			Practical Scanning Electron Microscopy –– Syllabus					
	Course objectives							
		To give an understanding of basic principles so users can optimize results						
	Quiz on reading at beginning of certain lectures plus two exams constitute grade for 2-credit section							
	HW is documentation of Lab session (e.g., SOP how to operate microscope, How to image uncoated samples; how to get hi-resol							
	Exams: slides based on examples we have given							
		lecture week	**topic**	**Instructor**	**lab**	**Lab instructor**		
Reading prior to lecture	7-Jan	1	SEM: what it can do for me? Vacuum principles	Matt		We are available, high expectations of studen		
		LL-1	SEM overview (Leo photos)	Matt	LEO 440	Matt	Dirt is my friend. Neural array	
Gold. Ch1; Joy 3		Friday	electron optics / apertures	Matt	demo: D.of Field, gold on carbon, opal uncoated and coated			
	14-Jan	2	sources/optics/beam energy	Matt	SOP: Leo 440, List of how to break the instrument; filament			
		LL-2	Leo details from SOP handout: getting started	Matt	Nova Nano	Matt/ Randy	Ni balls; Coated Duke balls	
Gold. Ch2	Quiz!	Friday	LEO / nanoNova comparison	Matt		theory of magnification: copper grid		
	21-Jan	3	**MLK Holiday**			contrast mechanisms; beam-sample interacti		
					Nova Nano	Matt/ Randy	Ni balls; Coated Duke balls	
Gold 3.0-3.4.1	**Quiz!**	Friday	beam diameter, current, spot	Matt				
Gold 3.4.2 **Quiz!**	28-Jan	4	SE/BSE formation and use- finding the "sweet-spot" for uncoated imaging	Ian				
		LL-4	Nova Nano Operation	Matt	Nova Nano	Matt/ Randy	Ni balls; Coated Duke balls	
Gold 15.1-3 **Quiz**!		Friday	"charging is my friend" & Hi-Vac imaging approaches	Ian				
	4-Feb	5	Strategies for imaging	Ian	S-3000 SOP; getting a beam; optimizing beam conditions Ia			
		LL-5	using the S-3000	Ian	**double up on lab schedule**		MSE staff	
		Friday	No class (instructors are in formal training on the nanoNova)					
Gold 4.2-.4 **Quiz!**	11-Feb	6	electron detection	Ian				
		LL-6	Fatal errors; NovaNano		nanoNova	Randy	Matt leaves tues	
		Friday	finish LV-SEM lab lecture	Matt	Intro to Nova nano; Ian: Friday lab			
	18-Feb	7	Presidents Day					
			Lab this week: LV operation		nanoNova LV	Randy		
		Friday	"charging is my friend"	Ian	SOP hi-vac imaging		choosing your HR detector	
	25-Feb	8	Artifacts in SEM	Ian	alternatives to coating (low voltage)			
Gold 5.1.3 & 5.3		LL-8	HV charge mitigation in nanoNo	Matt	nanoNova	Matt		
Gold 5.6	29-Feb	Friday	LV SEM / another perspective	Ian				
Gold 5.2 & **quiz**		LL-14	STEM-in-SEM	Matt	STEM			
Gold 14.1-.3 **quiz**	3-Mar	9	ESEM / water phase diagram & use in ESEM	Matt	detectors SE/BSE			
		LL-9	comparison of BSE detection	BSE	TLD nanoNova vs. 4-quad in Leo			
	7-Mar	Friday	Matt, TBD				**Ian gone**	

Gold 4.3 - 4.6 **quiz**	10-Mar	10	Physics of electron detection	Randy			**Matt gone this week**	
		LL-10	**lab midterm** (self-sufficiency on NovaNano)	Randy	nanoNova: you choose the sample			
	14-Mar	Friday	**Midterm exam**	Randy				
	17-Mar	Spring Break						
Gold Ch 6.1-6.3 **quiz**	24-Mar	11	ESEM & EDX	Ian	TBD	TA's - project	**Ian back**	
		LL-11	EDX overview		MetE system Topcon			
Gold 7.1-7.3; 8.1-8.3		Friday	EDX continues	Ian				
Gold 7.6,10.6 **quiz**	31-Mar	12	Quantitative microanalysis	Matt				
		LL-12	**standardless (phi-rho-Z)**	Matt	MetE system (quant) (Matt / ???)			
Gold 9.1-9.6 **quiz**		Friday	Quant continued	Matt				
Gold 7.3,7.4, 8.3 **qui**	7-Apr	13	WDX and the microprobe	Ian				
		LL-13	ESEM overview	Ian				
Gold 6.5		Friday	some clean-up: XRF; dynamic experiments in ESEM: video EM, heating & cooling	Ian				
	14-Apr	14	EBSD overview	Ian				
		Friday	how to specify and purchase your own SEM	Ian and Matt				
	21-Apr	15	Final review session	Ian, Matt, Randy				
		LL-15	Lab final: self-sufficiency on SEM of choice	Ian, Matt, Randy one-on-one at negotiated time; place TBD by student				
	28-Apr	16	Final exam 1300 - 1500 WEB 114					
		sample project for 4-cr students: image your sample under the following conditions						
		vacuum	voltage	detector				
(classical hairpin microscopy)		hi	15-30keV	SE / BSE	LEO 440			
(classical FEG)			2keV	SE	Quanta (ESEM)			
classical LVSEM		low-vacuum / air	15-30keV	BSE	Quanta (ESEM)			
ESEM mode		low-vacuum / water vapor	15-30keV	SE	ESEM			
HR-SEM		TLD	optimize	SE	Nova nano			
LV-HRSEM		Helix	optimize	SE	Nova nano			
LV-HRSEM		vCD	optimize	BSE	Nova nano			
(recent advancement)			50V (landing)	SE	Nova nano			