

## Materials Science and Engineering

### Course List

<i>Code</i>	<i>Course Title</i>	<i>Unit</i>
MSE 0211	Case Study in Materials Science Problems I	1
MSE 0222	Case Study in Materials Science Problems II	1
MSE 2001	Engineering Physics I	4
MSE 2002	Engineering Physics II	4
MSE 2003	Quantitative Methods for Materials Science I	3
MSE 2004	Quantitative Methods for Materials Science II	3
MSE 2011	Introduction to Materials Science and Engineering	4
MSE 2112	Thermodynamics of Materials	4
MSE 2822	Metallography and Thermal Properties Laboratory	1
MSE 3011	Kinetics in Materials Processes	4
MSE 3111	Mechanical Properties of Materials	3
MSE 3212	Electrical Properties of Materials	3
MSE 3811	Kinetics Laboratory	1
MSE 3821	Mechanical Properties Laboratory	1
MSE 4010	Techniques in Materials Characterization	3
MSE 4210	Electronic Packaging	3
MSE 4220	Electrochemistry and Its Industrial Applications	3
MSE 4430	Ceramics and Their Industrial Applications	3
MSE 4440	Polymers and Their Industrial Applications	3
MSE 4450	Introduction to Nanotechnology	3
MSE 4510, 4520, 4530, 4540, 4550	Selected Topics in Materials Science and Engineering	3 each
MSE 4610/4620	Materials Science and Engineering Project I/II	3/3
MSE 4811	Microstructural Analysis Laboratory	1
MSE 4831	Ceramics Laboratory	1
MSE 4841	Polymers Laboratory	1
MSE 5010	Topics in Advanced Materials Research I (Nanotechnology)	3
MSE 5040	Topics in Advanced Materials Research IV (Transmission Electron Microscopy)	3
MSE 5060	Structure and Properties of Materials	3
MSE 5070	Deformation of Materials	3
MSE 5080	Surface Science	3

### Course Description

MSE 0211  
Case Study in Materials Science Problems I  
1 U; 1 STOT; 1st term  
Tutorial problems primarily related to materials science and engineering and MSE 2001.

MSE 0222  
Case Study in Materials Science Problems II  
1 U; 1 STOT; 2nd term  
Tutorial problems primarily related to materials science and engineering and MSE 2002.

MSE 2001

Engineering Physics I

4 U; 4 Lect. 1 Tut.; 1st term

Particle kinematics and dynamics. Systems of particles and collisions. Oscillations. Temperature. Kinetic theory and ideal gas. Statistical mechanics. First law of thermodynamics. Second law of thermodynamics. Combined first and second laws.

MSE 2002

Engineering Physics II

4 U; 4 Lect. 1 Tut.; 2nd term

Electrostatics and magnetostatics in free space. Conductors. Electric current and DC circuits. Electromagnetic induction and AC circuits. Maxwell's equations (integral and differential forms). Nature of light. Reflection and refraction at plane interfaces. Interferences. Diffraction. Gratings and spectra.

MSE 2003

Quantitative Methods for Materials Science I

3 U; 3 Lect. 1 Tut.; 1st term

This course is designed to introduce students the quantitative methods in solving materials science problems. Topics to be covered include to develop the basic analytical skills in solving the physical problems in solid, liquid and gas and to outline the applications in heat transfer, diffusion as well as thermodynamics of materials. (Not for students who have taken MAT 2360 or 2370 or PHY 2004.)

MSE 2004

Quantitative Methods for Materials Science II

3 U; 3 Lect. 1 Tut.; 2nd term

This course is designed to introduce students the quantitative methods in solving materials science problems. Topics to be covered include the basic analytical skills in solving the problems in mechanical properties of materials and crystallography. In addition, applications in materials transport will be covered. (Not for students who have taken MAT 2370 or PHY 2004 or 2601.)

MSE 2011

Introduction to Materials Science and Engineering

4 U; 3 Lect. 3 Lab. 1 Tut.; 1st term

Introduction to the properties, synthesis and processing, and industrial applications of common engineering materials including metals, alloys, semiconductors, ceramics, polymers and composites. Design considerations in selecting a material, its chemical composition and microstructure for satisfying a certain set of engineering specifications. Concepts of product reliability and profitability.

MSE 2112

Thermodynamics of Materials

4 U; 4 Lect. 1 Tut.; 2nd term

The structure of thermodynamics; the laws of thermodynamics; thermodynamic functions, Maxwell relations and applications; equilibrium in thermodynamic systems; thermodynamics of unary systems, Clausius-Clapeyron equation; thermodynamics of multicomponent systems, properties of mixtures, solution models; phase diagrams. Students are advised to take MSE 2001 or its equivalent before taking this course.

MSE 2822

Metallography and Thermal Properties Laboratory

1 U; 3 Lab.; 2nd term

Microstructural studies of materials by optical microscopy, specimen preparation, calorimetry. Students taking this course are recommended to take MSE 2112 concurrently.

MSE 3011

Kinetics in Materials Processes

4 U; 4 Lect. 1 Tut.; 1st term

Basic rate theory, atom movements, theory of interface, kinetics of phase changes, and design in materials synthesis and processing. Students are advised to take MSE 2112 or its equivalent before taking this course.

MSE 3111

Mechanical Properties of Materials

3 U; 3 Lect. 1 Tut.; 2nd term

Phenomenology and theory of the mechanisms by which solids can deform. Design and application. Students are advised to take MSE 2112 or its equivalent before taking this course.

MSE 3212

Electrical Properties of Materials

3 U; 3 Lect. 1 Tut.; 2nd term

Wave nature of electrons. Electron in a square well. Single electron atom model and periodic table. Bonds. Motions of free electron gas. Free electron model of metals. Band Structure of solids. Semiconductors. Semiconductor devices. Dielectric materials. (Not for students who have taken ELE 2510.)

MSE 3811

Kinetics Laboratory

1 U; 3 Lab.; 1st term

Laboratory experiments to illustrate the principles taught in the course MSE 3011. Students are advised to take MSE 2112 or its equivalent before taking this course and also recommended to take MSE 3011 concurrently.

MSE 3821

Mechanical Properties Laboratory

1 U; 3 Lab.; 2nd term

Laboratory experiments to illustrate the principles taught in the course MSE 3111. Students taking this course are recommended to take MSE 3111 concurrently.

MSE 4010

Techniques in Materials Characterization

3 U; 3 Lect. 1 Tut.; 1st term

Principles and operation of materials characterization techniques with electron sources, atom and ion sources, X-ray diffractometry and other techniques. Students are recommended to take MSE 4811 concurrently. Prerequisite: permission of the instructor.

MSE 4210

Electronic Packaging

3 U; 3 Lect. 1 Tut.; 2nd term

This course provides an overview of concepts and applications of electronic packaging, soldering and materials. Topics include: thick and thin films technologies, polymeric materials in electronic packaging, testing of material properties and electrical performance. Prerequisite: permission of the instructor.

MSE 4220

Electrochemistry and Its Industrial Applications

3 U; 3 Lect. 1 Tut.

This course provides basic principles and concepts in electrochemistry and electro deposition. Topics include transport of ions, mechanism of deposition, chemistry for depositions of various metals and alloys, properties of deposits, characterization techniques, electrophoresis, electroplating on plastics, and electro deposition for electronic packaging. Prerequisite: permission of the instructor.

MSE 4430

Ceramics and Their Industrial Applications

3 U; 3 Lect. 1 Tut.; 2nd term

This course will cover topics on crystal structures, microstructures and properties of ceramic materials, design and processing of advanced ceramics and their industrial applications. Prerequisite: permission of the instructor.

MSE 4440

Polymers and Their Industrial Applications

3 U; 3 Lect. 1 Tut.; 1st term

This course covers common polymeric materials of important industrial applications. Concentration is devoted to the processing-structure-property relationship. Practical knowledge, materials selection, and design are emphasized. Prerequisite: permission of the instructor.

MSE 4450

Introduction to Nanotechnology

3 U; 3 Lect. 1 Tut.; 1st term

This course provides an introduction to basic concepts in quantum mechanics. Topics include: electron tunneling, bond and bands, wave mechanics applied to low-dimensional semiconductors, quantum wells, wires and dots and size effects in semiconductors, applications to nanotechnology, and growth of nanosize materials.

MSE 4510, 4520, 4530, 4540, 4550

Selected Topics in Materials Science and Engineering

3 U each; 3 Lect. 1 Tut.

Different topics may be offered from year to year, depending on available expertise and current developments. Prerequisite: permission of the instructor.

MSE 4610/4620

Materials Science and Engineering Project I/II

3/3 U; 6 Tut. or 6 Lab.; 2-term

A project in materials science and engineering. These two courses should normally be taken as a sequence. Prerequisite: permission of the instructor.

MSE 4811

Microstructural Analysis Laboratory

1 U; 3 Lab.; 1st term

This laboratory course provides practice in microstructural analysis of materials. Students are recommended to take MSE 4010 concurrently.

MSE 4831

Ceramics Laboratory

1 U; 3 Lab.; 2nd term

This laboratory course includes experiments on synthesis and characterization of ceramic materials, and illustrates their microstructure-property relationships. Students are recommended to take MSE 4430 concurrently.

MSE 4841

Polymers Laboratory

1 U; 3 Lab.; 1st term

This laboratory course includes experiments on synthesis and characterization of polymeric materials, and illustrates their microstructure-property relationships. Students are recommended to take MSE 4440 concurrently.

MSE 5010

Topics in Advanced Materials Research I (Nanotechnology)

3 U; 3 Lect.

Low dimensional functional material such as thin films, nanowires, quantum wells and dots. Deposition technologies and characterization techniques. Applications related phenomena such as nanosize strengthening and quantum size effect. Prerequisite: permission of the instructor.

MSE 5040

Topics in Advanced Materials Research IV (Transmission Electron Microscopy)

3 U; 3 Lect.; 1st term

This course is intended to provide basics of transmission electron microscopy. Topics include: principles of transmission electron microscope; theory of electron diffraction, and interpretation of crystal symmetry; wave optics and imaging principle of TEM; theory and interpretation of high-resolution electron microscopy; electron energy loss spectroscopy in identifying material chemical composition and electronic structures; and laboratory demonstration. Prerequisite: permission of the instructor.

MSE 5060

Structure and Properties of Materials

3 U; 3 Lect.

This course will cover various topics on structures and properties of materials at graduate level. Topics include: structures, chemical equilibria, phase diagrams and transformations, reaction kinetics, and diffusion in materials. Prerequisite: permission of the instructor.

MSE 5070

Deformation of Materials

3 U; 3 Lect.

This course will cover relationships between mechanical properties and structures of materials, deformation and fracture in solids. Prerequisite: permission of the instructor.

MSE 5080

Surface Science

3 U; 2 Lect. 3 Lab.; 2nd term

This course serves as an introduction to surface science. Major topics are: vacuum technology, electron-surface interactions, photon-surface interactions, ion-surface interactions, scanning probe microscopy and case studies in surface science. Prerequisite: permission of the instructor. (Not for students who have taken PHY 5610.)

## Study Scheme

### 1. Major Programme

#### A. Applicable to students admitted in 2003-04 and thereafter

Students are required to complete a minimum of 66 units of courses as follows:

- |      |   |             |
|------|---|-------------|
| (i)  | Required Courses (Please see Note and item 2.(i) and (ii)):<br>MSE 0211, 0222, 2001, 2002, 2004, 2011, 2112, 2822,<br>3011, 3111, 3212, 3811, 3821, 4010, 4430, 4440,<br>4610/4620, 4811, 4831, 4841, ELE 2860 <sup>#</sup> , MAT<br>2360 <sup>#</sup> or MSE 2003  | 54-57 units |
| (ii) | Elective Courses:<br>MSE 4210, 4220, 4450, 4510, 4520, 4530, 4540, 4550,<br>5010, 5020, 5030, 5040, 5060, 5070, ELE 4110 <sup>#</sup> ,<br>4190 <sup>#</sup> , 4510 <sup>#</sup> , 4530 <sup>#</sup> , 4560 <sup>#</sup> , 4570 <sup>#</sup> , PHY courses coded<br>3000 level and above <sup>#</sup> (except PHY 3052) | 9-12 units  |

---

Total: 66 units

<sup>#</sup> to be included in the Major GPA as well

#### Recommended course pattern

##### First Year of Attendance

1st term : MSE 0211, 2001, 2011, MAT 2360 12 units

2nd term : MSE 0222, 2002, 2004, 2112, 2822, ELE 2860 15 units

##### Second Year of Attendance

1st term : MSE 3011, 3811, 4440, 4841, elective course(s) 9-12 units

2nd term : MSE 3111, 3212, 3821, 4430, 4831 11 units

##### Third Year of Attendance

1st term : MSE 4010, 4610, 4811, elective course(s) 7-13 units

2nd term : MSE 4620, elective course(s) 3-12 units

---

Total: 66 units

#### B. Applicable to students admitted in 2002-03

Students are required to complete a minimum of 67 units of courses as follows:

- |      |   |             |
|------|---|-------------|
| (i)  | Required Courses (Please see Note and item 2.(i) and (ii)):<br>MSE 2001, 2002, 2011, 2112, 2822, 3011, 3111, 3811,<br>3821, 4010, 4430, 4440, 4610/4620, 4811, 4831,<br>4841, ELE 2510 <sup>#</sup> or MSE 3212, ELE 2860 <sup>#</sup> , MAT<br>2360 <sup>#</sup>   | 49-52 units |
| (ii) | Elective Courses:<br>MSE 4210, 4220, 4450, 4510, 4520, 4530, 4540, 4550,<br>5010, 5020, 5030, 5040, 5060, 5070, ELE 4110 <sup>#</sup> ,<br>4190 <sup>#</sup> , 4510 <sup>#</sup> , 4530 <sup>#</sup> , 4560 <sup>#</sup> , 4570 <sup>#</sup> , PHY courses coded<br>3000 level and above <sup>#</sup> (except PHY 3052) | 15-18 units |

---

Total: 67 units

<sup>#</sup> to be included in the Major GPA as well

**Recommended course pattern***First Year of Attendance*

1st term : MSE 2001, 2011, MAT 2360	11 units
2nd term : MSE 2002, 2112, 2822, ELE 2860	11 units

*Second Year of Attendance*

1st term : MSE 3011, 3811, 4440, 4841, elective course(s)	9-12 units
2nd term : MSE 3111, 3821, 4430, 4831, ELE 2510 or MSE 3212	11 units

*Third Year of Attendance*

1st term : MSE 4010, 4610, 4811, elective course(s)	7-13 units
2nd term : MSE 4620, elective course(s)	3-12 units

---

Total: 67 units

**C. Applicable to students admitted in 2001-02**

Students are required to complete a minimum of 67 units of courses as follows:

- |   |             |
|---|-------------|
| (i) Required Courses (Please see Note and item 2.(i) and (ii)):   | 49-52 units |
| MSE 2001, 2002, 2011, 2112, 2822, 3011, 3111, 3811, 3821, 4010, 4430, 4440, 4610/4620, 4811, 4831, 4841, ELE 2510 <sup>#</sup> , 2860 <sup>#</sup> , MAT 2360 <sup>#</sup>  |             |
| (ii) Elective Courses:  | 15-18 units |
| MSE 4210, 4220, 4450, 4510, 4520, 4530, 4540, 4550, 5010, 5020, 5030, 5040, 5060, 5070, ELE 4110 <sup>#</sup> , 4190 <sup>#</sup> , 4510 <sup>#</sup> , 4530 <sup>#</sup> , 4560 <sup>#</sup> , 4570 <sup>#</sup> , PHY courses coded 3000 level and above <sup>#</sup> (except PHY 3052) |             |

---

Total: 67 units

<sup>#</sup> to be included in the Major GPA as well

**Recommended course pattern***First Year of Attendance*

1st term : MSE 2001, 2011, MAT 2360	11 units
2nd term : MSE 2002, 2112, 2822, ELE 2860	11 units

*Second Year of Attendance*

1st term : MSE 3011, 3811, 4440, 4841, elective course(s)	9-12 units
2nd term : MSE 3111, 3821, 4430, 4831, ELE 2510	11 units

*Third Year of Attendance*

1st term : MSE 4010, 4610, 4811, elective course(s)	7-13 units
2nd term : MSE 4620, elective course(s)	3-12 units

---

Total: 67 units

Note: Students should obtain Grade "D" or above in each of the courses of MSE 2001, 2002 and 2011. Otherwise, they are required to repeat the course(s). Students who cannot meet the Grade "D" requirement in any one of the courses mentioned above after two attempts will be required to withdraw from the University. Please refer to Reg. 15.2(d) of the General Regulations Governing Full-time Undergraduate Studies.

**2. Course Exemptions (Applicable to students admitted in 2001-02 and thereafter)**

- (i) Students who obtained a grade not lower than "C" in HKALE\* "Pure Mathematics" can apply for exemption from the course MAT 2360. Students who are exempted from the course should take 3 more units of Major elective course in place of the exempted course.

- (ii) Students who fail no more than one required course may be allowed to substitute it by another elective course as approved by the Programme Committee, provided that 1) the course is failed in the final two terms of attendance before (anticipated) graduation, and 2) the students concerned satisfy all other graduation requirements.

\* *Only applicable to students admitted on the strength of HKALE results. The HKALE results to be deemed acceptable for course exemption purpose must be obtained in that particular sitting of HKALE which the University has used to assess the admission qualification of the student concerned.*

3. *Faculty Language Requirement*

(Please refer to the “Faculty Language Requirement” of Faculty of Science for details.)