

# Doctor of Philosophy Program in Materials Science and Engineering (International Program)

School: Molecular Science and Engineering

## Curriculum Structure

### 1. Program Structure 1.1

<b>1.1 Total Credits of the Program</b>	<b>No less than</b>	<b>50</b>	<b>Credits</b>
<b>1.2 Program Details</b>			
<b>Courses</b>	<b>No less than</b>	<b>8</b>	<b>Credits (non-credits)</b>
Colloquium		2	Credits (non-credits)
Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering		3	Credits (non-credits)
<b>Thesis</b>	<b>No less than</b>	<b>50</b>	<b>Credits</b>
<b>1.3 Course Lists</b>			
<b>Courses</b>	<b>No less than</b>	<b>8</b>	<b>Credits (non-credits)</b>
Colloquium			
- MSE 688 Colloquium III		1	Credit (non-credit)
- MSE 689 Colloquium IV		1	Credit (non-credit)
Professional Development			
- MSE 668 Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering			
- MSE 669 Leadership in Science and Engineering		3	Credits (non-credits)
<b>Thesis</b>	<b>No less than</b>	<b>50</b>	<b>Credits</b>
- MSE 699 Thesis		1-50	Credits

### 2. Program Structure 1.2

<b>2.1 Total Credits of the Program</b>	<b>No less than</b>	<b>76</b>	<b>Credits</b>
<b>2.2 Program Details</b>			
<b>Courses</b>	<b>No less than</b>	<b>10</b>	<b>Credits (non-credits)</b>
Colloquium		4	Credits (non-credits)
Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering		3	Credits (non-credits)
<b>Thesis</b>	<b>No less than</b>	<b>76</b>	<b>Credits</b>
<b>2.3 Course Lists</b>			
<b>Courses</b>	<b>No less than</b>	<b>10</b>	<b>Credits (non-credits)</b>
Colloquium			
- MSE 588 Colloquium I		1	Credit (non-credit)
- MSE 589 Colloquium II		1	Credit (non-credit)
- MSE 688 Colloquium III		1	Credit (non-credit)
- MSE 689 Colloquium IV		1	Credit (non-credit)
Professional Development			
- MSE 668 Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering			
- MSE 669 Leadership in Science and Engineering		3	Credits (non-credits)
<b>Thesis</b>	<b>No less than</b>	<b>76</b>	<b>Credits</b>
- MSE 698 Thesis		1-76	Credits

### 3. Program Structure 2.1

<b>3.1 Total Credits of the Program</b>	<b>No less than</b>	<b>50</b>	<b>Credits</b>
<b>3.2 Program Details</b>			
<b>Courses</b>	<b>No less than</b>	<b>14</b>	<b>Credits</b>
Seminar		2	Credits
Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering		3	Credits (non-credits)
Elective Courses*	No less than	12	Credits
<b>Thesis</b>	<b>No less than</b>	<b>36</b>	<b>Credits</b>
<b>3.3 Course Lists</b>			
<b>Courses</b>	<b>No less than</b>	<b>14</b>	<b>Credits</b>
Seminar			
- MSE 678 Seminar III		1	Credit
- MSE 679 Seminar IV		1	Credit
Professional Development			
- MSE 668 Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering			
- MSE 669 Leadership in Science and Engineering		3	Credits (non-credits)
Elective Courses*	No less than	12	Credits
- MSE 501 Thermodynamics and Kinetic Processes in Materials		3	Credits
- MSE 502 Chemical Synthesis of Materials		3	Credits
- MSE 503 Structure and Properties of Materials		3	Credits
- MSE 504 Characterization of Materials		3	Credits

Note: Other elective courses shown below in the **Elective Courses\*** list can be selected

<b>Thesis</b>	<b>No less than</b>	<b>36</b>	<b>Credits</b>
- MSE 699 Thesis		1-36	Credits

### 4. Program Structure 2.2

<b>4.1 Total Credits of the Program</b>	<b>No less than</b>	<b>76</b>	<b>Credits</b>
<b>4.2 Program Details</b>			
<b>Courses</b>	<b>No less than</b>	<b>28</b>	<b>Credits</b>
Seminar		4	Credits
Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering		3	Credits (non-credits)
Core Courses	No less than	12	Credits
Elective Courses*	No less than	12	Credits
<b>Thesis</b>	<b>No less than</b>	<b>48</b>	<b>Credits</b>
<b>4.3 Course Lists</b>			
<b>Courses</b>	<b>No less than</b>	<b>28</b>	<b>Credits</b>
Seminar			
- MSE 578 Seminar I		1	Credit

- MSE 579 Seminar II		1	Credit
- MSE 678 Seminar III		1	Credit
- MSE 679 Seminar IV		1	Credit
Professional Development			
- MSE 668 Professional Development		3	Credits (non-credits)
Leadership in Science and Engineering			
- MSE 669 Leadership in Science and Engineering		3	Credits (non-credits)
Core Courses			
- MSE 501 Thermodynamics and Kinetic Processes in Materials		3	Credits
- MSE 502 Chemical Synthesis of Materials		3	Credits
- MSE 503 Structure and Properties of Materials		3	Credits
- MSE 504 Characterization of Materials		3	Credits
Elective Courses*	No less than	12	Credits
<b>Thesis</b>	<b>No less than</b>	<b>48</b>	<b>Credits</b>
- MSE 698 Thesis		1-48	Credits

### Elective Courses\*

Students are required to select no less than 6 credits from MSE courses and 6 more credits from MSE courses or courses from other program. Courses other than those prescribed in the below list are at the discretion of advisory committee and Head of the School or Program Director or equivalent position.

#### (1) Frontiers in Materials Science and Engineering

MSE 512	Solid State Chemistry and Physics	3(3-0-6)
MSE 515	Modeling and Simulation of Materials	3(3-0-6)
MSE 611	Surface and Interface Properties of Materials	3(3-0-6)
MSE 612	Electronic Structures of Solid Surface and Nano-scale Materials	3(3-0-6)
MSE 615	Molecular Structures and Properties of Polymers	3(3-0-6)
MSE 616	Chemistry and Physics of Nanostructures	3(3-0-6)
MSE 617	Electrochemistry and Corrosion	3(3-0-6)
MSE 619	Frontiers in Materials Science and Technology	3(3-0-6)
CHE 612	Electrochemical Energy Systems	3(3-0-6)
BSE 612	Biocatalysis and Mechanistic Enzymology	3(3-0-6)

#### (2) Specialized Courses on Molecular Design and Synthesis Processes

MSE 521	Advanced Synthesis for Organic and Inorganic and Biological Materials	3(3-0-6)
MSE 522	Synthesis and Processing of Electronic and Photonic Materials	3(3-0-6)
MSE 523	Ceramic Processing	3(3-0-6)

MSE 525	Electrochemical Processing of Materials	3(3-0-6)
MSE 526	Rheology and Processing of Polymers	3(3-0-6)
MSE 621	Composite Materials and Processing	3(3-0-6)
MSE 624	Molecular Design of Functional Polymers	3(3-0-6)
MSE 627	Qualitative Property Predictions for Transition Metal Complexes	3(3-0-6)
CHE 521	Applied Catalysis	3(3-0-6)
CHE 522	Design and Preparation of Heterogeneous Catalysts	3(3-0-6)
CHE 622	Quantum Simulation of Molecules and Materials	3(3-0-6)
CHE 623	Advanced Catalysis and Electrocatalysis	3(3-0-6)
CHE 624	Industrial Catalysis	3(3-0-6)

### **(3) Advanced Courses on Cutting-Edge Analysis and Characterization of Materials**

MSE 532	Electron Microscopy and Diffraction	3(3-0-6)
MSE 631	X-ray Science and Applications	3(3-0-6)
MSE 634	Spectroscopic Methods for Organic Compounds	3(3-0-6)

### **(4) Novel Materials, New Processes and Applications**

MSE 541	Materials for Energy, Environmental and Biological Applications	3(3-0-6)
MSE 542	Photovoltaic and Solar Cell Materials and Devices	3(3-0-6)
MSE 543	Sensor and Transducer Materials and Technology	3(3-0-6)
MSE 544	Advanced Ceramics and Applications	3(3-0-6)
MSE 545	Catalytic Materials and Applications	3(3-0-6)
MSE 642	Nano Electronic and Photonic Materials and Devices	3(3-0-6)
MSE 643	High-Performance Structural Materials	3(3-0-6)
MSE 644	Composite and Hybrid Materials	3(3-0-6)
MSE 645	Biomaterials and Soft Materials	3(3-0-6)
MSE 646	Thin-Film Semiconductors and Devices	3(3-0-6)
MSE 667	Selected Topics in Materials Science and Engineering	3(3-0-6)
CHE 696	Selected Topics in Chemical Engineering	3(3-0-6)
BSE 642	Biosensor and Electrochemistry	3(3-0-6)

## Study Plan

### Program 1.1

<b>Semester 1 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 688	Colloquium III	1 Credit (non-credit)
MSE 699	Thesis	3 Credits
	Total	<u>3</u> Credits
<b>Semester 2 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 668	Professional Development	3 Credits (non-credits)
MSE 669	Leadership in Science and Engineering	3 Credits (non-credits)
MSE 689	Colloquium IV	1 Credit (non-credit)
MSE 699	Thesis	3 Credits
	Total	<u>3</u> Credits
<b>Semester 1 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	3 Credits
	Total	<u>3</u> Credits
<b>Semester 2 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	15 Credits
	Total	<u>15</u> Credits
<b>Semester 1 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	15 Credits
	Total	<u>15</u> Credits
<b>Semester 2 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	11 Credits
	Total	<u>11</u> Credits

## Program 1.2

<b>Semester 1 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 588	Colloquium I	1 Credit (non-credit)
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 2 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 668	Professional Development	3 Credits (non-credits)
MSE 669	Leadership in Science and Engineering	3 Credits (non-credits)
MSE 589	Colloquium II	1 Credit (non-credit)
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 1 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 688	Colloquium III	1 Credit (non-credit)
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 2 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 689	Colloquium IV	1 Credit (non-credit)
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 1 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 2 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	3 Credits
Total		<u>3</u> Credits
<b>Semester 1 of 4<sup>th</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	15 Credits
Total		<u>15</u> Credits
<b>Semester 2 of 4<sup>th</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	15 Credits
Total		<u>15</u> Credits
<b>Semester 1 of 5<sup>th</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	15 Credits
Total		<u>15</u> Credits
<b>Semester 2 of 5<sup>th</sup> Year</b>		<b>Credits</b>
MSE 698	Thesis	13 Credits
Total		<u>13</u> Credits

## Program 2.1

<b>Semester 1 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 678	Seminar III	1 Credit
MSE 699	Thesis	3 Credits
	Elective Courses	9 Credits
	Total	<u>13</u> Credits
<b>Semester 2 of 1<sup>st</sup> Year</b>		<b>Credits</b>
MSE 668	Professional Development	3 Credits (non-credits)
MSE 669	Leadership in Science and Engineering	3 Credits (non-credits)
MSE 679	Seminar IV	1 Credit
MSE 699	Thesis	3 Credits
	Elective Course	3 Credits
	Total	<u>7</u> Credits
<b>Semester 1 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	3 Credits
	Total	<u>3</u> Credits
<b>Semester 2 of 2<sup>nd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	3 Credits
	Total	<u>3</u> Credits
<b>Semester 1 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	15 Credits
	Total	<u>15</u> Credits
<b>Semester 2 of 3<sup>rd</sup> Year</b>		<b>Credits</b>
MSE 699	Thesis	9 Credits
	Total	<u>9</u> Credits

## Program 2.2

	<b>Semester 1 of 1<sup>st</sup> Year</b>	<b>Credits</b>
MSE 501	Thermodynamics and Kinetic Processes in Materials	3 Credits
MSE 502	Chemical Synthesis of Materials	3 Credits
MSE 578	Seminar I	1 Credit
MSE 698	Thesis	3 Credit
	Elective Course	3 Credits
	Total	<u>13</u> Credits
	<b>Semester 2 of 1<sup>st</sup> Year</b>	<b>Credits</b>
MSE 503	Structure and Properties of Materials	3 Credits
MSE 504	Characterization of Materials	3 Credits
MSE 579	Seminar II	1 Credit
MSE 698	Thesis	3 Credits
MSE 668	Professional Development	3 Credits (non-credits)
MSE 669	Leadership in Science and Engineering	3 Credits (non-credits)
	Elective Course	3 Credits
	Total	<u>13</u> Credits
	<b>Semester 1 of 2<sup>nd</sup> Year</b>	<b>Credits</b>
MSE 678	Seminar III	1 Credit
MSE 698	Thesis	3 Credit
	Elective Courses	6 Credits
	Total	<u>10</u> Credits
	<b>Semester 2 of 2<sup>nd</sup> Year</b>	<b>Credits</b>
MSE 679	Seminar IV	1 Credit
MSE 698	Thesis	3 Credits
	Total	<u>4</u> Credits
	<b>Semester 1 of 3<sup>rd</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	3 Credits
	Total	<u>3</u> Credits
	<b>Semester 2 of 3<sup>rd</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	3 Credits
	Total	<u>3</u> Credits
	<b>Semester 1 of 4<sup>th</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	9 Credits
	Total	<u>9</u> Credits
	<b>Semester 2 of 4<sup>th</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	9 Credits
	Total	<u>9</u> Credits
	<b>Semester 1 of 5<sup>th</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	6 Credits
	Total	<u>6</u> Credits
	<b>Semester 2 of 5<sup>th</sup> Year</b>	<b>Credits</b>
MSE 698	Thesis	6 Credits
	Total	<u>6</u> Credits