



**Prerequisites: General Chemistry, Organic Chemistry, Instrumental Analysis**

## **SYLLABUS**

### **COURSE OBJECTIVES**

1. Students will apply their knowledge of both organic and analytical chemistry in the classification and identification of controlled substances.
2. Students will study the various combustion reactions involved during the firing of a gun, arson, and explosions.
3. Students will apply their knowledge of organic, inorganic, and analytical chemistry for the analysis and identification of colorants used in ink and paint formulations.
4. Students will build upon their knowledge of organic chemistry in the area of polymers (adhesives and synthetic fibers).
5. Students will study the chemistry of glass and other trace forensic evidence.

### **COURSE OUTCOMES**

1. Students will be able to design a protocol consisting of both presumptive and confirmatory tests, for the identification of an unknown controlled substance.
2. Provided with evidence from the site of a fire or explosion, students will be able to design a method for analysis, in order to determine whether or not the event was intentional or accidental.
3. Students will be able to design protocols for the instrumental analysis of organic and inorganic colorants found in ink and paint formulations.
4. Students will be able to design protocols for the identification of adhesive and synthetic fibers found at the scene of a crime.
5. Students will be able to identify the difficulties encountered in the analysis of glass and other trace forensic evidence.

## **REQUIRED MATERIALS FOR THE COURSE**

**TEXT:** Blackledge, Robert D., Forensic Analysis on the Cutting Edge, John Wiley and Sons, Inc., Hoboken, NJ, 2007. ISBN: 978-0-471-71644-0

**e-College Course:** This course is an e-companion course. You can log onto the course webpage by accessing *Cedar Crest Online* by accessing the Cedar Crest home page and then clicking on “Current Students”. This will bring you to a menu list from which you should click on “Online Courses (eCollege)”. This will navigate you to the Cedar Crest Online home page where you should login using your Login ID and password. Click on “Go to Class” then click on “Courses”. Click on “Fall 2009 eCompanion” followed by clicking on “FSC 507 00 Forensic Chemistry”. This should navigate you to the course website where information will be posted concerning the course. You should check this often for updated information about assignments and course schedule. We will be using multiple external reference sources in addition to the required text. The references will be listed here as well as the syllabus. Additional information may be uploaded to this site so please check it often.

**CALCULATOR:** A scientific hand calculator will be needed for this class.  
Please bring it to class with you.

## **MEETING TIMES**

Lecture: Tuesday, Thursday: 9:30 – 10:45 AM; OBK-1

Instructor’s office: Oberkotter 6; Phone: Ext. #3495

Office Hours: Regularly scheduled office hours are: Tues., Thurs. & Fri. 11 AM – 12 Noon.

I am always willing to help at anytime, if my schedule permits. Feel free to stop by whenever I am in my office. To ensure of my availability for assistance, it would be best to schedule an appointment.

Email: Tabrette@cedarcrest.edu

## **GRADING SYSTEM**

The grade for this course is based on, three one-hour exams (300 pts), attendance/class participation (25 pts) and a comprehensive final exam (175 pts).

The final letter grade will be awarded according to the following scale:

|            |                |            |                |
|------------|----------------|------------|----------------|
| 93 – 100%  | A              | 80 – 82.9% | B <sup>-</sup> |
| 90 – 92.9% | A <sup>-</sup> | 76 – 79.9% | C <sup>+</sup> |
| 87 – 89.9% | B <sup>+</sup> | 70 – 75.9% | C              |
| 83 – 86.9% | B              | Below 70%  | F              |

## POLICIES

### Classroom Attendance

Classroom attendance is **mandatory** in order to perform well in this class. If class is missed due to illness, sports event, or family emergence, the student is still responsible for any missed assignments and obtaining the lecture notes. No class participation points can be earned due to absences.

### Attendance on Examination Days

Attendance on exam days is mandatory. If an exam is missed due to illness or a family emergency, a make-up test may be given upon receipt of a **written** excuse from either a doctor or the Dean of Students' Office.

### Homework Assignments

Homework problems may be assigned throughout the course. At this level the student is expected to be able to complete these on her own. Answer keys will be posted and the instructor will be available to discuss or help the student upon her request.

### Obtaining Assistance

Do not hesitate to seek assistance concerning class lectures, homework assignments, or grading. If the student can not make it to the instructor's scheduled office hours, she should make arrangements to meet with the instructor at an alternative time at both the student's and the instructor's convenience.

### 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 of 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."

The instructor expects each student to abide by the college's honor code. This honor code applies to all activities associated with this course. The student should realize that the honor code is an important aspect of the educational process at Cedar Crest College.

Cedar Crest College Faculty and Administration support the following statement concerning Classroom Protocol:

"Appropriate classroom behavior is implicit in the Cedar Crest College Honor Code. Such 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, early departures, inappropriate conversations, and any other behaviors that might disrupt instruction and/or compromise students' access to their Cedar Crest College education."

Please be sure to put all cell phones and pagers on vibrate during class times. No texting during class, please!

### **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 his/her own.
- Adhere to the rules of acknowledging outside sources, as defined by the instructor, never plagiarizing or misrepresenting intellectual property.
- Neither seeks nor receives 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 the consultation with the instructor and the chair, you should see the Provost.”

It is the instructor’s policy to deal with violations of these Standards for Academic Conduct by awarding a grade of 0 for the assignment or examination in question.

### **Students with Learning Disabilities**

The instructor supports the Cedar Crest College policy regarding learning disabilities as follows:

“Students with documented disabilities who may need academic accommodations should discuss these needs with their professors during the first two weeks of class. Students with disabilities who wish to request accommodations should contact the Advising Center.”

### **CHRONOLOGICAL PLAN FOR THE COURSE**

The schedule on the following page lists the dates and topics, which constitute the lectures pertaining to this course. A summary of the testing schedule and content is provided. The schedule **may be** modified throughout the course, as needed.

### **Testing Schedule Summary**

| <u>2009 Date</u> | <u>Test</u> | <u>Material Included</u>             |
|------------------|-------------|--------------------------------------|
| Thurs. 9/15      | Exam 1      | Part I and II plus reading materials |
| Thurs. 10/8      | Exam 2      | Part III plus reading materials      |
| Tues. 11/17      | Exam 3      | Part IV and V plus reading materials |
| TBA              | Final Exam  | Part VI and Comprehensive            |

## Lecture Topics Schedule

| <u>Date:</u>  | <u>Topic</u>  | <u>Reading Assignment:</u>                    |
|---|---|---|
| <b>Part I. Introduction</b>                                   |   |   |
| 8/25  | Introduction to Forensic Chemistry                        | Ref. 1, Ch. 1-3                               |
| <b>Part II. Statistics in Forensic Chemistry</b>              |   |   |
| 8/27  | Statistics in Forensic Chemistry                          | Ref. 2, Appendix 1                            |
| 9/1   | Sampling, and Data Quality                                | Handout                                       |
| 9/3   | Uncertainty in Forensic Science                           | Handout                                       |
| 9/8   | Multivariate Statistics, Calibration, and Quality Control | <i>Blackledge, Ch. 13</i>                     |
| <b>Part III. Controlled and Toxic Substance Analysis</b>      |   |   |
| 9/10  | Forensic Aspects of Controlled Substances                 | Ref. 3, Ch. 1                                 |
| 9/15  | <b>Exam 1</b>   |   |
| 9/17  | Forensic Drug Analysis I                                  | Ref. 4, Ch. 4                                 |
| 9/22  | Forensic Drug Analysis II: Basic Drugs                    |   |
| 9/29  | Chemistry of Clandestine Drug Production                  | Ref. 5, Ch. 5                                 |
| 10/1  | Chemistry of Medico-legal Analysis of Ethanol             | Ref. 7, Ch. 5; Ref. 6, Ch. 12                 |
| 10/6  | Sample Preparation, & Immunoassay                         | Ref. 5, Ch. 5.2.6; Appendix L                 |
| 10/8  | <b>Exam 2</b>   |   |
| 10/13   | <b>Fall Break!</b>  |   |
| <b>Part IV. Fire Debris and Explosive Analysis</b>            |   |   |
| 10/15   | Chemistry of Combustion: Arson & Explosives               | Ref. 8, Ch. 1–3,<br><i>Blackledge, Ch. 10</i> |
| 10/20   | Fire Debris Analysis                                      | Ref. 8, Ch. 5                                 |
| 10/22   | Explosives and GSR Analysis                               | Handout                                       |
| <b>Part V. Forensic Chemistry of Polymers</b>                 |   |   |
| 10/27   | Introduction and Overview of Polymers                     | Ref. 9, Ch. 1                                 |
| 10/29   | Forensic Analysis of Paper, Fibers, & Polymers            | Ref. 4, Ch. 6                                 |
| 11/3  | Forensic Analysis of Dyes in Fibers by MS                 | <i>Blackledge, Ch.8</i>                       |
| 11/5  | <b>No Class - NEAFS</b>                                   |   |
| 11/10   | Characterization of Surface-Modified Fibers               | <i>Blackledge, Ch.9</i>                       |
| 11/12   | Forensic Chemistry and Analysis of Paints                 | Ref. 6, Ch. 8                                 |
| 11/17   | <b>Exam 3</b>   |   |
| <b>Part VI. Forensic Chemistry in Trace Evidence Analysis</b> |   |   |
| 11/19   | Chemistry & Forensic Analysis of Glass                    | <i>Blackledge, Ch.11</i>                      |
| 11/24   | Forensic Chemistry and Analysis of Inks                   | <i>Blackledge, Ch. 3</i>                      |
| 11/26   | <b>Happy Thanksgiving!</b>                                |   |
| 12/1  | Chemistry of Color and Colorants                          | <i>Blackledge, Ch. 14</i>                     |
| 12/3  | Forensic Examination of Pressure Sensitive Tapes          | <i>Blackledge, Ch. 12</i>                     |
| <b>TBA</b>  | <b>Final Exam</b>   |   |

## READING REFERENCE ASSIGNMENTS:

We will be using multiple external reference sources in addition to the required text. The references are listed below. You may access the electronic versions of the texts through ForensicnetBase. To access this service go to <http://library.cedarcrest.edu> then click on "Full Text" from the menu list. Next Scroll down to the FORENSICnet.Base; tab and click on it. You can then search down the list of titles and click on the reference of choice. Once you do this you can click "Read it Online!" You can then save the chapter on your computer for future reading and reference. Other required readings will either be distributed in class or posted on e-College.

- 1) Eckert, William G. Introduction to Forensic Sciences, 2<sup>nd</sup> Edition, Chapters 1-3, (CRC Press, 1997).
- 2) Skoog, D.A., Holler, J. and Nieman, T.A. Principles of Instrumental Analysis, 6<sup>th</sup> Edition, (Saunders College Publishing, 2006).
- 3) *Drug Abuse Handbook*, 2<sup>nd</sup> Ed., Chapter 1, Criminalistics: Introduction to Controlled Substances, Joseph P. Bono, Taylor & Francis, 2008.
- 4) Richard Saferstein, *Forensic Science Handbook II* (2005), (Prentice Hall).
- 5) Donnell R. Christian, *Forensic Investigation of Clandestine Laboratories*, (CRC Press)
- 6) Richard Saferstein, *Forensic Science Handbook I* (2<sup>nd</sup> Ed, 2002) (Prentice Hall).
- 7) *Drug Abuse Handbook*, 2<sup>nd</sup> Ed., Chapter 5, Alcohol, Alan Wayne Jones, (Taylor & Francis, 2008).
- 8) Lentini, John, *Scientific Protocols for Fire Investigation*, (Taylor & Francis, 2006).
- 9) Robertson, James *Forensic Examination of Fibres*, 2<sup>nd</sup> Edition, (Ellis Horwood , 1999).

## BIBLIOGRAPHY:

- Baden, M. M.; Hennessee, J. A. *Unnatural Death: Confessions of a Medical Examiner*, Ballantine Books, New York, 1989.
- Bell, S. *Forensic Chemistry*, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005. ISBN: 0-13-147835-4
- 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.
- Blackledge, Robert D., *Forensic Analysis on the Cutting Edge*, John Wiley and Sons, Inc., Hoboken, NJ, 2007.
- Bono, J. P. *Drug Abuse Handbook Chapter 1, Criminalistics: Introduction to Controlled Substances*, Taylor & Francis.
- Brewer, W. E.; Galipo, R. C.; Morgan, S. L.; Habben, K. H. "Confirmation of volatiles by solid-phase microextraction and GC/MS," *J. Anal. Toxicol.* **1997**, 21(4), 286-290.
- Caddy, B. *Forensic Analysis of Glass and Paint Analysis and Interpretation*, Taylor & Francis, 2001.
- Christian, D. R. *Forensic Investigation of Clandestine Laboratories*, CRC Press.
- Davis, G. *Forensic Science*, American Chemical Society, Washington, DC, 1986.
- Dwyer, J.; Kocieniewski, D.; Murphy, D; Tyre, P. *Two Seconds Under the World: Terror Comes to America (The Conspiracy behind the World Trade Center Bombing)*, Crown Publishers, Inc., New York, 1994.
- Eckert, William G. *Introduction to Forensic Sciences*, 2<sup>nd</sup> Edition, CRC Press, 1997.
- Emsley, J. *The Elements of Murder: A History of Poison*, Oxford University Press, USA, 2006. ISBN: 978-0192806000.
- Evans, C. *The Casebook of Forensic Detection*, John Wiley & Sons, New York, 1996.
- Fisher, D. *Hard Evidence*, Bantam DoubleDay Dell Publ. Group, NY, 1995.
- Gerber, S. M., Ed., *Chemistry and Crime; From Sherlock Holmes to Today's Courtroom*, American Chemical Society, Washington, DC, 1984. ISBN: 978-0841207851.

- Gerber, S. M., Saferstein, R., Eds., *More Chemistry and Crime; From Marsh Arsenic Test to DNA Profile*, American Chemical Society, Washington, DC, 1984.  
ISBN: 978-0841234062.
- Ho, M. H. *Analytical Methods in Forensic Chemistry*, Ellis Horwood, Ltd., London, 1990.
- Houck, M., Siegel, J. *Fundamentals of Forensic Science*, Elsevier/Academic Press 2006.
- Hunt, S. M. *Investigation of Serological Evidence: A Manual for Field Investigators*, Charles C. Thomas Publ. Ltd., London, 1984.
- James, S. H., Nordby, J. J. *Forensic Science, An Introduction to Scientific and Investigative Techniques*, (CRC Press, 2003).
- Johll, M. *Investigating Chemistry; A Forensic Science Perspective*, W.H. Freeman and Co., New York, NY, 2007. ISBN: 978-0-7167-6433-5.
- Khan, J., Kennedy, T. J., Christian, Jr., C. *Basic Principles of Forensic Chemistry*, Humana Press, 2008. ISBN: 978-1-934115-06-0
- Lentini, John, *Scientific Protocols for Fire Investigation*, Taylor and Francis, Boca Raton, FL, 2006. ISBN: 978-0-8493-2082-8
- Lowry, W. T. *Forensic Toxicology: Controlled Substances and Dangerous Drugs*, Plenum Publ. Co., NY, 1979.
- Maples, W. R.; Browning, M. *Dead Men Do Tell Tales*, Bantam DoubleDay, NY, 1994.
- Meloan, C. E., James, R. E., Saferstein, R. *Laboratory Manual for Criminalistics*, Pearson Prentice Hall, Upper Saddle, NJ, 2007. ISBN: 0-13-221657-4.
- Robertson, J. *Forensic Examination of Fibres*, (Ellis Horwood , 1992).
- Saferstein, R. *Criminalistics: An Introduction to Forensic Science*, 9th. ed. Pearson Prentice Hall, Upper Saddle River, New Jersey, 2006. ISBN: 0-13-221655-8.
- Saferstein, R. *Forensic Science Handbooks I, 2<sup>nd</sup> Ed*, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2002.
- Saferstein, R. *Forensic Science Handbooks II*, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005.
- Saferstein, R. *Forensic Science Handbooks III*, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2005.



Skoog, D.A., Holler, J. and Nieman, T.A. Principles of Instrumental Analysis, 6<sup>th</sup> Edition, Saunders College Publishing, 2006.

Tebbett, I., Ed., *Gas Chromatography in Forensic Science*, Ellis Horwood, Ltd., London, 1993.

Terry, I. M.; Robertson, J. C. *Instrumental Data for Drug Analysis*, CRC Press, Boca Raton, FL, 1991.

Wecht, C.; Curriden, M.; Wecht, B. *Grave Secrets*, Penguin books USA, Inc., New York, 1996.

Widmark, E. M. P. *Principles and Applications of Medico-Legal Alcohol Determination*, translated from original 1932 ed., Biomedical Publications, Davis, CA, 1981.

Yinon, J., Ed., *Forensic Applications of Mass Spectrometry* (Modern Mass Spectrometry), CRC Press, Boca Raton, FL, 1995.