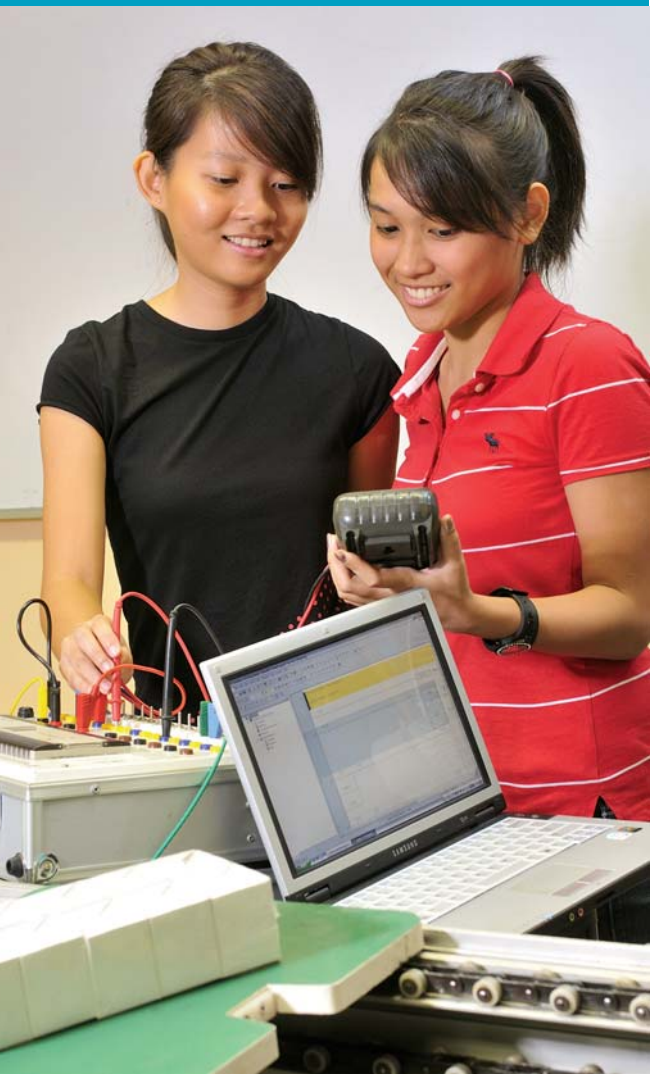
DIPLOMA IN ELECTRICAL ENGINEERING (EE)

(3-YEAR COURSE)

SCHOOL OF ENGINEERING

ELECTRICAL & ELECTRONICS CLUSTER



Reliable power systems and sophisticated electronic and computer systems are an integral part of high-tech industries such as aerospace, entertainment and financial services. To prepare students for an exciting career in these industries, we offer the broad-based and flexible **Diploma in Electrical Engineering (EE).**

In the first and second year, students will pick up technical skills in the core fields of electrical, electronic and computer engineering, and related skills in business management, entrepreneurship, communication, innovation and more.

In the final year, students will be given the flexibility to specialise in an option in areas such as electrical, electronic, computer networking, solar technology, and business and marketing. To make learning more interesting and challenging, students can also choose to work on a full-time project or take up a local or overseas internship programme. Local internships are with leading companies such as PowerGrid Ltd and Singapore Technologies Aerospace, while overseas ones are with companies and institutions of higher learning in China, Thailand, Malaysia, Australia and Germany.

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

Strategic industrial collaborations have 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, Power Quality Centre, Instrumentation & Control Centre and Solar Technology Centre.

We also forge strong industrial partnership with many leading companies such as National Instruments, Fluke Networks, Tyco Electronics Singapore and Omron Asia Pacific. This enables us to constantly align our course with ever-changing technologies and stay ahead. Our students enjoy the benefits of learning the latest technologies and working with the most advanced facilities and equipment.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE 'O' Level examination (or equivalent) results and fulfill the aggregate computation requirements:

Subject	'O' Level Grade
English Language	1-7**
Mathematics (Elementary/Additional)	1-6
Science (with Physics or Chemistry or Biology component) or Design & Technology or Computer Studies	1-6

The aggregate computation for selection is based on grades obtained for English, Mathematics, Science or Design & Technology or Computer Studies and two other subjects.

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

Candidates with severe vision deficiency should not apply for the course. Those with colour appreciation 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 for the application of 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 like business, accountancy, and arts and sciences at local universities. Some of the universities are:

- **National University of Singapore**
- **Nanyang Technological University**
- **Singapore Management University**
- **University of Manchester (UK)**
- **Imperial College (UK)**
- **University of Sheffield (UK)**
- **University of New South Wales (Australia)**
- **Queensland University of Technology (Australia)**

COURSE CURRICULUM

Module Name	Credit Units
YEAR 1	
Level 1.1 (27 hours per week)	
Electrical Technology	6
Engineering Mathematics 1	5
Engineering Mechanics	5
Computer Programming	4
Engineering: A Creative Profession	3
Creativity & Applied Thinking Skills^	2
Sports & Wellness^	2
Level 1.2 (25 hours per week)	
Analogue Electronics	5
Engineering Mathematics 2	5
Computer-Aided Drawing	2
Electrical & Electronic Practical Skills	3
AC Circuits	4
Digital Electronics & Practice	2
Communication Toolkit^	4
YEAR 2	
Level 2.1 (25 hours per week)	
Electric Circuit Analysis & Measurement	6
Electrical Machines & Drives	6
PC Networking	3
Industrial Automation	3
Sensors & Instrumentation	3
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (23 hours per week)	
Electronic Devices & Circuits	6
Engineering Mathematics 3A	4
Power Devices & Applications	3
Microcontroller & Applications	3
Elective Discipline Module	3
Innovation & Enterprise in Action^	4
Elective Discipline Modules	
PC Internetworking Technology	3
Programmable Logic Devices	3
YEAR 3	
Level 3.1	
Power Engineering Option (19 hours per week)	
Power Distribution & Protection	5
Electrical Installation Design	5
Control & Automation	5
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Data & Network Systems Option (19 hours per week)	
Internetworking	4
Wireless LAN Technologies	5
Distributed Control Systems	6
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Engineering Management Option (19 hours per week)	
Engineering Contract & Project Management	5
Power System Economics & Energy Market	5
Electrical Installation Design	5
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Electronics Option (19 hours per week)	
Electronic System Design	5
Power Electronics	5
Embedded System Design	5
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2

Module Name	Credit Units
Solar Technology Option (19 hours per week)	
Solar Cell Technology	5
Photovoltaic Technology	5
Design & Operation of Photovoltaic Systems	5
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Business Management Option (19 hours per week)	
Customer Relationship Management	3
E-Commerce	4
Service Operation Management	4
1 module from Marketing & Entrepreneurship option	4
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Marketing & Entrepreneurship Option (19 hours per week)	
Business Creation	4
Enterprise Development	3
Product Design and Marketing	4
1 module from Business Management Option	4
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2	
(Student to do one)	
Six-month Internship	25
Six-month Design and Development Project	25
Across Level Modules (Level 1.2 onwards) (6 hours per week)	
School of Engineering (SoE) elective module*	3
School of Engineering (SoE) elective module*	3

Notes:
^ For more details on Interdisciplinary Studies (IS) modules, please log on to www.np.edu.sg/is/.
* For more details on School of Engineering elective modules, please refer to page 165.

IS Modules
The School of Interdisciplinary Studies (IS) delivers the interdisciplinary curriculum under the Ngee Ann Learning Model (NLM). The NLM was introduced in 2001 to nurture a new generation of professionals with multidisciplinary skills to meet the challenges of a knowledge-based economy. The NLM incorporates core disciplines and Interdisciplinary Studies. It also nurtures innovative and entrepreneurial traits through the Innovation & Enterprise in Action (I & E in Action) module. IS modules challenge boundaries and offer insights into Communication, Entrepreneurship, Life Skills, Media & the Arts, and Science & Technology.

SoE Elective Modules
The SoE elective modules fall under a wide range of clusters under both Engineering and Non-Engineering categories. The aim is to provide every student with the opportunity to broaden his/her knowledge and/or deepen their discipline specific areas. Each cluster comprises a minimum of three 3-hour modules. Students are required to take two modules in order to satisfy the minimum graduating requirement.

COURSE MODULES

LEVEL 1.1

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.

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. 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.

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.

Engineering: A Creative Profession
This continuous assessment module provides students the opening exposure to engineering analysis, design, and problem-solving through case studies and projects. It excites students with a view of what to expect in engineering, facilitate them with a foundation of essential development tools commonly used, and inspires them in a profession driven by the passion to advance society through technology.

LEVEL 1.2

Analogue Electronics
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.

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

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.

Electrical & Electronic Practical Skills
This module provides 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.

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.

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-Flop and Data Handling Circuits. Students will be able to explain and analyse the workings of digital circuits through hands-on experiments in the laboratory.

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.

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.

Industrial Automation
This module will train students in electrical control systems, which cover sequential motor control circuits, direct-on-line and star-delta motor starter circuits. 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 for programming the Programmable Logic Controller (PLC) and perform exercises relevant to its industrial applications.

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

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-analog and analog-to-digital converters, integrated-circuit logic families and memory devices.

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

Power Devices & Applications
This module trains students in the use of power semi-conductor devices in the area of electrical power control. Students will learn about the characteristics and application techniques of devices. They will also

have the opportunity to construct controllers made from these devices to operate motors, solar power supply, voltage regulators and lighting control circuits. The hands-on sessions will also hone students' skills in the use of electronic workbench instruments and trouble-shooting techniques.

Microcontroller & Applications

This practice-oriented module is designed to equip students with an understanding of the conceptual and operational aspects of a micro-controller 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.

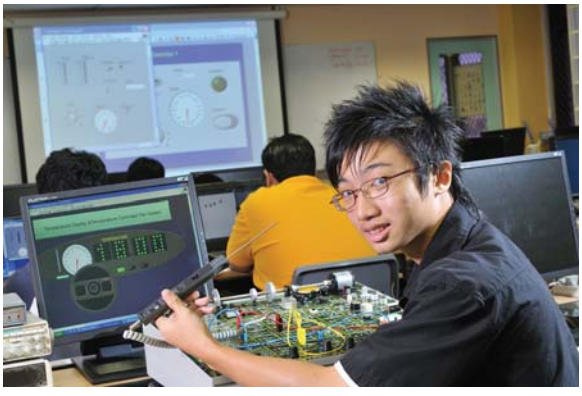
ELECTIVE DISCIPLINE MODULES

PC Internetworking Technology

In today's networked community, Local Area Networks (LAN) are interconnected for central control and distribution of information. The important devices that make the network so dominant are the routers and switches that interconnect all local networks and provide a path to the Internet community. In this module, students will focus on the concepts of routing, Inter-network Operating System (IOS), and routing protocols. They will also develop hands-on skills in router configuration, IOS software management, routing protocol configuration, router troubleshooting, and the creation and placement of Access Control Lists for controlling networking traffic.

Programmable Logic Devices

Students will focus on digital systems design and Programmable Logic Devices (PLD), combining them into an entity useful for designers in the areas of digital systems and rapid system prototyping. All major design description (entry) tools are introduced, including schematic entry tools and hardware description languages. The complete design procedure, which includes design entry, processing and verification, is shown as an example of a simple digital system. Other topics include the introduction to VHDL, a tool used increasingly in digital system prototyping and design.



LEVEL 3.1

POWER ENGINEERING OPTION

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.

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 include fault calculation, principles of operation of switching devices, switchboards, transformers and cables, and the economical 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.

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.

DATA & NETWORK SYSTEMS OPTION

Internetworking

This module is the third of four courses preparing students for the Cisco Certified Network Associate (CCNA) certification. The topics covered follow the Cisco Networking Academy CCNA3 course on Switching Basics and Intermediate Routing very closely.

Wireless LAN Technologies

This module provides students with classroom and laboratory experience in current and emerging wireless LAN technologies. The module focuses on the design, planning, implementation, operation and troubleshooting of Wireless LANs. It covers a comprehensive overview of technologies, security, and design best practices with particular emphasis on hands-on skills in wireless LAN setup & 802.11 (a, b, and g) technologies, products troubleshooting, & solutions, resilient WLAN radio technologies, WLAN applications and site surveys, WLAN products, design, installation, configuration and troubleshooting, security, vendor interoperability strategies, and emerging wireless technologies.

Distributed Control Systems

This module instills the fundamental knowledge of control networking in Distributed Control Systems (DCS). This module gives an insight to the technologies of different kinds of control systems such as centralised, hierarchical, fieldbus, distributed control network and other essential

theories like field device node, Input/Output (IO), communication, control network-to-IP interfacing, network management and design, that are needed to understand the module.

ENGINEERING MANAGEMENT OPTION

Engineering Contract & Project Management

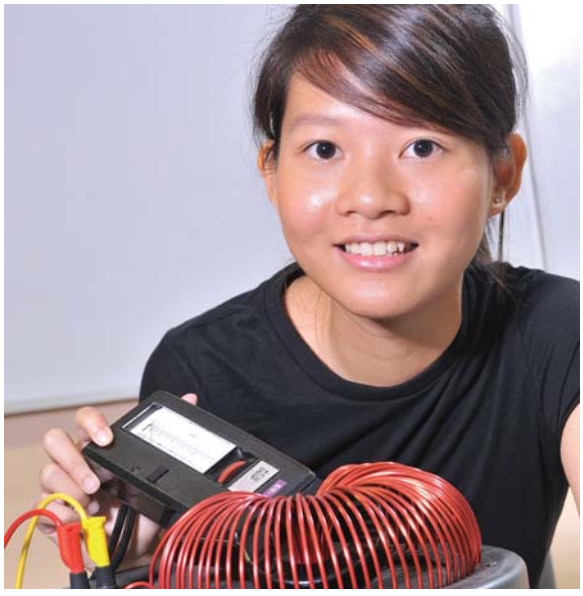
This module provides students with an understanding of the various aspects of electrical contracting and management procedures. Upon completion of this module, they will be able to prepare competitive bids for submission of tenders for projects pertaining to electrical services. They will also be able 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.

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.

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.



ELECTRONICS OPTION

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, and 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.

Power Electronics

This module deals mainly with the applications of power semiconductor devices for the control and conversion of electric power. The objective is to provide students with a broad understanding of the various power conversion circuits and their industrial applications. The 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 are studied in detail together with their applications.

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 to use modern microcontroller technologies to implement 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.

SOLAR TECHNOLOGY OPTION

Solar Cell Technology

The Solar Cell Technology module will focus on silicon bulk processes for the fabrication of photovoltaic devices. It aims to give students an understanding of how solar cell functions and fabrication. The module provides students with hands-on training in the NP cleanroom.

Photovoltaic 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.

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 stand-alone and on-grid systems, sizing of cables and batteries, lightning protection, power protection and power quality issues.

BUSINESS MANAGEMENT OPTION

Customer Relationship Management
The module aims at providing students with an understanding of the concepts and principles of excellent customer service. They learn about service interaction, building customer satisfaction and exceeding customers' expectations. On completion of the module, students will understand the basics of fostering a positive attitude, use techniques and behaviour to win customer loyalty, get others to give quality service and apply winning telephone and website techniques.

e-Commerce
This course is designed to provide students with an insight to the role of Electronic Commerce in the e-business world. Major topics covered in this module include an introduction to Electronic Commerce, the linkage of E-Commerce to E-Business, value chain concept and competition, e-Procurement and strategic sourcing, e-Fulfillment in B2B and B2C e-Commerce, customer relationship management, enterprise resource planning, and internet applications and collaborative tools with hands-on practical sessions on Movie Maker and Dreamweaver software.

Service Operation Management
Students will be introduced to concepts and techniques related to all aspects of the management and operation of services. They will develop their skills in both strategic and operational issues pertaining to services. Topics include both qualitative and quantitative aspects of service management, as well as balanced scorecard and Six Sigma, so as to give students the wide-ranging techniques for ensuring quality and evaluating long-term strategy planning. They will be able to apply this knowledge to service innovations and management.

MARKETING & ENTREPRENEURSHIP OPTION

Business Creation
This module focuses on how technologists can adapt an entrepreneurial mindset to create their own business. Through case studies and discussions, youth entrepreneur networks and working with mentors, it explores entrepreneurial traits and what it takes to become a successful entrepreneur. This module also gives an introduction to the essential elements of starting and running a business, and the two other complementary modules in this option.

Enterprise Development
This module introduces and explores the types and sources of funds necessary for enterprise development, and strategies for sustainability and growth in an era of rapid technological developments.

Product Design & Marketing
This module focuses on the importance of product design from marketing perspectives. The product design and development process focuses on what it takes to sell the products based on consumers' needs and wants rather than product features alone. Students learn about marketing principles, concepts and strategies and are also given opportunities to develop their own business plan for their product.

LEVEL 3.2

Six-month 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 impleme ntation, industrial liaisons and character building. Participating companies will have the opportunity to assess prospective employees and secure the services of these students in advance.

Six-month Design and Development Project
Working on a design project, students will learn essential traits like leadership, team spirit, positive work attitude, independence, good presentation and management skills, and innovation. It promotes project management capabilities through project planning, scheduling, group discussions, project load balancing and planning project milestones using the Gantt chart. Students get to practice and improve their oral and written communication skills by submitting reports and making presentations.

ACROSS-LEVEL MODULES (LEVEL 1.2 ONWARDS)

School of Engineering Elective Modules and the Diploma Plus Programme
Students take two modules from a wide range of clusters under the engineering and non-engineering elective clusters to complete their diploma. Furthermore, students can qualify for a diploma plus by simply topping up with two additional modules from the same cluster as one of the electives. The Diploma Plus Certificate helps students if they wish to pursue a university degree or increase their employability in discipline-specific areas. Students can choose electives from the range listed below.

Engineering Clusters
- Advanced Engineering Mathematics*
- Applied Physics*
- Biomedical Engineering
- Electrical Control & Measurement
- Industrial Control
- Industrial Electronics
- Information Technology
- Mechanical Technology
- Stage Management & Technology
- Telecommunication Distribution Technology

Non-engineering Clusters
- Economics & Financial Applications
- Green Development
- Leisure & Retail Management

Other Available Diploma Plus Certificates
- Business
- Innovation Management
- Languages (Japanese)

* Designed in collaboration with the Department of Electrical and Computer Engineering, National University of Singapore (NUS). The syllabus is based on the first-year engineering mathematics and science curricula of NUS.

For detailed module descriptions under each cluster, please refer to page 165.

DIPLOMA IN ELECTRONIC & COMPUTER ENGINEERING (ECE)

(3-YEAR COURSE)

SCHOOL OF ENGINEERING

ELECTRICAL & ELECTRONICS CLUSTER

Electronics play a significant role in our daily life. The **Diploma in Electronics & Computer Engineering (ECE)** delivers modules that provide a strong foundation and knowledge in areas such as electronic circuit design, telecommunications, computer architecture and computer programming. The curriculum also caters to the diverse interests of students by allowing them to choose either engineering or non-engineering options in the final year.

The engineering options are Aerospace Electronics, Computer & Communication Systems and Microelectronics. The non-engineering options are Business Management and Marketing & Entrepreneurship. Students also have the option to follow the traditional pathway or opt for a six-month internship.

The Aerospace Electronics (AE) option was designed to align with the Singapore Airworthiness Requirements (SAR66) standard, stipulated by the Civil Aviation Authority of Singapore (CAAS).

The non-engineering track provides students with the opportunity to progress into the fast growing business and marketing industries.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE 'O' Level examination (or equivalent) results and fulfill the aggregate computation requirements:

Subject	'O' Level Grade
English Language	1-7**
Mathematics (Elementary/Additional)	1-6
Science (with Physics or Chemistry or Biology component) or Design & Technology or Computer Studies	1-6

The aggregate computation for selection is based on grades obtained for English, Mathematics, Science or Design & Technology or Computer Studies and two other subjects.

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

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

CAREER PROSPECTS

ECE graduates can look forward to a spectrum of exciting careers in the areas of design and development, operations, technical support, sales and marketing.

Graduates from the Aerospace Electronics option can find employment in the aerospace industry, providing maintenance and technical support for electronic systems and instrumentations on board an aircraft.

Graduates from the Computer & Communication Systems option can seek employment in the IT, telecommunications and manufacturing sectors dealing with computer-related products. They may be involved in the design and development of telecommunication equipment and systems, computer software and hardware, Internet applications, and maintenance of computer network systems.

Graduates from the Microelectronics option can find jobs in the semiconductor and wafer fabrication and advanced displays industries. They can be employed in areas of design, production, assembly, testing and R&D activities.

The non-engineering options provide graduates with both engineering and business knowledge, allowing them a greater choice in their future career paths.

In the public sector, ECE graduates can be employed as Technical Officers, responsible for installing and maintaining essential public services and even sophisticated military electronics and related hardware in Singapore's Ministry of Defence.

ACCREDITATION FOR FURTHER STUDIES

Each year, 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 Masters and Doctoral degrees.

Graduates from the Electronic & Computer Engineering course are given advanced standing or credit exemptions of one to two years in local and overseas universities when they apply for admission to relevant courses such as:

- **National University of Singapore and Nanyang Technological University**
  About one year exemption for Bachelor of Computer Science, Computer Engineering, Electrical & Electronics Engineering
- **University of New South Wales (Australia)**
  1.5 years exemption for Bachelor in Electrical, Computer and Software Engineering
- **University of Queensland (Australia)**
  Two years exemption for Bachelor in Electrical or Computer Systems Engineering

COURSE CURRICULUM

Module Name	Credit Units
YEAR 1	
Level 1.1 (27 hours per week)	
Electrical Technology	6
Engineering: A Creative Profession	3
Computer Programming	4
Engineering Mathematics 1	5
Engineering Mechanics	5
Sports and Wellness^	2
Creativity & Applied Thinking Skills^	2
Level 1.2 (26 hours per week)	
Analogue Electronics	5
Electronic Practical Skills	4
Engineering Mathematics 2	5
Electrical & Electronics Drawing & Computer-Aided Design	3
Digital Electronics	5
Communication Toolkit^	4
YEAR 2	
Level 2.1 (26 hours per week)	
Analogue Circuit Design & Applications	5
Applications Programming	4
Digital System Design & Applications	5
Engineering Mathematics 3A	4
Electronic Design & Prototyping	4
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (25 hours per week)	
Telecommunication Principles	6
Electronic Project Design Practice	4
Object-Oriented Programming	5
Microcontroller Programming and Interfacing	6
Innovation & Enterprise in Action^	4
YEAR 3	
Level 3.1 (15 - 19 hours per week depending on the Option)	
Semester 1 modules from an Option	11 - 15
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2 (21 - 25 hours per week depending on the Option)	
Semester 2 modules from an Option	21 - 25
Across Level Modules (Level 1.2 onwards) (6 hours per week)	
School of Engineering (SoE) elective module*	3
School of Engineering (SoE) elective module*	3

Notes:
^ For more details on Interdisciplinary Studies (IS) modules, please log on to www.np.edu.sg/is/.
* For more details on School of Engineering elective modules, please refer to page 165.
Students are required to own Notebook Computers.

IS Modules
The School of Interdisciplinary Studies (IS) delivers the interdisciplinary curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge-based economy. IS modules challenge boundaries and offer insights into Communication, Entrepreneurship, Life Skills, Media & the Arts, and Science & Technology.

School of Engineering (SOE) Elective Modules
Students are required to take a minimum of two SoE elective modules in order to satisfy the minimum graduating requirement. These elective modules fall under a wide range of clusters in both Engineering and Non-Engineering categories. The aim is to provide students with the opportunity to broaden their knowledge in discipline specific areas.

Options

Module Name	Credit Units
Aerospace Electronics Option	
Level 3.1 (14 hours per week)	
Project Design and Development 1	8
Aircraft Electrical & Instrumentation Systems	6
Level 3.2 (22 hours per week)	
Project Design and Development 2	12
Aircraft Navigation & Communication Systems	5
Fundamentals of Control Systems	5
Business Management Option	
Level 3.1 (15 hours per week)	
Project Design and Development 1	8
Customer Relationship Management	3
Service Operation Management	4
Level 3.2 (21 hours per week)	
Project Design and Development 2	12
E-commerce	4
Fundamentals of Control Systems	5
Marketing and Entrepreneurship Option	
Level 3.1 (15 hours per week)	
Project Design and Development 1	8
Enterprise Development	3
Product Design & Marketing	4
Level 3.2 (21 hours per week)	
Project Design and Development 2	12
Business Creation	4
Fundamentals of Control Systems	5
Computer and Communication Systems Option	
Internship Pathway	
Level 3.1 (11 hours per week)	
Fundamentals of Control Systems	5
Data Communications and Networking	6
Level 3.2 (25 hours per week)	
Six-month Internship	25
Non-Internship Pathway	
Level 3.1 (14 hours/week)	
Project Design and Development 1	8
Data Communications and Networking	6
Level 3.2 (22 hours per week)	
Project Design and Development 2	12
Computer Systems Architecture & Administration	5
Fundamentals of Control Systems	5

Module Name	Credit Units
Microelectronics Option	
Internship Pathway	
Level 3.1 (11 hours per week)	
Fundamentals of Control Systems	5
Microelectronics Test Systems	6
Level 3.2 (25 hours per week)	
Six-Month Internship	25
Non-Internship Pathway	
Level 3.1 (13 hours per week)	
Project Design and Development 1	8
Wafer Fabrication Technology	5
Level 3.2 (23 hours per week)	
Project Design and Development 2	12
Advanced Wafer Fabrication Technology	6
Fundamentals of Control Systems	5

COURSE MODULES

LEVEL 1.1

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.

Engineering: A Creative Profession

This continuous assessment module provides students the opening exposure to engineering analysis, design, and problem-solving through case studies and projects. It excites students with a view of what to expect in engineering, facilitate them with a foundation of essential development tools commonly used, and inspires them in a profession driven by the passion to advance society through technology.

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.

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. 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

Analogue Electronics
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 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.

Electronic Practical Skills
This is a hands-on module that aims to equip students with the necessary practical skills in electronic circuit construction, testing, measurement and analysis. Students will also put into practice concepts covered in the Level 1 module Electrical Technology.

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

Electrical & Electronic Drawing & Computer-Aided Design
This module introduces the concepts of electronic circuit drawing and printed circuit board (PCB) layout using a modern computer-based electronic design automation (EDA) package. Using the software, students will design PCBs, starting from schematic capture to PCB layout post-processing and library parts creation. The module, which adopts a completely hands-on approach, prepares them for final-year projects that involve electronic circuit design and manufacturing.

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 subjects 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.

LEVEL 2.1

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.

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

Digital System Design & Applications
This module builds on the fundamental digital concepts covered in Digital Electronics and uses Programmable Logic Devices to implement various combinational and sequential logic circuits. It also covers various practical aspects of digital interfacing and applications.

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

Electronic Design & Prototyping
The main objectives of this module are to introduce students to the techniques of PCB computer-aided design, and to provide opportunities for the acquisition of practical skills in electronic project design. Students will learn the planning, development, construction and testing of electronic prototypes. The focus of the module is on hands-on practice for basic PCB design, PCB fabrication and technical writing skills. Fault finding on electronic circuits, an essential skill in construction, is also introduced.

LEVEL 2.2

Telecommunication Principles
This module is the introductory module to radio communication. This module gives an understanding of the basic concepts of analog communication systems. Characteristics of a basic communication system and the environmental factors that affect communication will be first discussed. A review of the mathematical groundwork of signal analysis will also be done and the concepts that are necessary for the

understanding of linear systems will be developed, with emphasis on resonance and filters. Students will be taught the fundamental concepts of analog modulation techniques like AM and FM and their applications. The demodulation process will subsequently be taught so that the students can understand the electrical characteristics underlying AM/FM reception and learn to appreciate the features of a good quality receiver.

Object Oriented Programming

The aim of this module is to build on the foundation of the Applications Programming module and introduce the concepts of Object Oriented Programming. Its key coverage includes the object oriented programming paradigm, Web related programming and database access.

Electronic Project Design Practice

The main objective of this module is to enable students to appreciate the importance of project design from theory to practice. Students will learn the correct approach to the development, construction and testing of projects. The hands-on practice involves basic hardware design techniques and implementation. Fault-finding on electronic circuits is introduced to enhance the skills of the students. Hands on practice, design of printed circuit boards using self-generated component footprints and report writing skills are also essential components of this module.

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.

LEVEL 3.1 AND 3.2

COMMON MODULES

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, control systems' components, 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.

Six-month Internship

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

Project Design and 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.

Project Design and 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.

AEROSPACE ELECTRONICS OPTION

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 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. The systems covered are 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.

BUSINESS MANAGEMENT OPTION

Customer Relationship Management

The module aims to provide students with an understanding of the concepts and principles of excellent customer service, such as practical service skills for service interaction, building customer satisfaction and exceeding customer expectation. On completion of the module, the student should be able to understand the basics of fostering positive quality attitude, use techniques and behaviour to win customer loyalty, get others to give quality service, and apply winning telephone and website techniques.

Service Operation Management

Students will be introduced to concepts and techniques related to all aspects of the management and operation of services and are designed to develop students' skills in both strategic and operational issues pertaining to services. Topics cover both qualitative and quantitative aspects of service management and also balanced scorecard and Six Sigma so as to give students the wide-ranging techniques for ensuring quality and evaluating long-term strategy planning. Students will be able to apply this knowledge for service innovations and management.

e-Commerce

Students gain an understanding of the role of Electronic Commerce in the e-business world by learning about e-Supply Chain Management with synchronisation of the supply chain through e-Marketplaces. This module discusses the value creation in e-Supply Chain and the various e-business trends. Major topics covered in this module include an

introduction to Electronic Commerce, the linkage of E-Commerce to E-Business, value chain concept and competition, e-Procurement and strategic sourcing, e-Fulfillment in B2B and B2C e-Commerce, Customer Relationship Management, Enterprise Resource Planning, and internet applications and collaborative tools with hands-on practical sessions on Movie Maker and Dreamweaver software.

MARKETING & ENTREPRENEURSHIP OPTION

Business Creation
This module focuses on how technologists can adapt an entrepreneurial mindset to create their own business. Through case studies and discussions, youth entrepreneur networks and working with mentors, it explores entrepreneurial traits and what it takes to become a successful entrepreneur. This module also gives an introduction to the essential elements of starting and running a business, and the two other complementary modules in this option.

Enterprise Development
The module focuses on enterprise development. It introduces and discusses the types and sources of funds necessary for enterprise development, and strategies for sustainability and growth in the era of rapid technological developments.

Product Design & Marketing
This module focuses on the importance of product design from marketing perspectives. The product design and development process focuses on what it takes to sell the products based on consumers' needs and wants rather than product features alone. This module also focuses on marketing principles, concepts and strategies. Students are also given opportunities to develop their own business plan for their product.

COMPUTER & COMMUNICATION SYSTEMS OPTION

Data Communications & Networking
This module provides the foundation for understanding principles in data communications and networking. Students will acquire an understanding of and be able to apply key concepts and processes associated with digital and data transmission of information, transmission media, the OSI reference model, network topologies, protocols and TCP/IP protocol suite.

Computer Systems Architecture & Administration
This module aims to educate students on a general-purpose computer system in terms of its hardware, architecture and administration in a network environment.

MICROELECTRONICS OPTION

Microelectronics Test Systems
This module introduces students to test engineering for electronic circuits. It provides them with the basic concepts of testing for both the design and test aspects. At the end of the module, students will be able to apply the concept of Design for Testability as well as perform actual testing on a printed circuit board (PCB) in circuit tester and a digital Integrated Circuit (IC) tester.

Wafer Fabrication Technology
This module aims to provide students with a basic knowledge of Integrated Circuit (IC) fabrication. The processes that are required to convert a blank wafer to one that is covered with complex circuits are explored, as well as topics on the various supporting technologies required in the wafer fabrication industry. Finally, process and device simulations are covered, with students undertaking a simulation exercise in building and operating their own virtual transistors.

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

ACROSS LEVEL MODULES (LEVEL 1.2 ONWARDS)

School of Engineering Elective Modules and the Diploma Plus Programme
Students take two modules from a wide range of clusters under the engineering and non-engineering elective clusters to complete their diploma. Furthermore, students can qualify for a diploma plus by simply topping up with two additional modules from the same cluster as one of the electives. The Diploma Plus Certificate helps students if they wish to pursue a university degree or increase their employability in discipline-specific areas. Students can choose electives from the range listed below.

Engineering Clusters
- Advanced Engineering Mathematics*
- Aerospace Electronics
- Applied Physics*
- Biomedical Engineering
- Computer & Communication Systems
- Industrial Electronics
- Information Technology
- Microelectronics
- Network Systems & Security
- Computing Methodology

Non-engineering Clusters
- Economics & Financial Applications
- Green Development
- Leisure & Retail Management

Other Available Diploma Plus Certificates
- Business
- Innovation Management
- Languages (Japanese)

* Designed in collaboration with the Department of Electrical and Computer Engineering, National University of Singapore (NUS). The syllabus is based on the first-year engineering mathematics and science curricula of NUS.

For detailed module descriptions under each cluster, please refer to page 165.