

CHEMISTRY 107
FORENSIC CHEMISTRY

BULLETIN INFORMATION

CHEM 107 – Forensic Chemistry (4 credit hrs)

Course Description:

Surveys chemical aspects of criminal investigation and adjudication including drug, arson, DNA, paint, and fiber identification.

Note: Three lecture and three laboratory hours per week.

SAMPLE COURSE OVERVIEW

This course is an introduction to forensic chemistry intended for non-science majors. The course examines the many ways that chemical principles and scientific techniques are applied in modern crime investigation: the chemical characteristics of fuels and explosives as well as arson-related methods; other ways of identifying criminals through chemical processes, including blood and bodily fluid analyses, the chemical characteristics found in paints, fibers, hair, DNA, and fingerprinting; and the chemical properties of drug analysis. Through readings, lectures, demonstrations, homework, and laboratory exercises, students learn the fundamentals of forensic chemistry and its applications in crime investigation and adjudication. Student learning is evaluated through exams, assignments, participation in class discussions and activities, a case study project, and laboratory reports.

ITEMIZED LEARNING OUTCOMES

Upon successful completion of CHEM 107, students will be able to:

1. Demonstrate understanding of the scientific method.
2. Discuss the basic principles, concepts, terms, and scientific techniques associated with forensic chemistry.
3. Evaluate the relationships between science, technology, and society as these affect forensic issues.
By specifically being able to:
 - Identify steps of scientific method; describe and perform various forensic analytical techniques.
 - Explain the characteristics of fuels and explosives, and their chemical evidence.
 - Classify drugs, identify their chemical properties, and conduct their analysis.
 - Describe the characteristics and properties of various materials such as hair, paint, polymers, fibers.
 - Categorize the different types of bodily fluid and their related analysis.
 - Explain the processes involved in sampling and conserving evidence.
 - Define forensic and legal concepts.
 - Apply metrology to analyze real case scenarios.
 - Research a science topic and communicate findings for a non-scientific audience.

- Use laboratory safety procedures; conduct and document an experiment.
- Identify common laboratory supplies and equipment.
- Explain how the principles and techniques of forensic chemistry are applied in criminal investigations and discuss how forensic chemical evidence can be used in the adjudication of legal cases.

SAMPLE REQUIRED TEXTS/SUGGESTED READINGS/MATERIALS

Criminalistics: An Introduction to Forensic Science, R. Saferstein

Course slides and lab manual

SAMPLE ASSIGNMENTS AND/OR EXAMS

The expected learning outcomes will be assessed through exams, assignments, participation in class discussions and activities, a case study project, and laboratory reports.

- 1. Five (5) exams.** Exams consist of multiple choice, true/false, short answer, and essay questions. Four of the exams are administered periodically in the semester, and the fifth exam is given as the final, cumulative exam.
 - a) Exam 1:** topics for assessment on exam 1 include Chemistry and the Law, Measurements, Uncertainty, and Statistics, Locard's Exchange Principle, Quality Assurance and Quality Control, Lifting Fingerprints Dusting, Reporting Defensible Uncertainty and Representative Samples.
 - b) Exam 2:** topics for assessment on exam 2 include Forensic Drugs Analysis (organic and inorganic), Classification of Fingerprints, Drugs in the Body, and Forensic Toxicology (ethanol toxicity).
 - c) Exam 3:** topics for assessment on exam 3 include Explosives, Firearms and Associated Chemical Evidence, The Chemistry of Colors and Colorants, The Chemistry of Polymers (hair and fibers), and Forensic Analysis of Inks and Paints.
 - d) Exam 4:** topics for assessment on exam 4 include tool marks and other impressions, analysis of glass, forensic pathology, forensic anthropology, and computer forensics.
 - e) Exam 5:** cumulative topics from exams 1-4 will be included on exam 5.
- 2. Assignments:** A short assignment, consisting of 3-5 multiple choice questions or short answer questions, is given to accompany each chapter in the text. Assignments are intended to assess how well students can recall, identify, describe, and analyze the chemical properties/characteristics of materials and the techniques used in forensic investigations.
- 3. Participation:** Includes attendance at both lecture and laboratory sessions, participation in class discussions and activities, and compliance with laboratory safety rules and procedures.
- 4. Case study project:** Students will be assigned a case study. Using knowledge gained in the course and the documents and analysis of the case, students will research problems presented in the case, investigate the case, and build a forensic report. Students will then summarize their case and findings for a non-scientific audience in a brief presentation. The case study project is designed to assess how well students can apply the principles, concepts, and techniques of forensic chemistry to the investigation and adjudication of specific criminal cases.

5. **Laboratory reports:** The laboratory component of the course consists of eleven labs. Each lab consists of a set of pre-lab questions and discussion, a procedural explanation, safety requirements and precautions, a student-led experiment, and post-lab questions and discussion. For each lab, students complete a laboratory report designed to assess how well students can employ scientific techniques to identify, classify, and analyze the chemical properties/characteristics of materials in forensic investigations and evaluate their applications in criminal cases.

SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ ASSIGNMENTS, EXAMS/PROJECTS

<u>Class</u>	<u>Lecture Topic</u>	<u>Lab Topic</u>
1	Introduction	Locard's Exchange Principle
2	Chemistry and the Law	
3	Foundations: Measurements, Uncertainty, and Statistics	Lifting Fingerprints Dusting
4	Foundations: Measurements, Uncertainty, and Statistics	
5	Quality Assurance and Quality Control	Crime Scene Sketching and Evidence Collection
6	Reporting Defensible Uncertainty and Representative Samples	
7	Exam 1; Chemical Fundamentals	Microscopy Use and Function
8	Chemical Fundamentals	
9	Instrumentation	Latent Detection Methods
10	Instrumentation	
11	Drugs as Physical Evidence: Seized Drugs and Their Analysis	Classification of Fingerprints
12	Drugs as Physical Evidence: Seized Drugs and Their Analysis	
13	Exam 2; Forensic Drugs Analysis	
14	Forensic Drugs Analysis	
15	Drugs in the Body	
16	Drugs in the Body	
17	Forensic Toxicology	Arson Investigation
18	Forensic Toxicology	

19	Exam 3; Chemistry of Combustion and Arson	Explosives and Explosive Residues
20	Explosives	
21	Firearms and Associated Chemical Evidence	Analysis of Soils
22	The Chemistry of Colors and Colorants	
23	The Chemistry of Polymers	Analysis of Glass
24	Forensic Analysis of Inks and Paints	
25	Exam 4; Chemical Analysis of Materials	Analysis of Hair, Fiber, and Paint
26	Chemical Analysis of Materials	
27	Case Studies	
28	Case Studies	
	Exam 5 (cumulative) according to University exam schedule	