

4 Specialisations in ESP

Nanoscience and Technology (NANO)

Understanding, design, fabrication and testing of structures and materials at the nanometer scale. Students learn how controlling shape and size at the nanometer scale enables the design of smaller, lighter, faster and better performing materials, components and systems.

Career Opportunities:

Graduate & research studies; Nanostructured materials engineering; Nano-electronics manufacturing & Designs

Companies that may hire NANO graduates include:

MICRON, Applied Materials, KLA Tencor, Global Foundries, SIMTech, IMRE, Merck, ExxonMobil, BP, and many more...

Computational Engineering Science (CES)

Using mathematics, physics and mechanics to understand nature and build computational models to solve scientific and engineering problems. Models may be created in computers (virtual models), that enables the design of engineering systems to perform a function. Such virtual models guide the design and creation of engineering products like automobiles, airplanes, energy systems, etc. Virtual models may also be used for applications in biomedicine, like surgical planning and to develop techniques for drug delivery.

Career Opportunities:

Graduate & research studies; Computational engineered simulations and modelling to aid investigations and designs of energy, biomedical, photonics, mechanical, structural applications; R&D in electronics industries, Software Engineer, IT Analyst

Companies that may hire CES graduates include:

Sembawang Shipyard, Jurong Consultants, ST Kinetics, NING Research, Worley Parsons, DSO, Halliburton, Schlumberger, DNV GL, Lloyd's Register, Any consulting company that provides simulation/modelling services, Financial institutions, Aircraft and Automotive manufacturers, Software companies and many more...

Photonics and Optics (PO)

(offered only to students from cohort 2016 and earlier)

Focuses on how light and electromagnetic radiation can be used in various cutting-edge areas of research including advanced imaging, photonic devices, optical communication and optical materials.

Career Opportunities:

Graduate & research studies; Imaging industries; Manufacturing; Defence; Security; Electronics

Companies that may hire PO graduates include:

KLA Tencor, Nikon, Leica, Zeiss, Olympus; MICRON, Applied Materials; Research Institutes, A*STAR IMRE, DSI, IME, IMCB, IBN, DSO and many more...

Energy Science and Technology (EST)

Provides an understanding of production and conversion of various forms of energy. It addresses non-renewable as well as renewable energy sources. Students learn to tackle some of the most pressing problems we face today in terms of energy generation, storage and management, while gaining an understanding of energy issues from a public policy perspective.

Career Opportunities:

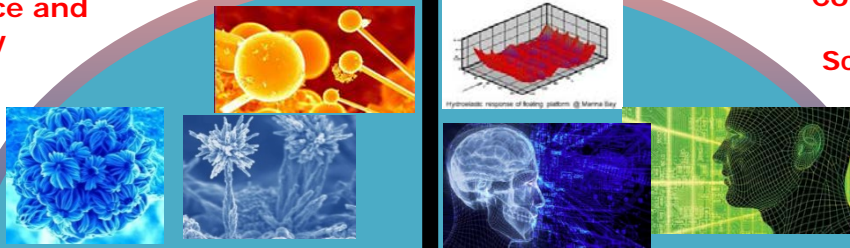
Graduate & research studies; Energy harvesting; Solar and clean energy industries; Energy storage; Lithium battery related industries; Building and industrial energy systems optimization; Electric vehicles and Micro-grid related applications

Companies that may hire ES graduates include:

Siemens, REC, ABB, SIA Engineering, Phoenix Solar, Jurong Consultants, LJ Energy, Schneider Electric, SERIS, Halliburton, Schlumberger, Shell, Vestas, Sembawang, Keppel Seghers and many more ...

At the end of Year 2, students will opt for one (or even two) of the four specialisations:

**Nanoscience and
Technology
(NANO)**



**Computational
Engineering
Science (CES)**

4 Specialisations in ESP

Photonics and Optics (PO)

**Energy Science and
Technology (EST)**

Modules for Specialisations

Cohort matriculated before AY2014/15

- Students are required to complete a total of 10 modules, i.e.
 - 5 mandatory Core modules of each specialisation,
 - 2 Technical electives chosen from modules within the same specialisation
 - 3 modules can either be from core modules or technical electives of all ESP specialisations.

Cohort matriculated AY2014/15 and later

- Students are required to complete a total of 6 modules specific to each specialisation, i.e.
 - 4 mandatory Core modules of each specialisation and
 - 2 Technical electives chosen from within the same specialisation.

Note: Students who wish to read two specialisations may use the Unrestricted Elective Modules for the second specialisation. No module can be double-counted for more than one specialisation. This means to say, students wishing to complete 2 specialisations needs to read a minimum total of 12 modules (6 for each specialisation).

Nanoscience and Technology

Core modules:

Core modules	
ESP3102	From Making Nano to Probing Nano
CM3296	Molecular Modelling: Theory and Practice
PC3251	Nanophysics
PC4259	Surface Physics
CM3251	Nanochemistry (<i>module will cease as a core module from Cohort AY2014/15</i>)

Technical electives: Choose 2 elective modules

Elective modules	
BN5101	Biomedical Engineering Systems (Formerly known as Engineering Principles in Medicine I)
BN5205	Computational Biomechanics
CM3231	Quantum Chemistry and Molecular Thermodynamics
CM3232	Physical Chemistry of the Solid State and Interfaces
CM3251	Nanochemistry
CM5223	Topics in Supramolecular Chemistry
EE3407	Analog Electronics
EE3408C	Integrated Analog Design
EE4401	Optoelectronics
EE4433	Nanometer Scale Information Storage
EE4437	Photonics – Principles and Applications (<i>add to list from AY2016/17</i>)
ESP4206	Continuum Mechanics (<i>ESP4206 replaces ESP3206 w.e.f AY2015/16 Sem 1</i>)
ESP4302	Nanophotonics (<i>module is no longer offered from AY2016/17</i>)
ME4284	Micro Sensors and Micro Actuators (<i>module will cease from AY2015/16 onwards</i>)
PC3233	Atomic & Molecular Physics I
PC3235	Solid State Physics 1
PC3236	Computational Methods in Physics
PC3241	Solid State Devices
PC3274	Mathematical Methods in Physics II
PC4240	Solid State Physics 2
PC4253	Thin Film Technology
PC4274	Mathematical Methods in Physics III
PC5205	Topics in Surface Physics
PC5212	Physics of Nanostructures

Computational Engineering Science

Core modules:

Core modules	
ESP4206	Continuum Mechanics (<i>ESP4206 replaces ESP3206 w.e.f AY2015/16 Sem 1</i>)
MA3227	Numerical Analysis II
PC3274	Mathematical Methods in Physics II
ME4291	Finite Element Analysis
IE2110 / MA3236	Operations Research I / Non-Linear Programming (<i>module will cease as a core module from Cohort AY2014/15</i>)

Technical electives: Choose 2 elective modules

Elective modules	
BN5101	Biomedical Engineering Systems (Formerly known as Engineering Principles in Medicine I)
BN5205	Computational Biomechanics
CE4258	Structural Stability & Dynamics
CG3207	Computer Architecture (<i>add to list from AY2015/16 Sem 2</i>)
CM3296	Molecular Modelling: Theory & Practice
CN3421	Process Modelling & Numerical Simulation
CS3216	Software Development on Evolving Platforms (<i>add to list from AY2015/16 Sem 2</i>)
EE2023	Signals and Systems (<i>add to list from AY2015/16 Sem 2</i>)
EE2024	Programming for Computer Interfaces (<i>add to list from AY2015/16 Sem 2</i>)
EE3204	Computer Communications Networks I (<i>add to list from AY2015/16 Sem 2</i>)
EE3407	Analog Electronics
IE2110 / MA3236	Operations Research I / Non-Linear Programming
MA2108	Mathematical Analysis I
MA3220	Ordinary Differential Equations
MA3229	Introduction to Geometric Modelling
MA4230	Matrix Computation
MA4255	Numerical Partial Differential Equations
MA5233	Computational Mathematics
ME4211	Applied Mechanics
ME4233	Computational Methods in Fluid Mechanics
MLE5210	Modelling and Simulation of Materials <i>*Will only be offered in future</i>
PC3236	Computational Methods in Physics
PC4274	Mathematical Methods in Physics III

Photonics and Optics (offered only to students from cohort 2016 and earlier)

Core modules:

Core modules	
EE2023	Signals and Systems
PC3247	Modern Optics
ESP4302	Nanophotonics (<i>module is no longer offered from AY2016/17</i>)
EE4437	Photonics – Principles and Applications (<i>module replaces ESP4302 as a core from AY2016/17</i>)
EE4603	Biomedical Imaging Systems
BN4406	Biophotonics and Bioimaging (<i>module will cease as a core module from Cohort AY2014/15</i>)

Technical electives: Choose 2 elective modules

Elective modules	
BN4406	Biophotonics and Bioimaging
BN5101	Biomedical Engineering Systems (Formerly known as Engineering Principles in Medicine I)
BN5205	Computational Biomechanics
CS3216	Software Development on Evolving Platforms
EE3206	Introduction to Computer Vision and Image Processing
EE3407	Analog Electronics
EE4212	Computer Vision
EE4213	Image Processing
EE4305	Introduction to Fuzzy/Neural Systems
EE4401	Optoelectronics
EE4604	Biological Perception in Digital Media
EE4605	Bio-Instrumentation & Signal Analysis
ESP4206	Continuum Mechanics (<i>ESP4206 replaces ESP3206 w.e.f AY2015/16 Sem 1</i>)
ESP4301	Charged Particle Optics <i>*Will only be offered in future</i>
PC3243	Photonics
PC3274	Mathematical Methods in Physics II
PC4274	Mathematical Methods in Physics III

Energy Science and Technology

Core modules:

Core modules	
ESP3401	Photovoltaic Devices & Systems
ME3221	Energy Conversion Processes
EE2022	Electrical Energy Systems (<i>module will cease from AY2015/16 onwards</i>)
EE3505C	Electrical Energy Systems (<i>module replaces EE2022 from AY2015/16 onwards</i>)
ESP4402	Transport Phenomena in Energy Systems
ME3122	Heat Transfer (<i>module will cease as a core module from Cohort AY2014/15</i>)

Technical electives: Choose 2 elective modules

Elective modules	
BN5101	Biomedical Engineering Systems (Formerly known as Engineering Principles in Medicine I) (<i>to be removed from AY2014/15 Sem 2</i>)
BN5205	Computational Biomechanics (<i>to be removed from AY2014/15 Sem 2</i>)
CG3207	Computer Architecture (<i>add to list from AY2015/16 Sem 2</i>)
CN3124	Fluid-Solid Systems (Formerly known as Particle Technology)
CM3232	Physical Chemistry of the Solid State and Interfaces
CS3216	Software Development on Evolving Platforms (<i>add to list from AY2015/16 Sem 2</i>)
EE2023	Signals and Systems (<i>add to list from AY2015/16 Sem 2</i>)
EE2024	Programming for Computer Interfaces (<i>add to list from AY2015/16 Sem 2</i>)
EE2025	Power Electronics (<i>Offered from AY2015/16 onwards</i>)
EE3204	Computer Communications Networks I (<i>add to list from AY2015/16 Sem 2</i>)
EE3407	Analog Electronics
EE3501C	Power Electronics (<i>module will cease from AY2015/16 onwards</i>)
EE4501	Power System Management and Protection
EE4502	Electric Drives & Control
EE4510	Solar Photovoltaic Energy Systems
EE4511	Sustainable Energy Systems
ESP4206	Continuum Mechanics (<i>ESP4206 replaces ESP3206 w.e.f AY2015/16 Sem 1</i>)
ESP4401	Optimization of Energy System (<i>new module : to be offered w.e.f AY2015/2016 Sem 1</i>)
ESP5402	Nanomaterials for Energy Systems <i>*Will only be offered in future</i>
ME3122	Heat Transfer
ME4223	Thermal Environmental Engineering
ME4225	Industrial Heat Transfer
ME4226	Energy and Thermal Systems Analysis (<i>add to list from AY2014/15 Sem 2</i>)
ME4227	Internal Combustion Engines (<i>add to list from AY2014/15 Sem 2</i>)
ME4284	Micro Sensors and Micro Actuators (<i>module will cease from AY2015/16 onwards</i>)
ME5207	Solar Energy Systems
ME5516	Emerging Energy Conversion and Storage Technologies (<i>add to list from AY2014/15 Sem 2</i>)
PC3241	Solid State Devices
PC3274	Mathematical Methods in Physics II
PC4253	Thin Film Technology
PC4274	Mathematical Methods in Physics III