Syllabus for
**CHE 400–Chemical Instrumentation Lecture**
2.0 Credit Hours
Fall 2017

## I. COURSE DESCRIPTION

The practical and theoretical investigation of principles, operating parameters, and applications of instruments used for chemical analysis. Gives special attention to electrochemistry and spectroscopy.
Prerequisites: CHE 300 Lecture and Lab.
Corequisite: CHE 400 Lab

## II. COURSE GOALS

CHE 400 is valuable to the future medical technologist, industrial quality control chemist, analytical chemist, chemistry graduate student and researcher by providing them with the ability to discuss advantages, limitations, and the applicability of various pieces of equipment.

This course is designed to enable the student to do the following:

A. Gain knowledge of the basic principles of spectrophotometry, electrochemistry, and chromatography.

B. Study the theoretical and practical aspect of instrumentation as applied to chemical analysis of many different samples.

C. Develops a level of competence that will enable him or her to critically choose the proper method of analysis for a given sample.

## III. STUDENT LEARNING OUTCOMES FOR THIS COURSE

The following objectives represent specific domains of learning to be achieved in each topical unit. As a result of successfully completing each unit, the student will be able to do the following:

A. Basic Electronics
1. Solve for currents and voltages in a simple DC circuit using Kirchhoff's laws.
2. Sketch the potentiometer and DC Wheatstone bridge circuit and discuss their uses and operation.
3. Draw the symbol for the op amp and discuss its different operational modes.
4. Discuss ways of optimizing signal-to-noise in a system.
5. Discuss AD converters and computer interfacing.

B. Basic Optics
1. Explain refraction, reflection, diffraction, dispersion, and interference in optics.
2. Draw the principal components of a monochromator.
3. Discuss the relationships between slit width, dispersion, and resolution for prism and grating instruments.

C. Basic Spectrophotometry
   1. Sketch the basic components of a flame emission photometer, atomic absorption photometer, ir, uv-vis, and NMR.
   2. Explain the basic physical property being measured in each major area of spectrophotometry.
   3. Discuss the types of samples that can be examined and their detection limits for each type of spectrophotometry.

D. NMR

E. Mass Spectrometry

F. Chromatography
   1. Briefly discuss the chromatographic process.
   2. List the factors influencing retention time and peak shape.
   3. Discuss liquid chromatography.
   4. Discuss gas chromatography.
      a. Detectors and columns.
      b. Applications.

G. Electrochemistry
   1. Summarize the various electrometric methods, listing: quantity measured limits of detectability, cost, time, and name of method.
   2. List the advantages and disadvantages of potentiometric titrations.
   3. Discuss the characteristics of the standard hydrogen electrode.

## IV. TEXTBOOKS AND OTHER LEARNING RESOURCES

A. Required Textbook

Skoog, D. A., F. J. Holler, and T. A. Nieman. Principles of Instrumental Analysis. 5th ed. Philadelphia: Saunders College, 1998. ISBN: 0-03-002078-6.

B. Optional Materials
   1. Strobel, H. A. Chemical Instrumentation: A Systematic Approach. 2nd ed.. Reading: Addison-Wesley Publishing Co., 1973.

   2. Willard, H. H., et al. Instrumental Methods of Analysis. 6th ed.. New York: D. Van Nostrand Company**,** 1981.

   3. Electronic calculator.

## V. POLICIES AND PROCEDURES

A. University Policies and Procedures
   1. Attendance at each class or laboratory is mandatory at Oral Roberts University. Excessive absences can reduce a student's grade or deny credit for the course.
   2. Students taking a late exam because of an unauthorized absence are charged a late exam fee.
   3. Students and faculty at Oral Roberts University must adhere to all laws addressing the ethical use of others' materials, whether it is in the form of print, electronic, video, multimedia, or computer software. Plagiarism and other forms

of cheating involve both lying and stealing and are violations of ORU's Honor Code: "I will not cheat or plagiarize; I will do my own academic work and will not inappropriately collaborate with other students on assignments." Plagiarism is usually defined as copying someone else's ideas, words, or sentence structure and submitting them as one's own. Other forms of academic dishonesty include (but are not limited to) the following:

a. Submitting another's work as one's own or colluding with someone else and submitting that work as though it were his or hers;
b. Failing to meet group assignment or project requirements while claiming to have done so;
c. Failing to cite sources used in a paper;
d. Creating results for experiments, observations, interviews, or projects that were not done;
e. Receiving or giving unauthorized help on assignments.

By submitting an assignment in any form, the student gives permission for the assignment to be checked for plagiarism, either by submitting the work for electronic verification or by other means. Penalties for any of the above infractions may result in disciplinary action including failing the assignment or failing the course or expulsion from the University, as determined by department and University guidelines.

4. Final exams cannot be given before their scheduled times. Students need to check the final exam schedule before planning return flights or other events at the end of the semester.
5. Students are to be in compliance with University, school, and departmental policies regarding the Whole Person Assessment requirements. Students should consult the Whole Person Assessment handbooks for requirements regarding general education and the students' majors.
    a. The penalty for not submitting electronically or for incorrectly submitting an artifact is a zero for that assignment.
    b. By submitting an assignment, the student gives permission for the assignment to be assessed electronically.

B. School and/or Department Policies and Procedures

1. The Department of Biology and Chemistry adheres to the Assessment policy concerning plagiarism as described in the University Catalog, "Written assignments using sources must demonstrate ethical and accurate use of source material. Plagiarism and any unethical or inappropriate use of sources are not tolerated."
2. The following assessment actions will be taken in the of event of documented instances of plagiarism on written assignments, copying of homework assignments, or cheating during examinations:
    a. An automatic zero will be given for the assignment or exam.
    b. The original assignment or exam will be kept in the student file and a copy will be given to the student. This could have a negative impact on letters of reference and admission to graduate schools and other postgraduate programs.
    c. The Department will take repeated offences as grounds for further action.
3. Any Whole Person Assessment activity required in this course must be completed and assessed prior to the end of the semester to receive course credit, otherwise a grade of incomplete will be assigned.

C. Course Policies and Procedures

1. Evaluation Procedures

a. Grading System

| | |
|---|---|
| Two hourly exams | 200 points |
| Five Quizzes | 100 points |
| . Final | 100 points |
| TOTAL | 400 points |

b. Letter grades for the course will be based on the percentage of points earned:
A=85% or higher, B=84-65%, C=64-55%, D=below 55%

c. It may be necessary to curve grades to protect academic standards, but the above scale is typical of previous semesters.

2. Other Policies and /or Procedures

1. The student will be assigned representative homework problems. The problems will provide insight into the basis for solutions to various problems.

2. No student will be able to take an examination late unless he or she has received permission prior to administration of the exam. A penalty will be assessed for all students taking late exams without an excuse.

3. Whole Person Assessment Requirements
None.

VI. COURSE CALENDAR

| **Week** | **Text** | **Topic Discussed** |
|---|---|---|
| 1 | Ch. 2 | Electric Circuits |
| 2 | Ch. 3 | Elementary Electronics |
| 3 | Ch. 3, 4 | Electromagnetic Radiation |
| 4 | Ch. 5 | Optics |
| 5 | Ch. 6 | UV—Visible Spectroscopy |
| 6 | Ch. 7 | UV—Visible Spectroscopy |
| 7 | Ch. 8 | Infrared Spectroscopy |
| 8 | Ch. 10 | Fluorometry |
| 9 | Ch. 11 | Flame Spectrometry (AA) |
| 10 | Ch. 14 | NMR Spectroscopy |
| 11 | Ch. 18 | Electrochemical Methods |
| 12 | Ch. 19 | Potentiometric Methods |
| 13 | Ch. 21 | Mass Spectrometry |
| 14 | Ch. 24 | Chromatography Principles |
| 15 | Ch. 25, 26 | Gas and Liquid Chromatography |

**Course Inventory for ORU's Student Learning Outcomes**

**Chemical Instrumentation Lecture–CHE 400**
**Fall 2017**

This course contributes to the ORU student learning outcomes as indicated below:
**Significant Contribution** – Addresses the outcome directly and includes targeted assessment.
**Moderate Contribution** – Addresses the outcome directly or indirectly and includes some assessment.
**Minimal Contribution** – Addresses the outcome indirectly and includes little or no assessment.
**No Contribution** – Does not address the outcome.

The Student Learning Glossary at http://ir.oru.edu/doc/glossary.pdf defines each outcome and each of the proficiencies/capacities.

| OUTCOMES & Proficiencies/Capacities | | Significant Contribution | Moderate Contribution | Minimal Contribution | No Contribution |
|---|---|---|---|---|---|
| **1** | **Outcome #1 – Spiritually Alive** Proficiencies/Capacities | | | | |
| 1A | Biblical knowledge | | | | X |
| 1B | Sensitivity to the Holy Spirit | | | X | |
| 1C | Evangelistic capability | | | | X |
| 1D | Ethical behavior | | | X | |
| **2** | **Outcome #2 – Intellectually Alert** Proficiencies/Capacities | | | | |
| 2A | Critical thinking | X | | | |
| 2B | Information literacy | X | | | |
| 2C | Global & historical perspectives | | | X | |
| 2D | Aesthetic appreciation | | | X | |
| 2E | Intellectual creativity | | X | | |
| **3** | **Outcome #3 – Physically Disciplined** Proficiencies/Capacities | | | | |
| 3A | Healthy lifestyle | | | | X |
| 3B | Physically disciplined lifestyle | | | | X |
| **4** | **Outcome #4 – Socially Adept** Proficiencies/Capacities | | | | |
| 4A | Communication skills | X | | | |
| 4B | Interpersonal skills | X | | | |
| 4C | Appreciation of cultural & linguistic differences | | | | X |
| 4D | Responsible citizenship | | | X | |
| 4E | Leadership capacity | | X | | |