Cedar Crest College
Master of Science Program in Forensic Science

Instructors: Jacqueline Speir, M.S.
Brian Gestring, M.S.
Lawrence Quarino, Ph.D

Course Title: Advanced Microscopy, FSC 513
Spring 2009

Prerequisites: CHE 347 or equivalent

Course Description: An advanced study in the theory and practical application of microscopy methods. The course will focus on polarized light, fluorescence and scanning electron microscopy. Emphasis will be placed on spectroscopic methods that can be interfaced with microscopy such as micro-FTIR, microspectrophotometry and x-ray microanalysis. Additionally, digital imaging and photomicrography will be discussed.

Course Objectives:

1. To ensure that students understand the fundamentals of microscopic methods typically used in forensic science.

2. To ensure that the students understand the fundamentals of spectroscopic methods of microanalysis.

3. To ensure that students understand the fundamentals of photomicrography and digital imaging.

4. To ensure that students understand the utility of microscopy in the analysis of all types of trace evidence.

Course Outcomes:

1. Students will understand the fundamentals of microscopic methods typically used in forensic science.

2. Students will understand the fundamentals of spectroscopic methods of microanalysis.

3. Students will understand the fundamentals of photomicrography and digital imaging.

4. Students will recognize the utility of microscopy as a primary method of analysis for a variety of trace evidence.

Course Content Outline

Topic	*Instructor*	*Date*
I. Review of Polarized Light Microscopy A. Refractive Index B. Reason for Anisotropy C. Uniaxial Unknown Lab Exercise D. Birefringence Lecture E. Lab Exercise on Birefringence F. Sign of Elongation (SOE) G. Lab Exercise on SOE H. TATP & Conoscopy	**Speir**	**1/17/09**
II. Digital Photomicrography **A. Fundamentals of Photography** **B. Photography of Microscopic Samples** **a. Varieties of microscopes and camera platforms**	**Gestring**	**1/18/09**
III. Stereomicroscopy **A. Greenough v. CMO design** **B. Magnification** **a. Zoom System** **C. Resolution** **D. Depth of Field**	**Quarino**	**1/24/09**
IV. Fluorescence Microscopy **A. Principles of Fluorescence** **B. Optical Design** C. **Light Sources**.	**Quarino**	**1/24/09**
V. Dark Field Microscopy **A. Annular Condenser Cone** **a. Numerical Aperture** b. **Condenser Masks**	**Quarino**	**1/24/09**

Lab Exercises for Sections III-V.

1. *Separation of materials in unknowns using steromicroscopy.*
2. *Demonstration of fluorescence and dark-field microscopy.*

Topic	*Instructor*	*Date*
VI. Phase Contrast Microscopy	**Quarino**	**1/24/09**

A. Principles and Optical Design

B. Lab Exercise

Becke line method comparison: phase contrast v. light microscopy

VII. Microspectrophotometry **Quarino** **1/24/09**

A. Micro-IR

- **a. Properties of Light**
- **b. Absorption of IR Light**
- **c. Optics**
- **d. Spectral Accuracy**
- **e. Sample Preparation**
- **f. Techniques**

B. Micro-UV/Vis

- **a. Absorption of UV/Vis Light**
- **b. Color**
- **c. Instrument Design**
- **d. Sample Preparation**
- **e. Spectral Comparison**

C. Lab Instruction

- **a. Demonstration of Micro-IR spectroscopy**

VIII. SEM/EDX **Quarino** **1/25/09**

A. SEM

- **a. Image Formation and Microscope Design**
- **b. Magnification**
- **c. Back Scatter and Secondary Electrons**
- **d. Contrast and Electron Penetration Depth**
- **e. Vacuum System**
- **f. Sample Preparation**
- **g. Depth of Field**
- **h. Cathodoluminscence**

B. EDX

- **b. Continuum X-Ray Production**
- **c. Characteristic X-Ray Production**
- **d. Auger Process**
- **e. Fluorescent Yield**
- **f. Critical Ionization Energiews**
- **g. Moseley's Law**
- **h. Detectors**
- **i. X-Ray Fluorescence**

Topic	*Instructor*	*Date*
B. Lab Instruction	**Quarino**	**1/25/09**
a. Demonstration of SEM/EDX		

Course Assessment

Students will be given an unknown composed of many different types of materials. Using the techniques discussed in the class, students will determine the contents of the unknown.

Students will submit a paper to Dr. Quarino outlying the techniques used and summarizing results and conclusions. The paper will be in the format of manuscripts published in the Journal of Forensic Sciences. Documentation using digital photography where appropriate is expected.

Grades will be on the bases of correct identifications, false identification and the quality of the manuscript. Half the grade will be based on the quality of the manuscript and the other half on the analytical results. From this, a letter grade (A, A-, B+, B, B-, C+, C, F) will be determined.

The paper is due on **February 27**.

Honor Philosophy

The Cedar Crest College Honor Philosophy states that students should uphold community standards for academic and social behavior in order to preserve a learning environment dedicated to personal and academic excellence. Upholding community standards is a matter of personal integrity and honor. Individuals who accept the honor or membership in the Cedar Crest College community of scholars pledge to accept responsibility for their actions in all academic and social situations and for the effect their actions may have on other members of the College community.

Bibliography:

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Beveridge, A., Fung, T., MacDougall, D., "Use of Infrared Spectroscopy for the Analysis of Paint Fragments" in *Forensic Examination of Glass and Paint*, B.Caddy, editor, Taylor and Francis, 2001.

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Goldstein, J., Newbury, D.E., Joy, D.C., et al., *Scanning Electron Microscopy and x-ray Microanalysis*, Third Edition, Springer, 2003.

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