Materials Engineering Courses for Supplementary Study and Continuous Professional Development To Satisfy Admission Requirements of Materials Discipline

(Candidates must read this leaflet in conjunction with M3 Routes to Membership)

1 General Academic Requirements

The academic requirement for MHKIE (Materials (MAT) Discipline) can be met with by:

1.1 a recognised Bachelor degree relevant to the Discipline; or

1.2 a recognised Bachelor degree in engineering, plus a Master Degree in Materials Engineering

1.3 a recognised Bachelor degree in engineering, plus-top up as detailed hereafter; or

1.4 a natural / applied science or engineering Bachelor degree, plus top-up as detailed hereafter.

1.5 Qualification of 1.1 and 1.2 fully satisfy the academic requirement for the MAT Discipline. Requirements for candidates with qualifications of 1.3 and 1.4 are detailed in section 2 and 3 respectively. The number of top up Master level credits/courses required to satisfy the HKIE MAT Discipline depends on the academic achievements of the applicants.

1.6 Applicants with HKIE accredited or recognised engineering degrees as described in Section 1.3 are required to take 12 top-up credits of Master level materials engineering courses, or equivalent. The detail of the courses required is listed in section 2.

1.7 On the other hand, applicants with science or engineering bachelor degrees as described in Section 1.4 are required to take 30 top-up credits of Master level materials engineering courses, or equivalent. The detail of the courses required is listed in section 3.

1.8 The relevancy of a Bachelor degree to the Discipline (section 1.1), the acceptability of a Bachelor degree as the basis on which top-up is possible (sections 1.2 to 1.4), and the assessment of the top-up requirements to individual applications are to be determined by the MAT Discipline Advisory Panel (DAP). Depending on the relevance of the bachelor degree of the applicant, some credits may be waived subject to the approval of the MAT DAP.

1.9 Applicants holding recognised academic qualifications meeting the academic requirements of Building, Civil, Chemical, Environmental and Structural Disciplines with two subjects in construction engineering materials at undergraduate level or above maybe accepted subject to review by the MAT DAP. This is applicable to applicants via membership routes other than formal training route.

2. Top Up requirements for Qualification of 1.3

2.1 Applicants with a HKIE accredited engineering degree as described in Section 1.3, or equivalent, are required to take 12 credits of Master level materials engineering courses including 6 compulsory credits and 6 elective credits, OR equivalent. Examples of the compulsory and elective courses are listed in section 2.4 and 2.5 respectively.

2.2 Applicants with HKIE accredited engineering degree would be allowed to enroll in the HKIE Scheme "A" training program in the MAT Discipline. The approval of the HKIE Training Committee is then required. Such applicants would be allowed to complete the top-up program before or after the completion of the HKIE MAT Discipline Scheme "A" training but the responsible experience towards Corporate Membership would only be counted after the top-up requirements being fulfilled.

2.3 Applicants apply via the General Experience Route or Mature Route (with recognised academic qualifications) are required to complete the abovementioned 12 credits of Master level materials engineering courses 12 months before the submission of the MHKIE membership application.

2.4 Compulsory Courses (6 credits required)

Compulsory Courses: Course Content	**Course Code – Name (University)**	**No. of Credits[1]**
Materials Characterization techniques: Overview of analytical techniques; Optical & electron microscopies and x-ray analysis; Scanning probe microscopy; Surface analytical techniques; Nondestructive techniques	AP5301 – Instrumental Methods of Analysis and Laboratory (CityU, Dept. of Phys & Materials Sci.)	3
Properties of Materials: Overview of micro-crystalline and nanocrystalline phases; Thermodynamics & kinetics of materials, Phase Diagram; Mechanical behavior; Physical behavior, electrical, magnetic, optical; Nanostructured materials; Processing technology, chemical, laser processing etc..	AP5302 – Nanostructured Materials (CityU, Dept. of Phys & Materials Sci.)	3

2.5 Electives: (6 credits from the following)

Electives: Course Content	**Course Code – Name (University)**	**No. of Credits[2]**
Semiconductor and Devices: Semiconductor Physics; P-N junction; Metal-semiconductor junctions; Bipolar junction transistors; Optoelectronic Devices; The junction field effect transistor; The MOS transistors; Integrated Circuits; Semiconducting materials; Optical properties of semiconducting materials	AP5265 – Semiconductor Physics and Devices (CityU, Dept. of Phys & Materials Sci.)	3

Composite Materials: Fibre-matrix interface; Micromechanics; Mechanics of laminate; Failure criteria; Processing of composites; Metal matrix nanocomposites; Ceramic matrix nanocomposites; Polymer Nanocomposites	AP6118 – Design with Composite and Nanocomposite Materials (CityU, Dept. of Phys & Materials Sci.)	3
Microelectronic Materials: Semiconductor physics; Crystal growth and wafer preparation; Epitaxy; Oxidation; Lithography; Etching; Polysilicon and dielectric film deposition; Diffusion; Ion implantation; Metallization; Testing, assembly, and packaging	AP6120 – Microelectronic Materials and Processing (CityU, Dept. of Phys & Materials Sci.)	3
Thin Film Technology: Structure of thin films; Physical parameters of films; Physical deposition techniques; Electrical discharges; Chemical deposition techniques; Processing Technologies; Deposition of some advanced materials	AP6121 – Thin Film Technology and Nanocrystalline Coatings (CityU, Dept. of Phys & Materials Sci.)	3
Electroceramics: Elementary solid state science; fabrication of ceramics; Ceramic conductors; Dielectrics and insulators; Measurement techniques; Piezoelectric ceramics; Pyroelectric materials; Electro-optic ceramics; Magnetic ceramics	AP6126 – Electroceramics (CityU, Dept. of Phys & Materials Sci.)	3
Electronic Packaging: Introduction to electronic packaging; Packaging materials and processes; Package reliability	AP6171 – Electronic Packaging and Materials (CityU, Dept. of Phys & Materials Sci.)	3
Biomedical Materials: Introduction of biomedical materials; Mechanical and physical properties; Spinal biomechanics; Characterization of the mechanical and biological properties; Biological response to foreign materials; photochemical crosslinking technology of polymers; Surface treatment; Engineering technique and management; Case Analysis	AP6173 − Biomedical Materials: From Engineering To Clinical Applications (CityU, Dept. of Phys & Materials Sci.)	3
Polymers: polymer science; Viscoelasticity; Rubber Elasticity; Yielding; Fracture; Polymer Melt Rheology; Polymer Processing; Liquid crystalline polymers	AP6199 − Mechanical Properties of Solid Polymers (CityU, Dept. of Phys & Materials Sci.)	3
Corrosion: thermodynamics and electrode potential; Electrode kinetics; Activation and concentration polarization; Passivation; Localized corrosion; Galvanic corrosion; Intergranular corrosion; Materials selection cases; Surface modification techniques	AP6303 − Corrosion and Surface Engineering (CityU, Dept. of Phys & Materials Sci.)	3
Materials Selection: Creep; Fracture toughness; Performance Indices and Materials Selection Charts, Materials Selection with Shape; Case Study	AP6304 − Materials Selection (CityU, Dept. of Phys & Materials Sci.)	3

Failure Analysis: General procedures of failure analysis; Failure mechanisms; Case Studies	AP6305 − Failure Analysis and Case Studies (CityU, Dept. of Phys & Materials Sci.)	3
Building Materials: Introduction to building materials; Steel Frame Construction; Cement; Aggregates; Design of concrete mix; Testing of concrete; Durability; Admixtures; Special concrete; Glass; Cladding; Materials for Interior walls, Partitions, Ceiling and Floorings	AP6307 − Building Materials (CityU, Dept. of Phys & Materials Sci.)	3
Special Topics on Advanced Materials: Examples: Amorphous solids; Battery materials; Electronic packaging materials; Ferroelectric materials; Nanostructured materials; Organic semiconductors; Shape-memory alloys; Superhard coatings; Failure of nanostructured materials; Synthesis of nanowires	AP6714 − Special Topics in Materials Engineering and Nanotechnology (CityU, Dept. of Phys & Materials Sci.)	3
Concrete mixes; quality control; in-situ strength assessment; non-destructive testing; cracks and other defects; maintenance and repair.	CIVL6013 − Concrete technology (HKU, Dept. of Civil Eng.)	1 module (~ 3 credits)
Traffic loading; subgrade properties; soil stabilization; bituminous materials; flexible pavement design; rigid pavement design; pavement maintenance and upgrading; pavement management systems.	CIVL6035 − Highway pavement engineering (HKU, Dept. of Civil Eng.)	1 module (~ 3 credits)
Soil and rock classification system; field instrumentation technique; in-situ tests; laboratory tests; stress-path and its application; groundwater monitoring; stress measurement; GPS and laser scanning monitoring methods.	CIVL6077 − Ground investigation and soil testing (HKU, Dept. of Civil Eng.)	1 module (~ 3 credits)
The constituents of concrete; the structures of the concrete at nano-scale, micro-scale, and macro-scale; the properties and test methods of fresh and hardened concrete; special concretes including fiber reinforced concrete, micro-silica concrete, concrete densified with small particles, ultra high strength concrete, self compacting concrete and macro defect free concrete; concrete failure mechanisms and fracture models; fundamentals of non-destructive testing and common NDT methods for concrete structures.	CIEM 524 − Advanced Concrete Technology (HKUST, Dept. of Civil Eng.)	3
Degradation problems caused by non-uniform deformation changes, poor durability, natural and man-made disasters (e.g. fire and earthquake); general procedures and common techniques for infrastructure inspection and evaluation; conventional repair techniques such as patching and strengthening with steel; fundamentals of composite materials and composite mechanics; advanced rehabilitation techniques using composite materials.	CIEM 525 − Renovation Engineering (HKUST, Dept. of Civil Eng.)	3

Stress, strain and tensor transformation; boundary value problems in elasticity: formulation and solution methods; plastic analysis; beams on elastic foundation; torsion with and without warping restraint; behavior of thin-walled sections; plates and shells; instability problems.	CIEM 533 – Advanced Mechanics of Materials (HKUST, Dept. of Civil Eng.)	3

3. Top Up requirements for Qualification of 1.4

3.1 Applicants with science or engineering bachelor degree NOT accredited by the HKIE as described in Section 1.4 are required to take 30 credits of Master level materials engineering courses including 6 compulsory credits and 24 elective credits, OR equivalent. The compulsory and elective courses are listed in section 3.4 and 3.5 respectively.

3.2 Such applicants can only enroll in the HKIE Scheme "A" training program in the MAT Discipline after the completion of the top-up program. The approval of the HKIE Training Committee is then required.

3.3 Applicants applying via the General Experience Route or Mature Route (with recognized academic qualifications) are normally required to complete the abovementioned 30 credits of Master level materials engineering courses 24 months before the submission of the MHKIE membership application.

3.4 Compulsory Courses (6 credits required)

Compulsory Courses: Course Content	**Course Code – Name (University)**	**No. of Credits[2]**
Materials Characterization techniques: Overview of analytical techniques; Optical & electron microscopies and x-ray analysis; Scanning probe microscopy; Surface analytical techniques; Nondestructive techniques	AP5301–Instrumental Methods of Analysis and Laboratory (CityU, Dept. of Phys & Materials Sci.)	3
Properties of Materials: Overview of micro-crystalline and nanocrystalline phases; Thermodynamics & kinetics of materials, Phase Diagram; Mechanical behaviour; Physical behaviour, electrical, magnetic, optical; Nanostructured materials; Processing technology, chemical and laser processing.	AP5302–Nanostructured Materials (CityU, Dept. of Phys & Materials Sci.)	3

3.5 Electives: (24 credits from the following)

Electives: Course Content	**Course Code – Name (University)**	**No. of Credits[2]**
Engineering Maths I:[3] Random variables; Distribution; Data and sample description; Estimation of Parameters; Tests of Hypothesis; Regression. ANOVA	MA5172 – Applied Statistics for Sciences and Engineering (CityU, Dept. of Phys & Materials Sci.)	3

Engineering Maths II:[3] The fundamental stationary and time-dependent boundary value problems of solid and fluid mechanics. Classical and weak solutions. Green's functions. Solutions by Fourier series and Fourier transforms. Euler-Lagrange equation and minimization of functions	MA5601 − Applied Partial Differential Equations (CityU, Dept. of Phys & Materials Sci.)	3
Engineering Project:[3] The project should be carried out on an individual basis on an engineering R&D project. The literature survey, planning of the project and experimental work, data analysis, writing the dissertation and oral examination should be carried out by the student independently this course	AP6306 − Dissertation (CityU, Dept. of Phys & Materials Sci.)	6
Semiconductor and Devices: Semiconductor Physics; P-N junction; Metal-semiconductor junctions; Bipolar junction transistors; Optoelectronic Devices; The junction field effect transistor; The MOS transistors; Integrated Circuits; Semiconducting materials; Optical properties of semiconducting materials	AP5265–Semiconductor Physics and Devices (CityU, Dept. of Phys & Materials Sci.)	3
Composite Materials: Fibre-matrix interface; Micromechanics; Mechanics of laminate; Failure criteria; Processing of composites; Metal matrix nanocomposites; Ceramic matrix nanocomposites; Polymer Nanocomposites	AP6118–Design with Composite and Nanocomposite Materials (CityU, Dept. of Phys & Materials Sci.)	3
Microelectronic Materials: Semiconductor physics; Crystal growth and wafer preparation; Epitaxy; Oxidation; Lithography; Etching; Polysilicon and dielectric film deposition; Diffusion; Ion implantation; Metallization; Testing, assembly, and packaging	AP6120 − Microelectronic Materials and Processing (CityU, Dept. of Phys & Materials Sci.)	3
Thin Film Technology: Structure of thin films; Physical parameters of films; Physical deposition techniques; Electrical discharges; Chemical deposition techniques; Processing Technologies; Deposition of some advanced materials	AP6121 − Thin Film Technology and Nanocrystalline Coatings (CityU, Dept. of Phys & Materials Sci.)	3
Electroceramics: Elementary solid state science; fabrication of ceramics; Ceramic conductors; Dielectrics and insulators; Measurement techniques; Piezoelectric ceramics; Pyroelectric materials; Electro-optic ceramics; Magnetic ceramics	AP6126 − Electroceramics (CityU, Dept. of Phys & Materials Sci.)	3
Electronic Packaging: Introduction to electronic packaging; Packaging materials and processes; Package reliability	AP6171 − Electronic Packaging and Materials (CityU, Dept. of Phys & Materials Sci.)	3

Biomedical Materials: Introduction of biomedical materials; Mechanical and physical properties; Spinal biomechanics; Characterization of the mechanical and biological properties; Biological response to foreign materials; photochemical crosslinking technology; Surface treatment; Engineering technique and management; Case Analysis	AP6173 − Biomedical Materials: From Engineering To Clinical Applications (CityU, Dept. of Phys & Materials Sci.)	3
Polymers: polymer science; Viscoelasticity; Rubber Elasticity; Yielding; Fracture; Polymer Melt Rheology; Polymer Processing; Liquid crystalline polymers	AP6199 − Mechanical Properties of Solid Polymers (CityU, Dept. of Phys & Materials Sci.)	3
Corrosion: thermodynamics and electrode potential; Electrode kinetics; Activation and concentration polarization; Passivation; Localized corrosion; Galvanic corrosion; Intergranular corrosion; Materials selection cases; Surface modification techniques	AP6303 − Corrosion and Surface Engineering (CityU, Dept. of Phys & Materials Sci.)	3
Materials Selection: Creep; Fracture toughness; Performance Indices and Materials Selection Charts, Materials Selection with Shape; Case Study	AP6304 − Materials Selection (CityU, Dept. of Phys & Materials Sci.)	3
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Traffic loading; subgrade properties; soil stabilization; bituminous materials; flexible pavement design; rigid pavement design; pavement maintenance and upgrading; pavement management systems.	CIVL6035 − Highway pavement engineering (HKU, Dept. of Civil Eng.)	1 module (~ 3 credits)

Soil and rock classification system; field instrumentation technique; in-situ tests; laboratory tests; stress-path and its application; groundwater monitoring; stress measurement; GPS and laser scanning monitoring methods.	CIVL6077 − Ground investigation and soil testing (HKU, Dept. of Civil Eng.)	1 module (~ 3 credits)
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Degradation problems caused by non-uniform deformation changes, poor durability, natural and man-made disasters (e.g. fire and earthquake); general procedures and common techniques for infrastructure inspection and evaluation; conventional repair techniques such as patching and strengthening with steel; fundamentals of composite materials and composite mechanics; advanced rehabilitation techniques using composite materials.	CIEM 525 − Renovation Engineering (HKUST, Dept. of Civil Eng.)	3
Stress, strain and tensor transformation; boundary value problems in elasticity: formulation and solution methods; plastic analysis; beams on elastic foundation; torsion with and without warping restraint; behavior of thin-walled sections; plates and shells; instability problems.	CIEM 533 − Advanced Mechanics of Materials (HKUST, Dept. of Civil Eng.)	3

4. Review of the List of Courses

The list of course shown in sections 3 will be updated by the MAT DAP from time to time to include relevant courses which are suitable for top up purpose towards the HKIE MAT Discipline.

Notes:

[1] *One credits corresponds to 13 lecture hours, OR equivalent.*

[2] *One credits corresponds to 13 lecture hours, OR equivalent.*

[3] *Applicants without a HKIE accredited engineering degree must include the (i) Engineering Maths I, (ii) Engineering Maths II and (iii) Engineering Project in the 24 credits in their top-up programs. They can apply to waive these three courses if they have taken equivalent courses in previous bachelor program or master program.*