

**CHEM 670: Forensic Analytical Methods**  
**LECTURE SYLLABUS**  
**4/23/26**

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**Instructor:** *Dr. Ellen Hondrogiannis*  
**Office:** SC 3301D  
**E-mail:** EHondrogiannis@towson.edu  
**Office hours:** By appointment or anytime my door is open.  
**Web:** Blackboard (BB)  
**Meeting times and location:** T 2:00 – 3:50 SC 5252; R 2 – 3:50 SC 5331  
Although we are in lab on Thursdays we may still lecture. I will announce the schedule the Tuesday before.

**Course Objective:** This course is designed to provide students with an overview of the theory and practical aspects of the trace evidence analysis of explosives, fire debris, drugs, and other less frequently encountered types of evidence.

**Prerequisite:** FRSC 602 for trace students taught by Sivey and Devadas. In addition, students should have a strong background in General Chemistry and Analytical Chemistry. Among other concepts, students should know how to convert among different units, prepare solutions, make calibration curves, and use the ATR-FTIR and GC/MS and interpret the data. Students who still need help with the ATR-FTIR and GC/MS will be expected to spend time outside of class to learn the operation and how to collect data. Students are also expected to follow oral instructions – not everything will be provided as a power point and/or written out. When oral instructions are given students should take notes.

Students arrive at this course with a variety of different backgrounds. Based on your prior undergraduate laboratory experiences in addition to material that you may or may not have retained from your undergraduate chemistry courses you may find that you need to put more effort into these laboratories and/or learning the lecture material. You will do best on the exams if you understand the material since you will be required to apply the material that you have learned to answer the exam questions.

Students are not permitted to take pictures of the board and are instead encouraged to work through concepts/calculations as they are presented in class. Students are also not allowed to record lectures. Anyone found recording the lectures, in possession of recordings, or sharing recordings will be given an F for this course. You are expected to attend class and take notes. This skill will help prepare you for how information will be communicated in the workforce. You are encouraged to ask questions.

**Attendance:**

Lecture: While attendance is not required, you will benefit by attending the lectures. Although some of the material can be found on BB, through handouts, or in your text, the degree to which we cover each topic will differ. If you miss lecture, please obtain the notes from another student. I will not assist you in learning the material if you are not present for lecture. I will also not assist you in learning material from assessments if you missed the same topics in class. Please note that all assessments are cumulative.

Lab components: Due to sharing of instrumentation with other classes, it is difficult to reschedule the laboratories. If you miss a lab, you will not be permitted to make it up. You will still be required to complete the laboratory component of the exam. You must schedule time to run the GC/MS laboratory component of the exam outside of class time. You should also plan on scheduling to use the GC/MS outside of class time to practice using the GC/MS and analyzing the data.

<https://catalog.towson.edu/graduate/procedures-policies/class-attendance-absence-policy/>

**Concepts and Skills:** Upon completion of this course, each student will:

1. Understand

- characterization methods for and various types of trace evidence.
- the history of explosives.
- fire scene examination for the purpose of determining the origin and cause as well as significance of post fire indicators and fire patterns.
- the chemical composition of petroleum products
- trace evidence excluding drugs (i.e., tapes, air bags, pepper spray, bank dyes)
- attribution of forensic evidence.
- linear discriminant function analysis and principle component analysis.

- inductively coupled plasma - optical emission spectroscopy (including preparing samples and evaluating data).
  - scanning electron microscopy
2. Be able to perform and evaluate data for
    - the microscopic, FTIR, and GC/MS instrument tests to determine the type of low explosive.
    - ASTM analysis of petroleum products using GC/MS.
    - portable Raman for GSR and other types of trace evidence.
  3. Be able to carry out discriminant function analysis (dfa) on given data and generate dfa plots, write functions, and extract relevant statistical parameters.
  4. Orally present peer-reviewed literature on attribution in forensics in a format suitable for presentation at a professional meeting.

### **Exam Practicals**

Exams 1 and 2 will each consist of a written and laboratory component. You will have the opportunity to perform the same laboratories to learn the techniques (on which you will be examined) during lab time. You are also encouraged to practice outside of lab time. You should take notes during these times to understand the analysis and ask your professor questions. I encourage you to take responsibility for your learning by reading back through your notes and any assigned reading material. After the practice period is over you will not be allowed to ask the professor questions, but you can use your own notes. You cannot ask your classmates for help during the laboratory component of the exam. This includes anything from the experimental, instrumentation, data analysis and write up. The laboratory portion on the exam will be an **application** of what you have learned in the laboratory. If you miss a laboratory, you cannot make it up but must still complete the laboratory portion of the exam. If you choose not to do the laboratory portion of the exam you will receive a zero for that portion of the exam. The laboratory portion of the exam may be up to 50% of your exam grade.

### **Oral Presentation**

You are to orally present a recent (~ last 5 years) peer-reviewed article dealing with attribution of trace evidence. The grading rubric is attached. You should be prepared to present starting the 4th week of classes. This will require you to start working on this assignment immediately. Use the rubric to ensure you have covered all the relevant topics. As a graduate student you are expected to “proof”

your own power point using the rubric provided and the example I will present. I suggest logging into the Cook Library, using the Scopus database, and entering the appropriate keywords to search for an article.

- Reference Material:**
1. *Forensic Analysis on the Cutting Edge New Methods for Trace Evidence Analysis*, Blackledge, Robert D. Wiley. 2007. **Required.** I will keep a library copy in my research lab for your use. Please use this only in the Science Complex and return it to the lab the same day so everyone in the class can access it.
  2. Powerpoints that can be downloaded from blackboard.
  3. Various handouts.
  4. Availability of RAs to help you learn the GC/MS. First sign up on BookmyLab <https://towsoncore.bookmylab.com/index.php> (pw is pass) then email one of the RAs 72 h ahead of time. (The RAs are also doing research. Emailing them earlier will allow them to plan their research as well.) This training should include an overview of the instrument, editing a method and sequence and saving these to your own method and sequence folders, running a sample already on the instrument, analyzing the data including EIC, saving the data into your data folder, replotting the chromatogram and mass spec using Excel. Once you are trained in this you should return to the instrument and repeat everything on your own and/or with minimum guidance from the RA.  
Alex Potter: [apotter2@students.towson.edu](mailto:apotter2@students.towson.edu) (T: 9-12; W 10-1; Thursday 9-1 pm)  
Leslie Juengst: [ljuengst@towson.edu](mailto:ljuengst@towson.edu) (T: 9-1 pm; W: 12-3 pm; Thursday 1-4 pm)  
Kayla South: [ksouth3@students.towson.edu](mailto:ksouth3@students.towson.edu) (M: 9:30-2:30 pm; W: 12:30 – 6 pm)  
Briget Campbell: [bcampbe8@students.towson.edu](mailto:bcampbe8@students.towson.edu) (T: 11-2; W: 11-3; Thurs 12-2; 4-5)

**Academic Integrity:** Students are subject to the University Student Academic Integrity Policy (<https://inside.towson.edu/generalcampus/tupolicies>), and academic dishonesty will NOT be tolerated. If a student is caught cheating, then the student will receive a zero on the assignment/exam or may be given a grade of “F” for the course. Please avoid situations where one may also interpret that cheating has occurred. You are taking this class because you hope to work in a crime laboratory and present your results in court. Integrity is of the utmost importance.

**Chemistry Department Statement on Classroom Diversity and Inclusion:** The students, faculty, and staff at Towson University represent a diverse and vibrant community of learners and scholars. As a community, we value the unique contributions of each individual and promote active participation in all aspects of the learning process by each community member. Your instructor strives to create a classroom environment built upon the principles of mutual respect and support. Toward this end, all members participating in this course are expected to demonstrate respect for all other members of the class. If you feel these expectations have not been met, please speak with your instructor or the designated liaison, Dr. Cindy Zeller ([czeller@towson.edu](mailto:czeller@towson.edu)).

**Laboratory Policy for Pregnant Students:** Pregnant students should consult their physicians for advice on whether to perform experiments in the laboratory. Students are encouraged to provide their physician with a list of the chemicals that they might be exposed to while in lab. They should also check the MSDS sheets (available in the Department) to be aware of the hazards of the chemicals.

If a student is advised against performing laboratory work, then faculty must make accommodations for the student. Any accommodations should comprise a workload that is approximately equivalent to the regularly scheduled laboratory work. These accommodations may include:

- performing “dry” experiments only, in a place free from exposure - to ongoing experiments;
- performing the wet chemistry at a later date;
- receiving an incomplete grade in the course pending completion -- of experimental work

**Grading:**

<b>Topic – all exams are cumulative</b>	<b>Points</b>
Exam 1 including laboratory exam and any assigned reading	100
Exam 2 including laboratory exam and any assigned reading	100
Exam 3 including any assigned reading	100
Exam 4 during final exam time	100
Oral Presentation (cannot be dropped)	50
There is no final exam, however, the laboratory report for Exam 2 is due the day of your scheduled final exam at the	

time at which your exam is scheduled to begin.	
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### Grading Scale

A	93.00-100%
A-	90.00-92.99%
B+	87.00-89.99%
B	80.00-86.99%
C	70.00-79.99%
F	<70.00%

**Course Evaluation:** Your 3 highest exam scores will be averaged along with your oral presentation to calculate your overall grade. There are no make-up exams. You do not need to provide me with an excuse for missing the exam. The assumption is that the missed exam score will be your lowest and this will be your dropped assessment. If you miss more than two exams, then I will give you an oral exam during finals week. This 30-minute oral exam will be cumulative and will count for 100 points. I am happy to review any returned exam or oral presentation material *within one week* of you receiving the material. After that time, the returned exam or oral presentation grade will not be changed. If I do review your exam or presentation, then I will regrade the entire exam and/or presentation.

### Schedule. All presentations are scheduled for Tuesdays.

Week of	Topics
1/26	<p>Introduction to course            Attribution of forensic evidence            GC/MS</p> <ul style="list-style-type: none"> <li><i>If you are not fluent with running samples on the GC/MS and analyzing data, then you should seek help from an RA to run a solution that is already on the instrument. You should analyze the data and replot in Excel. This practice gets you ready to move forward with the first lab. You should do this within the first two weeks.</i></li> </ul> <p><b>Thursday – Half students clean the ion source (5331 A); half students learn GC/MS; Wear lab attire</b></p>
2/2	<p><b>Tuesday – Half students clean the ion source (5331 A); half students learn GC/MS; Wear lab attire.</b></p> <p><i>Oral presentation topic on attribution <b>due to me by email by 2/5 at beginning of class</b>, or 5 points will be deducted for each day the presentation topic is not submitted/approved. Having these topics will allow me to make any needed changes to the syllabus.</i></p> <p><b>GC/MS; Ch. 1 Ch. 1</b> (know instrument capabilities and output – elemental versus organic)</p>

2/9	<p>Characterization of smokeless powders (Ch.10 be familiar with different SP shapes, know measurements in Table 10.3. GC/MS method parameters are given in Table 10.6. Do NOT exceed 280°C on our instrument.)</p> <p><b>Thursday Laboratory</b> microscopic and IR analysis of low explosive analysis. Begin SP extraction for GC/MS analysis.</p>
2/16	<p>Examples of explosive devices and IR Instrumental explosive analysis continued</p> <p><b>Laboratory; ATR-FTIR; GC/MS data analysis</b></p>
2/23	<p>(T) multivariate analysis</p> <p><b>Thursday Open Lab</b> <span style="float: right;">Viviana explosives ICP/MS</span></p>
3/2	<p><b>Tuesday Exam 1; includes reading material: Thursday “time” for laboratory portion of exam. You are to carry this out independently including operation of instruments and all data analysis.</b></p>
3/9	<p>Flammable substance analysis</p> <p><b>Thursday laboratory</b> <span style="float: right;">Dayannara cocaine ICP/MS</span></p>
3/16	<p><b>No classes– SPRING BREAK</b></p>
3/23	<p>Flammable substance analysis</p> <p><b>Thursday Lab IL Extraction</b> <span style="float: right;">Ariana Smokeless Powders</span></p>
3/30	<p>Flammable substance analysis</p> <p><b>Thursday Open Lab</b> <span style="float: right;">Skye microplastics fertilizers</span></p>
4/6	<p>(T) multivariate data analysis/ICP/MS/OES <span style="float: right;">Bridget NP ICP-MS</span></p> <p><b>Thursday ICP/OES</b></p>
4/13	<p>ICP/MS/OES; XRF, XRD, IC, LC/MS/MS</p> <p><b>Thursday ICP/OES data analysis</b></p> <p style="text-align: right;">Gabriela sarin, DAT</p>
4/20	<p><b>Tuesday Exam 2; includes reading material</b></p> <p><b>Thursday meet in UEBL first floor for XRF, XRD, IC, LC/MS/MS exposure</b></p>
4/27	<p>(T) CWAs, LATOF</p> <p><b>Thursday “time” for laboratory portion of exam. You are to carry this out independently including operation of instruments and all data analysis</b></p> <p style="text-align: right;">Meagan XRF artwork</p>
5/4	<p>(T) Airbag, glass cuts, tape, IRMS analysis (Ch 2 be very familiar with Case Sample 2, but glance at remaining case samples. Ch. 11 recognize cuts made by tearing, scissors, knife. Ch 12 focus on duct tape; delete 12.6.2, 12.6.3. Ch 15 know up to and including 15.6; glance at examples and recognize output.)</p> <p><b>Thursday SEM- Professor Devadas</b> <span style="float: right;">Ava ATR-FTIR paint</span></p>
5/11	<p>(T) (Ch 7 know 7.1 and 7.2; know output), ink analysis (Ch. 3 know general instrumentation – as covered in lecture; know 3.4, 3.7), Ch. 5 know all of 5.4 capsaicins; know bank dyes from lecture.</p> <p><b>Thursday extraction of capsaicin and GC/MS analysis.</b></p>

5/12	<b>5/12(T) Exam 3 (cumulative) includes reading material; 2-3 pm written;</b> Last day of classes.
<b>5/19 T</b>	3 pm. E2 lab portion of exam due to me by email or under my door. <b>Exam 4</b>