Class Syllabus – Fall Semester, 115 Academic Year

Department of Mechanical Engineering, National Chung Cheng University

Course Name: Engineering Materials				Dept.		IBPME
				Course Code		4232007
Instructors	**Pei-Chen Huang**	Credits	3	Compulsory	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:
General Physics or General Chemistry

Class Description:
The course contents and aims are the introduction of fundamental material science on atomic structure, crystal structure, common engineering materials, and so on. The properties, behaviors, processing, estimation approach will be systemically explained and understand the material performance, majority on the mechanical, electrical, thermal, and optical properties of metals, ceramics, polymers, and semiconductor materials. Throughout, emphasis is on the processing-structure-properties-performance in mechanical and opto-electromechanical applications.

Class Objective:

The object of this course is to enable students to understand the correlation and relationship between the internal structure of materials from atomic level to microstructure level to macroscale level. After learning this course, the student is able to interpret material behavior in terms of underlying structural mechanisms, and use quantitative approaches to characterize physical properties of materials, and exercise informed judgment in materials selection and engineering design under real-world demands.

Textbooks	W.D. Callister, Materials Science and Engineering, Taiwan Edition, Wiley, 2026 (滄海書局代理) **Please respect intellectual property rights and do not illegally photocopy textbooks specified by the instructor.**

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 ■ Final Exam □ In-class Quiz □ In-class homework ■ Homework □ Mid-term Report □ Final Report □ Special Report ■ Other □ 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	
Atomic structures and crystallography	1. Atomic structures 2. Crystal systems 3. Crystallographic directions/planes 4. X ray diffraction on crystalline materials	12				B1 B2 B5 B6
Diffusion and mechanical properties	1. Ceramics and carbon 2. Diffusion 3. Mechanical testing and properties	8				B1 B2 B5 B6
Crystalline defects and microstructure examination	1. 1.1D, 2D, 3D defects 2. Ceramics and carbon isomorphs 3. Metallographic preparation	7				B1 B2 B6
Strengthening of materials	1. Dislocations 2. Slip systems 3. Recovery and recrystallization 4. Strengthening mechanisms	10				B1 B2 B5 B6
Phase diagrams	1. Solubility curves 2. Binary isomorphous system 3. Binary eutectic system 4. Binary peritectic system 5. Iron-carbon phase diagram	11				B1 B2 B5 B6
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	Quantitative treatment and study of elastic and plastic deformation, stress–strain analysis, and thermally activated processes, diffusion, and phase diagrams, the students consolidate the mathematical and mechanics foundations required for practical engineering analysis.
B2	Ability to absorb and integrate cross-domain knowledge	By systematically linking material processing routes to resulting microstructures and properties, the course trains students to integrate knowledge across mechanical, materials, and opto-electromechanical domains.
B5	Mechanical and opto-electromechanical systems, component design and process planning capabilities	Study of the principal material classes and their electrical, thermal, and optical responses equips students to select appropriate materials, anticipate processing-induced effects, and contribute to component design and process planning for multidisciplinary systems.
B6	Ability to identify, analyse and solve professional problems	Coverage of failure mechanisms with case-based discussion of materials selection, develops students' capacity to identify the root causes of engineering failures, analyze them using appropriate materials-science principles, and technically justified solutions to professional problems.

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
Mon 10:10-13:00	Engineering Building II R116	Midterm Exam I: 25% Midterm Exam II: 25% Final Exam: 25% Attendance: 5% Assignments: 20%	Fri. 10:10-12:00	Questionnaire

Weeks	Teaching & Homework Progress	Note
1	Atomic structure and inter-atomic bonding	
2	Crystal structures	
3	Crystallographic points/ directions	
4	Crystallographic planes	
5	X-ray diffraction	
6	Ceramic structure	
6	Midterm I (Chap.1-3)	
7	Diffusion	
8	Carbon/Point defects	
9	Microscopic examination	
10	Mechanical properties	
11	Dislocations/ Slip systems/Slip in single crystals	
12	Recovery, recrystallisation	
13	Failure and fracture	
13	Midterm II (Chap.5-9)	
14	Binary isomorphous phase diagrams	
15	Binary eutectic system	
16	Peritectic system, Gibbs phase rule	

17	The iron-carbon system	
18	Final exam	