Chaminade University
OF HONOLULU

Clarence T.C. Ching Hall, Room 254

FS 625 Trace Evidence Lecture
Fall 2014

Instructor: Dale K. Purcell, Ph.D.
Assistant Professor of Forensic Sciences
Office: Henry Hall 2
Telephone: 808-440-4209
email: dale.purcell@chaminade.edu

Lecture: Tuesdays and Thursdays, 1300 – 1420 hours

Office Hours: M & W, 1100 – 1200 hours and T & Th, 1130 – 1230 hours
Any other time by appointment

COURSE DESCRIPTION

Micro analysis of transfer evidence is best described as a holistic approach to the application of microscopical and microspectrophotometric techniques to the observation, collection, and analysis of micrometer sized materials. Physical transfer evidence has three main and distinct uses in investigations: 1) investigative leads, 2) associative evidence, and 3) event reconstruction. Dr. Paul Leland Kirk said it best in the preface of his book, *Crime Investigation (1953)*:

> Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as silent evidence against him. Not only his fingerprints or his footprints, but his hair, the fibres from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects – all these and more bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. *It is factual evidence.* Physical evidence cannot be wrong; it cannot perjure itself; it cannot be wholly absent. Only its interpretation can err. Only human failure to find it, study and understand it, can diminish its value. (Italic emphasis in the original.)

Microscopical analyses and evaluation of transfer evidence for characteristic and individualistic attributes presents formidable challenges in the forensic sciences. These attributes include the necessity to observe and analyze small, microscopic sized items for the purposes of identification and discrimination of source attribution (common origin) when dealing with different samples. The demands placed on the forensic scientist to establish inference of source is more stringent than those demands required by most other scientific

disciplines, which deal mostly with the identification of materials and not the inference of source.

MEASURABLE LEARNING OUTCOMES

Reasoning

- Collect and properly analyze and interpret data from analytical procedures. Solve problems based on factual information and critical thinking. Use modern microanalytical techniques to solve qualitative and quantitative analytical problems.
- Use acquired data to solve appropriate problems related to analysis of various materials.
- Interpret analytical data and relate the information to identification of different materials.
- Formulate accurate opinions to present and defend in courts of law and other public venue.

Knowledge

- Outline the theory and operation of various microanalytical techniques and instruments; Synthesize related scientific literature.
- Describe physical and chemical principles involved in micro analysis.

Practical skills

- Apply knowledge of microscopy and related microspectroscopical instrumentation to the analysis of various materials encountered in forensic science and pursue research in analysis of various types of transfer evidence.
- Explain the importance about accuracy and reliability of the results
- Apply statistical methods to obtained data as a test of accuracy and reliability; maintain accurate record and documentations for all procedures carried out in the microanalysis laboratory.
- Explain the principles of objective and unbiased interpretation of data and recognize the misuse or improper or inaccurate use of data.

Communication

- Present scientific facts and opinions in a clear and logical oral and written manner;
- Describe analytical procedures and results using discussion, written assignments, and exams.

REQUIRED TEXTS (free eBooks available through Sullivan Family Library)

Inman, Keith and Norah Rudin, Principles and Practice of Criminalistics: The Profession of Forensic Science, CRC Press, Taylor & Francis Group, Boca Raton, Florida, (2001).

Petraco, Nicholas and Thomas A. Kubic, Color Atlas and Manual of Microscopy for Criminalists, Chemists, and Conservators, CRC Press, Taylor & Francis Group, Boca-Raton, Florida, (2004).

Robertson, James and Michael Grieve, Forensic Examination of Fibres, 2nd ed, , CRC Press, Taylor & Francis Group, Boca-Raton, Florida, (1999).

Robertson, James, Forensic Examination of Human Hair, CRC Press, Taylor & Francis Group, Boca-Raton, Florida, (1999).

Caddy, Brian, Forensic Examination of Glass and Paint: analysis and interpretation, CRC Press, Taylor & Francis Group, Boca-Raton, Florida, (2001).

A list of suggested reading materials will be distributed.

Internet Resources: Molecular Expressions (http://micro.magnet.fsu.edu).

Class Handouts: I will supply numerous handouts.

Manufacturer's Literature: Application and product literature is a valuable resource.

TENTATIVE LECTURE SCHEDULE

Week	Lecture Topics – Subject to Change
1	**Introduction to Trace Evidence and Ethics in Criminalistics** A. Investigative Process B. Role of Forensic Science/Criminalistics C. Expert Witness and Ethical Responsibilities D. Scientist vs. Technician E. Laboratory vis-à-vis the Police Function F. Physical Evidence G. Future of Forensic Science H. Concepts of Identification and Individualization I. Uncertainty, Probability, Statistics and Significance I. Professional Ethics in Trace Evidence Analysis and Research
2	**Microchemistry** A. Microscale work in Trace Evidence Examinations B. Chemistry on a Microscale C. Techniques of Microchemical Crystal Tests D. Inorganic Analyses E. Organic Analyses F. The Microscope in Criminalistics 1. Stereo Microscope 2. Comparison Microscope 3. Conventional Research Microscope 4. Microscope as a Testing and Measuring Tool **Density Determinations** A. Liquid - Mohr-Westphal - Pycnometer B. Solid - Westphal - Displacement - Microdisplacement - Flotation C. Comparative Density - Flotation - Density gradient
3	**Light Review I** A. Dispersion B. Refraction C. Diffraction D. Refractive Index E. Spectra 1. Continuous 2. Discontinuous F. Color Temperature G. Lenses: Principal and Conjugate Foci H. Lens Aberrations
4	**Light Review II** A. Refractive Index 1. Utility of Measurement in Forensic Science 2. Refractometers 3. Absolute and comparative refractive index of a glass particle 4. Becke line 5. Oblique Illumination Method 6. Dispersion staining 7. Phase contrast 8. Chaulnes Cell Method for a micro sample of a liquid B. Dispersion

5 & 6	**Crystals and Polarized Light** A. Isotropic, Anisotropic Materials B. Double Refraction - Birefringence C. Polarization by Reflection; Dielectric Mirror D. Nicol Prism E. Dichroism, Pleochroism F. Dichroic Filters - "Polaroid" G. Ray Velocity Surfaces H. Indicatrix Models
7 & 8	**Polarizing Microscope - Optical Crystallography** A. Orthoscopic Observations 1. Extinction 2. Retardation 3. Newton's Colors 4. ¼ λ compensator 5. λ compensator 6. Quartz wedge 7. Sign of Elongation B. Microscopic Morphology of Fibers C. Optical Property Measurements on Fibers 1. Birefringence 2. n-parallel and n-perpendicular 3. Drawn and Undrawn fibers D. Conoscopic Observations 1. Interference Figures 2. Uniaxial Crystals a. ε and ω b. Optic sign 3. Biaxial Crystals a. OAP b. Principal Refractive Indices c. Acute bisectrix d. Optic normal e. Optic axial angle
9	**Microscope I** A. Lamp filament B. Primary and Secondary Radiators C. Lamp diaphragm
10	**Microscope II** A. Substage Condenser B. Critical Illumination C. Köhler Illumination D. Diaphragms and Condenser Cone E. Resolution and Physical Optics F. Abbe's Diffraction Theory of Image Formation
11 & 12	**Microscope III** A. Review Abbe's Diffraction Slide Experiment B. Resolution - Resolving Power C. Visibility 1. Color images 2. Refraction images D. Empty Magnification E. Magnification defined F. The microscope as a measuring instrument/micrometers G. Objectives - Achromatic/Apochromatic H. Darkfield and Ultramicroscopy 1. Vertical Illumination
13	**Phase Contrast** A. Theory B. Uses in Trace Evidence Examinations **Differential Interference Contrast** A. Theory B. Uses in Trace Evidence Examinations
14	**Trace Evidence: Review of Various Cases** A. Homicide B. Class Discussion Report of the January 1970 Grand Jury or other case example
15	**The Future of Trace Evidence Examinations** A. Present Difficulties and Needs B. Future Improvements

Table 1: Lecture Schedule (continued)

EVALUATION OF STUDENT PERFORMANCE

Grading:

The final course grade is comprehensive and contributed by homework, announced and unannounced quizzes, oral exams, and a final exam. During all quizzes and exams, other than a scientific calculator, absolutely no electronic devices are allowed, this includes cell phones. You must silence your cellphone prior to the start of a quiz or exam. If your cell phone rings during any quiz or exam, you will be required to immediately turn in you exam and exit the room.

Activity	**Points**
Written exercises (3)	50 / exercise
Quizzes: oral or written (3)	50 / quiz
Midterm Exam: written	300 / exam
Final Exam	600 / exam

Grading Scale / Points		
100% - 90%	A	1200 - 1080
89% - 80%	B	1079 - 960
79% - 70%	C	959 - 840
$\leq$ 69%	F	$\leq$ 839

The course grade depends solely on each student's individual performance, rather than any other personal reason. If the student misses a quiz due to an emergency, a make-up quiz or equivalent assignment must be requested in writing within one calendar week and must be accompanied by an official document and statement to prove the emergency; otherwise there will be no make-up quiz and the grade will be zero. There is no compromise of the grade for a verifiable emergency (medical or other) situation. All students must attend the final exam. Missing the final exam will lead to either a failing grade or an incomplete, but only due to an emergency. No make-up final exam will be given.

Student Success:

In addition to attending lectures and performing laboratory experiments, students are expected to spend a considerable amount of time every week studying for this course. A successful student will find it necessary to spend study time (10-20 hours, depending on the student's progress and comprehension) in the laboratory using microscopes to analyze trace evidence. Students are encouraged to study in small, well organized groups. Peer-based teaching has proven to be a very valuable experience that results in a deeper understanding of course materials, which is reflected in higher individual performance and retention of course content.

Cheating:

Each student is expected to complete the laboratory work independently. Submission of identical lab report or sharing data is treated as cheating. Cheating on an exam, homework or laboratory assignment will result in a zero for that particular assignment, or lead to a stricter penalty based on official University policy.

Statement of University Policy on Plagiarism:

Plagiarism is the presentation of someone else's ideas, words, or artistic, scientific, or technical work as one's own creation. Using the ideas or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotation all require proper citation to the original source.

Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism.

It is the student's responsibility to recognize the difference between statements that are common knowledge (which do not require documentation) and restatements of the ideas of others. Paraphrase, summary, and direct quotation are acceptable forms of restatement, as long as the source is cited.

REMINDERS OF IMPORTANT UNIVERSITY-WIDE POLICIES
The following policies are summarized from the Student Handbook. Please remember, it is your responsibility as a student to review these and the other policies that your Handbook contains.

Attendance:
Students are expected to attend all classes. The University assumes you are mature enough to be responsible for your own behavior. Any absence of two weeks or more will be reported to the Office of the Associate Provost and the Registrar. You should notify me when illness prevents you from attending class and make arrangements to complete missed assignments. Notification may be done by calling me, or by leaving word at the Faculty Services (735-4739). Depending on your circumstances, I may modify deadlines of course requirements. Anyone who stops attending a course without officially withdrawing may receive a failing grade. Students with three or more unexcused absences will lose one letter grade.

Classroom Deportment
- You are expected to be punctual; unexcused tardiness will be considered an absence.
- Smoking and alcoholic beverages are prohibited in all classrooms, whether or not class is in session.
- No pets are allowed in class. Exceptions will be made in the case of a seeing-eye dog.
- Personal audiovisual equipment not pertinent to the class is prohibited during class.
- Follow the University's "dress code" requiring footwear and appropriate shirts to be worn during all classes, as well as in the library, cafeteria, and administrative offices.

Academic Honesty:
Students are responsible for promoting academic honesty at Chaminade by not participating in or facilitating others' participation in any act of academic dishonesty, and by reporting incidences of academic dishonesty (such as theft of tests, records, and other confidential materials, altering grades, and/or plagiarism) to their instructors.

Freedom of Expression:
Students are free to take reasoned exception to the views offered in particular courses of study. They may be required to know thoroughly the specific bodies of knowledge or interpretations or theories set by the professor, but are free to reserve personal judgment as to the truth or falsity of them.

Students are expected to maintain the standards of academic performance articulated in course syllabi, supplemental readings, assignments, and Academic and Student Affairs policies. The instructor is considered the normal and competent judge of academic work. Students have an appeals process in the rare case of unjust grading and evaluation by the procedure detailed in the Academic Grievance section of the Student Handbook.

ADA Accommodations:
In compliance with Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA) of 1990, and the ADA Amendments Act (2008), Chaminade University of Honolulu offers accommodations for individuals with disabilities. If you would like to determine if you qualify for ADA accommodations, please contact the Counseling Center at (808) 735-4845. Once your documentation is submitted, the assessments will be reviewed and the student will be notified.

If one qualifies for ADA accommodations an ADA contract will be signed by the student. Please remember that once you have signed an ADA agreement, you need to contact the ADA coordinator each semester (including summer sessions) to identify which instructors you want notified of your accommodations. This is to ensure your privacy. Faculty will be informed of the accommodations you are to receive but not the nature of your disability. From the time that appropriate documentation is received by the ADA Coordinator, please allow 2 to 3 weeks to process your paperwork. Processing time may vary pending the volume of requests received. You can find more information at http://www.chaminade.edu/student_life/sss/counseling_services.php