

Syllabus (Tentative)
ENS 413/513 - Experimental Methods in Nanoscience 1
Fall 2024-2025

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Teaching Assistant	<i>Mehmet Kahraman</i>
Objective	The objective of this series of courses is to introduce some of the basic experimental methods utilized in nanoscience. The aim is to teach fundamentals of growth, fabrication and characterization of materials and devices in nanoscale. Topics appear to be mostly relevant to physical sciences but can be useful in many multi-disciplinary applications. ENS X13 focuses on nanofabrication.
Lecture/Lab Hours	
Evaluation	Preliminary work 20%, Lab Report 40%, Exams 40%
Attendance policy	Attendance is required. No make ups will be offered for the experiments. Missing 2 lectures or experiments leads to course failure. In case of an emergency, contact the lecturer as soon as possible.

Topic	Sub-topics	Weeks (Lecture + Exp.)
ENS 413/513		
Introduction to the course		1+0
Vacuum science and technology	Pumps, gauges, materials, fittings and practical aspects	1+1
Lithography	Optical lithography, e-beam lithography, other techniques	2+2
Physical deposition	Thermal evaporation, E-beam evaporation, Sputtering, PLD, MBE	1+1
Chemical deposition	CVD, PECVD, ALD	1+2
Etching	Physical and chemical etching, wet etching, RIE, Focused Ion Beam	1+1
Total		7+7
ENS 414/514 (Content may be updated)		
Microscopy	Optical microscopes, electron microscopes, scanning probe microscopes	2+2
Structural characterization of thin films with photons, electrons	Raman, ellipsometry, XRD, LEED, Auger Spectroscopy, EDX	1+2
Electrical characterization	DC and AC measurement techniques to characterize materials and devices	2+2
Cryogenics	Generation, transportation and storage of cryogenics. Operation principles of various cryostats.	1+2
Total		6+8