Materials Chemistry

(Grade 2024)

Course code: 080403

I. Cultivation Objectives

1. General cultivation objective

This program cultivates engineering talents with comprehensive development of morality, intellect, physique, aesthetics and labor, who have solid knowledge of materials science and chemistry and master the design and preparation technology of advanced functional materials (especially thermally functional materials). Graduates can be engaged in the research and development of new products, processes and technologies for functional materials across industries such as integrated circuits, building energy efficiency, new energy vehicles, and biomedicine. They will be capable of undertaking production management, process control and quality management, and have the potential to pursue further studies.

2. Objective of value guidance

Have consciousness of green manufacturing, sustainable development, environmental protection and production safety, a healthy personality and psychological quality, good scientific and cultural literacy, correct professional ethics, professional conduct and a sense of social responsibility, which will be applied in the design, development and implementation of material process solutions to promote the development of the national functional materials especially thermally functional materials industry.

3. Five years after graduation, students in this program should achieve the following objectives:

(1) Be able to apply knowledge of Materials Chemistry to optimize materials production processes in real companies, to analyse and propose effective solutions to complex engineering problems such as the development of new materials, materials modification and materials performance testing.

(2) Possesses high professional competence and comprehensive skills, capable of engaging in scientific research, technological development, and management in the fields of materials chemistry, thermally functional materials, and related disciplines. Adaptable to both independent and team-based work environments.

(3) Be familiar with the important laws, regulations and policies of the professions and industries related to the materials, chemical and environmental fields, and to be able to analyse trends in the relevant fields.

(4) Be familiar with and comply with important laws, regulations and policies of the professions and industries related to the field of Materials Chemistry, have good moral and humanistic qualities, have an consciousness of the environment and sustainability, comply with professional codes, have an artisanal spirit and assume social responsibility.

(5) Have good interpersonal, psychological, organizational and management and implementation skills, be a team player, able to integrate, drive or coordinate the organization and implementation of projects and play an effective role.

II. Graduation requirements

1. Engineering Knowledge: Have the ability to apply knowledge of mathematics, natural sciences, engineering fundamentals and Materials Chemistry to solve complex engineering problems in the design and preparation, structure and properties, processes and equipment, products and applications of advanced functional materials.

1.1 Be able to apply knowledge of mathematics, natural sciences, engineering fundamentals and Materials Chemistry to appropriately formulate engineering problems in advanced functional materials.

1.2 Be able to develop suitable mathematical models for the design and preparation, structure and properties, processes and equipment, and products and applications of advanced functional materials and solve them using appropriate engineering conditions.

1.3 Be able to apply knowledge of mathematics, natural sciences, engineering fundamentals, Materials Chemistry and mathematical models to the derivation and analysis of complex engineering problems in the design and preparation, structure and properties, processes and equipment, products and applications of advanced functional materials.

1.4 Be able to apply knowledge of mathematics, natural sciences, engineering fundamentals, Materials Chemistry and mathematical models to the comparison and synthesis of solutions to complex engineering problems in the design and preparation, structure and properties, processes and equipment, products and applications of advanced functional materials.

2. Analysis of the Problem: Be able to apply the fundamental principles of mathematics, natural science, engineering science and Materials Chemistry to identify and express complex engineering problems in the design and preparation, structures and properties, processes and equipment, and products and applications of advanced functional materials, and to obtain valid conclusions through literature research and analysis.

2.1 Be able to apply the basic principles of mathematics, natural science, engineering science and Materials Chemistry to identify and judge the key aspects of complex engineering problems in the design and preparation, structure and properties, processes and equipment, and products and applications of advanced functional materials.

2.2 Be able to apply basic principles and mathematical modelling methods from mathematics, natural science, engineering science and Materials Chemistry to correctly represent complex engineering problems in the

design and preparation, structures and properties, processes and equipment, and products and applications of advanced functional materials.

2.3 Be able to recognize that there are multiple solutions available for complex engineering problems in advanced functional materials and will seek alternative solutions through literature research.
2.4 Be able to apply basic principles and draw on literature research to analyse the factors influencing complex engineering problems in advanced functional materials and to obtain valid conclusions.

3. Design/develop of solutions: Have the ability to conceive and design solutions to complex engineering problems in the field of advanced functional materials, to design systems, units (components) or processes that meet specific needs, and to demonstrate a sense of innovation in the design process, taking into account social, health, safety, legal, cultural and environmental considerations.

3.1 Understand basic design/development methods and techniques for the full cycle and full process of engineering design and product development of advanced functional materials and understand the various factors that influence Product Design and technical solutions for advanced functional materials.
3.2 Be able to design and develop units (components) that meet specific needs in the preparation, process, equipment and application of advanced functional materials by addressing solutions to complex engineering problems in advanced functional materials.

3.3 Be able to present design/development solutions for the full process of Product Design of advanced functional materials in the form of drawings, design specifications, data diagrams or physical objects, and demonstrate a sense of innovation in the design process.

3.4 Be able to consider social, health, safety, legal, cultural and environmental constraints in complex engineering problems related to the design of products, units and processes for advanced functional materials.

4. Research: Have the ability to apply scientific principles and methods to complex engineering problems in advanced functional materials, including the design of experiments, analysis and interpretation of data, and the synthesis of information to reach sound and valid conclusions.

4.1 Be able to investigate and analyse solutions to complex engineering problems in advanced functional materials based on relevant scientific principles, through literature research or related methods.

4.2 Be able to select a research route and design a feasible experimental program according to the characteristics of the research object of advanced functional materials.
4.3 Be able to construct an experimental system according to the experimental scheme of environment-friendly functional materials and adopt scientific and safe methods and means to carry out experimental research, and be able to collect and collate experimental data correctly.

4-4 Be able to analyse and interpret the results of experimental research and obtain reasonable and valid conclusions through information synthesis.

5. Use of modern tools: Have the ability to develop, select and use appropriate modern instruments, graphic tools and software, information retrieval tools, etc., to predict and simulate solutions to complex engineering problems in the design and preparation, structure and properties, processes and equipment, products and applications of advanced functional materials, and to understand their limitations.

5-1 Understand the principles and methods of using modern instrumentation, information technology tools, engineering tools and simulation software in the field of advanced functional materials, and understand their limitations.

5.2 Be able to select and use appropriate instrumentation, information resources, engineering tools and simulation software to analyse, calculate and design complex engineering problems in the design and preparation, structure and properties, processes and equipment, and products and applications of advanced functional materials.

5.3 Be able to develop, select and use appropriate techniques and resources to predict and simulate complex engineering problems in the design and preparation, structure and properties, processes and equipment, and products and applications of advanced functional materials for a specific research target, and understand the limitations of simulation and prediction.

6. Engineering and Society: Have the ability to undertake a sound analysis of engineering practices related to Materials Chemistry based on engineering background knowledge and to evaluate the social, health, safety, legal and cultural impacts of the production, design and development of advanced functional materials, and to understand the responsibilities involved.

6-1 Have experience of internships and engineering practice in Materials Chemistry-related companies, knowledge of industrial technology standards, industrial policies and laws and regulations, and culture related to the field of advanced functional materials, and an understanding of the impacts of different social cultures on engineering activities.

6-2 Be able to analyse and evaluate the social, health, safety, legal and cultural impacts of the implementation of projects in the field of advanced functional materials and the impacts of these constraints on the implementation of relevant projects, and understand the responsibilities involved.

7. Environment and Sustainable Development: Have the ability to understand and evaluate the impacts of engineering practice issues of the production and development of advanced functional materials on the environment and sustainable development of society.

7-1 Understand national strategies for environmental and social sustainability and related policies, laws and regulations, and develop a concept of environmental protection and sustainable development and an understanding of its implications.

7-2 Be able to understand and evaluate the impacts of engineering practice on environmental and social sustainability in complex engineering problems related to the field of materials production.

8: Professional Codes: Have human and social science literacy, social responsibility and the ability to understand and comply with engineering ethics and codes of practice and responsibilities in the engineering practice of advanced functional materials.

8-1 Understand the fundamental significance of perspective on world, life and values and their impact, understand the national conditions of China, develop core values of socialism, and have humanistic knowledge, critical thinking skills, ability to deal with situations and scientific literacy.

8-2 Be able to understand the engineering ethics and codes of honesty and fairness and integrity in engineering practice and be able to follow them consciously in engineering practice.

8-3 Understand the engineer's social responsibility for the safety, health and well-being of the public, and for environmental protection, and be able to exercise conscious responsibility in the practice of engineering.

9: Individuals and teams: Have the ability to assume the role of individual, team member and leader of a team in a multidisciplinary context.

9-1 Understand the prevalence of multidisciplinary backgrounds in team work and the importance of teamwork to communicate effectively and work collaboratively with team members.

9-2 Be able to work independently or collaboratively in a team.

9-3 Be able to organize, co-ordinate and direct a team to carry out work and complete tasks on time.

10: Communication: Have the ability to communicate effectively with industry peers and the public on complex engineering issues related to advanced functional materials, including writing reports and briefs design, presenting statements, expressing their views clearly and answering questions. Have an international perspective and be able to communicate and interact in a cross-cultural context.

10-1 Master the methods and techniques of writing technical documents or scientific papers, and be able to clearly express professional views on complex engineering issues in the field of advanced functional materials orally, in manuscripts and diagrams. Be able to respond to queries, and understand the differences in communication with industry peers and the public.

10-2 Understand international trends and research hotspots in advanced functional materials and understand and respect the differences and diversity of different cultures around the world.

10-3 Have knowledge of a foreign language and a certain international perspective, with the ability to communicate and exchange basic information on professional issues in the field of advanced functional materials, in a cross-cultural context.

11: Project Management: Understand and master the principles of engineering management and economic decision-making methods and be able to apply them to engineering activities in the materials sector.

11-1 Be able to understand and appreciate the relevant engineering management principles and economic decision-making methods in engineering projects.

11-2 Understand the engineering management and economic decision-making issues involved in the full product cycle and process in the advanced functional materials industry.

11-3 Be able to analyse and evaluate engineering design and technology development options for advanced functional materials using engineering principles and economic decision-making methods in a multidisciplinary environment.

12: Lifelong learning: Have a sense of independent and lifelong learning, with the ability to learn and adapt to development.

12-1 Be able to understand trends in the ongoing development of professional skills in the context of social and technological developments and recognize the need for continuous exploration and learning.

12-2 Have the ability to learn independently, including the ability to understand technical issues, summarize and ask questions, etc.

III. Schooling System

Four years.

IV. Length of Study

Flexible study period, generally four years, the minimum length of flexibility is not less than three years, the longest not more than six years.

V. Requirements for Graduation and Degree Conferring

In order to graduate, students must complete the minimum number of credits required by the Instructive Cultivation Plan for each course category and all the content required by the Extracurricular Class, with a total of 168 credits, and will be awarded a Bachelor of Engineering degree if they meet the requirements for the award of a Bachelor's degree.

VI. Discipline

Materials Science and Engineering, Chemistry

VII. Core Courses

Inorganic Chemistry, Organic Chemistry, Analytical Chemistry, Physical Chemistry, Fundamentals of Materials Science, Materials Chemistry, Materials Analysis and Testing, Polymer Chemistry and Physics, Physical and Mechanical Properties of Materials, Materials Technology

VIII. Course Structure and Course Hours (excluding Extracurricular Class)

Category	**Total Credit**	**%**	**Total Course Hours**	**Theory Learning**	**Practical Training**
Public Fundamental Course	58.5	35	1072	982	90
General Education	10	6	160	160	0
Engineering Fundamental Course	6	3	96	64	32
Professional Fundamental Course	28	17	448	448	0
Professional Course	23	14	368	336	32
Professional Practice	41.5	25	1000	0	1000
Total	167	100	3144	1990	1154
Theory: **Practical** (%)	63:37				

IX. Teaching schedule (1)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	Theory Learning	Practical	Recommended semester
Public Fundamental Course	required	School of Marxism	b1080001	Basic Principles of Marxism	test	3	48	42	6	Autumn 1
	required	School of Marxism	b1080009	Ethics and the Rule of Law	non-test	3	48	42	6	Autumn 1
	required	School of Marxism	b1080006	Outline of Modern Chinese History	non-test	3	48	42	6	Spring 1
	required	School of Marxism	b1080010	Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics	test	3	48	42	6	Spring 2
	required	School of Marxism	b1080011	Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	test	3	48	42	6	Autumn 2
	required	School of Marxism	-----	Situation and Policy (Modules 1 to 4)	non-test	2	32	28	4	Autumn 1 to Spring 2
	required	School of Marxism	b1080008	Labour Education A	non-test	0.5	16	16		Spring 1
	required	School of Mathematics, Physics and Statistics	b1020080+	Advanced MathematicsA1	test	4	64	64		Autumn 1
	required	School of Mathematics, Physics and Statistics	b1020081+	Advanced MathematicsA2	test	4	64	64		Spring 1
	required	School of Mathematics, Physics and Statistics	b1020012	Linear Algebra	test	2	32	32		Spring 1
	required	School of Mathematics, Physics and Statistics	b1020013	Probability Theory and Mathematical Statistics	test	2	32	32		Autumn 2
	required	School of Foreign Language and Cultural Communication	b1020018	Academic Chinese	non-test	2	32	32		Spring 1
	required	School of Mathematics, Physics and Statistics	b1020064	Academic Physics A (Module 3)	test	3	48	48		Spring 1
	required	School of Mathematics, Physics and Statistics	b1020065	Academic Physics B	test	2	32	32		Autumn 2
	required	School of Mathematics, Physics and Statistics	b1020111	Academic Physics C	non-test	2	32		32	Spring 1
	required	College of Physical Education	-----	Physical Education I to VI	non-test	3	160	160		Autumn 1 to Autumn 4
	required	Others	b1110003	Military skills	non-test	0.5	2W			Autumn 1
	required	Others	b1110002	Military theory	non-test	0.5	32	32		Autumn 2
	required	Others	b1080009	Mental Health Education for University Students	non-test	2	32	16	16	Autumn 1
	required	Engineering Training	b1010005	University Computer Fundamentals	non-test	2	32	32		Spring 1
	required	School of Foreign Language and Cultural Communication	b1020003	General English III	test	3	48	48		Autumn 1
	required	School of Foreign Language and Cultural Communication	b1020004	General English IV	test	3	48	48		Spring 1
	required	School of Foreign Language and Cultural Communication	b1020005	General Academic English A	test	2	32	32		Autumn 2
	required	School of Foreign Language and Cultural Communication	---	English Knowledge Expansion	non-test	2	32	32		Spring 2
	required	School of Computer and Information Engineering	b1012001	Artificial Intelligence Application and Practice	non-test	1	16	8	8	Spring 1
	required	School of Resources and Environment	b1012002	Green, Low-carbon and Ecological Civilization	non-test	1	16	16		Autumn 1
Subtotal (Public Fundamental Course)						**58.5**	**1072**	**982**	**90**	
General Education	selective	Art Education Center	b0-----	Aesthetic Education	non-test	2	32	32		Autumn, Spring
	selective	Each College	b0-----	Social Sciences and Humanistic Qualities	non-test	4	64	64		Autumn, Spring

				Natural Sciences and Technology Innovation	non-test	4	64	64		Autumn, Spring
Subtotal				**(General Education)**		**10**	**160**	**160**		

IX. Teaching schedule (2)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	Theory Learning	Practical Training	Recommended semester
Engineering Fundamental	required	Engineering Training	b2090005	Electrical and Electronic Technology	non-test	3	48	32	16	Autumn 3
	required	School of Energy and Materials	b2014001	Mechanical drawing	test	3	48	32	16	Autumn 3
subtotal (Engineering Fundamental Course)						**6**	**96**	**64**	**32**	
Professional Fundamental Course	required	School of Energy and Materials	b2013130	Inorganic chemistry	test	4	64	64		Autumn 1
	required	School of Energy and Materials	b2013099	Introduction to the Program of Materials Chemistry	non-test	1	16	16		Autumn 1
	required	School of Energy and Materials	b2013093	Organic Chemistry	test	3	48	48		Spring 1
	required	School of Energy and Materials	b2013015	Fundamentals of Materials Science	test	3	48	48		Autumn 2
	required	School of Energy and Materials	b2013031	Analytical Chemistry	test	3	48	48		Autumn 2
	required	School of Energy and Materials	b2013177	Physical Chemistry	test	3	48	48		Spring 2
	required	School of Energy and Materials	b2013007	Materials Analysis and Testing	test	3	48	48		Spring 2
	required	School of Energy and Materials	b2013035	Polymer Chemistry and Physics	test	3	48	48		Spring 2
	required	School of Energy and Materials	b2013010	Materials Chemistry	test	3	48	48		Autumn 3
	required	School of Energy and Materials	b2013175	Scientific and Technical Paper Writing and Literature Search	non-test	2	32	32		Autumn 1
Subtotal (Professional Fundamental Course)						**28**	**448**	**448**		
Professional Course	required	School of Energy and Materials	b2014002	Physical and Mechanical Properties of Materials	test	2	32	32		Spring 2
	required	School of Energy and Materials	b2013103	Materials Technology	test	2	32	32		Autumn 3
	required	School of Energy and Materials	b2013092	Applied Electrochemistry (English-taught)	test	3	48	32	16	Autumn 3
	required	School of Energy and Materials	b2013006	Material table interface	test	3	48	32	16	Spring 3
	required	School of Energy and Materials	b2013106	Nanomaterials technology	test	3	48	48		Spring 3
	required	School of Energy and Materials	b2014003	Semiconductor materials	test	3	48	48		Spring 3
	required	School of Energy and Materials	b2013032	Packaging materials and devices	non-test	2	32	32		Spring 3
	required	School of Energy and Materials	b2014004	Project Management	non-test	1	16	16		Autumn 4
	Subtotal(Required Professional Course)					**19**	**304**	**272**	**32**	
	Selective 2 Credits	School of Energy and Materials	b2013005	Thin film materials and preparation technology	non-test	2	32	32		Spring 3
		School of Energy and Materials	b2013033	Composite materials	test	2	32	32		Spring 3
		School of Energy and Materials	b2013029	Electronic chemicals	non-test	2	32	32		Spring 3
	Selective 2 Credits	School of Energy and Materials	b2013086	Introduction to New Energy Materials	non-test	2	32	32		Autumn 4
		School of Energy and Materials	b2013069	Energy saving materials for buildings	non-test	2	32	32		Autumn 4
		School of Energy and Materials	b2013111	Optoelectronic materials and devices	non-test	2	32	32		Autumn 4
	Subtotal (Selective Professional Course)					**4**	**64**	**64**		

Subtotal (Professional Course)		**23**	**368**	**336**	**32**	

IX. Teaching schedule (3)

Category	Type	Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	Theory Learning	Practical Training	Recommended semester
Professional Practice	required	School of Energy and Materials	b4013052	Inorganic chemistry experiments	non-test	1	24		24	Autumn 1
	required	School of Energy and Materials	b4013043	Organic chemistry experiments	non-test	1	24		24	Spring 1
	required	Engineering Training	b4090003	Basic Engineering Training C	non-test	2	48		48	Summer 1
	required	School of Energy and Materials	b4013076	Cognitive Placement	non-test	1	24		24	Summer 1
	required	School of Energy and Materials	b4013015	Analytical chemistry experiments	non-test	1	24		24	Autumn 2
	required	School of Energy and Materials	b4013017	Polymer chemistry and physics experiments	non-test	1	24		24	Spring 2
	required	School of Energy and Materials	b4013036	Academic Lectures	non-test	1	24		24	Summer 2
	required	School of Energy and Materials	b4013035	Physical chemistry experiments	non-test	1	24		24	Summer 2
	required	School of Energy and Materials	b4014040	Comprehensive Experiment - Preparation and Application of Smart Sensing Materials	non-test	3	72		72	Summer 2
	required	School of Energy and Materials	b4013001	Materials Chemistry experiments	non-test	1	24		24	Autumn 3
	required	School of Energy and Materials	b4014002	Comprehensive Experiment - Preparation and Application of Green Catalytic Materials	non-test	3	72		72	Autumn 3
	required	School of Energy and Materials	b4013087	Labour Education B	non-test	0.5	16		16	Spring 3
	required	School of Energy and Materials	b4000002	the Program of Materials Chemistry Innovation and Entrepreneurship	non-test	2	48		48	Spring 3
	required	School of Energy and Materials	b4014005	Basic training in battery materials	non-test	2	48		48	Summer 3
	required	School of Energy and Materials	b4013079	Professional internships	non-test	1	24		24	Summer 3
	required	School of Energy and Materials	b4014018	Comprehensive Experiment - Preparation and application of photocatalytic materials	non-test	3	72		72	Autumn 4
	required	School of Energy and Materials	b4013002	Materials Chemistry Graduation Internship and Graduation Design (Thesis)	non-test	12	288		288	Spring 4
				Subtotal(Required Professional Practice)		**36.5**	**880**		**880**	
	Selective 3 Credits	School of Energy and Materials	b4014003	Comprehensive Experiment - Preparation and Application of Thermally Conductive	non-test	3	72		72	Spring 3
		School of Energy and Materials	b4014004	Comprehensive Experiment - Preparation and Application of Thermoelectric Materials	non-test	3	72		72	Spring 3
	Selective 2 Credits	School of Energy and Materials	b4014006	Comprehensive Experiment - Preparation and application of thermal interface materials	non-test	2	48		48	Summer 3
		School of Energy and Materials	b4014007	Comprehensive experiment - Preparation and performance testing of thermal storage materials	non-test	2	48		48	Summer 3
				Subtotal(Selective Professional Practice)		**5**	**120**		**120**	
				Subtotal(Professional Practice)		**41.5**	**1000**		**1000**	
Extracurricular	required	Others	b5110001	Extracurricular Class	non-test	**1**	-	-	-	Autumn, Spring,
				Total		**168**	**3144**	**1990**	**1154**	

★Explanation of the relevance of professional certificates to the course:

Students will learn analytical chemistry, analytical chemistry experiments, materials analysis and testing, and materials structure characterization, and will be able to sit for the vocational qualification examinations related to this subject: chemical analyst, chemical examiner, and materials composition examiner.

XI. Extracurricular Class

Through taking extracurricular classes, students are encouraged to take part in academic lectures, social practice activities, campus cultural and sports activities, innovative and entrepreneurial activities, voluntary activities, etc. to improve their social adaptability and enhance the competitiveness in the job market. Details are specified in Students' Manual.