DIPLOMA IN AUTOMATION & MECHATRONIC SYSTEMS

Imagine stepping out of your smart home, taking a self-driving vehicle to your favourite restaurant, and getting served by a robotic waitress. The field of automation is steadily growing and finding its way into every home, company and industry. If you want to engineer the next generation of smart machines, the Diploma in Automation & Mechatronic Systems (AMS) is your ideal choice.

AMS prepares students for exciting careers in diverse sectors ranging from precision engineering, aerospace, electronics, energy and chemical, food manufacturing, marine & offshore and sea transport. You will learn to use emerging skills in robotics and automation, design thinking, Internet of Things (IoT) and data analytics to develop high-tech solutions for consumer products and industrial applications. What's more, AMS's emphasis on project-based learning, design thinking and experiential learning will give you an edge in developing applications of industrial robots, autonomous vehicles, modular production systems (MPS) and smart sensor technology.

In the first two years, you will build a strong foundation in the various disciplines of engineering – electrical, electronics, mechanical and programming. You will also learn practical skills in Computer-Aided Design and development of control software for smart devices and automated lines.

In your third year, you will learn how to control industrial robots and build an autonomous vehicle. You will also go on a six-month internship with companies such as ST Land Systems, PSA Singapore, Keppel Offshore & Marine and A*STAR. Or you can choose to work on a final-year project to design and develop a high-tech product prototype. You will also get to work on an Integrated Real-world Project in every semester. These projects will develop your critical thinking, problem-solving and technical skills.

YEAR 1 COURSE MODULES

LEVEL 1.1

Electrical Engineering Fundamentals
This module provides a foundation in electricity covering basic concepts of electrical circuits and the methods used to analyse them. The module emphasises the understanding of the basic electrical circuit laws (Ohm's Law, Kirchhoff's Voltage and Current Laws) and network theorems, and their application to electrical network analysis. Topics covered include fundamentals of electricity, network theorems, capacitance, electromagnetic induction and inductance.

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

Integrated Real-world Project 1
This module aims to integrate the knowledge learnt in the semester and apply it to a real-world project to understand its relevance. Students will work in teams and undertake the project development underpinned by the design thinking approach. On completion of the module, students will be able to apply the skills and develop confidence in tackling projects. Data analytics will be introduced using case-based approach and applied in the integrated real-world project.

Career & Professional Preparation 1 will be incorporated to give students a foundational introduction to their three-year diploma course curriculum and how it prepares them for industry. It will help them to embark on their course with the end in mind, through guided reflection of their personal characteristics, and producing an overall game plan for their future education and career goals.

Mechanical Engineering Fundamentals
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 include forces and resultants, moments and couples, equilibrium and the concepts of plane friction. This module also aims to equip students with the skills to analyse problems of rigid bodies in motion. Only linear motion in two dimensions will be covered. Topics include kinematics and kinetics of linear motion.

Programming
This practice-oriented module equips students with basic knowledge and skills in computer programming using a suitable high-level language. The main topics include basic computer programming concepts and fundamental programming constructs such as sequences, selection and repetition.

LEVEL 1.2

Electrical & Electronic Technology
The aim of this module is to introduce the fundamental concepts of digital electronic devices and circuits. It intends to deepen the electrical fundamentals learnt in the first semester. Topics include AC circuit theory and transformer fundamentals, number systems, Boolean algebra, combinational logic design, applications of latches, flip-flops, counters and registers.

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

Integrated Real-world Project 2
This module aims to integrate the knowledge learnt in the semester and apply to a real-world project and understand the relevance and application of the modules learnt. Students will work in teams and undertake the project development underpinned by the design thinking approach. On completion of the module, students will be able to apply the skills and develop confidence in tackling projects at the higher levels.

This module will also imbue in students a sense of civic consciousness in the context of engineering and society. It serves to create awareness amongst students about the impact of engineering on society in general. In the process it introduces the application of cultural quotient (CQ) skills and mould students' disposition to understand and collaborate across diverse cultures in real world settings.

Materials & Manufacturing Technology
This module introduces students to properties of common engineering materials with emphasis on mechanical testing methods, heat-treatment, international standard specifications, and selection and applications of such materials. Topics include classification of materials, mechanical testing, alloying, steels, non-ferrous alloys, plastics, ceramics and composites. For manufacturing technology, students will acquire the basic knowledge and skills of manufacturing processes, including drilling, turning, milling, grinding, non-conventional machining, welding and assembly.

Thermofluids
Students will learn the basic laws governing the behaviour of fluids under the influence of energy transfer. Topics include systems concept, temperature and pressure, fluid statics, fluid in motion, continuity equation, laminar and turbulent flows, ideal incompressible flow, Bernoulli's equation, flow measurement and Pitot tube, external flow and application of thermofluid's principles in simple engineering systems.

YEAR 1 COURSE CURRICULUM

Module Name	Credit Units
Level 1.1 (20 hours per week)	
Electrical Engineering Fundamentals	3
Engineering Mathematics 1	4
English Language Express*	NA
Innovation Made Possible^	3
Integrated Real-world Project 1	4
Mechanical Engineering Fundamentals	3
Programming	3
Level 1.2 (21 hours per week)	
Communication Essentials^	3
Electrical & Electronics Technology	3
Engineering Mathematics 2	4
Health & Wellness^	1
Integrated Real-world Project 2	4
Materials & Manufacturing Technology	3
Thermofluids	3

^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is
* This module is only offered to students who are weaker in the English Language.

IS Modules
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YEAR 2 COURSE MODULES

LEVEL 2.1

Computer-Aided Design & Drafting
This practice-oriented module is designed to give students an appreciation of the scope of computer graphics and hands-on practice in the applications of Computer-Aided Design (CAD) in engineering design. This module aims to help students in the application of the drafting concepts and modelling techniques for development of product models in the design process. Students will learn the principles and capabilities of CAD through three dimensional (3D) solid modelling of engineering components and assembly.

Engineering System Design
This module aims to equip students with the fundamental knowledge and practice of the engineering design process, the applications of engineering principles and analysis in the design, sizing and selection of components such as electric motor, coupling, gears, bearing, chain drives, and fastener. This module will also introduce the basic concept of Geometrical Dimensioning & Tolerance (GD&T) to the students. Case studies of existing machines and systems, guided tutorials, quizzes, assignments, and a practical project will be used to reinforce the theoretical aspects.

Industrial Automation
This module aims to equip students with the basic knowledge of automation technologies and their applications in the manufacturing and process industries. With the rise of new digital industrial technology, known as Industry 4.0, students will also be introduced to smart sensors which have the ability to collect data that can be used for data analysis. Major topics include electro-pneumatics technology, programmable logic control and IO-Linked technology (for smart sensors). The essential hardware components used in automated systems, such as sensors, valves and actuators will be applied to the automated systems. Widely accepted industrial control programming language ladder and inline structured text will be covered, in conjunction with the learning of programming logic controllers and computer interfaces. Laboratory work involves hands-on circuit construction and implementation using these various technologies and techniques, which enhances students' understanding of the practical aspects of circuit designs.

Integrated Real-world Project 3
This module aims to equip students with the knowledge of design, build, commission, maintain, repair, and adjust automated modular production system, and also program using programmable logic controllers (PLCs) and human machine interfaces (HMI).

Major topics include analysis and commissioning of mechatronics system, design and assemble of electrical circuit, and software programming to perform the necessary control. Through guided hands-on project work, the students will apply their knowledge on modular production systems where they can find the industrial applications in automated production and process lines. They must also master problem-solving techniques to ensure correct and safe machine operation according to their test project.

The module will also introduce the concept of OPC-UA as it allows communicating with industrial equipment and systems for data collection and control, which is part of Industry 4.0 Smart Factory. The Career and Professional Preparation 2 will be incorporated to equip students with skills necessary to seek and secure work. They will also be equipped to communicate their personal brand in a positive way. As students sharpen their communication skills, they will also learn how to market themselves effectively.

Strength of Materials
This module aims to provide students with the foundational knowledge of strength of materials with emphasis on applications and problem solving. It introduces to students the methods in the calculation of stresses and strains in various structural members such as beams, columns and shafts. Taking into account the material properties, students would then be able to apply the methods to predict the response of a structure under loading. Topics include simple stresses and strains, torsion in shaft, shear force and bending moment diagrams, stresses in beams, combined stresses and experimental stress analysis.

LEVEL 2.2

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

Integrated Real-world Project 4
This module aims to equip students with the knowledge of designing, building and testing devices for automation. Students will be introduced concepts on programming smart devices using controller, Internet of Things (IoT) and computer vision. Student will program a controller to interface with input/output devices for collection of sensor data and controlling of devices. They will perform tasks such as data logging and processing, monitoring and controlling of devices. Students will also perform basic analytics skills in preparing data for analysis. They will subsequently process the data and design rules/decision to control the devices. Students will also use video inputs from camera and computer vision technique to perform object detection.

This module will also imbue in students a sense of civic consciousness in the context of engineering and safety. The module will also imbue in students' a safety-oriented mindset and develop students' workplace safety and health (WSH) competencies and raise their safety awareness of self and their surroundings.

Microcontroller & System
This module equips students with knowledge and practical skills to design and build microcontroller-based applications. It covers the fundamental concepts of microcontrollers and the interfacing with external applications.

Network Fundamentals
This module covers the introduction to the architecture, structure, functions, components, and models of the Internet and other computer networks. The principles and structure of IP addressing and the fundamentals of Ethernet concepts, media, and operations are introduced to provide a foundation knowledge and skills for network infrastructure. Upon completion of the module, students will be able to build simple LANs, perform basic configurations for routers and switches, and implement IP addressing schemes.

Quality Systems & Analytics
This module prepares students to apply quality system management techniques and principles in their future workplace. Topics include Quality Systems and Audits, quality tools and techniques including the application of statistical software for process control, Gage Repeatability and Reproducibility, Hypothesis Testing, Design of Experiments, Statistical Process Control, and Mistake Proofing to optimise and improve products and processes. Process Capability Analysis, Lean Manufacturing for waste elimination and Six Sigma initiatives for defect reduction will also be discussed.

YEAR 2 COURSE CURRICULUM

Module Name	Credit Units
Level 2.1 (18 hours per week)	
Computer-Aided Design & Drafting	3
Engineering System Design	3
Industrial Automation	4
Integrated Real-world Project 3	4
Strength of Materials	4
Level 2.2 (20 hours per week)	
Applied Mechanics	4
Integrated Real-world Project 4	4
Microcontroller & System	3
Network Fundamentals	4
Quality Systems & Analytics	3
World Issues: A Singapore Perspective^	2

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YEAR 3 COURSE MODULES

LEVEL 3.1

Industrial Robot System & Application
This module introduces the integration and application of robot systems in the manufacturing industries. Fundamentals concepts in relationship to Industrial Robot Arms, such as robot configurations, robot coordinate system and transformation matrix is explored. Essential knowledge for robot implementations such as robot's perceptions, motion control and path planning concepts are reinforced through simulations under ROS (i.e. Robotic Operating System) environment. Students will also verify their robot implementations through practical sessions where simulation outcome is verified through actual physical robot systems.

Integrated Real-world Project 5
Autonomous vehicle and mobile robots are complex engineering system, which demand skillsets ranging from mechanical systems, electrical systems, software systems. This module provides hands-on experience to learner to acquire foundation know-how on developing an autonomous wheel-based robot for a real-world application. Learner will learn to use sensors, drives and software technologies that are commonly used in autonomous vehicle and robot. Learner will also gain knowledge on autonomous vehicle operations and safety regulatory requirements.

This module will also imbue in students a sense of civic consciousness in the context of engineering and sustainability. It will develop students' competencies in sustainable development, raise their awareness of sustainability in the context of society and the environment, and appreciate the impact engineering solutions may have on the environment.

Sensor & Drive Systems
This module covers the fundamental concepts and applications of Sensor Technologies and Drive Systems. Topics covered include the types and variations of smart sensors and actuators that are available in the industry. In addition, this module also focuses on practical knowledge required to select (sizing), implement (commissioning) and maintenance (tuning) of multi axis systems. Students will have the opportunity to explore the fundamental concepts of industrial hydraulic drives and circuits.

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

LEVEL 3.2

6-Month Internship (Local/Overseas)
The six-month internship provides students with the opportunity to apply the knowledge acquired in the classroom to work situations, and demonstrate problem solving, communication and interpersonal skills in a work environment. The programme enables students to hone their ability to work independently and in teams, while they take on one or more practical projects under the supervision of industry practitioners. The objective is to develop a professional approach to work based on the relevant code of practice.

Final Year Project
In this module, students will work in teams to design and develop a product or system related to the final year specialisation module. In the project, students learn to apply their knowledge and skills in creative problem solving, engineering and design, teamwork and project management. This module focuses on the identification of problem or need, research and design. Students are required to fabricate the prototype, assemble the parts, test and refine the prototype, and prepare the refined design and a project report. Students are also required to do a final presentation to a panel of examiners.

YEAR 3 COURSE CURRICULUM

Module Name	Credit Units
Level 3.1 (20 hours per week)	
Industrial Robot System & Application	4
Integrated Real-world Project 5	4
Project ID: Connecting the Dots^	4
Sensor & Drive Systems	4
Systems Modelling & Control	4
Level 3.2 (20 hours per week)	
6-Months internship (Local/Overseas) OR Final Year project	20

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