

The Materials Science and Engineering (MSE) programme is built on the solid foundation of the basic sciences (in the first year) in which Physics is one of the main components. Students from the MSE programme will thus benefit from this double degree programme by being able to delve deeper and broader into the Physics disciplines. Similarly, students with Physics background will benefit immensely from the Engineering applications, design and technological components the MSE programme has to offer (see Tables 1 and 2). A unique feature of this double degree programme is the integrated BEng/BSc (Hons) dissertation/Honours project where students will be jointly supervised by both MSE and Physics staff members and the areas of research will be at the interface of these two disciplines.

The programme structure will allow students to acquire knowledge through understanding the interface between the two major leading fields. Graduates will acquire a comprehensive knowledge of Physics and a thorough insight into the current Engineering practices of new technologies.

The double degree programme will accept students either through the Faculty of Science (Physics track) or the Faculty of Engineering (MSE track).

Science or Engineering students are encouraged to apply for pre-admission into the programme at the beginning of the first semester of Year One in their respective faculties. Selected pre-admitted students are advised to follow the suggested study plan provided (see Tables 3 and 4). They will be confirmed into the double degree programme after satisfactory performance in their first year.

The double degree programme will admit additional suitable students at the beginning of their second year from the Faculties of Science (Physics track) or Engineering (MSE and Common Engineering).

To be awarded a BEng in Materials Science and Engineering and BSc in Physics, a student must have:

- Completed a minimum of 180 MCs with a common CAP ≥ 2.00 ; and
- Passed the modules in accordance with Table 1

To be awarded a BEng in Materials Science and Engineering and BSc (Hons) in Physics, a student must have:

- Completed a minimum of 200 MCs with a common CAP ≥ 3.20 ; and
- Passed the modules in accordance with Table 2

Note:

Students who have not achieved a common CAP of 3.75 for any two consecutive semesters will be required to withdraw from the double degree programme.

Table 1: Summary of Requirements for BEng in MSE and BSc in Physics

Modular Requirements		MCs
University Requirements		20
General Education Modules (GE) (5 Modules, each of 4MCs) <ul style="list-style-type: none">Human Cultures (HC)Quantitative Reasoning (QR)Thinking and Expression (T&E)Singapore Studies (SS)Asking Questions (AQ)		20
ES1103 English for Academic Purposes ^[b]		—
Faculty Requirements (BEng)		11
ES1531 Critical Thinking & Writing ^[a]		4
ES2331 Communicating Engineering		4
EG2401 Engineering Professionalism		3
Faculty Requirements (BSc)		8
MA1101R Linear Algebra I ^[c]		4
CS1010E Programming Methodology ^[d]		4
Major Requirements		
Level-1000 Essential Modules (BEng)		16
CM1501 Organic Chemistry For Engineers		4
MA1102R Calculus ^[f]		4
MLE1111 Foundations of Materials Science & Engineering I		4
MLE1112 Foundations of Materials Science & Engineering II		4
Level-1000 Essential Modules (BSc) ^[e]		16
PC1141 Introduction to Classical Mechanics		4
PC1142 Introduction to Thermodynamics and Optics		4
PC1143 Introduction to Electricity & Magnetism		4
PC1144 Introduction to Modern Physics		4
Level-2000 Essential Modules (BEng)		20
MLE2101 Introduction to Structure of Materials		4
MLE2102 Thermodynamics and Phase Diagrams		3
MLE2103 Phase Transformation and Kinetics		3
MLE2104 Mechanical Properties of Materials		4
MLE2105 Electronic Properties of Materials		3
MLE2111 Materials Properties Laboratory		3
Level-2000 Essential Modules (BSc)		24
PC2130 Quantum Mechanics I		4
PC2131 Electricity and Magnetism I		4

Modular Requirements		MCs
PC2132	Classical Mechanics	4
PC2134	Mathematical Methods in Physics 2	4
PC2230	Thermodynamics and Statistical Mechanics	4
PC2193	Experimental Physics I	4
Level-3000 Essential Modules (BEng)		11
MLE3101	Materials Characterization Laboratory	4
MLE3111	Materials Processing Laboratory	3
MLE3103	Materials Design and Selection	4
Level-3000 Essential Modules (BSc)		8
PC3130	Quantum Mechanics II	4
PC3193	Experimental Physics II	4
Level-2000/3000 Elective Modules (BEng) ^[g]		12-16
MLE2106	Metallic Materials and Processing	
MLE2107	Ceramic Materials and Processing	
MLE3102	Degradation and Failure of Materials	
MLE3104	Polymeric and Composite Materials	
MLE3105	Dielectric and Magnetic Materials	
MLE3202	Materials for Biointerfaces	
Level-3000 Elective Modules (BSc)		8
Choose any <u>TWO</u> modules from the following: (All modules are worth 4 MCs unless otherwise stated)		
PC3231	Electricity and Magnetism II	
PC3232	Nuclear and Particle Physics	
PC3233	Atomic and Molecular Physics I	
PC3235	Solid State Physics I	
PC3236	Computational Methods in Physics	
PC3238	Fluid Dynamics	
PC3241	Solid State Devices	

Modular Requirements		MCs
PC3242	Physics of Semiconductor Processing	
PC3243	Photonics	
PC3246	Astrophysics I	
PC3247	Modern Optics	
PC3251	Nanophysics	
PC3267	Biophysics II	
PC3274	Mathematical Methods in Physics II	
PC3239	Special Problems in Undergraduate Physics II	
PC3288	UROPS in Physics I	
PC3289	Advanced UROPS in Physics II	
Level-4000 Essential Modules (BEng)		16
MLE4101	BEng Dissertation (over two semesters)	12
MLE4102	Design Project	4
Level-4000 Elective Modules (BEng) ^[h]		12-16
<p>Complete at least 12-16 MCs (of which at least two modules must be MLE4xxx) from the following group of electives:</p> <p>(All modules are worth 4 MCs unless otherwise stated)</p> <p><u>Polymeric and Biomedical Materials</u></p> <p>(four modules from this group are required for the specialisation, together with BEng specialised Dissertation)</p> <p>MLE4201 Advanced Materials Characterisation</p> <p>MLE4202 Selected advanced Topics on Polymers</p> <p>MLE4203 Polymeric Biomedical Materials</p> <p>ME4253 Biomaterials Engineering</p> <p>BN3301 Introduction to Biomaterials</p>		

Modular Requirements		MCs
BN4109	Special topics in Bioengineering	
BN4301	Principles of Tissue Engineering	
CM4266	Current Topics in Materials Chemistry	
PC4268	Biophysical Instrumentation and Biomolecular Electronics	
<u>Nanostructured Materials & Nanotechnology</u>		
(four modules from this group are required for the specialisation, together with BEng specialised Dissertation)		
MLE4201	Advanced Materials Characterisation	
MLE4204	Synthesis and Growth of Nanostructures	
MLE4205	Theory & Modelling of Material Properties	
MLE4206	Current topics on Nanomaterials	
MLE4208	Photovoltaic Materials	
MLE4210	Material for Energy Storage and Conversion	
PC4253	Thin film Technology	
CN4223R	Microelectronic Thin Films (3 MCs)	
<u>Other Elective Modules</u>		
MLE4207	Growth Aspects of Semiconductors or EE4436 Semiconductor Process Technology	
MLE4209	Magnetism and Magnetic Materials	
EE4437	Photonics – Principles and Applications	
CN4217R	Processing of Microelectronic Materials (3 MCs)	
CN4203R	Polymer Engineering	
CN5251	Membrane Science and Technology	
ME4283	Micro-fabrication Process	
ME4293	Microelectronics Packaging	

Modular Requirements	MCs
Total	186

[a] BEng students are required to read a Critical Thinking & Writing module (ES1531 Critical Thinking & Writing) and a Communications module (ES2331 Communicating Engineering). Alternatively, students can read ES1501X Academic Expository Writing in place of both ES1531 and ES2331. USP/UTRP/RVRC students should refer to their respective programmes for USP/UTRP/RVRC modules to be read in place of ES1531 and/or ES2331.

[b] Students who score a Band 1 or Band 2 in Qualifying English Test (QET) have to read ES1103 and will be awarded with 4 MCs upon successful completion of the module.

[c] Modules are part of essential Level-1000 BEng Mathematics/ Science requirements.

[d] Modules are part BEng faculty requirements.

[e] All PC modules are read in replacement of essential Level-1000 BEng Mathematics/Science requirements of PC1431 and PC1432 (PC1431 overlaps with PC1141 and PC1142; PC1432 overlaps with PC1143 and PC1144).

[f] Modules are part of essential Level-1000 B.Sc. requirements.

[g] + [h] Students must read 28 MC from the basket of electives from BEng Level 2000/3000 and 4000 electives requirements.

Table 2: Summary of Requirements for BEng in MSE and BSc (Hons) in Physics

Modular Requirements	MCs
University Requirements	20
General Education Modules (GE) (5 Modules, each of 4MCs) <ul style="list-style-type: none"> Human Cultures (HC) Quantitative Reasoning (QR) Thinking and Expression (T&E) Singapore Studies (SS) Asking Questions (AQ) 	20
ES1103 English for Academic Purposes ^[b]	—
Faculty Requirements (BEng)	11
ES1531 Critical Thinking & Writing ^[a]	4
ES2331 Communicating Engineering	4
EG2401 Engineering Professionalism	3
Faculty Requirements (BSc)	12
CM1121 Basic Organic Chemistry <u>OR</u> CM1501 Organic Chemistry For Engineers ^[c]	4
MA1101R Linear Algebra I	4
CS1010E Programming Methodology ^[d]	4
Major Requirements	
Level-1000 Essential Modules (BEng)	12
MA1102R Calculus ^[f]	4

Modular Requirements		MCs
MLE1111	Foundations of Materials Science & Engineering I	4
MLE1112	Foundations of Materials Science & Engineering II	4
Level-1000 Essential Modules (BSc) ^[e]		16
PC1141	Introduction to Classical Mechanics	4
PC1142	Introduction to Thermodynamics and Optics	4
PC1143	Introduction to Electricity & Magnetism	4
PC1144	Introduction to Modern Physics	4
Level-2000 Essential Modules (BEng)		20
MLE2101	Introduction to Structure of Materials	4
MLE2102	Thermodynamics and Phase Diagrams	3
MLE2103	Phase Transformation and Kinetics	3
MLE2104	Mechanical Properties of Materials	4
MLE2105	Electronic Properties of Materials	3
MLE2111	Materials Properties Laboratory	3
Level-2000 Essential Modules (BSc)		24
PC2130	Quantum Mechanics I	4
PC2131	Electricity and Magnetism I	4
PC2132	Classical Mechanics	4
PC2134	Mathematical Methods in Physics 2	4
PC2230	Thermodynamics and Statistical Mechanics	4
PC2193	Experimental Physics I	4
Level-3000 Essential Modules (BEng)		11
MLE3103	Materials Design and Selection	4
MLE3101	Materials Characterization Laboratory	4
MLE3111	Materials Processing Laboratory	3
Level-3000 Essential Modules (BSc)		8
PC3130	Quantum Mechanics II	4
PC3193	Experimental Physics II	4
Level-2000/3000 Elective Modules (BEng) ^[h]		12-16
MLE2106	Metallic Materials and Processing	
MLE2107	Ceramic Materials and Processing	
MLE3102	Degradation and Failure of Materials	
MLE3104	Polymeric and Composite Materials	
MLE3105	Dielectric and Magnetic Materials	

Modular Requirements		MCs
MLE3202 Materials for Biointerfaces		
Level-3000 Elective Modules (BSc)		8
Choose any <u>TWO</u> modules from the following:		
(All modules are worth 4 MCs unless otherwise stated)		
PC3231	Electricity and Magnetism II	
PC3232	Nuclear and Particle Physics	
PC3233	Atomic and Molecular Physics I	
PC3235	Solid State Physics I	
PC3236	Computational Methods in Physics	
PC3238	Fluid Dynamics	
PC3241	Solid State Devices	
PC3242	Physics of Semiconductor Processing	
PC3243	Photonics	
PC3246	Astrophysics I	
PC3247	Modern Optics	
PC3251	Nanophysics	
PC3267	Biophysics II	
PC3274	Mathematical Methods in Physics II	
PC3239	Special Problems in Undergraduate Physics II	
PC3288	UROPS in Physics I	
PC3289	Advanced UROPS in Physics II	
Level-4000 Essential Modules (BEng)		20
MLE4102 Design Project		4
Level-4000 Essential (BSc)		
None		
Level-4000 Essential (Dissertation)		
MLE4101R Integrated BEng/BSc (Hons) Dissertation (over two semesters) OR		16

Modular Requirements		MCs
PC4199R	Integrated BEng/BSc (Hons) Dissertation (over two semesters)	
Level-4000 Elective Modules (BEng) ^[i]		12-16
<p>Complete at least 12-16 MCs (of which at least two modules must be MLE4xxx) from the following group of electives: (All modules are worth 4 MCs unless otherwise stated) <u>Polymeric and Biomedical Materials</u> (four modules from this group are required for the specialisation, together with BEng specialised Dissertation)</p>		
MLE4201	Advanced Materials Characterisation	
MLE4202	Selected advanced Topics on Polymers	
MLE4203	Polymeric Biomedical Materials	
ME4253	Biomaterials Engineering	
BN3301	Introduction to Biomaterials	
BN4109	Special topics in Bioengineering	
BN4301	Principles of Tissue Engineering	
CM4266	Current Topics in Materials Chemistry	
PC4268	Biophysical Instrumentation and Biomolecular Electronics	
<u>Nanostructured Materials & Nanotechnology</u> (four modules from this group are required for the specialisation, together with BEng specialised Dissertation)		
MLE4201	Advanced Materials Characterisation	
MLE4204	Synthesis and Growth of Nanostructures	
MLE4205	Theory & Modelling of Material Properties	
MLE4206	Current topics on Nanomaterials	
MLE4208	Photovoltaic Materials	
MLE4210	Materials for Energy Storage and Conversion	
PC4253	Thin film Technology	
CN4223R	Microelectronic Thin Films (3 MCs)	
<u>Other Elective Modules</u>		

Modular Requirements		MCs
MLE4207	Growth Aspects of Semiconductors or EE4436 Semiconductor Process Technology	
MLE4209	Magnetism and Magnetic Materials	
EE4437	Photonics – Principles and Applications	
CN4217R	Processing of Microelectronic Materials (3 MCs)	
CN4203R	Polymer Engineering	
CN5251	Membrane Science and Technology	
ME4283	Micro-fabrication Process	
ME4293	Microelectronics Packaging	
Level-4000 Elective Modules (BSc)		20
Choose any <u>FIVE</u> modules from the following (All modules are worth 4 MCs unless otherwise stated)		
PC4230	Quantum Mechanics III	
PC4232	Cosmology	
PC4240	Solid State Physics II	
PC4241	Statistical Mechanics	
PC4242	Electrodynamics	
PC4243	Atomic and Molecular Physics II	
PC4245	Particle Physics	
PC4246	Quantum Optics	
PC4248	General Relativity	
PC4249	Astrophysics II	
PC4253	Thin Film Technology	
PC4259	Surface Physics	
PC4262	Remote Sensing	
PC4267	Biophysics III	
PC4268	Biophysical Instrumentation and Biomolecular Electronics	
PC4274	Mathematical Methods in Physics III	
EE4437	Photonics – Principles and Applications	
EE4413	Low-dimensional Electronic Devices	
MLE4201	Advanced Materials Characterisation[g]	
MLE4204	Synthesis and Growth of Nanostructures[g]	
MLE4205	Theory and Modelling of Materials Properties[g]	
Any approved module offered by other Departments		
Total		210

- [a] BEng students are required to read a Critical Thinking & Writing module (ES1531 Critical Thinking & Writing) and a Communications module (ES2331 Communicating Engineering). Alternatively, students can read ES1501X Academic Expository Writing in place of both ES1531 and ES2331. USP/UTRP/RVRC students should refer to their respective programmes for USP/UTRP/RVRC modules to be read in place of ES1531 and/or ES2331.
- [b] Students who score a Band 1 or Band 2 in Qualifying English Test (QET) have to read ES1103 and will be awarded with 4 MCs upon successful completion of the module.
- [c] Modules are part of essential Level-1000 BEng Mathematics/ Science requirements.
- [d] Modules are part BEng faculty requirements.
- [e] All PC modules are read in replacement of essential Level-1000 BEng Mathematics/Science requirements of PC1431 and PC1432 (PC1431 overlaps with PC1141 and PC1142; PC1432 overlaps with PC1143 and PC1144).
- [f] Modules are part of essential Level-1000 BSc requirements.
- [g] These elective modules are only offered to students reading a double degree in Materials Science & Engineering and in Physics. Only two of them may be counted towards the Physics Level 4000 Elective requirements.
- [h] + [i] Students must read 28 MC from the basket of electives from B.Eng. Level 2000/3000 and 4000 electives requirements.