

Class Syllabus – Fall Semester, 115 Academic Year

Department of Mechanical Engineering, National Chung Cheng University

Course Name: : Material Science and Engineering				Dept.		IBPME	
				Course Code		4232906	
Instructors	Yi-Sheng Lai	Credits	3	Elective	Grade	Second-Year	
EMI	☒ Yes ☐ No						
Course type	☐ Humanistic Care Course ☒ Problem-oriented Course ☐ Integrate the curriculum ☐ Internship ☐ Competition Special Course ☒ Topic-based courses ☐ Practical courses ☐ Other						
Prerequisites: Chemistry Class Description : Materials science plays a crucial role in all aspects of life, encompassing the properties of matter and its comprehensive applications in science and engineering. This course, Materials Science and Engineering, helps students think theoretically to address and solve engineering problems. Class Objective : This course aims to help students understand materials preparation and processing techniques, design principles, and the interrelationships between the microstructure and macroscopic properties of materials. It will foster well-rounded engineering thinking, enabling students to excel in various fields, including chemical engineering, mechanical engineering, electrical engineering, electronic engineering, civil engineering, and architectural engineering.							
Textbooks							
An overview of the main points of teaching							
Teaching Materials	☒ PPT ☐ Self-edited textbooks ☐ Self-made instructional videos ☒ Course handouts ☐ Teaching Procedures ☐ Other						
Teaching Methods	☒ Lectures ☒ Oral presentation ☒ Case studies ☒ Group discussion ☒ Problem-oriented learning ☒ Other						
Evaluation Tools	☒ Mid-term Exam ☒ In-class Quiz ☒ Homework ☒ Final Report ☒ Other ☒ Final Exam ☒ In-class homework ☒ Mid-term Report ☒ Special Report ☒ Scales						

Teaching Resources	☒ Course website ☐ Electronic files of textbooks are available for download ☐ Internship website					
Instructor's Information	/					
Course Outlines		Teaching Hours				Core Competence
Unit Title	Contents	Lectures	Demo	Practice	Other	
Introduction to Materials Science and Engineering	1. Materials and Engineering 2. Materials Science and Engineering 3. Competition Among Materials Design and Selection	6		2	1	B1, B2, B3, B4, B6
Atomic Structure and Bonding	1. The structure of Atoms 2. Atomic numbers and Atomic Masses 3. The electronic Structure of Atoms Types of Atomic and molecular	6		2	1	B1, B2, B3, B4, B6
Crystal and Amorphous Structures in Materials	1. The space lattice and unite cells 2. Crystal systems and Bravais Lattices 3. Atom positions in unit cell Crystallographic planes and directions	6		2	1	B1, B2, B3, B4, B6
Solidification and Crystalline Imperfections	1. Solidification of metals 2. Solidification of single crystals 3. Metallic solid solutions Crystalline imperfections	6		2	1	B1, B2, B3, B4, B6
Thermally Activated Processes and Diffusion in Solids	1. Rate processes in solids 2. Atomic diffusion in solids Industrial applications of diffusion processes	6		2	1	B1, B2, B3, B4, B6
Mechanical Properties of Metals	1. The processing of metals and alloys 2. Stress and strain in metals 3. Tensile test 4. Hardness 5. Plastic deformation Fracture of metal	6		2	1	B1, B2, B3, B4, B6
Phase Diagrams	1. Gibbs phase rule 2. Cooling curves 3. Binary isomorphous alloy systems Nonequilibrium solidification of alloys	6		2	1	B1, B2, B3, B4, B6
Engineering Alloys	1. production of iron and steel 2. Iron carbide system 3. Heat treatment Alloy	6		2	1	B1, B2, B3, B4, B6

Polymeric Materials	1. Polymerization reactions 2. Industrial polymerization methods 3. Crystallinity and stereoisomerism in some thermoplastics Processing of plastic materials	6		2	1	B1, B2, B3, B4, B6
Ceramics	1. Simple ceramic crystal structure 2. Silicate structures 3. Processing of ceramics Glasses	6		2	1	B1, B2, B3, B4, B6
Composite Materials	1. Fiber for reinforced-plastic composite materials 2. Open mold processes 3. Concrete 4. Wood Bone	6		2	1	B1, B2, B3, B4, B6
Corrosion	1. General 2. Electrochemical corrosion of Metals 3. Galvanic cells 4. Corrosion rates Types of corrosion	6		2	1	B1, B2, B3, B4, B6
Electrical Properties of Materials	1. Electrical conduction in metals 2. Energy band model for electrical conduction 3. Intrinsic semiconductors 4. Extrinsic semiconductors Semiconductor devices	6		2	1	B1, B2, B3, B4, B6
Optical Properties and Superconductive Materials	1. Light and the electromagnetic spectrum 2. Refraction of light 3. Absorption, transmission and reflection of light 4. Luminescence Stimulated Emission of radiation and laser	6		2	1	B1, B2, B3, B4, B6
Magnetic Properties	1. Magnetic fields and quantities 2. Types of magnetism Effect of temperature on Ferromagnetism	6		2	1	B1, B2, B3, B4, B6
Presentation	Paper review presentation	1		1	1	B3, B5, B6, B7, B8, B9, B10
Achievable Core Competence		Achievable Objective				
B1	Possess the ability of basic engineering mathematics, solid mechanics, heat flow mechanics, automatic control, materials science and opto-mechanical integration engineering practical analysis	Possess the ability of basic engineering mathematics, solid mechanics, heat flow mechanics, automatic control, materials science and opto-mechanical integration engineering practical analysis				
B2	Ability to absorb and integrate cross-domain knowledge	Ability to absorb and integrate cross-domain knowledge				

B3	Ability to perform solid force experiments, heat flow experiments, mechanical project implementation, optoelectronic engineering experiments and analyze data	Ability to perform solid force experiments, heat flow experiments, mechanical project implementation, optoelectronic engineering experiments and analyze data
B4	Ability to write programming languages and computer-aided design	Ability to write programming languages and computer-aided design
B5	Mechanical and opto-electromechanical systems, component design and process planning capabilities	Mechanical and opto-electromechanical systems, component design and process planning capabilities
B6	Ability to identify, analyse and solve professional problems	Ability to identify, analyse and solve professional problems
B7	Ability to implement and innovate	Ability to implement and innovate
B8	Ability to engage in scientific writing and presentations	Ability to engage in scientific writing and presentations
B9	Ability to work as a team, communicate effectively and manage the program	Ability to work as a team, communicate effectively and manage the program
B10	Learn general knowledge and demonstrate the ability of engineering ethics, social responsibility and sustainable development	Learn general knowledge and demonstrate the ability of engineering ethics, social responsibility and sustainable development

Core competencies of the University Division

B1 Possess the ability of basic engineering mathematics, solid mechanics, heat flow mechanics, automatic control, materials science and opto-mechanical integration engineering practical analysis

B2 Ability to absorb and integrate cross-domain knowledge

B3 Ability to perform solid force experiments, heat flow experiments, mechanical project implementation, optoelectronic engineering experiments and analyze data

B4 Ability to write programming languages and computer-aided design

B5 Mechanical and opto-electromechanical systems, component design and process planning capabilities

B6 Ability to identify, analyse and solve professional problems

B7 Ability to implement and innovate

B8 Ability to engage in scientific writing and presentations

B9 Ability to work as a team, communicate effectively and manage the program

B10 Learn general knowledge and demonstrate the ability of engineering ethics, social responsibility and sustainable development

Weekly teaching plan				
Course Time	Course Location	Grading	Office hour	Teaching quality evaluation method
Tue 14:10-16:00 Thu 14:10-15:00	Engineering Building II R117	- Attendance, Assignments, and In-Class Presentations: 30% - Midterm Exam: 35% - Final Exam: 35% “The instructor reserves the right to adjust or modify the grading criteria and assessment details as necessary to accommodate the actual course implementation.”	Wed 13:00~14:00	Questionnaire
Weeks	Teaching & Homework Progress			Note
1	Introduction to Materials Science and Engineering			
2	Atomic Structure and Bonding			
3	Crystal and Amorphous Structures in Materials			
4	Solidification and Crystalline Imperfections			
5	Thermally Activated Processes and Diffusion in Solids			
6	Mechanical Properties of Metals I			
7	Phase Diagrams			
8	Engineering Alloys			
9	Midterm Exam			
10	Polymeric Materials			
11	Ceramics			
12	Composite Materials			
13	Corrosion			
14	Electrical Properties of Materials			
15	Optical Properties and Superconductive Materials			

16	Magnetic Properties	
17	Presentation	
18	Final Exam	

Others: The instructor reserves the right to modify the course content based on students' level of understanding.