DIPLOMA IN AUTOMATION & MECHATRONIC SYSTEMS

A bionic arm, a self-driving car and an autopilot train system - these are some icons of the amazing world of automation technology that are brought about by integrating various fields of engineering. 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 fields ranging from aerospace, marine, industrial systems and healthcare to surgical and consumer product industries. You will learn to use automation and mechatronic technology to develop high-tech solutions for consumer products and industrial applications. What's more, AMS's strong emphasis on Design Thinking and Practice will give you an edge in creating innovative solutions for using clean energy, developing new materials and processes, and designing high-tech consumer and industrial products.

In the first two years, you will build a strong grounding in the various disciplines of engineering - electrical, electronics, mechanical and computer programming. You will also be equipped with applied design thinking skills.

In your third year, you will learn how to integrate automation systems and manage projects. You will also go on a six-month internship with companies such as ST Kinetics, PSA Singapore, Keppel Offshore & Marine and A*STAR. Or you can choose to work on a final-year project to design and develop a "smart" product prototype. Depending on your interest, you can choose to specialise in one of our three specialisation options: Industrial Systems, Aerospace Systems and Marine & Offshore Systems.

SPECIALISATION OPTIONS

Industrial Systems
You will develop skills and expertise in automation techniques, systems design and integration skills as well as problem-solving techniques used in the design and integration of industrial systems.

Aerospace Systems
You will learn how to apply knowledge in mechanics, structure propulsion and electronics to the design and development of aerospace systems and appreciate the use of automation systems in the aerospace industry.

Marine & Offshore Systems
You will be taught the fundamentals of marine engineering, propulsion, as well as ship and oil production to gain an understanding of the various systems used in ship production and offshore facilities.

COURSE MODULES

LEVEL 1.1 Common Curriculum for CEP and Non-CEP Pathways

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.

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 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.
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.

Programming

This practice-oriented module equips students with basic knowledge and skills in computer programming using C language. The main topics include basic computer programming concepts, fundamentals of C programming including branching, loops, and functions.

Integrated Real-world Project 1

This module aims to integrate the knowledge learnt in the semester and apply to a real-world project and further enhanced through relevant contextualization. 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 I

This module helps 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 three-year 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. The module aims to deepen students' commitment to the sector that the course prepares them for.

LEVEL 1.2 Mechanical Track

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.

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.

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.

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.

Engineering & Society

The module aims to imbue students with a sense of purpose as they pursue an engineering education and providing students with a moral compass in their journey as engineering professionals. The sense of purpose is encapsulated by the development and application of professional skills, within the engineering context, that would allow students to make a contribution to society. The module will develop students’ cultural quotient (CQ) capabilities and mould their mental disposition to understand and collaborate across diverse cultures. CQ is crucial in the engineering profession due to the proliferation of global connectivity and collaboration, which requires an engineer to empathise, relate, adapt and work effectively with people from diverse backgrounds and cultures. The module will also feature our signature pedagogies, namely, design thinking and service-learning, so that students will be sensitised to the challenges of working as engineers in new and unfamiliar settings.

COURSE CURRICULUM

YEAR 1 Level 1.1 (23 hours per week)

Career & Professional Preparation I 2
Mechanical Engineering Fundamentals 3
Electrical Engineering Fundamentals 3
Engineering Mathematics 1 4
Programming 4
Integrated Real-world Project 1 4
Innovation Made Possible ^ 3

Level 1.2 (27 hours per week)

Electrical & Electronics Technology 4
Engineering & Society 2
Materials & Manufacturing Technology 4
Thermofluids 4
Engineering Mathematics 2 4
Integrated Real-world Project 2 4
Sports & Wellness^ 2
Communication Essentials^ 3

Notes:

^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

IS Modules
The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students’ competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.
COURSE MODULES
LEVEL 2.1

Applied Thermofluids
Thermo-fluids is a module of science and engineering encompassing 2 intersecting fields namely Thermodynamics and Fluid mechanics. In relation to mechanical engineering, Thermodynamics is the science of converting energy involving heat to mechanical work and Fluid Mechanics is the study of physical forces in a system in the presence of fluid when at rest or in motion. Heat energy had to be transported by fluid in order to undergo various thermodynamic processes and becomes mechanical work eventually. The way fluid would flow ultimately dominates the entire thermal energy conversion process.

This module extends the coverage of Thermofluids in year 1, which further the basic concepts and principles of Thermodynamics and Fluid mechanics concepts. Behaviour of fluids under different conditions like static, dynamic and under the influence of heat will be covered in further details. The most important 2nd law of Thermodynamics will be introduced. Subsequently, Basic Engineering cycles developed from the 2nd law including Steam power cycles and Gas power cycles will be discussed. Students will also be taught on the methods of Engine performance testing.

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

Career & Professional Preparation II
This module helps 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.

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

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

Engineering Mathematics 3B
This module is a continuation of Engineering Mathematics 2. Topics include integration techniques and applications, first order differential equation, Laplace transform, probability and statistics.
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.

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

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

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

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

COURSE CURRICULUM
Curriculum structure is currently under review and changes are still pending.

YEAR 2
Level 2.1 (24 hours per week)

- Applied Thermofluids 5
- Automation in a Mechatronic World 3
- Career & Professional Preparation II 2
- Computer-Aided Design & Drafting 4
- Engineering Design Analysis 4
- Engineering Mathematics 3B 4
- Interdisciplinary Studies (IS) elective ^ 2
Level 2.2 (25 hours per week)

Applied Mechanics 5
Industrial Automation 5
Mechatronic Design Practice 3
Microcontroller & Interfacing 5
Strength of Materials 5
World Issues: A Singapore Perspective ^ 2

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## COURSE MODULES

### LEVEL 3.1 & 3.2

### Automation Systems Integration
This practical-based module aims to equip students with a working knowledge of advanced process control involving both digital Input/Output and analogue Input/Output, industrial standard PLC (Programmable Logic Controller) programming using IEC 6113 standard languages. Students will also be exposed to robot applications and programming using academic robots with programming environment.

Students will acquire PLC programming skills using Ladder Diagram, Structures Text (ST), and Sequential Function Chart (SFC) through practical sessions in programming on Modular Production System. Practical sessions in off-line (virtual) robot programming on DENSO VE206A robotic will enable students to understand the implementation of robot motion control for automated process.

### Emerging Mechatronic Technologies (Project Track Only)
This module comprises three areas of engineering: Micro Electromechanical Systems (MEMS), Introduction to Digital Image Processing and Applied Optics. The topics covered in MEMS provide an understanding of MEMS devices, their fabrication techniques and applications. Digital Image Processing provides techniques of image processing using software and GUI commands. Students will also learn about image manipulation, analysis and video tracking. Applied Optics will expose students to the basic optical theories, equipment and effect of different lighting systems.

### 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.

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

### Six-Month Internship
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.

### 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.
AEROSPACE SYSTEMS SPECIALISATION

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

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

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

MARINE & OFFSHORE SYSTEMS SPECIALISATION

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

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

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

INDUSTRIAL SYSTEMS SPECIALISATION

**Communication & Vision Systems**
The module focuses on 2 areas of engineering: Data Communication and Networking, specifically on Fieldbuses and Industrial Networks, and Computer Vision. The topics covered in Data Communication and Networking provide a basic understanding of both wired and wireless communication technologies based on the various network standards and models. Fieldbuses and Industrial Networks aims to expose students to the various industrial networks protocols used in process control and automation. Computer Vision provides basic knowledge of various image processing techniques.

**Industrial Drive Systems**
This module builds on modules taught in Level 1 and 2 to equip students with knowledge of both electrical and mechanical drive systems which are the core manipulating and actuating systems of all machines. This module focuses on practical knowledge required to select (sizing), implement (commissioning) and maintain the multi axis system. Topics cover introduction of multi axes system and the components with many variations and types that are available in the industry. Motors, motor drives, encoders, power supply, mechanical drives and brakes, motion controller and structures required to mount these motors are also taught.

**Unmanned Systems**
This module introduces the system architecture of unmanned systems. Students will gain practical insight into both hardware and software aspects in developing, integrating and operating unmanned systems. Topics of hardware components such as battery systems, navigation sensors, and detection systems along with software components such as operating system and motion planning will be covered. Students will also review case studies of unmanned systems operating across land, sea and sky.

**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 their knowledge/skills in their main discipline of study, or to equip them with additional professional knowledge that would better prepare them for further study or increase their employability. Students can select elective modules from a wide range of clusters to obtain their Diploma Plus Certificate. DPP is optional and it will not affect the graduating requirement for the award of a diploma.

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

**Engineering clusters**
- Applied physics#
- Aviation fundamentals
- Workplace Safety & Health

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

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

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

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

**COURSE CURRICULUM**

Curriculum structure is currently under review and changes are still pending.

**YEAR 3**

**INTERNSHIP**

Level 3.1 (28 hours per week)
<table>
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<tr>
<th>Course/Module</th>
<th>Level</th>
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<tbody>
<tr>
<td>Automation Systems Integration</td>
<td>4</td>
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<tr>
<td>Project Management</td>
<td>3</td>
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<tr>
<td>Systems Modelling &amp; Control</td>
<td>5</td>
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<tr>
<td>Project ID - Connecting the Dots</td>
<td>4</td>
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<td><strong>AEROSPACE SYSTEMS SPECIALISATION</strong></td>
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**Level 3.2 (22 hours per week)**

- 6-Month Internship                                      | 22    |

**NON-INTERNSHIP**

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Level 3.2 (22 hours per week)
Emerging Mechatronic Technologies  5
Final-year Project  17

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