Materials Science and Engineering

(Grade 2023)

Course code: 080401

I. Cultivation Objectives

1. General cultivation objective

This program cultivates technical talents who have good overall development in moral, intellectual, physical, aesthetic and labour aspects, have spirit of "strong conviction, hard work and commitment", master the basic theory, professional knowledge and application skills of materials science and engineering, adapt to the rapid technological development of new energy industry, meet the needs of national and Yangtze River Delta economic construction, and are competent in the design, research and development, production, operation and management of new energy materials and devices in the emerging industries and new economy of efficient "energy production", "energy storage" and "energy conservation"..

2. Objective of value guidance

The program takes moral education as the core of education, practices the core values of socialism, highlights the promotion of the spirit of model workers and craftsmanship, cultivates students to develop a rigorous and meticulous, dedicated and responsible work attitude, and to have the quality of strong conviction, hard work and commitment" to promote the development of the national new energy materials and their comprehensive development and utilization industry. The programme is designed to promote the development of new energy materials and the comprehensive development and utilization of new energy materials industry.

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

(1) Professional foundation and skills: Have solid knowledge of mathematics, physics, chemistry and other natural sciences; have basic knowledge of engineering theory such as electrical and electronics, engineering drawing, computers and certain knowledge of engineering management; have professional knowledge and technology in the field of Materials Science and Engineering, to analyse and research complex engineering problems in the fields of high-efficiency energy storage, high-efficiency energy transfer and high-efficiency energy conservation and to propose system solutions.

(2) Career orientation: Be able to follow the frontier technology of new energy Materials Science and Engineering and related fields, with the ability of engineering practice and innovative thinking. Be able to undertake the production, management, research and development, design and other work of new new energy materials and devices, and reach the level of engineer practice.

(3) Basic qualities: Be familiar with the important laws, regulations and policies of the professions and industries related to materials and new energy, have good moral and humanistic qualities, have a sense of law, environment and sustainability, and be able to abide by professional ethics and social responsibility.

(4) Social skills: Have good interpersonal skills, organizational 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.

(5) Self-development: Understand the laws of the development of new energy materials technology, continuously improve the application ability and level, have the habit and ability of self-development and lifelong learning, and be able to actively adapt to the changes and development of the professional environment.

II. Graduation requirements

1. Engineering knowledge: Have the ability to apply mathematical, natural science and engineering fundamentals and professional knowledge to complex engineering problems in the field of Materials Science and Engineering.

1-1 Have knowledge of Advanced Mathematics, Probability Theory, Linear Algebra and the basic methods of applying them to the formulation, modelling and solution of Materials Science and Engineering problems, with strong logical thinking skills and mathematical applications.

1-2 Master a basic knowledge of the natural sciences such as physics, chemistry and mechanics that can be used in the design, calculation and analysis of complex Materials Science and Engineering problems.

1-3 Have knowledge of mechanical, electrical and electronic engineering techniques and engineering principles, and the ability to apply relevant engineering fundamentals to preliminary engineering design.

1-4 Master basic theoretical and professional knowledge of Materials Science and Engineering and new energy sources, and be able to apply them to complex engineering problems in the field of new energy Materials Science and Engineering by combining mathematical, natural science and engineering knowledge.

2. Analysis of the Problem: Have the ability to apply the fundamental principles of mathematics, natural sciences and engineering sciences to identify, represent, and analyse complex engineering problems in Materials Science and Engineering through literature research in order to reach valid conclusions.

2-1 Demonstrate the ability to formulate and model complex Materials Science and Engineering problems using the fundamental principles of mathematics, natural and engineering sciences studied.

2-2 Be able to express scientific and engineering problems of complex new energy-related materials and devices and seek their solutions based on the fundamental principles of materials science and engineering and related fundamental knowledge.

2-3 Be able to apply the fundamental principles of the relevant sciences and draw on literature research to analyse complex engineering problems in the preparation/processing and application of new energy materials and their devices and to obtain valid conclusions.

3. Design/develop of solutions: Be able to conceptualize and design solutions to complex engineering problems in the field of Materials Science and Engineering based on CDIO engineering concepts, and design systems, units (components) or processes that meet the specific needs of the new energy field, and be able to demonstrate a sense of innovation in the design process, taking into account social, health, safety, legal, cultural and environmental factors.

3-1 Understand the full process of materials product development and the basic methods of its process design, and understand the various factors that influence the product development process and process design.

3-2 Be able to address complex engineering problems in the field of Materials Science and Engineering based on the fundamental laws of material composition, organization, structure and properties, through the rational design of processes, the correct selection of materials and the development of processing techniques to meet specific needs.

3-3 Be able to develop innovative design solutions that take into account social, health, safety, legal, cultural and environmental considerations in the engineering design and development of Materials Science and Engineering.

4. Research: Have the ability to apply scientific principles and methods to complex engineering problems in the field of Materials Science and Engineering, including designing experiments, analyzing and interpreting data, and synthesizing information to reach reasonable and valid conclusions.

4-1 Be able to analyse relevant phenomena and properties in Materials Science and Engineering problems based on scientific principles, basic principles of engineering technology and experimental analysis methods.

4-2 Be able to apply the basic principles and scientific methods of Materials Science and Engineering to select research pathways and design experimental protocols based on practical new energy engineering problems.

4-3 Be able to optimize experimental plans, select or build experimental platforms, collect experimental data scientifically, analyse and interpret experimental research results, and draw reasonable and valid conclusions through information synthesis for complex engineering problems in the field of Materials Science and Engineering.

5. Use of modern tools: Have the ability to develop, select and use appropriate techniques, resources, modern engineering tools and information technology tools for complex engineering problems in Materials Science and Engineering, including the prediction and simulation of complex engineering problems in Materials Science and Engineering and new energy sources, and to understand their limitations.

5-1 Have knowledge of the principles and methods of using engineering graphics and computer-aided design and understanding of their limitations.

5-2 Be able to develop, select and use modern specialist testing equipment and analytical tools for complex engineering problems in the field of Materials Science and Engineering, to effectively use modern materials and device analysis tools to predict and simulate complex engineering problems, and be able to analyse and understand their limitations.

6. Engineering and Society: Have the ability to undertake sound analysis based on background knowledge of engineering and to evaluate the social, health, safety, legal and cultural impacts of engineering practices and solutions to complex engineering problems in the field of Materials Science and Engineering, and to understand the responsibilities involved.

6-1 Have the knowledge of Materials Science and Engineering and the technical standards, industrial policies and laws and regulations, and culture of the new energy-related industries.

6-2 Be able to objectively analyse and evaluate the social, health, safety, legal and cultural impacts of engineering practices and solutions to complex engineering problems in the field of Materials Science and Engineering, and understand the responsibilities involved.

7. Environment and Sustainable Development: Have the ability to understand and evaluate the impacts of professional engineering practice on environmental and social sustainability in relation to complex engineering problems in the field of Materials Science and Engineering.

7-1 Understand national strategies and related policies, laws and regulations for energy, environment and social sustainability, and be able to develop a concept of environmental protection and sustainable development and an understanding of its impacts.

7-2 Be able to understand and evaluate the impacts of engineering practice on environmental and social sustainability for complex engineering problems related to the field of Materials Science and Engineering.

8. Professional Codes: Have humanities and social sciences literacy, social responsibility and the ability to understand and comply with engineering ethics and codes of practice and responsibilities in the field of Materials Science and Engineering.

8-1 Have knowledge of literature, history, philosophy, law and ethics and other humanities, understanding of national conditions and history, and humanities and social science literacy.

8-2 Be able to understand and comply with professional ethics and codes of conduct in the practice of engineering in the field of materials science and engineering. Be able to exercise conscious responsibility and a sense of social responsibility.

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

9-1 Demonstrate interpersonal and teamwork skills with the ability to work independently or cooperatively in a team.

9-2 Be able to do well in the roles they assume in a multidisciplinary context and organize, be able to coordinate and direct the work of a team.

10. Communication: Have the ability to communicate effectively with industry peers and the public on complex engineering issues in the field of Materials Science and Engineering, including writing reports, briefs design, making presentations, expressing views clearly and answering questions; have a good command of a foreign language, an international perspective and the ability to communicate and interact in a cross-cultural context.

10-1 Master the methods and presentation skills of writing technical documents or scientific papers, and have the ability to write reports, design presentations, present speeches and express themselves clearly, and be able to communicate and interact effectively with industry peers and the public on complex engineering issues in the field of Materials Science and Engineering related to new energy.

10-2 Master a foreign language, understand international trends and research hotspots in the field of Materials Science and Engineering, and have a certain international perspective and the ability to communicate and interact in a cross-cultural context.

11. Project Management: Understand and master the principles of engineering management and apply them in a multidisciplinary environment.

11-1 Have knowledge of the relevant engineering management principles involved in the practical activities of energy engineering.

11-2 Be able to apply engineering management methods in a multidisciplinary environment and in the process of engineering design and technology development in the field of new energy related Materials Science and Engineering.

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

12-1 Be able to recognize the importance of continuous exploration and learning in the context of social and technological development; have the ability to continuously acquire new knowledge through literature research, specialized communication, engineering practice, etc. and have an consciousness of independent and lifelong learning.

12-2 Be physically fit and have the ability to continually learn and adapt to development.

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 166 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

VII. Core Courses

Physical Chemistry, Fundamentals of Materials Science, Introduction to Solid State Physics, Structure and Properties of Materials, Materials Chemistry, Nanomaterials Technology, Chemical Power Sources, New Energy Technologies and Applications, Thin Film Materials and Device Preparation Technologies, Fundamentals of Materials Engineering

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

Category	**Total Credit**	**%**	**Total Course Hours**	**Theory Learning**	**Practical Training**
Public Fundamental Course	56.5	34	1040	960	80
General Education	10	6	160	160	0
Engineering Fundamental Course	10	6	160	128	32
Professional Fundamental Course	22	14	352	336	16
Professional Course	25	15	400	400	0
Professional Practice	41.5	25	1000	0	1000
Total	165	100	3112	1984	1128
Theory: **Practical** (%)	64:36				

IX. Teaching schedule (1)

Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	Theory Learning
School of Marxism	b1080001	Basic Principles of Marxism	test	3	48	42
School of Marxism	b1080009	Ethics and the Rule of Law	non-test	3	48	42
School of Marxism	b1080006	Outline of Modern Chinese History	non-test	3	48	42
School of Marxism	b1080010	Introduction to Mao Zedong Thought and the Theoretical System of Socialism with Chinese Characteristics	test	3	48	42
School of Marxism	b1080011	Introduction to Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era	test	2	32	28
School of Marxism	-----	Situation and Policy (Modules 1 to 4)	non-test	2	32	28
School of Marxism	b1080008	Labour Education A	non-test	0.5	16	16
School of Mathematics, Physics and Statistics	b1020080+	Advanced MathematicsA1	test	4	64	64
School of Mathematics, Physics and Statistics	b1020081+	Advanced MathematicsA2	test	4	64	64
School of Mathematics, Physics and Statistics	b1020012	Linear Algebra	test	2	32	32
School of Mathematics, Physics and Statistics	b1020013	Probability Theory and Mathematical Statistics	test	2	32	32
School of Foreign Language and Cultural Communication	b1020018	Academic Chinese	non-test	2	32	32
School of Mathematics, Physics and Statistics	b1020064	Academic Physics A (Module 3)	test	3	48	48
School of Mathematics, Physics and Statistics	b1020065	Academic Physics B	test	2	32	32
School of Mathematics, Physics and Statistics	b1020111	Academic Physics C	non-test	2	32	
College of Physical Education	-----	Physical Education I to VI	non-test	3	160	160
Others	b1110003	Military skills	non-test	0.5	2W	
Others	b1110002	Military theory	non-test	0.5	32	32
School of Foreign Language and Cultural Communication	b1020003	General English III	test	3	48	48
School of Foreign Language and Cultural Communication	b1020004	General English IV	test	3	48	48
School of Foreign Language and Cultural Communication	b1020005	General Academic English A	test	2	32	32
School of Foreign Language and Cultural Communication	---	English Knowledge Expansion	non-test	2	32	32
Engineering Training	b1010005	University Computer Fundamentals	non-test	2	32	32
Others	b1110004	Mental Health Education for University Students	non-test	2	32	16
Subtotal (Public Fundamental Course)				**56.5**	**1040**	**960**
Art Education Center	b0----	Aesthetic Education	non-test	2	32	32
Each College	b0----	Social Sciences and Humanistic Qualities	non-test	4	64	64
		Natural Sciences and Technology Innovation	non-test	4	64	64
Subtotal (General Education)				**10**	**160**	**160**

IX. Teaching schedule (2)

Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	Th Lea
School of Energy and Materials	b2013147cl	Mechanics of Materials	test	2	32	
School of Energy and Materials	b2013146cl	Mechanical drawing	test	4	64	
Engineering Training	b2090009	Electrical and Electronic Technology	test	4	64	
Subtotal (Engineering Fundamental Course)				**10**	**160**	
School of Energy and Materials	b2013098cl	Introduction to the Program of Materials Science and Engineering	non-test	1	16	
School of Energy and Materials	b2013133cl	Fundamentals of Materials Science I	test	2	32	
School of Energy and Materials	b2013148cl	Fundamentals of Materials Science II	test	2	32	
School of Energy and Materials	b2014022cl	Inorganic Chemistry	test	2	32	

School of Energy and Materials		b2014023cl	Organic Chemistry	test	2	32	
School of Energy and Materials		b2013081cl	Physical Chemistry	test	4	64	
School of Energy and Materials		b2013114cl	Introduction to Solid State Physics	test	2	32	
School of Energy and Materials		b2014005cl	Materials Chemistry	test	2	32	
School of Energy and Materials		b2013013cl	Material structure and properties	test	3	48	
School of Energy and Materials		b2013131cl	Materials Analysis and Testing	test	2	32	
Subtotal (Professional Fundamental Course)					**22**	**352**	3
School of Energy and Materials		b2014008cl	Chemical power supplies	test	2	32	
School of Energy and Materials		b2014009cl	New Energy Technology and Applications	non-test	2	32	
School of Energy and Materials		b2013009cl	Fundamentals of Materials Engineering	test	2	32	
School of Energy and Materials		b2013034cl	Polymers	test	3	48	
School of Energy and Materials		b2013072cl	Nanomaterials technology	test	2	32	
School of Energy and Materials		b2013005cl	Thin film materials and preparation technology	test	2	32	
School of Energy and Materials		b2013134cl	Energy Engineering Management	non-test	2	32	
School of Energy and Materials		b2014021	Scientific and Technical Paper Writing and Literature Search	non-test	1	16	
School of Energy and Materials		b2014007cl	Ethics in Engineering	non-test	1	16	
Subtotal(Required Professional Course)					**17**	**272**	2
	Module A	b2013149cl	Energy electrochemistry	non-test	2	32	
		b2013020cl	Energy Storage Materials and Technologies	non-test	2	32	
		b2013135cl	Lithium-ion battery principles and key technologies	non-test	2	32	
		b2013136cl	Hydrogen and fuel cell technology	non-test	2	32	
		b2013019cl	Supercapacitor Materials and Technologies	non-test	2	32	
		b2013137cl	Power Battery Technology and Applications	non-test	2	32	
	Module B	b2013003cl	Semiconductor Physics and Devices	non-test	2	32	
		b2013138cl	Heat Transfer in Materials	non-test	2	32	
		b2013139cl	Energy efficient materials and technologies	non-test	2	32	
		b2013140cl	Thermal Energy Conversion and Utilization	non-test	2	32	
		b2013141cl	Semiconductor Light Emitting Materials and Devices	non-test	2	32	
		b2013068cl	Introduction to Computational Materials Science	non-test	2	32	
	Module C	b2011064cl	Photovoltaic power generation technology	non-test	2	32	
		b2013142cl	Energy Conversion Materials and Devices	non-test	2	32	
		b2013143cl	Solar power systems and applications	non-test	2	32	
		b2013121cl	New solar cell materials	non-test	2	32	
		b2013144cl	Photothermal power generation technology and applications	non-test	2	32	
		b2013145cl	Solar cell process principle	non-test	2	32	
Subtotal (Selective Professional Course)					**8**	**128**	1
Subtotal (Professional Course)					**25**	**400**	4

IX. Teaching schedule (3)

Provided by	Course Code	Course Name	Assessment	Credit	Course Hours	The Lear
neering Training	b4090003	Basic Engineering Training C	non-test	2	48	
ol of Energy and Materials	b4014019cl	Inorganic Chemistry experiments	non-test	1	24	
ol of Energy and Materials	b4013073cl	Orientation	non-test	1	24	
ol of Energy and Materials	b4013050cl	Students participation in research practice	non-test	1	24	
ol of Energy and Materials	b4013036cl	Academic Lectures	non-test	1	24	
ol of Energy and Materials	b4013068cl	Tier 1 Project I (Introduction to New Energy Materials and Devices)	non-test	2	48	
ol of Energy and Materials	b4000003cl	the Program of Materials Science and Engineering Innovation and Entrepreneurship	non-test	2	48	
ol of Energy and Materials	b4013069cl	Materials analysis experiments	non-test	2	48	
ol of Energy and Materials	b4013060cl	Practice for New Energy Materials Engineering	non-test	2	48	
ol of Energy and Materials	b4013086cl	Training in the testing and analysis of thermophysical properties of materials	non-test	3	72	
ol of Energy and Materials	b4014009cl	Solar photothermal catalytic hydrogen precipitation	non-test	2	48	
ol of Energy and Materials	b4013067cl	Tier 1 Project II (Advanced New Energy Materials and Device Design)	non-test	2	48	
ol of Energy and Materials	b4013087	Labour Education B	non-test	0.5	16	
ol of Energy and Materials	b4013003	Materials Science and Engineering Graduation Internship and Graduation Design (Thesis)	non-test	12	288	
Subtotal(Required Professional Practice)				**33.5**	**808**	
Module A	b4014010cl	Level II project (chemical cell system)	non-test	4	96	
	b4014011cl	Level 2 projects (supercapacitors)	non-test	4	96	
	b4014012cl	Tier 2 project (electrochemical catalytic hydrogen precipitation)	non-test	4	96	
Module B	b4014013cl	Level 2 project (LED energy saving lamps)	non-test	4	96	
	b4014014cl	Secondary projects (solar photovoltaic - cogeneration)	non-test	4	96	
	b4014015cl	Secondary projects (waste heat conversion and utilization)	non-test	4	96	
Module C	b4014016cl	Secondary project (dye-sensitised solar cells)	non-test	4	96	
	b4014017cl	Tier 2 Project (Calcium Titanium Ore Solar Cells)	non-test	4	96	
	b4014018cl	Level II project (electrochromic devices)	non-test	4	96	
Subtotal(Selective Professional Practice)				**8**	**192**	

Subtotal(Professional Practice)				**41.5**	**1000**	
Others	b5110001	Extracurricular Class	non-test	**1**	-	-
Total				**166**	**3112**	**19**

1. Description of Selective Professional Course and Selective Practice:

The modular Professional Courses modules A, B and C correspond to the three directions of New Energy Efficient Storage Materials and Devices, New Energy Efficient Energy Saving Materials and Devices and New Energy Efficient Conversion Materials and Devices respectively.

When choosing the professional courses corresponding to the modules, students can only choose one of the modules A, B and C and complete the professional courses of that module in the Autumn 3 and Spring 3 semesters. The selective professional practice Module A, B and C in Summer 3 semester correspond to selective professional courses module A, B and C respectively, and students can only select selective professional practice courses in accordance with this correspondence (see Part 18: Topology Map).

2. Explanation of the relevance of professional certificates to the course:

Through the courses of photovoltaic power generation technology, new solar cell materials, building energy-saving technology and energy-saving materials, energy engineering management and new energy power generation technology, students can take the assessment of vocational qualifications related to this program or have the ability to take the relevant vocational qualifications in the future: photovoltaic engineer, energy-saving and emission reduction engineer, new energy engineer.

X. Credit of 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.