Chaminade University
OF HONOLULU

FS 480/680 Survey of Methods in the Analysis of Explosives
Undergraduate and Graduate
Spring 2014

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Lecture: Tuesday & Thursday, 0900 – 1050, Henry Hall Lab 6

Office Hours: Tuesdays and Thursday, 1130 – 1230 hours (walk-in)
Any other time by appointment

COURSE DESCRIPTION

An explosive is any material, either a single substance or a mixture of chemicals, which is capable of producing an extremely rapid reaction resulting in the formation of heat and a sudden increase in pressure. An explosion is characterized, usually with the expulsion of gas, by the sudden release of heat that causes a sudden expansion of the air in the neighborhood. All explosive substances produce heat; nearly all explosives produce gas too. The rapid change is invariably connected to the liberation of energy. The resulting post-blast products represent a lower energy state than did the explosive before it produced the explosion. Explosives are classified by the various stimuli to which they respond and by manner of their responses in producing explosions; I) propellants (low explosives), II) primary explosives (initiators), and III) high explosives.

Pyrotechnic are typically associated with amusement – Fireworks! The developments of pyrotechnic mixtures of inorganic salts are often used in different colored signal flares such as potassium nitrate, strontium nitrate and powdered charcoal (red flare). Within most pyrotechnics, after the propellant charge has burned completely and the rocket has attained the height of its flight, the fire reaches the charge in the head which bursts and throws out large and small stars of colorful displays.

This course will focus on intact explosive, uninitiated bulk or unconsumed materials in post-blast debris, and on trace residues, by-products, and components associated with an explosive device. Introduce the explosive train; an assembly of explosive elements arranged in order of decreasing sensitivity. The function of the explosive train is to accomplish the controlled augmentation of a small impulse into one of suitable energy to cause the main charge of a munition to function. The curriculum will outline the safe identification, documentation, handling, collection, and preservations of post-explosion residues. This course will survey analytical methods used in the detection and identification of explosive

compounds and mixtures. A variety of chromatographic separation systems and numerous spectroscopic techniques will be surveyed for their contributions to the development of an analytical protocol.

MEASURABLE LEARNING OUTCOMES

Reasoning

- The purpose of the survey of analytical methods is to introduce the breadth of analytical techniques.
- Recognize relevant questions associated with the analysis of explosives
- Recognize and understand related assumptions.
- Recognize strengths and weaknesses of analytical techniques.
- Develop a methodology based on data, information, and evidence.
- Gain knowledge to express scientific concepts and ideas.
- Gain knowledge to identify inferences that influence interpretations by which to draw conclusions.
- To develop intellectual standards essential to sound scientific understanding: clarity, accuracy, precision, relevance, depth, breadth, logic, and significance.

Knowledge

- Identify the principal areas of forensic investigations of explosions.
- Gain a fundamental understanding of the physics and chemistry of explosions.
- Recognition and analysis of incendiary devices, explosives and explosive residues.
- Identify guidelines for the forensic identification of explosive compounds and mixtures based on the use of scientifically acceptable analytical methods.
- Identify methods that provide significant chemical compound structural and/or elemental information.
- Identify methods that provide limited chemical compound structural or elemental information.
- Identify analytical methods that provide a high degree of selectivity.
- Evaluate scientific literature, conduct literature reviews to become familiar with the topics, and develop a deeper understanding of the underlying issues and complexities.
- Synthesize related scientific literature.

Practical skills

- Apply knowledge of current events and related topics to the evaluation of various analytical procedures, applications of these procedures to the appropriate types of evidence. And, to identify and pursue research in the analysis of various evidence and subjects associated with forensic evidence.
- Produce exemplary presentation of scientific subject matter in order to effectively communicate research design, which includes proper evidence controls (positive and negative), use of standards (SRMs, CRMs, etc.), proper use of the scientific method, presentation of data obtained through proper interpretation, and what constitutes a scientific opinion.

Communication

- Present scientific facts and opinions in a clear and logical oral and written manner;
- Become more confident and comfortable with concepts, principles, and theories related to the subject area in order to disseminate scientific information to other scientists and "juries" by delineating analytical procedures, results, discussions and interpretations.

REQUIRED READINGS

Yinon, Jehuda (1999) Forensic and Environmental Detection of Explosives, John Wiley & Sons, Ltd., New York, New York
ISBN: 978-0-471-98371-2

Crippin, James B. (2006) Explosives and Chemical Weapons Identification, Taylor & Francis: Forensic Science Techniques Series; CRC Press, Boca Raton, Florida
eBook ISBN: 978-1-4200-3762-3 (available through Sullivan Family Library)

I will provide either photocopies of the various articles or require students to perform literature searches and reviews based on assigned topics.

The foundation of this course is based on becoming familiar with the literature and the "state of the science" associated with various topics, and effective communication of issues related to these topics.

WRITING ASSIGNMENT REQUIREMENT

Undergraduate Students

All undergraduate students will be required to submit an annotated bibliography on an analytical method applied to a class of explosive. This annotated bibliography should contain at a minimum 20 articles published within the last ten years. For example a student may choose the analytical technique Ion Mobility Spectroscopy applied to Nitrogen containing explosives; perform a thorough literature review, and synthesize a comprehensive review of the "state-of-the-science" for this particular area of explosives analysis. No two students are permitted to have the same combination of analytical method and class of explosives. The student must submit their chosen combination by the third week of class meetings. The annotated bibliography is **due on *April 21, 2014***.

Paper guidelines: The final draft must be double spaced with one in margins, size 12 font in either Times New Roman or Arial. Use a separate title page. Submit your annotated bibliography via email in either MS Word .doc or .docx format. You must have available any reference article to be submitted upon request.

Graduate Students

All graduate students will be required to submit a research paper. The research paper should address a specific analytical technique and a class of explosives material. You should choose a pair that is of interest to you. No two students are permitted to have the same combination. Submit your selected combination by the third week of class meetings. The final research paper is **due on *April 21, 2014*** and it should be a minimum of fifteen but no more than seventeen pages. Follow the paper guidelines as stated above. Each graduate student will be required to give a short 20 minute presentation to the class about their research paper.

TENTATIVE LECTURE SCHEDULE

Week	Lecture Topics – Subject to Change
1 T, 1/14 Th, 1/16	**Introduction to Survey of Methods in the Analysis of Explosives** Birmingham 6 Centennial Olympic Park bombing Oklahoma City, Alfred P. Murrah Federal Building USS Cole UNABOM - Ted Kaczynski A scientific approach to explosion scene reconstructions
2 T, 1/21 Th, 1/23	**The Explosion Train** Primers Detonators Relays Delays Leads Boosters Main charges
3 T, 1/28 Th, 1/30	**Pyrotechnic Powders, Dynamite** Chemistry of Inorganic Powders Chemistry of Fireworks
4 T, 2/4 Th, 2/6	**Low Explosives and High Explosives** Black powder Smokeless power Detonation cords Blasting caps Military explosives Ammonium nitrate based explosives Slurry and emulsion explosives
5 T, 2/11 Th, 2/13	**TWGFEX** Recommended guidelines for forensic identification of intact explosives and explosive residues
6 T, 2/18 Th, 2/20	**66th Annual Meeting of the American Academy of Forensic Sciences** **Seattle, Washington,** **Washington State Convention Center**
7 T, 2/25 Th, 2/27	**Gas Chromatography and hyphenated techniques** GC-FID GC-ECD GC-Quadrupole MS GC- Ion Trap MS GC- MS-MS
8 T, 3/4 Th, 3/6	**Ion Mobility Spectrometry** Introduction to the principles of operation Characteristic detection Interpretation of Ion Mobility spectra
9 T, 3/11 Th, 3/13	**Capillary Electrophoresis** Introduction to the principles of operation Characteristic electrophorogram
10 T, 3/18 Th, 3/20	**Infrared Spectroscopy** Introduction to the principles of operation Infrared characteristic absorption and classification Interpretation of Infrared spectral data
11 T, 3/25 Th, 3/27	**Spring Recess, No Classes**
12 T, 4/1 Th, 4/3	**Raman Spectroscopy** Introduction to the principles of operation and application Stokes and Anti-Stokes Surface Enhanced Raman Scattering (SERS) Interpretation of Raman spectral data

13 T, 4/8 Th, 4/10	**Energy Dispersive X-ray (EDX) / X-ray Fluorescence (XRF)** Introduction to the principles of operation Characteristics of Energy Dispersive X-ray Spectroscopy Interpretation of elemental data
14 T, 4/15 Th, 4/17	**Polarized Light Microscopy** Microchemistry Techniques Characteristic microchemical crystal tests
15 T, 4/22 Th, 4/24	**Spot tests, Flame test, Melting Point, and Fusion Methods (polymorphisms)** Introduction to principles of applications
16 T, 4/29 Th, 5/1	**Graduate Student Presentations:** Topic TBA

EVALUATION OF STUDENT PERFORMANCE

Grading:

The final course grade is comprehensive and contributed by class discussions, midterm written exam, and a literature review with an annotated bibliography. Graduate students will in addition prepare a research paper and an oral presentation. During all classroom discussions absolutely no electronic devices are allowed, this includes cell phones. You must silence your cellphone prior to the start of a class.

Activity Undergraduate and Graduate	**Points**
Lecture discussion and participation	100
Midterm exam	150
Literature review and annotated bibliography	100
Cumulative final exam	200
Activity Graduate	**Points**
Research paper	100
Presentation on research paper	100

Undergraduate Grading Scale		
100% - 90%	A	>495/550 pts
89% - 80%	B	494 – 440 pts
79% - 70%	C	439 – 385 pts
69% - 60%	D	384 – 330 pts
$\leq$ 59%	F	<330 pts

Graduate Grading Scale		
100% - 90%	A	>675/ 750 pts
89% - 80%	B	674 – 600 pts
79% - 70%	C	599 – 525 pts
$\leq$ 69%	F	<599 pts

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, students are expected to spend a considerable amount of time every week studying for this course. 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 all written assignments and examinations independently. Cheating on an exam, homework or written 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 cases 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