DIPLOMA IN CIVIL & ENVIRONMENTAL ENGINEERING (CEE)

(3-YEAR COURSE)

SCHOOL OF ENGINEERING

ENVIRONMENT & ENERGY CLUSTER

From ancient Egypt to the present day, civil engineers have been engaged in the design and construction of countless structures such as buildings, dams, bridges, tunnels, highways, transit systems, airports, harbours and wastewater treatment plants. Engineering also plays an ever increasing role in the protection of the environment using the latest state-of-the-art technology. The **Diploma in Civil & Environmental Engineering (CEE)** is a dual discipline course that combines training for infrastructural development and environmental protection.

Students are equipped with the knowledge and skills to design, operate and manage structures in an environmentally safe and friendly manner. They will receive comprehensive training in the intricacies of building design, water and wastewater treatment, pollution control, waste management and recycling, and environmental health management.

Besides the discipline-specific core modules, students have a wide variety of elective modules to choose from and can graduate with additional Diploma Plus Certificates and Enhancement Certificates. These electives are carefully selected to cater to the students' diverse interests and changing trends in the industry.

In their second or final year of study, students will have the opportunity to participate in research studies and projects, internships, and immersion or exchange programmes, conducted either locally or overseas.

As the world's population increases and technology evolves together with mounting environmental concerns, the skills of civil and environmental engineers will be highly valued, particularly in the fields of design, construction, operation, research and management.

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 hearing deficiency should not apply for the course.

CAREER PROSPECTS

Graduates trained in civil and environmental engineering enjoy excellent job prospects both locally and overseas. There will be countless opportunities for them to apply their knowledge and skills to the building of infrastructures, protection of the environment and conservation of resources.

Equipped with broad-based knowledge and skills in dual disciplines, CEE graduates are well-placed for careers in both the public and private sectors. They are sought after by government agencies like the Land Transport Authority, Building Control Authority, National Environment Agency, Public Utilities Board, Ministry of the Environment and Water Resources, National Parks Board and Ministry of Defence.

In the private sector, they can take up careers as civil/structural designers, project supervisors, assistant environmental engineers, project engineers, environmental technologists, environmental control officers, assistant safety officers, laboratory analysts, research assistants and marketing executives.

ACCREDITATION FOR FURTHER STUDIES

CEE graduates can pursue bachelor's degree programmes in civil engineering or environmental engineering at local and overseas universities. Advanced standing or module exemptions may be granted at the following universities:

- **National University of Singapore** and **Nanyang Technological University**
  Advanced standing of one year for Civil Engineering or Environmental Engineering courses
- **University of Queensland (Australia)**
- **Bond University (Australia)**
- **University of Wollongong (Australia)**
- **RMIT University (Australia)**
- **University of Newcastle upon Tyne (UK)**

COURSE CURRICULUM (INTERNSHIP / PDD)

Module Name	Credit Units
YEAR 1	
Level 1.1 (25 hours per week)	
Structural Mechanics	5
Civil Engineering Construction	5
Ecology#	2
Environmental Health	4
Engineering Mathematics 1#	5
Creativity & Applied Thinking Skills^	2
Sports & Wellness^	2
Level 1.2 (25 hours per week)	
Land Surveying	4
Computer-Aided Design#	3
Environmental Chemistry & Analysis#	5
Hydraulics#	4
Engineering Mathematics 2#	5
Communication Toolkit^	4
YEAR 2	
Level 2.1 (24 hours per week)	
Structural Analysis	4
Project Management#	4
Noise Pollution Monitoring & Control#	4
Clean Water Technology	4
Engineering Mathematics 3#	4
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (20 hours per week)	
Geotechnical Engineering	5
Quantity Surveying	3
Environmental Management	4
Workplace Safety & Health 1#	4
Innovation & Enterprise in Action^	4
YEAR 3	
Level 3.1 (25 hours per week)	
Reinforced Concrete Design	5
Air Quality Monitoring & Control #	4
Steel Design	4
Workplace Safety & Health 2#	4
Water Reclamation Technology#	4
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2 (25 hours per week)	
(Student to do one)	
Six-month Internship	25
Project Design & Development (PDD)	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

COURSE CURRICULUM (NON-INTERNSHIP / NON-PDD)

Module Name	Credit Units
YEAR 1	
Level 1.1 (25 hours per week)	
Structural Mechanics	5
Civil Engineering Construction	5
Ecology#	2
Environmental Health	4
Engineering Mathematics 1#	5
Creativity & Applied Thinking Skills^	2
Sports & Wellness^	2
Level 1.2 (25 hours per week)	
Land Surveying	4
Computer-Aided Design#	3
Environmental Chemistry & Analysis#	5
Hydraulics#	4
Engineering Mathematics 2#	5
Communication Toolkit^	4
YEAR 2	
Level 2.1 (24 hours per week)	
Structural Analysis	4
Project Management #	4

Module Name	Credit Units
Noise Pollution Monitoring & Control #	4
Clean Water Technology #	4
Engineering Mathematics 3 #	4
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (25 per week)	
Geotechnical Engineering	5
Quantity Surveying	3
Environmental Management	4
Workplace Safety & Health 1 #	4
Innovation & Enterprise in Action^	4
Two-month Internship	5
YEAR 3	
Level 3.1 (22 hours per week)	
Reinforced Concrete Design	5
Air Quality Monitoring & Control #	4
Structural Inspection & Repairs	3
Project 1	6
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2 (23 hours per week)	
Steel Design	4
Workplace Safety & Health 2 #	4
Water Reclamation Technology #	4
International Business #	2
Project 2	9
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:
Common modules with other courses.
^ 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, 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
The SoE elective modules fall under a wide range of clusters under both Engineering and Non-Engineering categories. The aim is to provide students with the opportunity to broaden their knowledge and 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

Structural Mechanics
Strength and stability are important aspects of structures. This module explores the fundamentals of statics, moments, reactions, stresses and strains in structural elements, and how they arise due to different designs and loading criteria. These basic concepts are then used to analyse the behaviour of simple structures.

Civil Engineering Construction
This module introduces students to the various methods of construction involved in building and civil engineering works. It covers general practices in pre-construction works, reinforced concrete constructions, precastings, prestressing and structural steelworks. Excavation works, supports, ground water control, road works, pipeline constructions and tunnelling are also included.

Ecology
Ecology is the study of living things in their natural environment. This module focuses on the significance and functions of natural ecosystems, and how humans have affected these systems over time. It concentrates on the interaction between human activities, natural resources and the environment. As the human population grows and technology advances, pressures on the earth's natural systems are becoming increasingly intense and complex. This module aims to promote greater environmental awareness and nurture social responsibility towards the environment.

Environmental Health
In this module, students will learn about the characteristics of disease-bearing parasitic organisms and insects, and the impact of diseases on environmental health. They are taught the fundamentals of human anatomy and physiology, epidemiology and communicable disease control, and the application of this knowledge in implementing environmental health control programmes.

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.

LEVEL 1.2

Land Surveying
Students will study the elementary principles of plane surveying and learn to use survey instruments through fieldwork and assignments. Lessons cover the use of measuring tapes, prismatic compasses, levels and theodolites, and techniques in traversing surveys, levelling, plane tabling, tachometry and setting out of circular curves.

Computer-Aided Design
This module equips students with the principles and techniques of preparing computer-aided design (CAD) drawings in Architectural,

Engineering and Construction (AEC) projects. Students are also trained to interpret and extract information from CAD drawings and prepare CAD drawings according to CP 83. Emphasis is placed on preparing CAD drawings accurately so that information can be used electronically. AutoCAD is used in this module as it is widely adopted in the AEC industry.

Environmental Chemistry & Analysis

This module introduces students to the field of environmental engineering and provides the foundation for applications in pollution control and water and wastewater technology. Students will study the practical aspects of environmental chemistry, quantitative measurements and analysis of air, water and wastewater. Principles of measurement, instrumentation and analysis are emphasised using an application-oriented approach.

Hydraulics

This module introduces students to basic hydraulic principles and fundamental concepts that are essential for the study of water and wastewater technologies. Topics covered include the properties of fluids, manometry, hydrostatics and fundamental principles of fluid flow. Head loss in pipelines, design of pipelines, flow measurements and pipe network analysis will also be covered. Students will also learn about open channel flow and the design of surface water drainage systems.

Engineering Mathematics 2

This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. Throughout the module, a Computer Algebra System will be used when appropriate. Topics covered include trigonometry, coordinate geometry, differentiation and integration with applications.

LEVEL 2.1

Structural Analysis

This is a continuation of the Structural Mechanics module. Students will perform structural analysis for various concrete and steel designs. Students will learn to analyse and compute forces, deflections, shear forces and bending moments developed in structural members due to different loading criteria. Both statically determinate and indeterminate structures are covered.

Project Management

This module teaches students the essentials of engineering project management. Topics covered include contract administration, site layout and organisation, engineering economics and finance. Students will also study project-planning techniques including the use of a project network planning software.

Noise Pollution Monitoring & Control

The control of noise pollution is essential in all aspects of engineering. The rapid economic growth and growing affluence in Singapore have resulted in a greater need to control noise pollution. In this module, students are taught on how noise pollution arises and its impact on health, measurement and monitoring of noise levels, preventive and control measures, and local environmental legislation.

Clean Water Technology

This module introduces the processes for treating raw water from various surface water sources to produce potable water. Students will be taught raw water quality parameters, treatment techniques, and the monitoring and operation of water treatment systems. The focus is on conventional water treatment technologies, particularly on chemical coagulation and flocculation processes for removal of suspended and colloidal solids in raw water. Topics covered include pre-treatment of raw water, sedimentation, coagulation, flocculation, filtration and disinfection techniques.

Engineering Mathematics 3

This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. Topics covered include integration with applications, differential equations, Laplace transforms, and probability and statistics. A Computer Algebra System will be used throughout the module.

LEVEL 2.2

Geotechnical Engineering

In this module, students will study the behaviour of soils under structural loading. The properties of common types of soils, soil compaction, soil permeability, shear strength of soils, earth pressure and stability of slopes are covered in detail. Students will also learn about soil investigation, analysis of soil samples, and shallow and piled foundations.

Quantity Surveying

This module covers the principles of taking-off and measurement of quantities from construction drawings for the purpose of preparing cost estimates for civil engineering works. Topics covered include the measurement of quantities for earthworks, brickworks, concrete works, reinforcements, road pavements, pipelines, sewer lines and drainage. Students will also have practical sessions on the use of software for taking-off and costing.

Environmental Management

In this module, students will explore the concepts and principles of environmental management. Topics covered include the fundamentals of environmental impact assessment (EIA), environmental baseline studies (EBS), risk assessment, environmental management systems (EMS), ISO 14001, OSHA 18001 and environmental auditing. This module also covers the management of environmental health, particularly in the areas of food and meat hygiene. In addition, students will learn about the importance of health education and communication, and the legislation and laws pertaining to environmental management.

Workplace Safety & Health 1

This module focuses on the study of various aspects critical to the provision of a safe working environment. Topics covered include toxicology, clean air and ventilation, control of temperature and humidity, effects of noise and vibration on humans, industrial hygiene and industrial diseases.

Two-month Internship (Non-Internship/Non-PDD Pathway only)

In this module, students will be attached to organisations for a period of eight weeks to gain practical experience related to their course of study. This allows students to adapt themselves to the work environment in preparation for future employment. During their internship, they will undertake projects and tasks assigned by the organisation.

LEVELS 3.1 and 3.2

COMMON MODULES

Reinforced Concrete Design
In this module, students will learn how to use the current Code of Practice for the analysis and design of reinforced concrete structures. They will also study reinforcement detailing and learn how to prepare structural drawings for construction purposes.

Air Quality Monitoring & Control
Monitoring and control of both outdoor and indoor air pollution are important aspects of environmental management. Students are taught the fundamentals of how air pollution arises, types of pollutants, and the corresponding environmental and health impacts. Dispersion modelling, sampling and monitoring of pollutants, techniques of identification of pollutants, preventive and control measures, and local environmental legislation and guidelines on indoor air quality will also be introduced.

Steel Design
This module covers the design concepts of steel structures and elements using the current design code. Students will learn how to prepare structural steel detailings and drawings.

Workplace Safety & Health 2
The module provides students with knowledge of the relevant legislation and standards pertaining to occupational safety. The types of hazards found in various industries and the means for protection are also covered. Other topics include the safe use of hand and power tools, safe handling of materials, process hazards and electrical safety.

Water Reclamation Technology
The module introduces students to sewage characteristics, sewer design and maintenance and unit operations in a conventional wastewater treatment plant. The module will also cover the fundamentals of sewage collection systems for domestic wastewater, wastewater treatment technologies, monitoring and operation of wastewater treatment systems and the code of practice relevant to sewerage and wastewater treatment. Students will also learn about sludge treatment and disposal technologies. Emerging technologies in water reclamation and water recycling are also emphasised.

INTERNSHIP/PDD PATHWAY

Six-month Internship
In this module, students will be attached to organisations for a period of six months. This is to prepare them for future employment in their particular discipline of study. During their internship, they will undertake projects and tasks assigned by the organisations. This allows them the opportunity to take initiatives as well as to develop their self-confidence, interpersonal and adaptation skills.

Project Design & Development (PDD)
In this module, students will work in teams on a project in their particular discipline of study for a period of six months. The project will require them to research, experiment, analyse, critique and make recommendations on the subject of study. In addition to stretching the students' self-learning ability, the process will hone their essential traits like leadership, team spirit, independence, innovative spirit, and their presentation and management skills.

NON-INTERNSHIP/NON-PDD PATHWAY

Structural Inspection & Repairs
This module introduces the requirements of mandatory building inspection under the Building Control Act. It covers the inspection of existing reinforced concrete structures, concrete defects, structural and non-structural cracks, non-destructive tests and repair works. Students will also be given practical sessions on the use of equipment for non-destructive testing of concrete.

Project 1
In this module, students are expected to integrate the knowledge they gained in their first two years of study and undertake a year-long project on a topic in the field of civil and environmental engineering. This could be done as a case study, fabrication or computer-application project.

International Business
Students will learn about various types of business models, marketing and risk management for overseas projects. The focus is on critical success factors such as understanding cultural differences, project financing and human resource management in different countries.

Project 2
This module is a continuation of Project 1 where students undertake a year-long project on a topic in the field of civil and environmental engineering.

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*
- Mechanical 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 CLEAN ENERGY MANAGEMENT (CEM) NEW

(3-YEAR COURSE)

SCHOOL OF ENGINEERING

ENVIRONMENT & ENERGY CLUSTER

This **Diploma in Clean Energy Management (CEM)** provides focused-training in clean energy and energy management technologies, building on the strong foundation of studies in electrical and electronic engineering. Classroom learning will be supported by on-site real-life experiential learning at our new Solar Technology Centre and other clean energy sites.

Climate change coupled with high oil prices has galvanized policy makers the world over to find economically viable alternatives to fossil fuels and innovative solutions in efficient energy utilization 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 the six-month Project Design and Development Programme or the Local/Overseas Internship with leading companies in the clean energy or energy management sectors. Students may even get to work on exciting clean energy projects such as the SolarWorld Car Project at the Bochum University of Applied Science in Germany.

We build strong industrial partnerships with many leading companies. 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 & equipment.

This course has been strongly endorsed and supported by the Economic Development Board (EDB), Energy Market Authority (EMA), Building & Construction Authority (BCA), National Environment Agency (NEA), SolarWorld Asia Pacific Pte Ltd, Eco-solar Technologies Pte Ltd and many companies in the industry.

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

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 will be set up in Singapore by 2010, creating 3,000 jobs in the process, with an estimated 30 per cent 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, R&D institutes, and system integration companies related to solar and other clean energies. 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 and National University of Singapore. 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).

- **University of New South Wales (Australia)**
  Bachelor of Engineering in Photovoltaic & Solar Energy or Renewable Energy Engineering
- **University of Adelaide (Australia)**
  Bachelor of Engineering in Sustainable Energy Engineering
- **University of Dundee (UK)**
  Bachelor of Science in Renewable Energy
- **University of Exeter (UK)**
  Bachelor of Science in Renewable Energy
- **Oregon Institute of Technology (USA)**
  Bachelor of Science in Renewable Energy
- **University of Otago (New Zealand)**
  Bachelor of Applied Science in Energy Management

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	
(26 hours per week)	
Analogue Electronics	5
Engineering Mathematics 2	5
AC Circuits	4
Electrical & Electronic Practical Skills	3
Clean Energy & the Environment	3
Computer-Aided Drawing	2
Communication Toolkit^	4
YEAR 2	
Level 2.1 (23 hours per week)	
Electric Circuit Analysis & Measurement	6
Photovoltaic Technology	5
Digital Electronics & Practice	2
Energy Efficiency & Conservation	3
Wind & Hydro Power Technology	3
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (24 hours per week)	
Engineering Mathematics 3A	4
Energy Management in Electrical & Mechanical Systems	5
Fuel Cell Technology	3
Solar Cell Fabrication Technology	5
Clean Energy Mini-project	3
Innovation & Enterprise in Action^	4
YEAR 3	
Level 3.1 (19 hours per week)	
Design & Operation of PV System	5
Clean Energy System Integration	5
Energy Audit & Measurement	5
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 1.2 to 3.1	
Elective Discipline Modules (6 hours per week)	
Elective module 1	3
Elective module 2	3
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/.

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.

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 activity-driven module introduces students to the vocabulary, skills, applications and sheer inspiration that drive the engineering discipline. Through case studies and projects, students enjoy their first exposure to analysis, design and problem solving. The module offers students an exciting glimpse of what to expect later in the course, and provides a foundation of the essential tools needed to succeed in this dynamic profession.

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 is designed to provide students with the further 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. Topics include trigonometry, coordinate geometry, differentiation and integration with applications.

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.

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 equipments such as the oscilloscope, function generator and digital multi-meter.

Clean Energy & the Environment
This module covers fundamental knowledge on energy sustainability and economics, impact on the environment, global perspectives, and the interrelation between energy, environment and society. Students learn about conventional and alternative sources of energies and their impact on the environment. World issues such as the Kyoto Protocol agreement and fundamentals of carbon trading as well as the political, economical and social impact of climate change are also included.

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 2.1

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.

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.

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.

Energy Efficiency & Conservation
This module will cover energy efficiency in the five key sectors, namely power generation, industry, transportation, buildings and households. Topics include Green House Gases (GHS) emissions, energy cogeneration, tri-generation, energy efficient vehicles, envelope thermal transfer value (ETTV) studies of buildings, and government regulations on energy efficient building standards. Case studies will be used to demonstrate how technologies and effective energy management can improve energy efficiency.

Wind & Hydro Power Technology
This module provides students with fundamental knowledge on the characteristics of wind and hydropower systems. Topics include wind and hydropower sources, turbines characteristics, terminologies, aerodynamics of wind turbines, operations of wind and hydropower systems, and the environmental impact associated with each type of clean energy sources.

LEVEL 2.2

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.

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.

Fuel Cell Technology
This module covers the principle of operation and energy conversion of fuel cells, including the operations and performance of different types of fuel cells, their applications and challenges facing this technology.

Solar Cell Fabrication Technology
This module will focus on silicon bulk processes for the fabrication of photovoltaic devices. It aims to give students an understanding of the processes and safety measures in solar cell fabrication. The module provides students with hands-on training in the NP cleanroom as well as the opportunity to learn how to fabricate solar cells in the laboratory.

Clean Energy Mini-project
Students work on mini-projects to gain hands-on experience and understand how different clean energy technologies are deployed to convert clean energy sources to electrical power. Projects will include photovoltaic solar power system, fuel cell system, mini-wind power system and micro-hydroelectric power system.

LEVEL 3.1

Design & Operation of PV System
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 the concept of PV stand-alone and on-grid systems, sizing of cables and batteries, lightning protection, power protection and power quality issues.

Clean Energy System Integration
This module covers the technical and economic issues relating to the integration of clean energy sources, and the interconnection between clean energy and conventional power sources. Topics include an introduction to energy storage technologies, the protection of distribution generators and distribution schemes utilising distribution generation, system reliability, fault and stability studies, related regulations and standards on control 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 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.

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 an innovative spirit. 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.

ELECTIVE DISCIPLINE MODULES

Solar Thermal Technology
This module equips students with fundamental knowledge on the characteristics of solar thermal systems. Topics include fundamentals of thermodynamics and fluid mechanics, types of passive and active solar thermal systems. Students will have hands-on experience in designing simple yet effective solar thermal systems to harness solar energy for various uses.

Biomass and Bioenergy
This module equips students with fundamental knowledge on the use of biomass in the production of bioenergy. Students learn about biomass resources, photosynthetic process, fundamentals of bioenergy conversion technologies, case studies on bioenergy systems and their applications, biomass as a source of renewable energy, and its sustainable development to benefit the environment and economy.

Sensors & Instrumentation
The module equips 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.

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.

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 Design
- Applied Physics*
- Applied Technology
- Biomedical Engineering
- Industrial Control
- Industrial Electronics
- Information Technology
- Mechanical Technology
- Telecommunication Distribution Technology
- Workplace Safety & Health

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 ENVIRONMENTAL & WATER TECHNOLOGY (EWT)

(3-YEAR COURSE)

SCHOOL OF ENGINEERING

ENVIRONMENT & ENERGY CLUSTER

One in three people around the world do not have safe drinking water and each year, five million people die from drinking unclean water. Cyclones, tsunamis and earthquakes wreak havoc with our water sources, create human tragedies and affect food production. With climatic changes becoming more severe, the situation is expected to worsen. How can you help? If you are passionate about the environment and water resources, our **Diploma in Environmental & Water Technology (EWT)** will fulfill your career dreams.

This new, cutting-edge course focuses on environmental challenges and finding effective solutions to protect the environment and natural resources.

Jointly developed with the Public Utilities Board (PUB), EWT trains students to become specialists in addressing global concerns such as water and marine pollution, air pollution, global warming, ozone depletion, and improper handling of hazardous waste. Students benefit from a good grounding in the five key areas of water technology, waste management and resource conservation, renewable energy, pollution monitoring and control, environmental management, and health and safety.

Besides the discipline-specific core modules, students have a wide variety of elective modules to choose from, and can graduate with additional Diploma Plus Certificates and Enhancement Certificates. These electives are carefully selected to cater to the students' diverse interests and changing trends in the industry.

In their final year, students will do a year-long project. Alternatively, they can undertake a six-month Project Design & Development (PDD) or a six-month internship. Exposure to innovative projects and practical training equips students with the essential skills to excel in the workplace of the future.

Fully supported by the PUB and National Environment Agency, and endorsed by the Ministry of Manpower, EWT opens doors for graduates in the fast growing industry of environmental and water technology. These partnerships also allow students to gain real-life exposure to the industry prior to graduation.

Outstanding students can apply for PUB's full-term, bond-free scholarships with possible employment within the organisation upon graduation. In addition, Sembcorp scholarships with prospects of employment upon graduation are also available to EWT students.

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 hearing deficiency and 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

The Singapore government has set aside $2 billion in research funds to drive the growth of the environmental and water technology industry. The doubling of employment opportunities means that there will be 11,000 job openings by 2015.

Equipped with broad-based and practice-oriented knowledge and skills, EWT graduates are well placed for careers with government agencies, statutory boards, multi-national corporations and private organisations. They can work as environmental technologists, research assistants, water and wastewater treatment specialists, environmental health officers, assistant biodiversity officers, workplace health and safety auditors, as well as marketing executives for environment-related equipment and products.

ACCREDITATION FOR FURTHER STUDIES

Graduates will be able to gain direct admission to relevant bachelor's degree programmes offered by local universities and overseas universities in Australia and the United Kingdom. Overseas universities also grant module exemptions or one to two years advanced standing. Graduates can consider the following universities:

- **Nanyang Technological University**
- **National University of Singapore**
- **University of New South Wales (Australia)**
- **University of Western Australia**
- **University of Newcastle upon Tyne (UK)**
- **University of Strathclyde (UK)**

COURSE CURRICULUM (INTERNSHIP / PDD)

Module Name	Credit Units
YEAR 1	
Level 1.1 (23 hours per week)	
Environmental Chemistry & Analysis#	5
Fundamentals of Civil Engineering	5
Fundamentals of M&E Engineering	4
Engineering Mathematics 1#	5
Creativity & Applied Thinking Skills^	2
Sports & Wellness^	2
Level 1.2 (23 hours per week)	
Hydraulics#	4
Environmental Biology	5
Ecology#	2
Computer Aided Design#	3
Engineering Mathematics 2 #	5
Communication Toolkit^	4
YEAR 2	
Level 2.1 (24 hours per week)	
Clean Water Technology#	5
Workplace Safety & Health 1#	4
Noise Pollution Monitoring & Control #	4
Solid & Hazardous Waste Management	3
Engineering Mathematics 3 #	4
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (23 hours per week)	
Water Reclamation Technology#	4
Air Quality Monitoring & Control #	5
Renewable Energy	4
Environmental Biotechnology	3
Water & Marine Pollution	3
Innovation & Enterprise in Action^	4
YEAR 3	
Level 3.1 (26 hours per week)	
Environmental Management System	4
Workplace Safety & Health 2#	4
Energy Conservation & Management	3
Industrial Wastewater Technology	4
Membrane Science & Technology	3
Process Instrumentation & Control	4
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2 (25 hours per week)	
(Student to do one)	
Six-month Internship	25
Project Design & Development (PDD)	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

COURSE CURRICULUM
(NON-INTERNSHIP / NON-PDD)

Module Name	Credit Units
YEAR 1	
Level 1.1 (23 hours per week)	
Environmental Chemistry & Analysis#	5
Fundamentals of Civil Engineering	5
Fundamentals of M&E Engineering	4
Engineering Mathematics 1#	5
Creativity & Applied Thinking Skills^	2
Sports & Wellness^	2
Level 1.2 (23 hours per week)	
Hydraulics#	4
Environmental Biology	5
Ecology#	2
Computer-Aided Design#	3
Engineering Mathematics 2#	5
Communication Toolkit^	4
YEAR 2	
Level 2.1 (24 hours per week)	
Clean Water Technology#	5
Workplace Safety & Health 1#	4
Noise Pollution Monitoring & Control#	4
Solid & Hazardous Waste Management	3
Engineering Mathematics 3#	4
Interdisciplinary Studies (IS) module^	2
Interdisciplinary Studies (IS) module^	2
Level 2.2 (28 hours per week)	
Water Reclamation Technology#	4
Air Quality Monitoring & Control#	5
Renewable Energy	4
Environmental Biotechnology	3
Water & Marine Pollution	3
Innovation & Enterprise in Action^	4
Two-month Internship	5
YEAR 3	
Level 3.1 (21 hours per week)	
Environmental Management System	4
Workplace Safety & Health 2#	4
Energy Conservation & Management	3
Project 1	6
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
Level 3.2 (25 hours per week)	
Industrial Wastewater Technology	4
Membrane Science & Technology	3
Process Instrumentation & Control	4
Project Management#	3
International Business#	2
Project 2	9
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:
Common modules with other courses.
^ 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, 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
The SoE elective modules fall under a wide range of clusters under both Engineering and Non-Engineering categories. The aim is to provide students with the opportunity to broaden their knowledge and 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

Environmental Chemistry & Analysis
This module introduces students to the field of environmental engineering and provides the foundation for applications in pollution control, water and wastewater technology and hazardous waste management. Students will study the practical aspects of environmental chemistry, as well as quantitative measurements and analysis of air, water and wastewater. Principles of measurement, instrumentation and analysis are emphasised using an application-oriented approach.

Fundamentals of Civil Engineering
This module explores the basic principles and practices of civil engineering. The main topics covered include building materials, plants for earthwork, concreting, construction techniques, fundamentals of forces, stress and strain in structures, behaviour of structures under various loading conditions, basic analysis of forces, and bending moments in structural members. Topics on materials and plants for construction, construction technologies, fundamentals of structural mechanics and basic concepts in the analysis of structures are also incorporated. Students will also study elementary principles of land surveying.

Fundamentals of M&E Engineering
This module provides the fundamental knowledge of mechanical and electrical systems associated with water treatment, wastewater treatment, and solid & hazardous waste management. Students are also taught aspects of installation, operation and maintenance of these 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. Throughout the module, there is appropriate use of a Computer Algebra System. Topics include algebra, trigonometry, logarithms, matrices and complex numbers.

LEVEL 1.2

Hydraulics
This module introduces students to basic hydraulic principles and fundamental concepts that are essential for the study of water and wastewater technologies. Topics covered include the properties of fluids, manometry, hydrostatics and fundamental principles of fluid flow. Head loss in pipelines, design of pipelines, flow measurements and pipe network analysis will also be covered. Students will also learn open channel flow and the design of surface water drainage systems.

Environmental Biology
This module introduces students to the field of environmental microbiology, parasitology and epidemiology, and provides a foundation for further studies and applications in water and wastewater treatment, environmental health and environmental management. Students are also taught selected topics on human biology and food-borne diseases.

Ecology
Ecology is the study of living things in their natural environment. This module focuses on the significance and functions of natural ecosystems, and how humans have affected these systems over time. It concentrates on the interaction between human activities, natural resources, and the environment. As the human population grows and technology advances, pressures on the earth's natural systems are becoming increasingly intense and complex. This module aims to promote greater environmental awareness and nurture social responsibility towards the environment.

Computer-Aided Design
This module equips students with the principles and techniques of preparing computer-aided design (CAD) drawings in Architectural, Engineering and Construction (AEC) projects. Students are also trained to interpret and extract information from CAD drawings, and prepare CAD drawings according to CP 83. Emphasis is placed on preparing CAD drawings accurately so that information can be used electronically. AutoCAD is used in this module as it is widely adopted in the AEC industry.

Engineering Mathematics 2
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. Throughout the module, a Computer Algebra System will be used when appropriate. Topics covered include trigonometry, coordinate geometry, differentiation and integration with applications.

LEVEL 2.1

Clean Water Technology
In this module, students will study the processes for treating raw water from various surface water sources to produce potable water. Students are taught raw water quality parameters, treatment techniques, and the monitoring and operation of water treatment systems. The focus is on conventional water treatment technologies, particularly on chemical coagulation and flocculation processes for removal of suspended and colloidal solids in raw water. Topics covered include pre-treatment of raw water, sedimentation, coagulation, flocculation, filtration and disinfection techniques.

Workplace Safety & Health 1
This module focuses on the study of various aspects critical to the provision of a safe working environment. Topics covered include toxicology, clean air and ventilation, control of temperature and humidity, effects of noise and vibration on humans, industrial hygiene and industrial diseases.

Noise Pollution Monitoring & Control
The control of noise pollution is essential in all aspects of engineering. The rapid economic growth and growing affluence in Singapore have resulted in a greater need to control noise pollution. In this module, students are taught how noise pollution arises and its impact on health, measurement and monitoring of noise levels, preventive and control measures, and local environmental legislation.

Solid & Hazardous Waste Management
In this module, students will examine how solid and hazardous waste is generated, the pollution problems related to waste disposal, and methods of collection, handling, treatment and disposal of waste. Concepts of waste minimisation such as recycling, reusing, reducing and waste exchange will be highlighted as effective tools in waste management. Issues in biomedical waste generation, collection and treatment will be addressed. Local legislation for solid and hazardous waste will be explained in relation to the overall waste management practice.

Engineering Mathematics 3
This module provides students with mathematical skills for solving basic engineering problems. Topics are organised to keep pace with applications in the engineering modules. Topics covered include integration with applications, differential equations, Laplace transforms, and probability and statistics. A Computer Algebra System will be used throughout the module.

LEVEL 2.2

Water Reclamation Technology
The module introduces students to sewage characteristics, sewer design and maintenance and unit operations in a conventional wastewater treatment plant. Students will study the fundamentals of sewage collection systems for domestic wastewater, wastewater treatment technologies, monitoring and operation of wastewater treatment systems and the code of practice relevant to sewerage and wastewater treatment. Students will also be introduced to the treatment of sludge and disposal technologies. Emerging technologies in water reclamation and water recycling are also emphasised.

Air Quality Monitoring & Control
Monitoring and control of both outdoor and indoor air pollution are important aspects of environmental management. Students are taught the fundamentals of how air pollution arises, types of pollutants, and the corresponding environmental and health impacts. Dispersion modelling, sampling and monitoring of pollutants, techniques of identification of pollutants, preventive and control measures, and local environmental legislation and guidelines on indoor air quality will also be introduced.

Renewable Energy
In this module, students will be taught the various forms of renewable energy including solar energy, wind power and biomass. Students will learn about the basic technologies, reliability, cost and economics of these renewable energy sources. Other renewable energy sources such as hydropower, geothermal energy, ocean energy and fuel cells will be briefly covered. Other topics discussed include a comparison of conventional energy technologies with renewable sources, global issues in resource depletion, greenhouse gas emissions and alternate energy options in Singapore.

Environmental Biotechnology
Sustainable development calls for newer approaches to developmental activities and technologies so that eco-health is preserved alongside the conservation of invaluable natural resources. Environmental biotechnology is a tool that provides such an approach for understanding, managing, preserving and restoring environmental quality. Students will be exposed to biotechnological methodologies that can be suitably utilised to assess the well-being of ecosystems, transform pollutants to harmless substances, generate biodegradable materials from renewable sources and develop eco-friendly manufacturing and disposal processes. Applications, including recent developments in the field of biotechnology in aspects relating to the environment, will be covered.

Water & Marine Pollution
Students will be given an overview of water pollution and the impact of pollution on different types of water bodies like rivers, lakes and seas. They will learn the characteristics of polluted water bodies, types of waste streams and indicators of water pollution, waste disposal into river and the self-purification of river water systems. Eutrophication of lakes and reservoirs, marine pollution, its sources and impacts, and oil spill control at sea and beaches will also be covered.

Two-month Internship (Non-Internship/Non-PDD Pathway only)
In this module, students will be attached to organisations for a period of eight weeks to gain practical experience related to their course of study. This allows students to adapt themselves to the work environment in preparation for future employment. During their internship, they will undertake projects and tasks assigned by the organisation.

LEVEL 3.1 AND 3.2

COMMON MODULES

Environmental Management System
Students will learn the application of concepts and principles in environmental management. Topics covered include the fundamentals of environmental impact assessment (EIA), environmental baseline studies (EBS), risk assessment, environmental management systems (EMS), ISO 14001, OSHA 18001, and environmental auditing.

Workplace Safety & Health 2
This module provides students with knowledge of the relevant legislation and standards pertaining to occupational safety. The types of hazards found in various industries and the means for protection are also covered. Topics covered include the safe use of hand and power tools, the safe handling of materials, process hazards and electrical safety.

Energy Conservation & Management
Energy use is currently a major issue due to factors such as high energy consumption and reliance on depleting fossil fuels. Clean energy, a key strategic growth industry in Singapore, will form a useful conservation and management strategy in future. This module focuses on macroscopic perspectives and implementation issues on pressing energy conservation efforts, practices, incorporating clean energy, energy auditing and related regulations. It provides an overview of the energy industry, a global energy outlook along with necessary renewable technologies and related environmental impact and issues.

Industrial Wastewater Technology
Different industrial processes result in unique type and characteristics of industrial wastewater. Considering specific pollutants and toxic substances, treatment methodology applicable for conventional domestic wastewater is not all together applicable for industrial wastewater. This module introduces students to specific industrial wastewater problems and addresses possible unit processes applicable to industrial wastewater treatment. These unit processes, along with conventional water pollution treatment techniques, can then be applied as a complete treatment flow for different industrial wastewater types. The module will cover basic physical, chemical and biological treatment technologies and also highlight specific industrial wastewater treatment methods and anaerobic treatment applications.

Membrane Science & Technology
This module equips students with fundamental knowledge of membrane science and membrane applications in environmental engineering. Topics covered include the types of membranes and membrane modules, basic principles of membrane fabrication and design, general theory of membrane transport, membrane separation process, membrane fouling, liquid membranes, and facilitated transport. Membrane applications in water reclamation, recycling and reuse including desalination technology will also be covered.

Process Instrumentation & Control
Students will study the principles and applications of process instruments and the fundamentals of automatic process control systems including basic concepts of analogue and digital control, and principles of feedback and loop stability. This module includes a site visit to a control plant to enhance learning.

INTERNSHIP/PDD PATHWAY

Six-month Internship
In this module, students will be attached to organisations for a period of six months. This is to prepare them for future employment in their particular discipline of study. During their internship, they will undertake projects and tasks assigned by the organisations. This allows them the opportunity to take initiatives as well as to develop their self-confidence, interpersonal and adaptation skills.

Project Design & Development (PDD)
In this module, students will work in teams on a project in their particular discipline of study for a period of six months. The project will require them to research, experiment, analyse, critique and make recommendations on the subject of study. In addition to stretching the students' self-learning ability, the process will hone essential traits like leadership, team spirit, independence, innovative spirit, and their presentation and management skills.

NON-INTERNSHIP/NON-PDD PATHWAY

Project 1
In this module, students are expected to integrate the knowledge they gained in their first two years of study and undertake a year-long project on a topic in the field of environmental and water technology. This could be done as a case study, innovation, fabrication or computer-application project.

Project Management
This module teaches students the essentials of engineering project management. Topics covered include contract administration, site layout and organisation, engineering economics, and finance. Students will also study project planning techniques, including the use of a project network planning software.

International Business
Students will learn the various types of business models, marketing and risk management for overseas projects. The focus is on critical success factors such as understanding cultural differences, project financing and human resource management in different countries.

Project 2
This module is a continuation of Project 1 where students undertake a year-long project on a topic in the field of environmental and water technology.

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*
- Mechanical 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.