Trace Evidence and Microscopy
CHE 347
(4 credits)

Cedar Crest College
Department of Chemistry
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Lawrence Quarino, Ph.D.
M8
(610) 606-4666 x3567
laquarin@cedarcrest.edu

Course Syllabus

Trace Evidence and Microscopy
Introduction

Trace evidence analysis is a part of the area of forensic science known as criminalistics. Criminalistics involves the recognition, identification, and individualization of physical evidence from criminal investigations. The attempt at individualization (in other words, trying to determine a unique or particular source of an item of physical evidence) is what separates criminalistics from all other scientific endeavors. Through individualization, criminalistics attempts to link victims with suspects and people with crime scenes that subsequently can lead to the reconstruction of crimes. The purpose of this course is to acquaint the student with the philosophy and methodology of dealing with physical evidence, specifically trace evidence. Trace evidence can be defined as those types of evidence that often require microanalysis. The term trace evidence is associated with physical evidence such as hairs, fibers, glass, paint, and soil. Implicit in the term "microanalysis" is the use of the microscope as an analytical tool. Arguably, the microscope is the most important instrument in the analysis of trace evidence. In this course, students will be introduced to some of the qualitative and quantitative uses of microscopy in trace evidence analysis. In addition to microscopic analysis, other methodologies will be discussed as well. No attempt will be made to provide the student with all the techniques he or she will need to know to work in a forensic science trace evidence laboratory. Instead, a general approach is designed to give the student a sound, fundamental base upon which to build. The laboratory aspect of this course will consist mainly of work on unknowns designed to simulate physical evidence problems and to stimulate thinking about them. The lecture part of the course will provide much of the theoretical knowledge required to complete the exercises.

Course Objectives:

1. To familiarize the student with basic concepts of criminalistics and the role of a criminalist in a forensic investigation.

2. To introduce the student to several types of microscopy as analytical tools in forensic analysis with particular emphasis on light and polarized light microscopy.

3. To discuss the different types and analyses of trace evidence typically encountered in a forensic investigation and to teach the strengths and limitations of each.

4. To familiarize the student with the primary literature in the area of trace evidence analysis.

5. To help develop oral communication skills in the delivery of scientific information.

Course Outcomes:

1. The student will understand basic concepts in criminalistics and the use of the scientific method in a forensic investigation.

2. The student will understand basic theoretical concepts in several types or microscopy and have an in-depth understanding of light and polarized light microscopy. Each student will also understand the basic analytical measurements typically used by forensic microscopists.

3. The student will learn the different types of trace evidence typically encountered in a forensic investigation and the strengths and limitations of each.

4. The student will learn the descriptive parameters and techniques of analysis for different types of trace evidence.

5. The student will be knowledgeable with the primary literature in trace evidence analysis.

6. The student will competently present a journal article to the class in the area of trace evidence analysis.

Course Assessment

Progress in lecture will be monitored through 4 written in-class examinations (3 of which are non-comprehensive and will be given during the semester and 1 during the final examination period and is comprehensive). The professor reserves the right to give pop-quizzes at any point (each quiz will be worth two points to be subtracted or added to the final grade). The professor also reserves the right to give additional credit to those students who answer correctly (or at least on the right track) when called upon in class and to deduct credit from those students that answer inadequately.

Each student will give one class presentation on a journal article related to trace evidence analysis.

Required Text: Forensic Science Handbook, Volume I, Second Edition
R Saferstein, editor.
Pearson Education (Prentice-Hall), 2002.

Required Reading: Forensic Science Handbook, Volume II,
R Safersetin, editor,
Prentice-Hall, 2005
Chapters 4-6

Forensic Examination of Fibres,
JR Robertson, M. Grieve, editors
CRC Press, 1999
Chapters 8 and 10

Forensic Examination of Glass and Paint,
B Caddy, editor
CRC Press, 2001
Chapter 11

Optical Crystallography,
F. D. Bloss
Mineralogical Society of America, 1999
Chapters 1-5, 7

Lecture Time: T, R 8-9:15

Lecture Outline

Topic	Reading

Part I (August 25-September 8)

I. Optics   Saferstein, Volume I,
    A. Reflection   Chapter 5
        1. Image formation
           a. plane, concave, convex mirrors   Bloss, Chapters 1, 2, and 5

    B. Refraction
        1. refractive index and dispersion
        2. simple lenses
           a. lens theory
           b. magnification
           c. aberrations

II. Light Microscopy   Bloss, Chapter 3
    A. Simple
    B. Stereomicroscope
    C. Comparison
    D. Compound
        1. objectives
        2. substage condenser
        3. numerical aperture and resolution
        4. Abbe's theory of image formation
        5. oculars
        6. illuminators and illumination
           a. color temperature
           b. Kohler illumination
        7. visibility and image contrast
           a. phase contrast
           b. dark field

Part II (September 10-September 29)

I. Polarized Light Microscopy   Bloss, Chapters 4 and 7
    A. methods of polarization
    B. components of PLM
    C. image formation by interference
    D. orthoscopic observations
    E. conoscopic observations

Topic	Reading
II. Microspectrophotometry	Robertson/ Grieve, Chapters 8,10
III. Scanning electron microscopy	Caddy, Chapter 11

Exam I – October 1

Part III (October 6-November 12)

October 6 – Title for presentation due
October 17 – pdf of paper emailed to DQ due

I. Collection of trace evidence from crime scene and physical evidence	Saferstein, Volume II, Chapter 5
II. Drug analysis A. survey of controlled substances B. spot and microcystalline tests C. chromatographic and spectrometric methods of analysis	Saferstein, Volume II, Chapter 4
III. Hair examination	Saferstein, Volume I, Chapter 7
IV. Fiber examination	Saferstein, Volume II, Chapter 6
V. Soil examination	Saferstein, Volume I, Chapter 11
VI. Paint examination	Saferstein, Volume I, Chapter 8
VII. Glass examination	Saferstein, Volume I, Chapter 4
VIII. Arson and explosives debris	Saferstein, Volume I, Chapter 9

Exam 2 – November 5

Part IV (November 17-December 1)

Student Presentations

Exam 3 – December 3

There will be a **cumulative** final examination that will be held during the final exam week.

Grading
Your final grade will be determined as follows:

Exam #1   20%
Exam #2   20%
Exam #3   20%
Final Examination   30%
Presentation   10%

If the grade on the final examination is higher than any grade on exams #1-3, it will replace the grade on exam #1-3 provided the grade on the final is 70 or above.

Letter grades will be assigned as follows:

90-100%   A
88-89%   A-
86-87%   B+
80-85%   B
78-79%   B-
76-77%   C+
70-75%   C
68-69%   C-
60-67%   D
<59%   F

Community Standards for Academic Conduct

Academic integrity and ethics remain steadfast, withstanding technological change. Cedar Crest College academic standards therefore apply to all academic work, including, but not limited to, handwritten or computer-generated documents, video or audio recordings, and telecommunications.

As a student at Cedar Crest College, each student shall:
• Only submit work which is her own.
• Adhere to the rules of acknowledging outside sources, as defined by the instructor,

never plagiarizing or misrepresenting intellectual property.
• Neither seek nor receive aid from another student, converse with one another when inappropriate, nor use materials not authorized by the instructor.
• Follow the instructions of the professor in any academic situation or environment, including taking of examinations, laboratory procedures, the preparation of papers, properly and respectfully using College facilities and resources, including library and computing resources to ensure that these resources may be effectively shared by all members of the College community.
• Abide by the Cedar Crest Computer Use Policy.
• If a student perceives a violation of the Academic Standards, he/she will go to their instructor.
• If you are unable to resolve the problem with the instructor, you should go to the chair of the department. If you need further assistance after consultation with the instructor and the chair, you should see the Provost.

Classroom Protocol

Appropriate classroom behavior is defined and guided by complete protection for the rights of all students and faculty to a courteous, respectful classroom environment. That environment is free from distractions such as late arrivals (students will be deducted one point from each late arrival after the second time), early departures, inappropriate conversations and any other behaviors that might disrupt instruction and/or compromise students' access to the Cedar Crest College education.

Attendance in lecture is mandatory. It is understood that students may need to miss class due to illness or personal obligations. Students needing to be absent from class must contact the instructor prior to class. Students with valid reasons will not be penalized. In all cases, students will be responsible for all material covered in the missed class. Make-up exams will be given only in the event of illness or compelling personal matter. If a make-up exam is not granted, the final examination will include the percentage for the missed exam. If the instructor is not notified prior to the exam, documentation explaining the reason for the absence may be required.

Students will not be allowed any unexcused absences. For each unexcused absence, students will be deducted 1% from their final grade.

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.

Violations of the academic honor code will be dealt with according to the Cedar Crest College Forensic Science Program Policy and Procedures Manual.

Presentation

Using the guidelines below, each student must give a 10-minute class presentation on the article they selected. Students must submit the name and citation of their article by October 6 to avoid duplication. A pdf is due to the professor by October 17 which will be sent to each student via email. Students are required to read each article and are responsible for the information contained in the article (in other words you may be asked questions on an examination about the articles).

Guidelines for Projection of Paper Presentation

1. Dark background and light text give good contrast and show up well in a darkened room. Avoid color combinations such as red and blue, yellow and green, etc.
2. Times New Roman is the recommended font style.
3. Do not use a font below 24 pt.
4. Limit a frame to a single idea or point.
5. Do not crowd the frame. Limit the number of text lines per frame to a maximum of seven.
6. Use simple graphs and illustrations with a minimum of captions. Avoid using thin lines, dots, dashes, or other specialty lines unless they are very bold and black.
7. Do not read off slide.

Guidelines for Format of Paper Presentation

The presentation should follow the following outline:

1. Title slide.
2. Goals and objective of study.
3. A history of previous work in the subject area and how the presented paper hopes to contribute to the body of knowledge in the subject area.
4. Methods.
5. Data and data analysis (including statistics).

DO NOT PRESENT TABULATED DATA, Use graphs or charts
6. Conclusions.
7. Significance of study and future considerations.