

PROGRAM MODIFICATION

Proposing Institution: South Carolina State University

Program Title: Bachelor of Science in Chemistry

Program Options: B.S. Chemistry with Pre-Health Career Option
B.S. Chemistry with Graduate School /Industry Option
B.S. Chemistry with Radiochemistry Option
B.S. Chemistry with Environmental Science Option

Date of submission: May 7, 2014

APPROVED: _____
Thomas J. Elzey, President

Program Contact: Dr. Ruhullah Massoudi
Professor of Chemistry
Chemistry Academic Program Coordinator
rmassoudi@scsu.edu
803-536-7112

Dr. Judith Salley
Professor and Chairperson
djdsalley@scsu.edu
803-536-8509

2. Classification

Program Title: Bachelor of Science in Chemistry

Options: B.S. Chemistry with Pre-Health Career Option
B.S. Chemistry with Graduate School /Industry Option
B.S. Chemistry with Radiochemistry Option
B.S. Chemistry with Environmental Science Option

Academic unit in which the program resides: The Department of Biological and Physical Sciences

Designation/Type/Level: Baccalaureate; Bachelor of Science; Four-year program

Proposed date of implementation: This is an update to the SC CHE *Inventory of Approved Programs* of currently existing options in the B.S. Chemistry degree program. These options were approved over several years and were reauthorized by the SC State University Board of Trustees on December 5, 2013.

Current CIP code of the program: 400501

Site: Main campus of South Carolina State University in Orangeburg, SC.

Qualifies for supplemental Palmetto Fellows Scholarship and LIFE Scholarship awards: Yes

Delivery Mode: Traditional lecture and laboratory course delivery.

Area of Certification: N/A

3. Institutional Approval

Provost	November 14, 2013 (reauthorized)
President	November 14, 2013 (reauthorized)
Academic Affairs & Faculty Liaison Committee	November 14, 2013 (reauthorized)
Board of Trustees	December 5, 2013 (reauthorized)

4. Purpose

Description of the proposed modification:

This program modification proposal is to update the SC CHE *Inventory of Approved Programs* to reflect the undergraduate Chemistry program and its four options in pre-health, graduate school/industry, radiochemistry, and environmental science as they are currently offered by SC State. Please find enclosed on pages 8-11 the curricula of the four options under consideration.

The four chemistry concentrations are designed to prepare undergraduate students to continue their studies to the terminal degree or pursue employment in the local, state or global workforce. The Pre-Health Career option is designed to prepare students for admission to various

professional schools to pursue degrees in medicine, pharmacy, dentistry and other health related fields. Majors complete all chemistry core courses as well as the necessary biology courses needed for admission to medical school or other health related careers. Recommended electives for pre-health career majors are: Genetics, Microbiology, and Biochemistry II.

The Radiochemistry option is an interdisciplinary curriculum designed to provide a thorough understanding of both the radioactive and chemical characteristics of elements and compounds to address technical needs in many areas, including the nuclear material science, waste treatment and disposal, environmental and biomedical applications. In addition to the radiochemistry courses at SC State, students are required to complete a summer course at Clemson University in nuclear chemistry, and a summer advanced nuclear instrumentation course at the Savannah River Site.

The Graduate School/Industry option is designed to prepare undergraduate students to continue their studies to the terminal degree, or through unique interdisciplinary training, pursue careers in industry. Students will be exposed to basic theoretical and practical experiences including research techniques and instrumentation.

The Environmental Science option is an interdisciplinary curriculum designed to provide the foundation necessary to understand the critical relationship between society and the ecosphere. Students who pursue this option will be prepared for professional opportunities that exist in environmentally related industries, government agencies and graduate programs. Students must complete 22 to 23 credits of environmental coursework including recommended electives in botany, biostatistics, and waste management.

Statement of the purpose of the modified program:

The purpose of the program modification proposal is to update the SC CHE *Inventory of Approved Programs* to reflect the undergraduate Chemistry program and its four options as they are currently offered by SC State. The options were added to help attract additional students to the SC State program. The specific options were selected based on the faculty's credentials, university resources and infrastructure, as well as employment opportunities for our graduates.

Discussion of the objectives of the modified program:

The objectives of the program are to:

- 1) Enhance overall enrollment in the Chemistry degree program by offering options in specific subfields while maintaining a high level of quality in the students and a competitive degree.
- 2) Increase diversity in the fields of medicine, pharmacy, dentistry, nuclear chemistry, and environmental science which are extremely underrepresented with respect to African-Americans.
- 3) Enhance employment and graduate school opportunities for Chemistry majors by allowing them to gain specialized experience in these expanding fields.

5. Justification

Discussion of the need and rationale for the proposed modification:

This modification is needed so that the SC CHE *Inventory of Approved Programs* reflects the program as it is currently offered by SC State. The pre-health option will prepare students for admission to various professional schools to pursue degrees in medicine, pharmacy, dentistry

and other health related careers. Improving diversity in medicine and health related fields especially as it relates to African Americans remains a need in the state and in the nation. Producing graduates in these options would help to address that need. The radiochemistry option provides unique interdisciplinary training that will prepare students for new, developing careers in specialized areas such as nuclear chemistry, radiation chemistry, health physics and environmental sciences. Minorities remain underrepresented in all of these areas. Graduates of these SC State options are currently in graduate school or employed by state, federal and private industries. The graduate school/industry tract will prepare students to enroll in graduate school or seek employment in the field. There is a significant shortage of environmental chemists nationally and numerous job opportunities around the country including the Southeastern United States are available to these graduates.

Employment opportunities exist for chemists in a wide range of industries such as chemical manufacturing and pharmaceutical manufacturing. Jobs are also available in colleges and universities, government, independent testing and research. Projections by the US Bureau of Labor Statistics (BLS) Occupational Outlook Handbook, 2013 (<http://www.bls.gov/>) indicate that employment of chemists and material scientists is expected to grow by 6% from 2012 to 2022. The South Carolina Employment and Workforce website reveals that the highest estimated employment for Chemists in Richland, South Carolina in 2010 was the Chemical Manufacturing industry with 46.2% percent of the total employment. Professional, Scientific, and Technical Services ranked second with 17.5% percent of the total employment and the third largest was Public Administration with 7.2% percent of the total employment. The outlook for graduates in the Environmental science option is even more promising as “environmental science jobs are expected to grow 15% at a rate much faster than the average for all occupations (11%). This increased demand will result from a need to comply with environmental laws and regulations and a need to develop methods for clean-up of existing hazards.” Employment in the Pre-health option, especially for medical scientists is “projected to grow 13 percent between 2012 and 2022, about as fast as the average for all occupations. An increased reliance on pharmaceuticals, greater affluence that allows for more spending on medicine—along with a larger and aging population, and a greater understanding of biological processes are all factors that are expected to increase demand for medical scientists.”

With reference to Radiochemistry, according to a 2012 report published by the National Academy of Sciences entitled “*Assuring a Future US- based Nuclear and Radiochemistry Expertise*,” the five year projection is that the low number of graduates currently being produced is not conducive to sustain growth of the field. In addition many experts in the area have approached retirement age. The option in radiochemistry was initiated to meet this national critical need and prevent a workforce gap. The program has since its inception in 2006 produced 11 graduates with 100% placement in graduate school and employment in the field (*SC State Office of Institutional Research*). According to The Department of Biological and Physical Sciences tracking survey for graduates, a total of 21 students received degrees in chemistry from 2010-2014 and are employed or pursuing graduate or professional careers: Graduate or professional school – 48% (10/21), Industry employed in the field – 44% (9/21), and 10% (2/21) employed in other areas. The four graduates of the Radiochemistry program are pursuing graduate degrees.

In South Carolina, employment of environmental scientists and specialists is projected to grow 15 percent from 2012 to 2022, faster than the average for all occupations. (<https://jobs.scworks.org/vosnet/lmi/occsummary>). Heightened public interest in the hazards facing the environment, as well as the increasing demands placed on the environment by population growth, is projected to spur demand for environmental scientists and specialists.

Producing graduates in the Environmental Science option is critical to meet the state and national demand. Therefore, environmental scientists and specialists should have good job opportunities. In addition to growth, many job openings will be created by scientists who retire, advance to management positions, or change careers. South Carolina State is in a unique position to address both the need to increase the number of graduates with degrees in chemistry/environmental science for employment as well as the underrepresentation of minorities in the environmental science workforce. All of the students who chose this option were underrepresented minorities. In 1994 South Carolina State University established the Savannah River Environmental Sciences Field Station to educate, train and provide field experiences to students interested in environmental science careers. The field station offers courses to students in the chemistry option during the summer months and has served to attract students to the field, and job placement in state and federal agencies.

Discussion of the centrality of the modified program to the Commission-approved mission of the institution.

In keeping with the University's mission, all four of these options will contribute to producing "highly skilled" graduates who use current technology and methods that make them competitive in the job market and for acceptance in graduate or professional schools. As highly skilled graduates, they will become productive members of society that contribute to the "economic development of the state and the nation." Additionally, as an Historically Black College and University, SC State would produce graduates for employment fields in which minority professionals traditionally have been underrepresented.

6. Enrollment

Between 2008 and 2013, the Chemistry program at SC State has had an average enrollment of 49 students. Forty (40) students were enrolled in fall 2013. No significant new enrollment is expected as a result of this modification.

7. Curriculum

There are no curriculum changes under the proposed modification. Pages 7-10 list the curricula for the four options in the Chemistry degree program.

8. Faculty

No faculty changes are necessary to support this modification since the four options currently exist.

9. Physical Plant

There are no additional requirements on the physical plant since there is adequate space and facilities to support the existing Chemistry program in its current locations in Hodge Hall and Leroy Davis Hall.

10. Equipment

No new equipment is needed to support these already existing Chemistry degree options.

11. Library Resources

Library resources are adequate and no new library resources are needed to support the already existing options of the modification.

12. Accreditation, Approval, Licensure, or Certification

No specialized accreditation, licensure, or certification is required for the Chemistry program and its options.

13. Estimated Costs and Sources of Financing*

The Academic Program Coordinator (APC) will administer the program using 25% of his time which is worth \$18,205 per year or \$91,025 over five years.

The Chemistry program employs: four professors (including the APC) whose salaries (minus the 25% for the APC) total \$246,646; one associate professor with a salary of \$59,908; one assistant professor with a salary of \$53,560 and an adjunct instructor with a salary of \$47,000. The total annual expenditure on faculty salaries in the Chemistry program is \$ 407,114.

The clerical support staff is shared with the following programs: chemistry, physics, and biology. Therefore, one-third of her salary is attributed to the chemistry program at \$9,863 per year.

The program does not employ graduate students. No new library resources, equipment or physical facilities are needed for the existing options.

The enrollment for the next five years is based on current enrollment of 40 students with an average of 60% in-state students (roughly 24) and 40% out-of-state students (roughly 16). Annual in-state tuition for a full load of courses is \$9,776 and \$18,910 for out-of-state students. Thus, $24 \times \$9,776 = \$234,624$; and $16 \times \$18,910 = \$302,560$; giving a grand total of \$537,184 for the 40 students each year.

All program administration costs, faculty salaries, clerical support costs, and supplies and materials are already funded through the E&G budget and as such will constitute a reallocation of existing funds as the source of finance.

From the chart below, the modification of the Chemistry program as it currently exists has a five-year price tag of \$2,197,910 but will generate \$4,883,830 in revenue over the same period; providing a net income of \$2,685,920.

Table I - Costs to the Institution and Sources of Financing

ESTIMATED COSTS BY YEAR						
CATEGORY	1st	2nd	3rd	4th	5th	TOTALS
Program Administration	18,205	18,205	18,205	18,205	18,205	91,025
Faculty Salaries	407,114	407,114	407,114	407,114	407,114	2,035,570
Graduate Assistants	0	0	0	0	0	0
Clerical/Support Personnel	9,863	9,863	9,863	9,863	9,863	49,315
Supplies and Materials	4,000	4,000	4,500	4,500	5,000	22,000
Library Resources	0	0	0	0	0	0
Equipment	0	0	0	0	0	0
Facilities	0	0	0	0	0	0
TOTALS	439,182	439,182	439,682	439,682	440,182	2,197,910
SOURCES OF FINANCING BY YEAR						
Tuition Funding	537,184	537,184	537,184	537,184	537,184	2,685,920
Program-Specific Fees						
State Funding*						
Reallocation of Existing Funds*	439,182	439,182	439,682	439,682	440,182	2,197,910
Federal Funding						
Other Funding (Specify)						
TOTALS	976,366	976,366	976,866	976,866	977,366	4,883,830

**CURRICULUM LEADING TO THE DEGREE OF BACHELOR OF SCIENCE IN
CHEMISTRY
PRE-HEALTH CAREER OPTION
(122 Credits)**

FRESHMAN

First Semester	Credits	Second Semester	Credits
E 150 English Comp	3	E 151 English Comp	3
Et250/S250	3	PE150/HED151/MS101	2
C 150 General Chemistry I	3	C 152 General Chemistry II	3
C 151 General Chem Lab I	1	C 153 General Chem Lab II	1
M 208 Intro to Statistics/Env302Biostat	3	CS 150 Computer Science	3
UNIV 101 Intro Univ. Comm	2	PSY 250/SOC 250/EPSY 150	3
15		15	

SOPHOMORE

First Semester	Credits	Second Semester	Credits
P 250/254 Physics I	3	B 150 General Zoology	3
P 251 Physic Lab I	1	B154 General Zoology Lab	1
M 153 Calculus I	3	P 252/255 Physics II	3
C 306 Org. Chemistry I	3	P 253 Physics Lab	1
C 316 Org. Chemistry Lab I	1	C 307 Org. Chemistry II	3
C 201 Analytical Chemistry	4	C 317 Org. Chemistry Lab II	1
		M 163 Calculus II	3
		E 250/251 World Lit.	3
15		18	

JUNIOR

First Semester	Credits	Second Semester	Credits
C 403 Biochemistry	4	B 151 Botany	3
C405 PhysicalChemistry(1)	4	B 152 Botany Lab	1
B 201 Anatomy	3	C 406 Physical Chemistry II	4
B 211 Anatomy Lab	1	Art 250/Mu 250/D 254	3
Elective	4	Elective	4
16		15	

SENIOR

First Semester	Credits	Second Semester	Credits
C 410 Seminar	1	C408 Instrumental Analysis	4
C 407 Inorganic Chemistry	4	B 202 Vert. Physiology	4
ECON 250/255	3	ETS 250 Afr American Hist	3
French/German/Span 101	3	Elective	3
H250/251World History	3		
14		14	

Electives: B204-Genetics-4credits, B305-Microbiology-4credits, C404-Biochemistry II – 4credits

**CURRICULUM LEADING TO THE DEGREE OF BACHELOR OF SCIENCE IN
PROFESSIONAL CHEMISTRY ENVIRONMENTAL SCIENCE TRACT
(122 Credits)**

<u>FRESHMAN</u>			
First Semester	Credits	Second Semester	Credits
E 150 English Comp	<u>3</u>	E 151 English Comp	<u>3</u>
B 150 General Zoology	<u>4</u>	ECON 250/255	<u>3</u>
C 150 General Chemistry I	<u>3</u>	C 152 General Chemistry II	<u>3</u>
C 151 General ChemLab I	<u>1</u>	C 153 General Chem Lab II	<u>1</u>
M 208 Statistics or Env203 Biostatistics	<u>3</u>	CS 150 Computer Science	<u>3</u>
UNIV 101 Intro to University	<u>2</u>	H 250/251 World History	<u>3</u>
Total		Total	
16		16	

<u>SOPHOMORE</u>			
First Semester	Credits	Second Semester	Credits
P 250/254 Physics I	<u>3</u>	ET 250/ S250 Tech Comm	<u>3</u>
P 251 Physic Lab I	<u>1</u>	P 252/255 Physics II	<u>3</u>
M 153 Calculus I	<u>3</u>	P 253 Physics Lab	<u>1</u>
C 306 Org. Chemistry I	<u>3</u>	C 307 Org. Chemistry II	<u>3</u>
C 316 Org. Chemistry Lab I	<u>1</u>	C 317 Org. Chemistry Lab II	<u>1</u>
C 201 Analytical Chemistry	<u>4</u>	M 163 Calculus II	<u>3</u>
E250/251 World Literature	<u>3</u>		
Total		Total	
18		14	

<u>JUNIOR</u>			
First Semester	Credits	Second Semester	Credits
ENV 300 Environmental Sci.	<u>4</u>	Art250/Mu250/D254	<u>3</u>
C 405 Physical Chemical I	<u>4</u>	C 406 Physical Chemistry II	<u>4</u>
ENV 306 Land Use Decisions	<u>4</u>	Elective	<u>3</u>
ETS 250 African Amer. Hist	<u>3</u>	PE 150/HED 151/MS 101	<u>2</u>
		PSY250/SOC 250	<u>3</u>
Total		Total	
15		15	

<u>SENIOR</u>			
First Semester	Credits	Second Semester	Credits
C 410 Seminar	<u>1</u>	ENV 420 Environ Chem	<u>4</u>
C 407 Inorganic Chemistry	<u>4</u>	French/German/Span 101	<u>3</u>
C 403 Biochemistry	<u>4</u>	ENV 301/Masc 301(AnalMar.Polluts)	<u>4</u>
Elective	<u>4</u>	Elective	<u>4</u>
Total		Total	
13		15	

**CURRICULUM LEADING TO THE DEGREE OF BACHELOR OF SCIENCE IN
GRADUATE SCHOOL, INDUSTRY OPTION**

(120 Credits)

FRESHMAN

First Semester	Credits	Second Semester	Credits
E 150 English Comp	3	E 151 English Comp	3
ET 250/S250Tech.Com/S150PubSpk	3	M 152 Precalculus II	3
C 150 General Chemistry I	3	C 152 General Chemistry II	3
C 151 General ChemLab I	1	C 153 General Chem Lab II	1
M 208Statistics or Env203Biostatistics	3	CS 150 Computer Science	3
UNIV 101 Intro to University	2	PE 150/HED 151/MS 150	2
15		15	

SOPHOMORE

First Semester	Credits	Second Semester	Credits
P 250/254 Physics I	3	E 250/251 World Lit	3
P 251 Physic Lab I	1	P 252/255 Physics II	3
M 153 Calculus I	3	P 253 Physics Lab	1
C 306 Org. Chemistry I	3	C 307 Org. Chemistry II	3
C 316 Org. Chemistry Lab I	1	C 317 Org. Chemistry Lab II	1
C 201 Analytical Chemistry	4	M 163 Calculus II	3
15		14	

JUNIOR

First Semester	Credits	Second Semester	Credits
PSY250/Soc250/Epsy250	3	H250/251 World History	3
French/German/Span 101	3	C 406 Physical Chemistry II	4
C405 PhysicalChemistry(1)	4	C 412 Research in Chemistry	4
Elective	3	Art250/Mu250/D254	3
ETS250AfricanAmericanHistory	3		
16		14	

SENIOR

First Semester	Credits	Second Semester	Credits
C 410 Seminar	1	C408 Instrumental Analysis	4
C 407 Inorg. Chemistry	4	Approved Elective	4
C 403 Biochemistry	4	Elective	4
ECON250/255	3	French/German/Span 101	3
Elective	4		
16		15	

Approved Electives: Env 420(Environmental Chemistry) or C404 (Biochemistry II)

**BACHELOR OF SCIENCE DEGREE IN CHEMISTRY
RADIOCHEMISTRY CAREER OPTION
CURRICULUM SHEET (CHRC)
132 CREDITS**

FRESHMAN

First Semester	Credits	Second Semester	Credits
E 150 English Comp	3	E 151 English Comp	3
ET 250/ S 250 Tech. Com/ S 150 Pub. Spk	3	M 153 Calculus I	3
C 150 General Chemistry I	3	C 152 General Chemistry II	3
C 151 General Chemistry I Lab	1	C 153 General Chemistry II Lab	1
M 208 Statistics or Env 203 Biostatistics	3	CS 150 Computer Science	3
UNIV 101 Intro to University	2	PE 150/HED 151/MS 150	2
	15		15

SOPHOMORE

First Semester	Credits	Second Semester	Credits
P 250/254 101 Physics I	3	E 250/251 World Lit	3
P 251 Physics Lab I	1	P 252/255 101 Physics II	3
M 163 Calculus II	3	P 253 Physics Lab	1
C 306 Organic Chemistry I	3	C 307 Organic Chemistry II	3
C 316 Organic Chemistry I Lab	1	C 317 Organic Chemistry II Lab	1
C 201 Analytical Chemistry	4	M 237 Calculus III	3
C 204 Intro to Radiochemistry	3	P 313 Radioisotope Lab	3
	18		17

JUNIOR

First Semester	Credit	Second Semester	Credit
PSY 250/Soc 250/Epsy 250	3	H 250/251 World History	3
C 403 Biochemistry	4	C 406 Physical Chemistry II	4
C 405 Physical Chemistry I	4	C 412 Research in Chemistry	4
C 314 Nucl. & Radchem. Instrumentation	3	Art 250/Mu 250/D 254	3
* Elective	3	EE&S 491 Advanced Radiochemistry	3
	18		17

SENIOR

First Semester	Credit	Second Semester	Credit
C 410 Seminar	1	C 408 Instrumental Analysis	4
C 407 Inorg. Chemistry	4	Approved Elective	4
French/German/Spain 101	3	* Elective	3
ECON 250/255	3	French/German/Spain 102	3
** Elective	4	ETS 250 African American History	3
	15		17

Approved Electives: Env 420 (Environmental Chemistry) or C 404 (Biochemistry II) – 4 credits

* Recommended Electives: M 238 (Calculus IV) – 3 credits; M 403 (Differential Equation) – 3 credits

** The following elective is strongly recommended for the student to be successful in the pursuit of a Chemistry/Radiochemistry degree: C 414 (Research in Nuclear & Radiochemistry) – 4 credits