MECH4430 Materials Characterization
(Spring 22-23)

Course Code: MECH4430	**Course Title:** Materials Characterization
Required Course Or Elective Course: elective	**Terms Offered (Credits):** Fall or Spring (3 credits)
Faculty In Charge: Prof. Robin MA	**Pre-Requisites:** MECH2410
Course Structure: 3 hour lectures per week, 4 lab hours in total	
Textbook/Required Material: YANG LENG, "MATERIALS CHARACTERIZATION: INTRODUCTION TO MICROSCOPIC AND SPECTROSCOPIC METHODS" JOHN WILEY & SONS, 2nd Edition	
Bulletin Course Description: MECH4430 is an introductory course for various materials characterization techniques and explain both the fundamental principles and the applications of each technique, such as observation of microstructures with light microscopy, SEM, TEM, SPM; application of X-ray techniques to identify crystal structures (XRD) and to identify elements (XRF); surface analysis with XPS, AES, and SIMS; molecular analysis with vibrational spectroscopy; as well as thermal analysis. MECH4430 is intended to students who decide to enter industry related to materials technologies; students who decides to pursue advanced study program; and to anyone who is just interested in materials characterization techniques. By the end of this course, students will be able to (1) understand the general working principle of each characterization method; (2) identify suitable characterization technique to tackle materials problem; (3) know the advantages and limitations of each characterization method.	
Course Topics: • Introduction • Light microscopy • X-Ray diffraction (XRD) • Transmission electron microscopy (TEM) • Scanning electron microscopy (SEM) • Scanning probe microscopy (SPM) • X-ray spectroscopy for elemental analysis • Electron spectroscopy for elemental analysis • Secondary ion mass spectrometry (SIMS) for surface analysis • Thermal analysis	
Course Objectives: (correlated program objectives)	1. To introduce basic techniques for materials characterization. (P-O3) 2. To introduce the working principles and instrumentation of main techniques. (P-O3) 3. To introduce the interpretation of the characterization technique outputs (P-O3) 4. To practice metallographic examinations and observe operations of characterization equipment. (P-O3)
Course Outcomes: (correlated course objectives and program outcomes)	A. Students will be able to identify suitable techniques for specific materials characterization. (1) [POC1, POC2, POC3, POC6] B. Students will be able to use light microscopy for

	characterization (2) [POC1, POC2, POC3, POC6] C. Students will be able to understand the basic microscopy images of materials (3) [POC1, POC2, POC3, POC6] D. Students will be able to read the basic spectra of materials characterizations. (4) [POC1, POC2, POC3, POC6]
Assessment Tools: (correlated course outcomes)	Lab session 10% (A-D) Assignments 20% (A-D) Quizzes 30% (A-D) Report and presentation 40% (A-D)

BEng in Mechanical Engineering (4-year program)

Program Objectives:

P-O1. Be able to communicate and perform as an effective engineering professional in both individual and team-based project environments,

P-O2. Have an international outlook with clear perspectives on the Pearl river Delta and Greater China,

P-O3. Be able to research, design, develop, test, evaluate and implement engineering solutions to problems that are of complexity encountered in professional practice and leadership,

P-O4. Clearly Consider the ethical implications and societal impacts of engineering solutions,

P-O5. Continuously improve through lifelong learning.

Program Outcomes:

POC1. ability to identify and formulate problems in multidisciplinary environment with an understanding of engineering issues and constraints;

POC2. ability to design and conduct experiments as well as analyze and interpret data;

POC3. ability to apply knowledge of mathematics, science, and engineering for problem solving in mechanical engineering and related sectors or for further education in a research career;

POC4. ability to develop specification and to design system, component, or process to meet needs;

POC5. ability to understand the manufacturability, maintainability, and recyclability of engineering system and components;

POC6. ability to use modern engineering tools, techniques, and skills in engineering practice;

POC7. ability to communicate effectively;

POC8. ability to function in multi-disciplinary teams and provide leadership;

POC9. broadly educated with an understanding of the impact of engineering solutions on issues such as economics, business, politics, environment, health and safety, sustainability, and societal context;

POC10. clear understanding of professional and ethical responsibilities;

POC11. recognition of the need for life-long learning and continuing education;

POC12. international outlook with knowledge of contemporary issues.