

Physics 4230/7230 Fall 2016
Electron Microscopy and Microanalysis

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Text: *Scanning Electron Microscopy and X-ray Microanalysis*, Goldstein et al. Plenum,
Transmission Electron Microscopy: a Textbook for Materials Science, Williams and Carter, 2nd edition

Lectures: TR 316 Connaway Hall 2:30-3:45pm

Exam: R 10/6 316 Connaway Hall 2:30-3:45pm

R 11/10 316 Connaway Hall 2:30-3:45pm

Demos/Labs: Electron Microscopy Core, W125-W137 Vet Med Bldg at designated time

<u>DATE</u>	<u>FORMAT</u>	<u>TOPIC</u>
8/23	Lecture 1	Course Outline; Lab Schedules; Intro to SEM; Vacuum Systems & EMC Tour
8/25	Lecture 2	Electron Optics; Interaction Volume, Signal and Image Formation
8/29-9/2	Lab 1	SEM: Basic Operating Parameters (Hitachi S-4700)
9/5-9/9	Lab 2	SEM: Basic Beam/Specimen Interactions (Hitachi S-4700)
9/12-9/16	Lab 3	SEM: High Resolution Imaging (Hitachi)
9/20	Lecture 3	Specimen Preparation and Variable Pressure SEM
9/22	Lecture 4	EDS in SEM
9/26-9/30	Lab 4	SEM: LV Operation and Imaging (FEI Quanta 600F)
10/3-10/7	Lab 5	SEM/EDS Qualitative Analysis: (FEI Quanta 600F/Bruker Quantax 200)
10/6	Exam 1 on SEM and SEM EDS	
10/11	Lecture 5	Introduction to TEM 1
10/13	Lecture 6	Introduction to TEM 2
10/17-10/21	Lab 6	TEM: Direct Alignments and High Resolution Imaging
10/25	Lecture 7	Introduction to Scanning TEM and EDS
10/27	Lecture 8	Introduction to Energy Filtered TEM and EELS
10/31-11/4	Lab 7	TEM: Scanning TEM and EDS
11/7-11/11	Lab 8	TEM: Energy Filtered TEM and EELS
11/10	Exam 2 on TEM	
11/15	316 Connaway	Abstract Presentations for Individual Projects
11/17	316 Connaway	Abstract Presentations for Individual Projects
11/21-11/25	EMC	Thanksgiving Break (Individual Projects)
11/28-12/2	EMC	Individual Projects
12/5-12/9	EMC	Individual Projects
12/13	316 Connaway	Individual Project Presentations
12/15	316 Connaway	Individual Project Presentations
12/16	Final Project Report Due	

Class Policy

1. 12 students maximum.
2. Grades:

Exams (2)	15%
Lab reports (8)	55%
Individual Projects	30%

(10% abstract presentation, 40% final presentation, 50% final report)

Penalty for late laboratory homework: 10% off each day being late. Exceptions apply depending on circumstances.
3. There are 8 lectures, 8 (2 hour) labs with 8 lab reports, 2 exams, and an individual project. Due to the high demand of this course, full participation in lectures, laboratories, completion of lab assignments, and individual projects are expected. Exceptions can be made for cases, where students have to miss a lecture or laboratory for a conference (advance notification is required). Laboratories missed will be made up.
4. Each student has 1 hour consulting time prior to projects: sample prep, decision on scope time on Quanta (EDS), Hitachi (imaging) or Tecnai. Small to moderate number of samples can be characterized (this is for class projects only). Students are allowed approximately 10 hours for their individual projects.
5. Scope time is non-transferrable to other peers in your lab.
6. Cancellations or rescheduling on scope have to be at least 24 hours prior to appointments. This policy applies to labs, consulting time and individual projects time. Last minute notice will be subject to loss of your hours on scope.



How to Register as an EMC User through FOM Networks



1. Navigate to <http://emcore1.col.missouri.edu/>
2. Click on “Click here if you do not have a single sign on ID”

EMCore - FOM - Welcome

Time on server
Tuesday Jun. 10
09:03:06

Welcome to **EMCORE** Facility Online Manager (FOM©)

[Click here to login with Missouri single sign on ID](#)

Or

[Click here if you do not have a single sign on ID](#)

FOM© is an online accounting and instrument management software.

FOM© is FREE for small research group use (online scheduler only, with a minimal installation fee).

FOM© supports unlimited number of instruments, unlimited number of facilities, and unlimited number of users.

FOM© can be used as a simple scheduler or as a complicated management system. It can be used in a single laboratory, or used to host all the facilities on campus.

If you are interested in using FOM©, please contact FOM Networks at info@FOMNetworks.com.

Visit <http://www.FOMNetworks.com/> to see the features of FOM©

3. Click on “I am a new user”

User Login

Enter your username and password.

Username:

Password:

[I am a new user](#) [forgot my username or password](#)

4. Enter your information
 - USERNAME/password = pawprint/password
 - If department/supervisor aren't listed, please send email to Tommi via the system.
5. When it requests “Account Number”, please enter the MoCode you wish to use. Descriptive name can be a nickname you give to that MoCode, which you will see when reserving appointments (alternatively, you can just list the MoCode again).
6. Registration is complete. EMC staff will respond to your request.



How to reserve instrument time through FOM Networks



1. Once you are an approved, registered user (please see "Registering as a new user"), you will be able to reserve your instrument time.
2. Navigate to <http://emcore1.col.missouri.edu/>
3. Click on "Click here to login with Missouri single sign on ID"

4. Enter your information
 - USERNAME/password = pawprint/password
5. Select the instrument you wish to reserve time on (note: Only instruments you have access to will be listed)

6. Select Instrument to see appointment calendar and click the date/time you'd like to reserve.

7. Select the following and Click "Reserve"
 - **MoCode** that you wish the charges to be billed to
 - Reservation time start and end
 - additional microscope components needed
 - Manager assistance.
8. Your appointment should be reflected on the calendar
9. When you arrive at the EMC, log into FOM to activate your session.
10. When you are finished, log off FOM.

Abstract Presentations Format

5 minute presentation

- don't go over allotted time with presentation
- this leave time for questions (5 minutes)

4 Power Point Slides (1-2 minutes per slide)

- Slide 1: Title Page: Your name, Advisors name, Department affiliation and funding source acknowledgement
- Slide 2: Introduction: General overview to project and key questions you wish to answer with electron microscopy
- Slide 3: Methods: Sample Preparation, Instrumentation used, settings for chosen microscope, analyses
- Slide 4: Anticipated Results/Conclusions: Potential Problems, Caveats, Pitfalls

Project Report Format

Instructions for Paper Preparation

- 1. ELECTRONIC SETUP.** For the document layout, follow the example and the instructions provided below. In addition, you may use the template (MandM_template.doc) found in Course Documents Your paper must be submitted in .doc or .docx.
- 2. TEXT.** Papers should be a condensed version of the final presentation and include all significant findings. Write the text so that readers who are not specialists can appreciate the purpose of the study and understand the procedures and conclusions. Authors are strongly encouraged to adhere to the model example papers shown at the end of this document and keep the length to two (2) pages.
- 3. MARGINS.** Set the margins for each page so that the text occupies a centered rectangle 6.75 in. wide by 9 in. high (17.1 cm wide x 22.8 cm high).
- 4. PAGE 1 FORMAT.** Text only on this page, no illustrations. Title on first line must be 14-point boldface Times or Times New Roman with initial capitals. For the rest of the text use 12-point Times or Times New Roman. Use single line spacing if more than one line is needed for the title. Leave one line of space before the author names. Start the authors' name, each followed by a comma and one or more numerical superscripts as reference to each author's affiliation. Leave one line of space between author names and affiliations. Asterisk the first author's affiliation and complete postal address. Similarly on the next line type the next author's affiliation and complete address, etc. Do not center the title, author names or affiliations; return each line to the left margin. Single column format for the body of the text. Leave one line of space and begin the first paragraph without indentation. Skip a line before each new paragraph.
- 5. PAGE 2.** This page may include text, figures, and/or tables (if any). Place table captions **above** tables at the left margin; place figure captions **below** figures or to the side of figures.
- 6. LINE DRAWINGS, MICROGRAPHS AND PHOTOS.** All artwork must be electronically incorporated into the text. Show figure part number and scale bar (e.g., 1 μm) as needed. Color may be used. Line art must be created either in a drawing program or scanned into a suitable format for importing into the document; check that the weights of lines and sizes of label fonts in imbedded legends allow the figure to be understandable at the final reproduction size in the document.
- 7. TABLES.** All tables must be electronically incorporated into the text. Use the table-making functions of the word processor to create the table with a horizontal rule top and bottom and below the column headings. Indicate units (in parentheses) in column headings as needed. Type information single-spaced within the table.
- 8. REFERENCES.** Show citations in the text as an Arabic number on the line in square brackets, preferably at the end of the sentence, *before* the period [1]. Collect references at the end of the paper, before the figures. Acknowledge sponsorship or help from colleagues in the last reference corresponding to a numeral at the end of the text. *Do not use underlines.* For three or more authors, use first-named author's name plus "et al." Examples:

[1] R. C. G. da Rocha and R. P. Chopard, *Microsc. Microanal.* 8 S2 (2002) 232.

[2] W. G. Fisher et al., *Microsc. Microanal.* 8 (2002) 191.

[3] M. A. Hayat, *Principles and Techniques of Electron Microscopy*, 4th ed., Cambridge University Press, Cambridge, 2000.

[4] This research was supported by the Nano Research Fund under Contract N04-78-94. The aid of Dr. L. M. Limit of City University is gratefully acknowledged.