

Department of Mechanical Engineering, Academic Year 2024, 2nd Semester Syllabus (EN)

Course title : (Chinese) 材料分析與檢測 (English) Materials Analysis and Characterization					Dept.	Mech. Engrg.
					Code	4208354
Lecture	.Jong-Ning Aoh	credits	3	optional	Class	Graduate/senior
全英文授課 EMI	<input checked="" type="checkbox"/> 是 <input type="checkbox"/> 否					
Preliminary course required: Physics, Chemistry, Engineering Materials, Strength of Materials,						
Description: This course provides students with fundamental understanding on principles and techniques of modern materials analysis and characterization with emphasis on analysis of metallic and electronic materials. Fundamental knowledge on crystal structures of materials and microstructures of materials will be reviewed. Principles, instruments and techniques on optical microscopy, transmission and scanning electron-microscopy (SEM/TEM), X-ray diffraction (XRD), energy-dispersive spectroscopy (EDS), electron beam spectral diffraction (EBSD), and Raman spectroscopy are explained in details. <b style="color: red;">THIS COURSE IS AN EMI COURSE AND IS TAUGHT IN ENGLISH.						
Goal: The purpose of this course is to equip students with basic ability to carry out materials analysis using modern instruments.						
Textbooks /References	1. 材料分析(2 nd . Ed.)，汪建民主編，中國材料科學學會 2014 Reference books: 2. Wachtman, J.B. Characterization of Materials. Boston: Butterworth Heinemann, 1993. 3. S. K. Sharma (Ed), Handbook of Materials Characterization, Springer Verlag, 2018					
教學要點概述						
教材編選 teaching materials	<input checked="" type="checkbox"/> 自製簡報(ppt) <input checked="" type="checkbox"/> 課程講義 <input type="checkbox"/> 自編教科書 <input type="checkbox"/> 教學程式 <input checked="" type="checkbox"/> 自製教學影片 <input checked="" type="checkbox"/> 專業教科書					
教學方法 teaching methods	<input checked="" type="checkbox"/> 講述 <input type="checkbox"/> 小組討論 <input checked="" type="checkbox"/> 學生口頭報告 <input checked="" type="checkbox"/> 問題導向學習 <input type="checkbox"/> 個案研究 <input type="checkbox"/> 其他					
評量工具 Evaluation tools	<input checked="" type="checkbox"/> 期中考 <input checked="" type="checkbox"/> 期末考 <input type="checkbox"/> 隨堂測驗 <input type="checkbox"/> 隨堂作業 <input checked="" type="checkbox"/> 課後作業 <input type="checkbox"/> 期中報告 <input type="checkbox"/> 期末報告 <input checked="" type="checkbox"/> 專題報告 <input type="checkbox"/> 評量尺規 <input type="checkbox"/> 其他					
教學資源 teaching resources	<input checked="" type="checkbox"/> 課程網站 <input checked="" type="checkbox"/> 教材電子檔供下載 <input type="checkbox"/> 實習網站					
教師相關訊息 instructor's information						

Outline		course hour				Established Core competence
Subjects	Contents	Lecture	Demo	Exercise	Misc.	
Fundamental Crystallography	1. Crystal systems 2. Miller/Bravais indices 3. Crystallographic directions and plane	9				<u>D1-D8</u>
Fundamental Metallography	1. Defects in materials 2. Phase diagrams 3. Optical Microscopy	6				<u>D1-D8</u>
Principle of X-Ray diffraction	1. Bragg's law 2. X-ray diffraction analysis on elements 3. Stereographic projections	9				<u>D1-D8</u>
Electron Microscopy	1. Scanning Electron Microscopy (SEM) 2. Transmission Electron Microscopy (TEM) 3. Ewald sphere and reciprocal lattice 4. Selected area diffraction pattern SADP	7	1	1		<u>D1-D8</u>
Electron beam and energy beam techniques	1. Energy-dispersive spectroscopy (EDS), 2. Electron beam spectral diffraction (EBSD) 3. Raman spectroscopy	9	1	1		<u>D1-D8</u>
Nano-analysis	1. Scanning Probe Microscopy (SPM) 2. Nano-indentation	7	1	1		<u>D1-D8</u>
Core Competence of Graduate Program		Index for achieving Core Competence				
D1	Well established professional knowledge in mechanical and materials engineering	Mastering professional knowledge in engineering materials and materials analysis				
D2	Competence in planning and conducting research and development projects in mechanical and materials integrated engineering and related disciplines	Using appropriate analytical methods for materials research topics				
D3	Proficiency at professional writing papers in mechanical and materials engineering	Mastering the ability in write research reports or papers by using appropriate vocabulary and analytical logic				

D4	Capacity of innovative thinking and independent problem solving for mechanical and materials engineering challenges	Innovative thinking and independent problem solving by mastering and applying the professional knowledge and skills of materials analysis
D5	Effectiveness in communication and coordination in multi-disciplinary environments	Ability in communicating with people in different disciplines using multi-disciplinary terminology and thinking
D6	Well-balanced global vision	Well-balanced competence in communication and comprehension of professional knowledge and information in English
D7	Capability of leadership, planning, and management	Capability of leadership, planning, and management of materials related projects
D8	Engagement to lifelong learning	Life-long learning through acquiring materials analysis related knowledge from professional articles and medium

Course Content				
Time	Class	Evaluation	Office hour	Evaluation of course quality
Monday, 0910-1200	Mechanical Engineering R 215R	HW 20% Midterm 35% Final term 35% Practice 5% Attendance 5%	Monday 15:00~16:00 pm Rm. 424, Tel: 2720411 ext. 33304 E-mail: imejna @ccu.edu.tw	Questionnaire on Core Competence
Week	Contents			Remarks
1	Crystal systems, crystallographic directions and Miller/Bravais indices			
2	Crystal systems, crystallographic planes and Miller/Bravais indices			Homework I
3	Defects in materials and phase diagrams			
4	Optical Microscopy and metallography			
5	Bragg's law and X-ray diffraction analysis (XRD)			Homework II
6	Stereographic projectins (I)			
7	Stereographic projectins (II)			Homework III
8	Midterm exam			
9	Scanning Electron Microscopy (SEM) and Energy-dispersive spectroscopy (EDS)			
10	Practice in Scanning Electron Microscopy and EDS			

11	Transmission Electron Microscopy (TEM) and Ewald sphere and reciprocal lattice	Homework IV
12	TEM and selected area diffraction pattern (SADP)	
13	Electron beam spectral diffraction (EBSD)	Homework V
14	Raman spectroscopy	
15	Scanning Probe Microscopy (SPM) and practice	
16	Nano-indentation and practice	
17	Final review	
18	Final exam	