

Electron Microscopy for Materials Characterization

August 31-September 30, 2026

KZ7016 7.5hp <https://sisu.it.su.se/search/info/KZ7016/en>

The course will start on August 31 (Monday) at 9:15. Lectures, problem solutions and practical training sessions are conducted 9:15-12:00 and 13:00-16:00 according to the detailed schedule below. Demonstrations, problem solutions, and practical training sessions are the *compulsory parts* of the course. Lectures and exercises will be given in C513, and the exam will be in C516. The students will be divided into groups for the practical sessions.

Teachers:

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Course Responsible:

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Literature:

RE: *Physical Principles of Electron Microscopy: An introduction to TEM, SEM and AEM*, R.F. Egerton, 2nd edition, 2016, Springer. <https://libris.kb.se/bib/19631419>

WC: *Transmission Electron Microscopy: A Textbook for Materials Science*, D.B. Williams and C.B. Carter, 2nd edition, 2009, Springer. <https://libris.kb.se/bib/11775751>

ZHO: *Electron Crystallography - Electron microscopy and electron diffraction*, X. Zou, S. Hovmöller, P. Oleynikov, Oxford University Press. <https://libris.kb.se/bib/12544168>

CW: *Transmission Electron Microscopy*, C.B. Carter, D.B. Williams, eds., Cham, 2016, Springer. <https://libris.kb.se/bib/19667958>

* Additional materials handed out at the lectures and practical sessions.

The actual date of lab and exercise depends on the number of participants and will be finalized at the beginning of the course.

Week	Date	Teacher		Lecture (9:15 – 12:00)	Literature	Lab (13:00 -16:00) #
36	31/8 (Mon)	L1	CWT AA	General introduction to electron microscopy as tools for materials characterization Introduction to scanning electron microscopy (SEM)	RE: 5	
	1/9 (Tue)					
	2/9 (Wed)	L2	AA	Introduction to Energy Dispersive Spectroscopy (EDS) and Wave Dispersive Spectroscopy (WDS)	RE: 6	SEM lab (Group A) - PB EDS demo lab (Group B) - YZ
	3/9 (Thurs)	L3	AA	Applications of analytical SEM techniques for materials characterization	*	SEM lab (Group B) - PB EDS demo lab (Group A) - YZ
	4/9 (Fri)			SEM lab (Group C) - PB EDS demo lab (Group D) - YZ		SEM lab (Group D) - PB EDS demo lab (Group C) - YZ
37	7/9 (Mon)	L4	CWT	Introduction to transmission electron microscopy (TEM), electron-matter interactions	WC: 1-3	
	8/9 (Tue)	L5	CWT	Instrumentation and Electro-optics	WC: 5-10	Exercise 1 (All) – JL

	9/9 (Wed)	L6	CWT	TEM sample preparation (powder, FIB, ion milling, ultramicrotome, cryo-transfer)	WC: 10	Introduction of TEM & sample preparation (Group A+B+C+D) - JL
	10/9 (Thurs)	L7	XZ	Electron diffraction (ED) and phase analysis	WC: 11-13, 18; ZHO: 5	TEM + ED lab (Group A) - YZ
	11/9 (Fri)			TEM + ED lab (Group B) - YZ		TEM + ED lab (Group C) - YZ
38	14/9 (Mon)	L8	XZ	Imaging: BF, DF and phase contrast	WC: 22-23	TEM + ED lab (Group D) - YZ
	15/9 (Tue)	L9	XZ	Contrast transfer function (CTF) and high-resolution transmission electron microscopy (HRTEM)	ZHO: 6 WC: 28, 30	Exercise 2 (All) – YZ & JL
	16/9 (Wed)					HRTEM lab (Group A) - JL
	17/9 (Thu)			HRTEM lab (Group B) - JL		HRTEM lab (Group C) - JL
	18/9 (Fri)	L10	CWT	Aberration corrected TEM and scanning transmission electron microscopy (STEM) techniques	CW 11*	HRTEM lab (Group D) - JL
39	21/9 (Mon)	L11	CWT	TEM/STEM Spectroscopy (EDS and Electron energy loss spectroscopy (EELS)	WC 4, 37-40*	STEM+EELS lab (Group A) - AA
	22/9 (Tue)			STEM+EELS lab (Group B) - AA		STEM+EELS lab (Group C) - AA
	23/9 (Wed)	L12	CWT	In situ TEM characterization techniques, Applications of analytical EM in sustainable materials chemistry	CW: 2	STEM+EELS lab (Group D) - AA
	24/9 (Thurs)	L13	ALL	Repetition: questions and answers		
	25/9 (Fri)					
40	28/9 (Mon)					
	29/9 (Tue)	Examination (9:15-14:00) – C516				