



## DIPLOMA IN CLEAN ENERGY MANAGEMENT (CEM) 3-YEAR COURSE

ENVIRONMENT & ENERGY CLUSTER

The **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 is supported by on-site real-life experiential learning at our Solar Technology Centre, Wind Technology Training Centre and other clean energy sites.

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

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

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

Our strong industry partnerships with leading companies enable us to constantly align CEM 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.

CEM is strongly endorsed and supported by the Economic Development Board (EDB), Energy Market Authority (EMA), Building & Construction Authority (BCA), National Environment Agency (NEA) 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:

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

You must also fulfil the aggregate computation requirements.

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

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour 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 was officially opened by Prime Minister Lee Hsien

Loong in late 2010. It is projected to create 3,000 jobs, with an estimated 30 percent of these jobs for diploma holders. When fully completed, the \$6.3 billion plant will put Singapore firmly on the world map for clean energy.

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

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

### ACCREDITATION FOR FURTHER STUDIES

With a firm foundation in electrical and electronic engineering, graduates will be able to gain direct admission into engineering courses offered by Nanyang Technological University 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
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### 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
Idea Jumpstart <sup>^</sup>	2
Sports & Wellness <sup>^</sup>	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 and Contemporary Issues <sup>^</sup>	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
Idea Blueprint <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	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
Idea Launchpad <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

### YEAR 3

#### Level 3.1 (25 hours per week)

Design & Operation of PV System	5
Clean Energy System Integration	5
Energy Audit & Measurement	5
Solar Thermal Technology	3
Power Electronics & Applications	3

Module Name	Credit Units
World Issues: A Singapore Perspective <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2
<b>Level 3.2 (22 hours per week)</b>	
Six-month Local/Overseas Internship	22
or	
Project Design & Development	22

### Notes:

<sup>^</sup>For more details on Interdisciplinary Studies (IS) modules, please log on to [www.np.edu.sg/is/](http://www.np.edu.sg/is/)

<sup>#</sup> The Minor in Business Management has the same Year 1 curriculum.

### IS Modules

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

## COURSE MODULES

### LEVEL 1.1

#### 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 build basic electrical measurement skills and cover concepts learnt in lectures and tutorials.

#### Engineering Mathematics 1

This module provides students with mathematical skills for solving basic engineering problems. Topics

are organised to keep pace with applications in the engineering modules. They include algebra, trigonometry, logarithms, matrices and complex numbers. A Computer Algebra System will be used where appropriate.

### Engineering Mechanics

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

### Computer Programming

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

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

### 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 equips students with hands-on practical skills in basic electrical wiring and installation, industrial control using relays, sensors and programmable logic controllers. They learn to assemble, solder and test electronic circuits on breadboard, strip-board, and printed circuit board, and use test and measurement 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 a continuation of Engineering Mathematics 2. 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 a photovoltaic (PV) system and operation, identifying appropriate PV applications in power systems and undertaking simple PV system design. Topics include the concept of PV stand-alone and on-grid systems, sizing of cables and batteries, lightning protection, power protection and power quality issues.

#### 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.

#### 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.

#### Power Electronics & Applications

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

### LEVEL 3.2

#### Six-month Local/Overseas Internship

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

#### Project Design & Development

Working on a design project, students will develop essential traits like leadership, team spirit, positive work attitude, independence, good presentation and management skills, and an innovative spirit. It promotes project management capabilities through project planning, scheduling, group discussions, project load

balancing and planning project milestones using the Gantt chart. Students get to practice and improve their oral and written communication skills by submitting reports and making presentations.

### DIPLOMA PLUS PROGRAMME

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

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

#### Clusters

- Applied Physics\*
- Electrical Control & Measurement
- Leisure & Retail Management
- Industrial Control (World Skills Singapore)

#### Other Available Diploma Plus Certificates

- Advanced Engineering Mathematics\*
- Business
- Innovation Management
- Languages (Japanese)

\* Designed in collaboration with the Department of Electrical and Computer Engineering, National University of Singapore (NUS). The programme aims to bridge the gaps between the curriculum of engineering mathematics at polytechnics and that of first-year engineering mathematics in universities.

For detailed module descriptions under each cluster, please refer to page 180.





# DIPLOMA IN ENVIRONMENTAL & WATER TECHNOLOGY (EWT)

3-YEAR COURSE

ENVIRONMENT & ENERGY CLUSTER

More than one in six people around the world do not have access to safe drinking water and each year, water-related diseases contribute to four million deaths among children. Cyclones, tsunamis and earthquakes wreak havoc on our water sources and affect food production. With climate change 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 fulfil your career dreams.

This 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, green energy strategies, pollution monitoring and control, environmental management, and health & 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/or Enhancement Certificates. These electives are carefully selected to cater to the students' diverse interests and changing trends in the industry.

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 bond-free scholarships with possible employment with 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:

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

You must also fulfil the aggregate computation requirements.

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

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

## CAREER PROSPECTS

The Singapore government has set aside part of a \$2 billion research fund to drive the growth of the environmental and water technology industry. This is expected to result in the doubling of employment opportunities to a projected 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

Local and overseas universities accept EWT graduates into related bachelor's degree programmes with appropriate exemptions and advanced standing:

- Nanyang Technological University  
Direct entry to the second year of the Environmental Engineering programme
- National University of Singapore  
Module exemptions equivalent to one year for the Environmental Engineering course
- Murdoch University (Australia)  
2 years exemption for the Degree in Environmental Management, 2 years exemption for the Degree in Environmental Science
- University of Queensland (Australia)  
1 year exemption to the Degree in Chemical Engineering and 1 year exemption to the Degree in Civil Engineering
- University of New South Wales (Australia)
- University of Western Australia
- University of Newcastle upon Tyne (UK)
- University of Strathclyde (UK)

### COURSE CURRICULUM

Module Name	Credit Units
<b>YEAR 1</b>	
<b>Level 1.1 (25 hours per week)</b>	
Environmental Chemistry & Analysis	5
Fundamentals of Civil Engineering	5
Fundamentals of M&E Engineering	4
Ecology	2
Engineering Mathematics 1	5
Idea Jumpstart^	2
Sports & Wellness^	2

Module Name	Credit Units
<b>Level 1.2 (25 hours per week)</b>	
Hydraulics	4
Environmental Biology	5
Noise Pollution Monitoring & Control	4
Computer Aided Design	3
Engineering Mathematics 2	5
Communication & Contemporary Issues^	4
<b>YEAR 2</b>	
<b>Level 2.1 (26 hours per week)</b>	
Clean Water Technology	5
Air Quality Monitoring & Control	5
Green Energy Strategies	5
Solid & Hazardous Waste Management	3
Engineering Mathematics 3B	4
Idea Blueprint^	2
Interdisciplinary Studies (IS) module^	2
<b>Level 2.2 (26 hours per week)</b>	
Water Reclamation Technology	4
ABC Waters Management	3
Environmental Biotechnology	3
Water & Marine Pollution	3
Workplace Safety & Health	5
Process Instrumentation & Control	4
Idea Launchpad^	2
Interdisciplinary Studies (IS) module^	2
<b>YEAR 3</b>	
<b>Level 3.1 (24 hours per week)</b>	
Membrane Science & Technology	3
Environmental Management Systems	4
Industrial Wastewater Technology	4
Project Management	3
Environmental Research	6
World Issues: A Singapore Perspective^	2
Interdisciplinary Studies (IS) module^	2
<b>Level 3.2 (22 hours per week)</b>	
Six-month Internship	22

### Notes:

^ For more details on Interdisciplinary Studies (IS) modules, please log on to [www.np.edu.sg/is/](http://www.np.edu.sg/is/)

Students are required to own notebook computers.

### IS Modules

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

### COURSE MODULES

#### LEVEL 1.1

##### Environmental Chemistry & Analysis

This is an introductory module to the field of environmental engineering and it provides a foundation for applications in Pollution Control and Water & Wastewater Technology. Students will study the practical aspects of environmental chemistry, quantitative measurements and analysis of water and wastewater. Principles of measurement, instrumentation and analysis are emphasised with an application-oriented approach.

##### Fundamentals of Civil Engineering

The module introduces students to basic principles and practices of civil engineering. Students will learn elementary structural concepts and their applications. They will also explore the main types of civil engineering works, the construction technology involved, and the challenges civil engineers face. In addition, they will also be introduced to land surveying.

### Fundamentals of M&E Engineering

This module covers fundamental knowledge of mechanical and electrical engineering on the design, installation, operation and maintenance of mechanical & electrical plants and equipment associated with water and wastewater treatment plants. The topics included in this module are kinetics, kinematics, work, power and energy, DC electrical circuits and AC theory, electromagnetism and magnetic circuits, pumps and pumping theory, valves, fans and ventilation, compressed air systems, motors and alternators.

### Ecology

Ecology is the study of living things in their natural environment. This module focuses on the significance and function of natural ecosystems, how humans have affected these systems over time and, the scope for reversal of these trends to work towards a life-sustaining world. It concentrates on the interaction between human activities, natural resources and the environment. As human population grows and technology advances, pressures on 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.

### Engineering Mathematics 1

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

## LEVEL 1.2

### Hydraulics

Students will learn the basic hydraulic principles and fundamental concepts which are essential for the study of water and wastewater technologies. Properties of fluids, manometry, hydrostatics and fundamental principles of fluid flow will be taught. Head losses in

pipeline, design of pipeline, flow measurements and pipe network analysis will be covered. Students will also learn open channel flow and the design of surface water drainage systems.

### Environmental Biology

The module introduces students to the field of environmental health science and provides a foundation for further studies and application in environmental law, safety and health management. Students will be trained in the areas of microbiology, parasitology, entomology, vector control, epidemiology & communicable disease control, human biology and food hygiene.

### Noise Pollution Monitoring & Control

Singapore's rapid economic growth towards an industrialised and urbanised society coupled with an affluent population has resulted in a greater need to control noise in the general environment. The control of noise pollution is essential in all aspects of work and students will be taught the fundamentals of how noise pollution arises, health impacts of noise, measurement and monitoring of noise levels, preventive and control measures and local environmental legislation.

### Computer Aided Design

This module provides students with the principles and techniques of preparing computer-aided design (CAD) drawings in Architectural, Engineering and Construction (AEC) projects. Students will also be trained to interpret and extract information from CAD drawings and prepare CAD drawings according to CP 83. Emphasis will be 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 equips students with further mathematical skills to solve engineering problems. Topics include further trigonometry, trigonometric graphs, plane analytic geometry, differentiation with applications, and integration with applications.

## LEVEL 2.1

### Clean Water Technology

This module introduces the concepts of water treatment technologies for treating raw water from various sources. The focus in this module is to impart knowledge on the conventional water treatment technologies. The topics covered include pre-treatment, sedimentation, filtration and disinfection techniques for the treatment of potable water. Adverse effects of hardness and hardness treatment using chemical methods and the use of ion-exchange processes are covered in detail. Practical problems associated with the operation and maintenance of water treatment plants including mechanical & electrical equipment and possible solutions for these problems will be 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, indoor air quality audit, 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.

### Green Energy Strategies

Students analyse environmental issues caused by the dependency on fossil fuels and coals as energy sources and explore various forms of renewable energy such as solar, wind, biomass, hydro, geothermal, ocean and fuel cells. Relevant aspects of energy audits, conservation and management will also be covered.

### Solid & Hazardous Waste Management

In this module, students will be taught how solid and hazardous waste is generated, pollution problems related to waste disposal, 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 system.

### Engineering Mathematics 3B

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

### 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. 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.

#### ABC Waters Management

Singapore, with its extensive network of waterways and waterbodies, has an environmentally sustainable solution with water harvesting. This module provides an introduction to the Active, Beautiful and Clean (ABC) Waters Programme as part of the initiative to remake Singapore into a vibrant 'City of Gardens and Water'. Students will be taught on how to keep the waterways and waterbodies clean using ABC Waters design features; and retain and treat stormwater on site before slowly releasing it. Other topics covered include design concepts on sedimentation basins, swales and buffers, bio-retention swales, bio-retention basins, cleansing biotopes, bioengineering and constructed wetlands.

#### Environmental Biotechnology

Sustainable development calls for newer approaches towards developmental activities and technologies, so that eco-health is preserved alongside 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 systems. Effects of pollution in lakes and reservoirs, marine pollution, sources and impacts pollution in sea and oil spill control at sea and beaches will also be covered.

#### Workplace Safety & Health

The module covers the relevant legislation and standards pertaining to workplace safety and health. Students will be taught to identify the various types of industry hazards and the means of protection against these hazards. The topics will include risk management and control, safety management system, accident reporting and investigation, safe use of hand and power tools, safe handling of materials and machinery, and electrical safety.

#### 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 students' learning.

### LEVEL 3.1

#### Membrane Science & Technology

This module equips students with the 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 using membranes will also be covered.

#### Environmental Management Systems

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.

#### Industrial Wastewater Technology

Different industrial processes result in unique types 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. The module will cover basic physical, chemical and biological treatment technologies and also highlight specific industrial wastewater treatment methods. Where applicable, case studies will be used to illustrate specific industrial application of the technologies.

### Project Management

This module introduces students to the basics of project management. It covers the principles of Project Management in modern businesses at the various stages of planning. Elements of contract administration, as well as engineering economics and finance will also be taught.

### Environmental Research

In this module, students are expected to integrate the knowledge they have gained in the earlier semesters to undertake an environmental research project on a topic in the field of water, environmental science and technology.

## LEVEL 3.2

### 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.

## DIPLOMA PLUS PROGRAMME

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

Students can choose the DPP clusters from the range listed below. The offer of a DPP cluster is subject to the

condition that the minimum class size is met and based on available vacancies.

### Clusters

- Environmental Innovations
- Leisure & Retail Management

### Other Available Diploma Plus Certificates

- Advanced Engineering Mathematics\*
- Business
- Innovation Management
- Languages (Japanese)

\* Designed in collaboration with the Department of Electrical and Computer Engineering, National University of Singapore (NUS). The programme aims to bridge the gaps between the curriculum of engineering mathematics at polytechnics and that of first-year engineering mathematics in universities.

For detailed module descriptions under each cluster, please refer to page 180.





# DIPLOMA IN SUSTAINABLE URBAN DESIGN & ENGINEERING (SDE) 3-YEAR COURSE

ENVIRONMENT & ENERGY CLUSTER

From shopping at City Square Mall, Singapore's first eco-friendly mall, to living in HDB's Eco-Town@Punggol or URA's Jurong Lakeside District or hanging out at Marina Barrage, our newest and most high-tech reservoir, you're constantly coming into contact with one of the growing trends of today's world: sustainable urban design and development.

Sustainable urban design is concerned with ways to plan, design and construct buildings and develop the built environment that will be needed for a more sustainable society. The focus is on both new developments and modifications that can be made to existing developments.

If you are driven to transform the built environment in ways that provide for the ecological, economic, and social needs of the present without compromising those of the future, then sign up for the **Diploma in Sustainable Urban Design & Engineering (SDE)**.

Students will learn to look at the urban landscape in a different light – from how a well-planned town can build its new buildings and conserve its old through sustainable technologies, to how modern cities can integrate both work and leisure while protecting and preserving the environment.

SDE students will also gain knowledge in urban planning, conservation and refurbishment as well as receive training in the design and construction of environmentally sustainable buildings and infrastructure. Students who are not sure if they have a flair for design or an engineering mind have three semesters to build their foundation and discover their aptitude and passion. An internship also helps them make an informed choice between the Architecture or Sustainable Technologies specialisations.

## ENTRY REQUIREMENTS

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

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

You must also fulfil the aggregate computation requirements.

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

## CAREER PROSPECTS

In 2009, the Inter-Ministerial Committee for Sustainable Development (IMCSD) unveiled a blueprint for Singapore's sustainable development. The blueprint outlined the key goals and initiatives for the future through promotion of eco-friendly public housing, biodiversity, clean transport, sky-rise greenery, clean technology, sustainable high-density districts, and district sustainability programmes.

These initiatives have brought about a growing demand for technologists in the area of sustainable urban development and engineering. SDE graduates will be able to work in fields such as architectural planning and design, civil and structural design, environmental research and management, township planning, and building conservation and refurbishment.

## ACCREDITATION FOR FURTHER STUDIES

SDE graduates can pursue a degree in related fields such as architecture, civil engineering, construction management, project management or facilities management. They may even be granted advanced standing at both local and overseas universities, such as:

- Nanyang Technological University
- National University of Singapore
- RMIT University
- University of Strathclyde
- Heriot-Watt University
- Bond University
- Newcastle University

## COURSE CURRICULUM

Module Name	Credit Units
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### YEAR 1

#### Level 1.1 (26 hours per week)

Green Transportation	4
Building Behaviour Studies 1	5
Sustainable Building Design	4
Design Communications	4
Engineering Mathematics 1	5
Idea Jumpstart <sup>^</sup>	2
Sports & Wellness <sup>^</sup>	2

#### Level 1.2 (25 hours per week)

Sustainable City Planning	4
Building Systems Design	4
Structure & Fabric	4
Computer Aided Design 1	4
Engineering Mathematics 2	5
Communication & Contemporary Issues <sup>^</sup>	4

### YEAR 2

#### Level 2.1 (30 hours per week)

Workplace Safety & Health	5
Building Behaviour Studies 2	4
Infrastructure Works	4
Computer Aided Design 2	4
Engineering Mathematics 3B	4

Module Name	Credit Units
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Two-month Internship#	5
Idea Blueprint <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

### SPECIALISATION IN ARCHITECTURE

#### Level 2.2 (23 hours per week)

Design Studio 1	8
Integrated Building Systems	4
Landscape Design	3
History & Theory of Architecture	4
Idea Launchpad <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

### YEAR 3

#### Level 3.1 (22 hours per week)

Design Studio 2	10
Architectural Materials & Technology	4
Interior Design & Space Planning	4
World Issues: A Singapore Perspective <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

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

Design Studio 3	10
Project Management	4
Professional Practice	4
Urban Conservation & Refurbishment	4

### SPECIALISATION IN SUSTAINABLE TECHNOLOGIES

#### Level 2.2 (22 hours per week)

Geomatics	4
Structural Design 1	6
Fundamentals of Water Technology	4
Measurement & Costing	4
Idea Launchpad <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

### YEAR 3 (INTERNSHIP)

#### Level 3.1 (25 hours per week)

Soil Science	5
Structural Design 2	6
Clean Water Technology	5
Two-month Internship#	5
World Issues: A Singapore Perspective <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

#### Level 3.2 (20 hours per week)

Green Building Technologies	4
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Module Name	Credit Units
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Project Management	4
Water Reclamation Technology	4
Urban Conservation & Refurbishment	4
Structural Assessment & Improvement	4

### YEAR 3 (NON-INTERNSHIP)

#### Level 3.1 (24 hours per week)

Soil Science	5
Structural Design 2	6
Clean Water Technology	5
Project Management*	4
World Issues: A Singapore Perspective <sup>^</sup>	2
Interdisciplinary Studies (IS) module <sup>^</sup>	2

#### Level 3.2 (21 hours per week)

Green Building Technologies	4
Project Design & Development	5
Water Reclamation Technology	4
Urban Conservation & Refurbishment	4
Structural Assessment & Improvement	4

### Notes:

# The Two-month Internships are conducted during the vacation

\* Project Management may be taken in other BE courses or in OIAP

<sup>^</sup> For more details on Interdisciplinary Studies (IS) modules, please log on to [www.np.edu.sg/is/](http://www.np.edu.sg/is/)

Students are required to own notebook computers

### IS Modules

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

## COURSE MODULES

### LEVEL 1.1

#### Green Transportation

Students will learn the concepts of transportation planning and management. Topics include how travel models, driver and traffic flow characteristics are used for transportation system planning; highway geometric design and traffic signalization; and the characteristics of mass transit systems.

#### Building Behaviour Studies 1

Strength and stability are important aspects of structural elements that make up buildings and other infrastructures. 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.

#### Sustainable Building Design

This module covers sustainability issues relating to the development of our built environment which invariably includes buildings and infrastructure. Understanding the present challenges of the industry provides the backdrop for the issues to be addressed. Actions for sustainable designs, construction and care for our buildings are then discussed. Features of an eco-city development and case studies of exemplary buildings are also included.

#### Design Communications

This module equips students with a fundamental set of skills for architectural presentation and representation, providing a firm grounding for the practice of architectural design. Students will begin to cultivate a heightened sensitivity to the environment. Lectures present the use of various freehand sketching and drawing techniques, Sketch-up software and media, while tutorials provide an opportunity for students to apply the above knowledge. Students will also develop competence in physical model-making as a vital means of exploring and resolving design in 3D.

#### Engineering Mathematics 1

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

### LEVEL 1.2

#### Sustainable City Planning

This module outlines the framework for planning and development in Singapore and highlights local examples such as HDB's Eco-Town@Punggol, JTC's Cleantech and URA's Jurong Lakeside District. Students will learn the principles of master planning, urban design, planning codes and guidelines that are essential for a socially, ecologically and economically sustainable city/town. Topics include zoning, plot ratio, height control, gross floor area and other building codes of practice.

#### Building Systems Design

This module provides the fundamental knowledge of mechanical and electrical systems associated with buildings. Topics covered include water supply, sanitary and drainage systems, gas supply, air-conditioning systems, electrical supply systems, lifts, escalators and communication systems.

#### Structure & Fabric

In this module, students will study the basic principles and construction techniques for the main building elements of low-rise buildings. The properties and applications of common building materials and functional requirements of various building elements are also examined. This module prepares students for the study of more complex structures and methods applicable to multi-storey buildings and infrastructure construction in the Infrastructure Works module during the second year.

#### Computer Aided Design 1

This module provides students with the principles and techniques of preparing computer-aided design (CAD)

drawings for urban development which are typically architectural, engineering and construction projects. Students will also be trained to interpret, extract information from, and prepare CAD drawings according to Singapore's National Standard CP 83. Emphasis is placed on preparing CAD drawings accurately so that information can be used electronically. AutoCAD software is used in this module as it is widely used in urban development projects.

#### Engineering Mathematics 2

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

### LEVEL 2.1

#### Workplace Safety & Health

The module covers the relevant legislation and standards pertaining to workplace safety & health. Students will be taught to identify the various types of industry hazards and the means of protection against these hazards. Topics include risk management and control, safety management system, accident reporting and investigation, safe use of hand and power tools, safe handling of materials and machinery, and electrical safety.

#### Building Behaviour Studies 2

This is a continuation of Building Behaviour Studies 1. Students will perform structural analysis for various concrete and steel designs. They will learn to analyse and compute forces, deflections, shear forces and bending moments developed in structural members due to different loading criteria for both statically determinate and indeterminate structures.

#### Infrastructure Works

This module introduces students to the various methods of construction involved in complex structures, multi-storey buildings and infrastructure engineering works as part of urban development. It covers reinforced concrete construction, precast and

prestressed construction, and structural steelwork. Excavation works, excavation supports, ground water control, road works and pipeline construction are also included.

### Computer Aided Design 2

Building upon the earlier 2D Computer Aided Design module, students are introduced to advanced skills in visualisation and presentation. Using industry standard software for 3D modelling and graphic layout, students will learn to employ the techniques of 3D modelling in one's creative design process and seamlessly integrate these outputs into compelling presentations.

### Engineering Mathematics 3B

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

### Two-month Internship

Students will be attached to organisations for a period of eight weeks during their vacation to gain practical experience related to their course of study, and to hone their social skills and acquaint them with the work environment, thereby enabling them to adapt effectively to future employment in the private or public sector. The students should also be in a better position to make an informed choice of the two specialisations in the SDE course at the end of the internship. During their internship, they will undertake projects and tasks assigned by the organisation.

## SPECIALISATION IN ARCHITECTURE

### LEVEL 2.2

#### Design Studio 1

This introductory design module lays the foundation for subsequent architectural design studios. Through the presentation of projects which are experimental in nature, students are introduced to fundamental principles of design, including space, form, order, composition, aesthetics, anthropometrics, scale and proportion. The projects challenge students to exercise

critical thinking and develop creative design concepts to create meaningful spatial experiences within a small-scale site or development. Students have to demonstrate competency in presenting their project using basic architectural communication techniques, including orthographic projections of plan, section and elevation.

#### Integrated Building Systems

This module focuses on the realisation of an architect's concepts through the design of mechanical and electrical (M&E) systems. It is a follow-up to the first year module of Building Systems Design. Special references will be made to integrated drawings, specifications and codes of practices relating to sustainable design and development. Students will learn about how model designs are translated into real world developments through case studies

#### Landscape Design

This module aims to provide students an overview of the field of landscape design. Students will be taught on landscape theory, design processes and principles including the history of landscape architecture. Students will also learn about the types of plants commonly used in local landscaping together with their care and maintenance. The role of Singapore's landscape industry to urban development will also be introduced to students.

#### History & Theory of Architecture

Students will be provided with an overview of major movements, ideas, principles and traditions in Western and Asian architectural history and theory, and their influence on the global production of architecture. Exploring key works, architects and texts ranging from the classical era through the twenty first century, students will appreciate the development of architectural ideas and built works, and their relationship with the prevailing society and culture. Intellectual discourse and critique of architectural design are expected as learning outcomes.

### LEVEL 3.1

#### Design Studio 2

This project, situated within a small-scale site / development, remains experimental in nature and deals with tectonics of space. Building on Design Studio 1, students are also introduced to industry standard software for 3D visualisation and graphic presentation. Students learn to integrate both manual design skills, as well as 3D modelling techniques, in one's creative design process, and seamlessly integrate these skills into creating and presenting compelling designs.

#### Architectural Materials & Technology

Students will be exposed to more advanced building materials like glass, fabric, glass/fiber-reinforced-plastic materials. They will learn how such materials can add variety to architectural design as well as to detail them in a meaningful manner. Expanding on the students' understanding of basic construction and building, this module introduces more advanced technologies like post-tensioning, shell structures, and sustainable construction such as green roofs and walls. Topics such as waterproofing, painting and cladding systems are also introduced.

#### Interior Design & Space Planning

Students will learn the basic concepts of interior design, and an understanding of space planning and design for various types of projects ranging from small, single site operations to multi-national corporation businesses. The various stages of development will be taught, beginning with the understanding of a client's organisation to the appraisal of the design decision. The Code on Barrier-Free Accessibility in Buildings will also be covered for the design of barrier-free spaces.

### LEVEL 3.2

#### Design Studio 3

Students will develop design proposals in response to a defined mid-scale site or development. Through the study of architectural precedents and site analysis, students' design proposals should demonstrate a keen understanding of context and environment. The

meaning of a space in relation to its function and human activities is also demonstrated against the background of society and culture. Students must demonstrate further development in the use of different media in architectural communication, as well as proper drawing documentation.

#### Project Management

This module covers the principles of project management at various stages of a building and construction project. Elements of contract administration, quality management, coordination, engineering economics and finance will be taught.

#### Professional Practice

This module places architectural design in the context of a professional practice. Students will learn about how an architectural practice is organised, the roles and responsibilities of an architect, and his/her relationships with the other consultants and professionals of a building project team. Preparation of architectural specifications, bills of quantities, etc, relating to tender documentations, and preparation of drawings and documentations for statutory submissions will be taught. As a vital advancement tool in an architectural career, students will also learn the use of various approaches and media to conceptualise, prepare and present a portfolio.

#### Urban Conservation & Refurbishment

Conservation of urban structures is a strategic approach to ensure sustainability of developed cities. This module introduces the concepts needed to carry out refurbishments while conserving existing structures and the universal principles of sustainable construction and techniques as applied to alteration and addition projects. The option of refurbishment vis-à-vis redevelopment from the feasibility study, decision making, procurement, project planning and management to project completion and delivery are explained in this module. It includes the management of various problems expected in carrying out refurbishment works in occupied premises and the concomitant risks to the various parties. The technologies used in refurbishment are also discussed.

## SPECIALISATION IN SUSTAINABLE TECHNOLOGIES

### LEVEL 2.2

#### Geomatics

This is the science and technology of gathering, analysing, distributing and using geographic data. Students will learn to use instruments (Level and Total Station) to gather data with basic surveying techniques. They will learn to interpret, distribute and use these collected data for urban development projects. Students will carry out integrated assignments where the data collected will be transferred to AutoCAD software, to allow them to appreciate how the data are used in real projects.

#### Structural Design 1

This module trains students to use the current Code of Practice for the analysis and design of structural elements in reinforced concrete construction. Students will also learn to read structural drawings for construction purposes.

#### Fundamentals of Water Technology

This module introduces students to the basic behaviour of water as a fluid 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.

#### Measurement & Costing

This module covers the principles of taking-off and measurement of quantities from construction drawings for urban development works. It is used for preparing cost estimates and budgeting. 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.

### LEVELS 3.1 & 3.2

#### Soil Science

Students will study the behaviour of soil under structural loading. The properties of common types of soil, soil compaction, soil permeability, shear strength of soil, 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 to support intended structures.

#### Structural Design 2

The topics in this module cover the design concepts of steel structures and detailed design of various structural steel elements based on the provisions of the structural steel design code. Students will also be taught how to prepare structural steel detailing and drawings.

#### Clean Water Technology

This module introduces the concepts of water treatment technologies for treating raw water from various sources. The focus of this module is to impart knowledge on the conventional water treatment technologies. The topics covered include pre-treatment, sedimentation, filtration and disinfection techniques for the treatment of potable water. Adverse effects of hardness and hardness treatment using chemical methods and the use of ion-exchange processes are covered in detail. Practical problems associated with the operation and maintenance of water treatment plants including mechanical & electrical equipment and possible solutions for these problems will be emphasised.

#### Project Management

This module introduces students to the rudiments of modern construction project management. The module covers the principles of Project Management in the construction business at the various stages of planning. Elements of contract administration, construction and engineering economics and finance will be taught.

#### Green Building Technologies

Students will learn about government and industry initiatives to introduce green building technologies such as using recycled aggregates for structural and

non-structural uses, precast and modular construction. Students will learn, in detail, the different types of precast elements and how they are fabricated in the factory and assembled on site. They will also learn about the Green Mark Listing Scheme as well as the operating and sustainability issues of green technologies when applied in buildings.

#### Project Design & Development

Students are expected to integrate the knowledge they gained in their first five semesters of study and undertake a semester-long project on a topic relating to buildings, civil engineering, and sustainable design & development. This could be a case study, fabrication or computer-application project.

#### 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.

#### Urban Conservation & Refurbishment

Conservation of urban structures is a strategic approach to ensure the sustainability of developed cities. This module introduces the concepts needed to carry out refurbishments while conserving existing structures and the universal principles of sustainable construction and techniques, as applied to alteration and addition projects. The option of refurbishment vis-à-vis redevelopment from the feasibility study, decision making, procurement, project planning and management to project completion and delivery are explained in this module. It includes the management of various problems expected in carrying out refurbishment works in occupied premises and the concomitant

risks to the various parties. The technologies used in refurbishment are also discussed.

#### Structural Assessment & Improvement

This module introduces the requirements of mandatory building inspection under the local 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 be given practical sessions in the use of equipment for non-destructive testing of concrete. The module also covers the process of building condition survey in preparation for conservation and refurbishment projects.

#### Two-month Internship

Students will be attached to organisations for eight weeks during the vacation to observe how theory is put into practice. In addition to applying what they have learnt in real-life settings, this practical experience also helps them to better understand the modules that lie ahead. During their internship, they will undertake projects and tasks assigned by the organisations. This gives them the opportunity to take the initiative, develop their self-confidence, interpersonal and adaptation skills in preparation for future employment.

### DIPLOMA PLUS PROGRAMME

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

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