Pilot Licence (PPL) as specified in the Singapore Air Safety Publication by the Civil Aviation Authority of Singapore, the Certificate in Aviation Fundamentals cluster is designed for students who are interested in flying as a co-curricular activity or who are considering a career as a pilot. The syllabus is based on the five basic modules offered in the ground school examinations for the PPL. It provides a foundation in aircraft systems and operations with an emphasis on the basic principles of air navigation, meteorology, human performance and aviation technology. The cluster consists of three integrated modules:

**Aircraft Rating**
This module provides a foundation in aircraft systems and the basic principles of flight with an emphasis on general aviation aircraft. It covers the systems of fixed wing and rotary wing aircraft as well as the operating environment, airworthiness requirements, structural limitations and basic aircraft maintenance mainly from the perspective of a trainee pilot.

**Meteorology, Human Performance & Limitations**
This module consists of two components: Meteorology as well as Human Performance and Limitations. The meteorology component provides a foundation in the study of weather and its effect on flight operations. The component on human performance and limitations covers the factors and interactions between man and machine, and their impact on aviation safety with an emphasis on air crew performance in the flight environment.

**Aviation Law, Flight Rules & Procedures, and Navigation**
This module consists of two components: Aviation Law, Flight Rules and Procedures as well as Navigation. The first component provides a foundation in aviation laws and regulations, rules of the air and flight procedures to meet the basic requirements of a trainee pilot. The second component on Navigation covers the use of aeronautical charts with emphasis on basic air navigation including the determination of track, heading, air speed and ground speed. This module provides training in the essential skills and knowledge in flight rules and procedures as well as air navigation required for a basic pilot licence.

**ADVANCED ENGINEERING MATHEMATICS CLUSTER**

This cluster is designed for engineering students who wish to strengthen their mathematical foundation for university studies. The syllabus is based on the ‘A’ Level H2 Pure Mathematics syllabus. In consultation with NUS, NP graduates who have successfully completed the revised CAEM will be granted exemption from the NUS’ MA1301 Proficiency Test.

**Advanced Engineering Mathematics 1**
Students will learn topics such as functions and graphs, sequence, inequality, trigonometry, plane analytic geometry and series and matrices.

**Advanced Engineering Mathematics 2**
Students will learn topics such as complex numbers, vectors and series.

**Advanced Engineering Mathematics 3**
Students will learn topics such as differentiation and applications, integration and applications, differential equations, sequences and series (e.g. power series, taylor series, fourier series).
**BIOMEDICAL ENGINEERING CLUSTER**

This cluster prepares students for the exciting field of biomedical engineering. All three modules aim to bridge the gap with university science and mathematics modules in the engineering and science courses.

**Foundational Chemistry**
Students are introduced to the concepts of physical, inorganic and organic chemistry. Students will gain a working knowledge of the atomic nature of matter, periodic table and law, chemical bonding between particles, mole concept, the balancing of chemical equations, different types of chemical reactions, spontaneous and non-spontaneous processes, the role of catalysts, as well as the structure and properties of various organic compounds.

**Biomedical Signal Processing**
This module gives an introduction to biomedical signal processing and analysis. Students are introduced to fundamental signal processing techniques to analyse and process signals that originate from biological sources such as ECGs, EMGs, EEGs, and blood pressure signals, and integrate the information with physiological knowledge, useful for physiologic investigation and medical diagnosis and processing.

**Further Engineering Mathematics**
Students are introduced to the various types of differential equations and their solutions, as well as their applications in science and engineering. Students will gain a working knowledge of using differential equations in modelling physical and engineering systems. They will develop important skills to obtain the solution of a differential equation by applying analytic, numerical, or graphical techniques.

**COMPUTER-AIDED DESIGN SKILLS CLUSTER**

This cluster is specially designed to strengthen and deepen the technical knowledge and skills of students in using design software to solve challenging engineering design problems. Talented students will be invited to join the programme. The programme will equip students with strong engineering problem-solving skills and prepares them to participate in World Skill Singapore (WSS) Competition and related events.

**Fundamental Mechanical CAD**
This module is a practice-oriented module designed to give students strong fundamentals in using AutoDesk Inventor as Computer Aided Design tool in solving engineering design problems. This module covers sketching, 3D solid modelling concepts and techniques.

**Advanced Mechanical CAD**
This is a practice-oriented module designed to equip students with strong advanced software skills in modelling and solving engineering design problems. This module covers advanced CAD commands and engineering design principles. Topics include geometric dimensioning and tolerancing, assembly techniques and animation.

**Mechanical CAD Project**
This module is a project-based module designed to hone students’ knowledge and skill in solving complex engineering design problems. This module covers advanced engineering design concepts and assembly modelling techniques in a wide range of case studies and design projects.

**COMPUTER & COMMUNICATION SYSTEMS CLUSTER**

The modules in this cluster are designed to strengthen students’ knowledge in computer and communication systems. Students will acquire knowledge in computer networking, Linux Systems administration, web technologies and tools.

**Operating Systems & Networking**
This module covers fundamental operating system principles and networking concepts. UNIX/Linux is used as the primary operating system reference model for this module. Network Management and UNIX/Linux networking are included, together with an emphasis on writing basic application programmes. This module will prepare students with a suitable background for working in system administration, Local Area Network (LAN) and the internetworking environments.

**Internet Technology**
The module aims to provide the concept of Web operations and the tools used for developing Web-based applications. Students will learn the basics of HTML, Java language, JSP, JDBC and JavaScript so that they are able to develop multiple-tier Web-based database applications.

**Communication Systems & Applications**
This module provides the opportunity for students to explore and recognise the developments that are currently used in communication systems. Students will acquire an understanding of wireless technology and be able to apply key concepts and processes associated with transmission fundamentals, high frequency transmission media and wave propagation. They will then be able to appreciate the application of
RF technology to radar systems, satellite and mobile communication systems, fibre optical communication and the increasingly popular RFID and Bluetooth technology.

**INDUSTRIAL CONTROL CLUSTER**

This cluster equips students with knowledge and practical training in the areas of electrical control wiring systems. Students will also acquire skills in programming and designing Programmable Logic Controllers for industrial applications. It aims to train students to compete in the World Skills Singapore Competition (Industrial Control Category).

**Electrical Control & Wiring**
This module aims to provide students with knowledge and practical training in electrical control wiring system. Students will learn to read and interpret the circuit diagrams and wiring of control panels. The training will include mounting and wiring of control panels, PVC conduits, flexible conduits, connectors, junction boxes, PLC and other electrical components, and termination and numbering of cables according to layout diagrams.

**Control Circuit Design & Troubleshooting**
Students will learn the IEC Standards and symbols for Power Control and Protection components including relays, contactors, alarm and signal indicators, timers, limit switches, proximity sensors, photosensors, thermostats, protective devices, and motors. Students will also learn how to troubleshoot and locate faults on test panel within an allocated time.

**Advanced Programming for Programmable Logic Controller**
Students will learn to program and design Programmable Logic Controllers (PLC) and learn about their industrial applications. Programming of PLC on projects involves digital I/O, analogue I/O, timers, counters, and internal registers. Students will also learn how to simulate, test the PLC programme, and interface of the PLC with inverter, touch screen, sensors, switches, indicating lights, motors starters and other I/O devices.

**MECHATRONICS APPLICATION SKILLS CLUSTER**

This cluster is specially designed to strengthen the technical knowledge and practical skills of students in the applications of Mechatronic systems. Potential and talented students will be invited to join the programme, which will also equip students with strong engineering problem solving skills and prepare them for the World Skills Singapore (WSS) Competition and related events.

**Fundamental Mechatronics & Control**
This practice-oriented module is designed to give students strong fundamentals in electrical control systems and principles, characteristics, selection and application of sensors and actuators in typical Mechatronic systems. This module also introduces them to programmable logic controllers, control devices and the relevant Window-based programming software. Students will learn to design ladder diagrams with Programmable Logic Controller (PLC) using CX-Programmer and perform exercises relevant to industrial applications.

**Advanced Mechatronics & Control**
This module is a practice-oriented module that is designed to equip students with strong advanced software skills particularly in various industrial scenarios like testing, distribution, processing and sorting with Mechatronic systems. This module covers assembly skills for various Mechatronic systems and commissioning the individual or combined stations. Student will also practice on actual workstations used in the World Skills Competition.

**STAGE MANAGEMENT & TECHNOLOGY CLUSTER**

This cluster is aimed at providing students with knowledge related to Technical Theatre: stage technology, which includes lighting, props, theatre settings and layout; and management issues related to show/drama/concert productions. It also seeks to equip students with basic knowledge in managing supporting technology in shows such as sound, light and video controls. In addition, students can have practical sessions on creating, editing and mixing music to produce sound effects such as surround, spatial and other special effects.

**Introduction to Technical Theatre**
The module will provide students with brief knowledge in the topics of lighting, makeup, production, scene setting, sound for stage, theatrical property and costume. Students will study the effect of lighting for theatre productions including the size, intensity, shape, and colour of light for a given scene, which help to accentuate an actor’s features. The production process will be discussed briefly. Scenery, which includes set construction, scenic painting, soft goods (drapes and stage curtains) is described, as well as special effects and sound, such as musical underscoring, vocal and
instrument mixing and theatrical sound effects. Finally, the module will briefly study theatrical property, or props, which includes furnishings, set dressings, hand props, and an actor’s costume props.

**Introduction to Live Performing Arts**
The performing arts include theatre, motion pictures, drama, comedy, music, dance, opera, magic and the marching arts. In this module, students will learn to identify, analyse and appreciate the different types of performing arts. Studies include staging, ambience, audio reinforcement, genre of music, costumes, background and storyline.

**Stage Management**
In this workshop-based module, students learn the roles and responsibilities of the stage manager. Students learn the techniques of successfully managing the numerous aspects of a production, both on stage and backstage, in the pre-rehearsal, rehearsal, performance, and post-performance phases. This includes: the planning of a master calendar and prompt script; aspects of coordination with production designers; using light, sound and costume plots effectively; coordinating the efforts of the cast to stay on scripts; performing checks on safety, legal issues, lighting and sets; and the smooth coordination of technical and dress rehearsals.

**Workplace Safety**
This module equips students with the fundamental knowledge of workplace safety. Topics include spotting workplace hazards and various techniques used to control these hazards and minimise risk. In addition, students will learn the various methods that are deployed in the industry to ensure compliance with MOM legal requirements.

**Workplace Health**
This module equips students with knowledge in occupational health. Topics include identification of workplace health hazards and their prevention, implications of industrial noise, chemical hazards, lighting, thermal environment, radiation, confined space, general ventilation, occupational diseases and occupational health management.

**Workplace Safety Management & Risk Control**
This module introduces students to workplace safety management and risk control. Topics include managing WSH hazards and control measures, risk analysis, WSH policy, behavioural safety programmes, WSH legal issues and Work Injury Compensation Act, WSH incident investigation, WSH performance analysis and safety audit, safety education, training and communication.

**WORKPLACE SAFETY & HEALTH CLUSTER**
This cluster equips students with knowledge and understanding of workplace hazards as well as control measures for minimising, preventing and managing safety and health risks in workplaces of diverse industrial sectors. The programme develops their capabilities in managing Workplace Safety & Health (WSH) issues related to engineering practices, and prepares them for a career as industrial safety coordinators or officers.