

Term Information

Effective Term Summer 2020

General Information

Course Bulletin Listing/Subject Area Chemistry
Fiscal Unit/Academic Org Chemistry - D0628
College/Academic Group Arts and Sciences
Level/Career Graduate, Undergraduate
Course Number/Catalog 5786
Course Title Advance Chemistry Knowledge for Educators: Atomic Structure, Energy and Quantum Mechanics
Transcript Abbreviation Atoms and Quantum
Course Description For professionals and educators seeking an advanced understanding of General Chemistry content knowledge with consideration of how this understanding informs teaching and learning in College Credit Plus Chemistry courses. Topics typically found in the first semester of General Chemistry will be investigated.
Semester Credit Hours/Units Fixed: 5

Offering Information

Length Of Course 14 Week, 12 Week, 8 Week, 7 Week, 6 Week
Flexibly Scheduled Course Never
Does any section of this course have a distance education component? Yes
Is any section of the course offered 100% at a distance
Grading Basis Letter Grade
Repeatable No
Course Components Lecture
Grade Roster Component Lecture
Credit Available by Exam No
Admission Condition Course No
Off Campus Never
Campus of Offering Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites Undergraduate degree in chemistry or biochemistry
Exclusions
Electronically Enforced Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code 40.0501
Subsidy Level Doctoral Course
Intended Rank Senior, Masters, Doctoral, Professional

Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors

Course Details

Course goals or learning objectives/outcomes

- Synthesize methods, practices, and resources appropriate for teaching undergraduate General Chemistry with a deep understanding of fundamental topics that inform pedagogical decisions
- Demonstrate an awareness of the range and depth of topics in undergraduate General Chemistry courses, along with mastery of these topics.
- Adapt educational resources to support General Chemistry instruction based on one's learning objectives and the setting in which the resources are to be used.
- Use primary research articles to connect an advanced understanding of scientific ideas with their teaching and learning in General Chemistry.
- Complete a collaborative teacher inquiry project based on a topic, or topics, of your choosing.
- Communicate research findings in a paper synthesizing chemistry knowledge and classroom pedagogy.

Content Topic List

- Scientific measurement, error analysis, propagation of uncertainties, statistical analysis.
- Complete a collaborative teacher inquiry project
- The First Law of thermodynamics, temperature, heat and work, enthalpy, heat capacity.
- Experiments leading to a modern understanding of the atom, and how these experiments illustrate themes from the Nature of Science (NOS), including the development of conceptual models.
- Experiments involving radiation and photons, such as blackbody radiation and the photoelectric effect, and their role leading to the quantum hypothesis.
- Operator algebra and postulates of Quantum theory.
- Knowing the form of solutions to the Schrodinger equation, such as a particle in a box and a harmonic oscillator, and how these ideas inform General Chemical pedagogy.
- The Pauli Exclusion principle and Heisenberg's Uncertainty principle.
- Photoelectron spectroscopy and X-ray fluorescence spectroscopy, and how these can be used to support a discussion of electronic structure.

Sought Concurrence

No

Attachments

- Syllabus Course Chem 5786.docx: Chem 5786Course Syllabus
(Syllabus. Owner: Ramirez,Ana G)
- CCP program CBC approval.pdf: Grad Vice-Chair Approval
(Other Supporting Documentation. Owner: Ramirez,Ana G)
- Graduate Certificate Proposal.docx: Program Proposal
(Other Supporting Documentation. Owner: Ramirez,Ana G)
- CCP Advising Sheet.docx: Program Advising Sheet
(Other Supporting Documentation. Owner: Ramirez,Ana G)
- CBC certificate letter College Endorsement.docx: College Endorsement
(Other Supporting Documentation. Owner: Ramirez,Ana G)
- ASC 5786 Clark.pdf: ASC Technical Review
(Other Supporting Documentation. Owner: Ramirez,Ana G)

Comments

- -Since this is a distance course, please upload ASC Tech review sheet filled out by Mike Kaylor (or his delegate).
Instructions for online courses are here <https://ascas.osu.edu/distance-learning-courses>
-Why a 5000-level course that is not open to undergraduates? (No undergraduate rank is checked off.) Should this be a graduate course at the 6000 level? *(by Vankeerbergen,Bernadette Chantal on 10/15/2019 11:26 AM)*
- This course is part of the Advanced Chemistry Knowledge for Educators Stand-Alone Graduate Online Certificate Program. *(by Ramirez,Ana G on 09/25/2019 01:41 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Ramirez,Ana G	10/11/2019 10:35 AM	Submitted for Approval
Approved	Gustafson,Terry Lee	10/11/2019 11:32 AM	Unit Approval
Approved	Haddad,Deborah Moore	10/11/2019 03:56 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	10/15/2019 11:26 AM	ASCCAO Approval
Submitted	Ramirez,Ana G	11/22/2019 02:28 PM	Submitted for Approval
Approved	Wade,Christine M.T	11/22/2019 02:42 PM	Unit Approval
Approved	Haddad,Deborah Moore	11/22/2019 03:21 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	11/22/2019 03:21 PM	ASCCAO Approval



October 10, 2019

I am pleased to offer the College of Arts and Sciences' support for the proposed stand-alone graduate certificate in "Advanced Chemistry Knowledge for Educators." This proposed certificate will become part of a larger ASC initiative (supported by OAA) to provide College Credit Plus authorization programs in several fields for qualified high school teachers.

We are particularly pleased that CBC has developed this as an online program, which will undoubtedly enhance its reach and sustainability. We hope the other existing CC+ teacher programs (in English, Math, and Physics) will follow this example and develop online versions of their programs as well. In addition to CBC's efforts, ASC is working with ESCCO (Educational Service Center of Central Ohio) and Columbus State Community College to facilitate teacher access to our programs.

Sincerely,

Steve Fink

Associate Executive Dean



Christine M. Thomas
Fox Professor of Chemistry
Vice Chair of Graduate Studies
100 W. 18th Ave
Newman-Wolfram Laboratory 3109
Columbus, OH 43210
thomasc@chemistrv.ohio-state.edu

October 8, 2019

Dear ASC Curriculum Committee,

The Department of Chemistry and Biochemistry Graduate Studies Committee supports the proposed graduate academic certificate program and the four associated course proposals. This program will provide a valuable opportunity for high school chemistry teachers who want to further their chemistry education so that they can become accredited to teach College Credit Plus chemistry courses.

Sincerely,

Christine M. Thomas
Vice Chair of Graduate Studies
Department of Chemistry and Biochemistry

CHEMISTRY 5786 –Advanced Chemistry Knowledge for Educators: Atomic Structure, Energy, and Quantum Mechanics.

Summer 2020 (Online). 5 credit hours

Instructor Information

Instructor:	Ted M. Clark	Office:	120 Celeste Lab
Email:	Clark.789@osu.edu	Office Hours:	---

Course Description: For professionals and educators seeking an advanced understanding of General Chemistry content knowledge with consideration of how this understanding informs teaching and learning in College Credit Plus Chemistry courses. Topics typically found in the first semester of General Chemistry will be investigated, including scientific measurement and error analysis, the historical underpinnings of atomic structure leading to a quantum mechanical model, atomic properties, and energy and thermodynamics.

Prerequisites: Undergraduate degree in Chemistry or Biochemistry, or permission of instructor.

Required General Chemistry Textbooks

- Chemical Principles, The Quest for Insight (7th edition) by Atkins, Jones, Laverman. Printed copy or eText.
- Chemistry, The Central Science (14th Ed.) electronic textbook by Brown, LeMay, Bursten, Murphy, Woodward, & Stoltzfus, paired with the online homework system MasteringChemistry, will be provided.

How This Course Works

Mode of delivery: This course is 100% online. There are not required sessions when you must be logged in to Carmen at a scheduled time.

Pace of online activities: This course is divided into 3 modules: 1) review and analysis of General Chemistry course content, 2) teacher inquiry research project, 3) communicating findings and adapting resources. All of the modules will be open the entire semester, but there will be checkpoints along the way to monitor progress. Students are expected to keep pace with these checkpoints, but may schedule their efforts freely within that time frame. Students may also work ahead of schedule.

Credit hours and work expectations: This is a 5-credit-hour course. According to OSU guidelines, students should expect around 5 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 10 hours of homework (reading, writing papers) to receive an average grade (in this graduate course it is a B grade).

Attendance and participation: Attendance is based on your online activity. During most weeks you will probably log in to the course in Carmen multiple times. Office hours and live sessions are optional.

Discussion forum: An online discussion board will be used with every module. This is a place where you can share ideas, comments, and questions with the instructor and your classmates.



Course Objectives

Upon successful completion of this course, you should:

- Synthesize methods, practices, and resources appropriate for teaching undergraduate General Chemistry with a deep understanding of fundamental topics that inform pedagogical decisions.
- Demonstrate an awareness of the range and depth of topics in undergraduate General Chemistry courses, along with mastery of these topics.
- Adapt educational resources to support General Chemistry instruction based on one's learning objectives and the setting in which the resources are to be used.
- Use primary research articles to connect an advanced understanding of scientific ideas with their teaching and learning in General Chemistry.
- Complete a collaborative teacher inquiry project based on a topic, or topics, of your choosing. Potential topics include:
 - Scientific measurement, error analysis, propagation of uncertainties, statistical analysis.
 - The First Law of thermodynamics, temperature, heat and work, enthalpy, heat capacity.
 - Experiments leading to a modern understanding of the atom, and how these experiments illustrate themes from the Nature of Science (NOS), including the development of conceptual models.
 - Experiments involving radiation and photons, such as blackbody radiation and the photoelectric effect, and their role leading to the quantum hypothesis.
 - Operator algebra and postulates of Quantum theory.
 - Knowing the form of solutions to the Schrödinger equation, such as a particle in a box and a harmonic oscillator, and how these ideas inform General Chemical pedagogy.
 - The Pauli Exclusion principle and Heisenberg's Uncertainty principle.
 - Photoelectron spectroscopy and X-ray fluorescence spectroscopy, and how these can be used to support a discussion of electronic structure.
- Communicate research findings in a paper synthesizing chemistry knowledge and classroom pedagogy.

Grading

Grades are based on assignments divided into three broad modules:

Module 1: Review and analysis of General Chemistry course content (25% of total).

Module 2: Teacher Inquiry Research Project (50% of total).

Module 3: Communicating Findings and Adapting Resources (25% of total).

Overall grades are based on 1000 points:

A > 920 points. A- = 900 – 919 points.

B+ = 880 – 899 points. B = 820 – 879 points. B- = 800 – 819 points.

C+ = 780 – 799 points. C = 750 – 779 points.



Course Information & Policies

Title IV Attendance Requirement: Federal policy requires that attendance for all university students be verified during the first week of classes

STANDARDS OF ACADEMIC CONDUCT IN GENERAL CHEMISTRY

Violations of academic standards in General Chemistry will be referred to the University Committee of Academic Misconduct (COAM) as required by Faculty Rules. It is the responsibility of COAM to investigate all reported cases of student academic misconduct; illustrated by, but not limited to, cases of plagiarism and any dishonest practices in connection with examinations, quizzes, and graded assignments. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information see the Code of Student Conduct: studentlife.osu.edu/csc

Student Responsibilities: *Any graded material must represent your own work.* Unauthorized group efforts by students, use of another student's course materials, or assistance from individuals who already have taken the course, could place you in jeopardy of violation of the standards for the course. In some courses, group work is acceptable on certain activities (as explicitly stated by your instructor). In these cases, it is important that you know and understand where authorized collaboration (working in a group) ends and collusion (working together in an unauthorized manner) begins. Identical answers indicate copying or unacceptable group efforts - always answer questions in your own unique words. It is important that you consult with your instructor for clarification on whether or not collaboration is appropriate on an activity. *You should not assist others in violating academic standards.* Students supplying materials for others to "look at" may be charged with academic misconduct.

Commitment to Diversity: The Department of Chemistry and Biochemistry promotes a welcoming and inclusive environment for all students and staff, regardless of race, gender, ethnicity, national origin, disability or sexual orientation. There is no tolerance for hateful speech or actions. All violations of this policy should be reported to the OSU Bias Assessment and Response Team (BART, studentaffairs.osu.edu/bias). The Department encourages diversity at all levels, particularly among the next generation of scientists. Students are encouraged to participate in organizations that provide support specifically for science and engineering students who are African-American, Asian, disabled, Hispanic, LGBTQ or women. These organizations are listed on the Colleges of Arts and Sciences (artsandsciences.osu.edu/stem-organizations) and Engineering (engineering.osu.edu/studentorgs) websites.

Disability Services: The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), reasonable accommodations can be established. Students should first register with Student Life Disability Services, then meet with the General Chemistry SLDS Coordinator in the Undergraduate Studies Office (Holly Wheaton) who will assist you in establishing your accommodations in the course.

Contact SLDS

Email: slds@osu.edu

Phone: 614-292-3307

Address: 098 Baker Hall

Website: slds.osu.edu

Contact Holly Wheaton

Email: genchem@osu.edu

Phone: 614-292-6009

Address: 110 Celeste Lab



ASC Proposal Guidelines

1. Required Information

Name: Advanced Chemistry Knowledge for Educators. Type 3A Stand Alone Certificate.

Delivery: Combination of synchronous and asynchronous online courses.

Proposed implementation: Initial cohort begins summer 2020.

Academic units responsible for certificate administration: Department of Chemistry and Biochemistry, College of Arts and Sciences.

Description: The type 3A stand along certificate “Advanced Chemistry Knowledge for Educators” consists of a total of 18 credit hours distributed across four online courses. The certificate is designed to enhance the skills of high teachers, or those interested in becoming high school teachers, and provide accreditation to teach College Credit Plus chemistry courses. The proposed curriculum will begin in summer 2020. We anticipate an initial cohort of 8-10 students during the first year. Our goal is to award 30 certificates in the first three years of the program.

2. Rationale

Under the 2014 state law known as the “College Credit Plus Program,” minimum credentials have been established for instruction in College Credit Plus (CCP) courses. High school teachers who wish to be the instructors of record for survey-level college courses need one of the following: a Master’s degree in the content area, or a Master’s degree in a different area plus 18 graduate credits in the content area. The Department of Chemistry and Biochemistry has developed an 18-credit certificate to meet the needs of high school teachers who already possess a Master’s degree and who seek to be credentialed to teach College Credit Plus courses in Chemistry. This certificate provides evidence that a teacher possesses the minimum academic qualifications to teach CCP courses.

In the state of Ohio, total College Credit Plus enrollment was nearly 70,000 students in the 2016-2107 academic school year. The most common delivery method for these courses is by a credentialed high school instructor. Science is a subject taken by a significant number of students, trailing only English and Social Sciences. However, many high school science teachers lack the appropriate credentials to teach CCP Chemistry courses, and there are limited opportunities to earn these credentials in Ohio. This certificate program will address this need.

Student demand for the proposed certificate include 1) experienced teachers in Ohio currently teaching high school Chemistry course but are not eligible to teach CCP courses, 2) individuals completing a Masters of Education (MEd) program and who plan to teach CCP courses, 3) educators outside of Ohio seeking graduate credits in Chemistry in order to teach CCP-equivalent courses in their own states.

Upon completion of the academic certificate in the Advanced Chemistry Knowledge for Educators program, learners will be better prepared to 1) design a General Chemistry CCP course comparable to undergraduate courses in the Ohio, 2) deliver the course with an understanding of advanced, foundational content knowledge, 3) evaluate student achievement in the course.

3. Relationship to Other Programs

This certificate does not overlap with other programs or departments within the university.

This certificate has not been previously submitted for approval.

The University of Toledo currently offers an online program leading to the credentialing of CCP teachers in Chemistry as part of its Masters of Science and Education program.

4. Student Enrollment

We anticipate an initial cohort of 8-10 students during the first year. Our goal is to award 30 certificates in the first three years of the program. Efforts will be made to recruit teachers, both in Ohio and nationwide, using networks such as the American Modeling Teachers Association and regional National Science Teachers Association (NSTA) conferences. These efforts will include seeking to enroll underrepresented participants in STEM. STEM students who have completed the OSU Masters of Education program will also be targeted.

5. Curricular Requirements

A minimum of 18 credits is required for completion of the certificate. The curriculum is a four-course sequence. Courses are intended to be taken in order, although this is not a requirement.

- Summer: Online course (5 credit)
- Fall: Online course (4 credit)
- Spring: Online course (4 credit)
- Summer: Online course (5 credit)

The time to completion is a maximum of four years. The recommended curriculum is four semesters (summer, autumn, spring, summer).

Certificate Completion Sheet

Department of Chemistry and Biochemistry, The Ohio State University

Advanced Chemistry Knowledge for Educators, Type 3A Stand Alone Certificate

Student Name:

Student OSU Email:

Certificate Advisor Name:

Coursework

Course (hours)	Course Grade	Term Completed
Chemistry 5786, Advanced Chemistry Knowledge for Educators: Atomic Structure and Quantum Mechanics (5 credits).		
Chemistry 5787, Advanced Chemistry Knowledge for Educators: Bonding Models and States of Matter (4 credits).		
Chemistry 5788, Advanced Chemistry Knowledge for Educators: Kinetics, Thermodynamics, and Equilibrium (4 credits)		
Chemistry 5789, Advanced Chemistry Knowledge for Educators: Modern Applications and Instrumental Analysis (5 credits)		

Substitutions Approved:

Certificate Advisor Signature:

Date:

The Ohio State University
Arts and Sciences

Graduate Academic Certificate Advanced Chemistry Knowledge for Educators

Ted Clark, Associated Associate Professor

Department of Chemistry and Biochemist
110 Celeste Laboratory
120 West 18th Avenue
Columbus, OH 43210
Tel: 614-292-1204

Email: clark.789@osu.edu

Department website: <https://chemistry.osu.edu/>

Overview

Graduate Academic Certificate Program: Post-Bachelor Degree Stand-Alone Certificate Advanced Chemistry Knowledge for Educators consists of a total of 18 credit hours distributed across four online courses. The certificate is designed to enhance the skills of high teachers, or those interested in becoming high school teachers, and provide accreditation to teach College Credit Plus chemistry courses.

Certificate Requirements

Four required courses (18 credits).

Chemistry 5786 – Atomic Structures and Quantum Mechanics (5 credits)

Chemistry 5787 – Bonding Models and States of Matter (4 credits)

Chemistry 5788 – Kinetics, Thermodynamics, and Equilibrium (4 credits)

Chemistry 5789 – Modern Applications and Instrumental Analysis (5 credits)

Advanced Chemistry Knowledge for Educators program guidelines

Credit hours required

A minimum of 18 hrs. Credits must be at the 5000 level.

Overlap with courses in degree

Not Permitted. Pursued as independent of program.

Grades required

- Minimum C- for a course to be counted on the certificate.
- Minimum 3.00 cumulative point-hour ratio required for the certificate.
- Course work graded Pas/Non-Pass cannot be applied toward the certificate.

X193 credits

Not permitted.

Approval required

The certificate must be approved by the academic unit.

Filing the certificate program form

The certificate program form must be filed at least by the time the graduation application is submitted to a college/school counselor.

Changing the certificate

Once the certificate program is filed in the college office, any changes must be approved by the academic unit offering the certificate

Arts and Sciences Distance Learning Course Component Technical Review Checklist

Course: ASC 5786

Instructor: Ted Clark

Summary: Advanced Chemistry Knowledge for Educators: Atomic Structure, Energy and Quantum Mechanics

Standard - Course Technology	Yes	Yes with Revisions	No	Feedback/ Recomm.
6.1 The tools used in the course support the learning objectives and competencies.	X			<ul style="list-style-type: none"> • Carmen • Microsoft Office 365
6.2 Course tools promote learner engagement and active learning.	X			<ul style="list-style-type: none"> • Carmen Zoom • Carmen Message Boards. • Carmen Quiz modules.
6.3 Technologies required in the course are readily obtainable.	X			All are easily obtainable, and most are available with no charge to the students.
6.4 The course technologies are current.	X			All technologies are web based and updated regularly
6.5 Links are provided to privacy policies for all external tools required in the course.	X			No 3 rd party tools are present in this revision.
Standard - Learner Support				
7.1 The course instructions articulate or link to a clear description of the technical support offered and how to access it.	X			Links to 8HELP are provided.
7.2 Course instructions articulate or link to the institution's accessibility policies and services.	X			a
7.3 Course instructions articulate or link to an explanation of how the institution's academic support services and resources can help learners succeed in the course and how learners can obtain them.	X			b
7.4 Course instructions articulate or link to an explanation of how the institution's student services and resources can help learners succeed and how learners can obtain them.	X			c
Standard – Accessibility and Usability				
8.1 Course navigation facilitates ease of use.	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.2 Information is provided about the accessibility of all technologies required in the course.	X			No 3 rd party tools are present in this revision
8.3 The course provides alternative means of access to course materials in formats that meet the needs of diverse learners.	X			
8.4 The course design facilitates readability	X			
8.5 Course multimedia facilitate ease of use.	X			All assignments and activities that use the Carmen LMS with embedded multimedia facilitates ease of use. All other multimedia resources facilitate ease of use by being available through a standard web browser

Reviewer Information

- Date reviewed: 11/18/19
- Reviewed by: Ian Anderson

Notes: Remove references to CarmenConnect and replace with CarmenZoom. Assign days to the class schedule.

^aThe following statement about disability services (recommended 16 point font):
Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, slds@osu.edu; slds.osu.edu.

^bAdd to the syllabus this link with an overview and contact information for the student academic services offered on the OSU main campus.
<http://advising.osu.edu/welcome.shtml>

^cAdd to the syllabus this link with an overview and contact information for student services offered on the OSU main campus. <http://ssc.osu.edu>. Also, consider including this link in the “Other Course Policies” section of the syllabus.