Industrial Chemistry Technology (ICT, AAS) Report for the Academic Program Review Committee

Prepared by the members of the ICT Review Committee:

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A – Program Goals

The Ferris State University Industrial Chemistry Technology program is a lab-based associates degree. The mission and goal of the degree is largely to train capable laboratory technicians who are ready to enter the workforce. The 55th anniversary of the program was celebrated in the Spring of 2013, so it has had a lot of time to develop a reputation with many of the chemical companies around Michigan and the Midwest. The program has been most successful in Michigan, where it is well-known for producing good lab techs. ICT graduates go on to work in many well known companies, as well as up and coming smaller companies.

Professionally, many ICT graduates go on to earn higher level degrees, be it a bachelors in chemistry at Ferris State University or somewhere else. ICT grads have gone on to Masters and PhD. programs as well. Many ICT students have done well in other Ferris programs like pharmacy, plastics, or business.

The chemistry courses that are specifically included in the ICT program focus on theory, laboratory safety, practical, analytical and synthetic skills. The students who come to the program are generally proactive and able to think on their feet. The program, then, is built to encourage these traits and promote scientific creativity. This package of skills makes students industry ready.

The educational goals of the FSU ICT degree are to train students in an academic environment to take positions in industry as chemical technologists. Many chemical techs are trained on the job, but the academically trained chemical technologist who is educated in the basic, core sciences of chemistry, physics, and the applied sciences of chemistry technology and computer science, as well as having a background in mathematics, communications, and the arts will more quickly become a valued team member. The background intended for ICT students, then, is varied and diverse. The graduates of this program are equipped with the skills needed to successfully obtain entry-level employment in the rigorous chemical, pharmaceutical, or other related industries as well as to pursue further education in chemistry or other degree programs.

The FSU ICT program is well recognized for its strengths. There have been 50+ graduates from the ICT program since 2007. During a chunk of this time, up through 2013 the American Chemical Society certified the ICT program. ICT was honored as only one of a select few 2-year programs so recognized. However, since the beginning of 2013, 2-year programs are no longer selected for such certification by ACS. Program Response?

The Industrial Chemistry Technology program supports and strengthens the University's mission and goal, as well as all strategic plans therein or associated with the University. The specific additions that ICT students make toward the further advancement of the unit strategic planning of the physical sciences are distinct. The program advances scientific understanding and trains students to deal with complex scientific ideas in technological (instrumental) as well as theoretical ways, and also trains students to test the strengths of the hypotheses that are generated; this is the real goal and mission statement of science in general, not to mention its mechanism. Some ICT courses are strong introductory classes in the physical sciences that anyone could take, while others are designed for the professional/technical student to develop their specific job-related skills.

There are two main areas in which programs similar to ICT are oriented. One is to emphasize the preparation of chemical technicians to work in quality control, research and development, or various types of industrial support laboratories. This is the distinct goal of the Ferris ICT program as it has progressed. The other area of emphasis is in chemical process work, where technicians are less involved in the laboratory, but more involved in large scale plant operations. The ICT program does not emphasize this second area, although many grads are asked by the companies they work for to flex into such a role. Such preparatory programs with this emphasis require large engineering type facilities.

Finally, program goals are reflective of the fact that ICT grads are going more often to smaller companies and directly entering BA programs in greater numbers than ever. Ten to fifteen years ago, the bulk of the ICT grads found work at one of several large employers such Numbers? as Dow, Dow-Corning, Eli-Lily, etc. This is no longer the case. With most ICT grads also getting the Ferris BA in chemistry, the ICT degree is serving as a tremendous addition to the BA because of the emphasis on "hands on" lab work. Therefore, the skills that ICT students acquire are ultimately being put to use in different environments upon graduation. In Michigan, our program has long standing status. The importance of the ICT program being housed in a four year institution cannot be overemphasized. The competitive level our students thus attain is an important part of this development.

B – Program Visibility and Distinctiveness

The FSU ICT program is both visible and distinctive to employers in professional areas of the chemical industry. They know that our students are strong and reliable, and they come here to recruit them. The program is unique in the hands-on emphasis it offers and in the real-world experiences that are stressed in the classes.

The program does not fail to attract quality students. Those students who are taking upper level chemistry courses have been attracted many times over to the program. Those that are competent enough in the lab to be interested in the ICT program recognize a desire to improve the decision making skills that they possess. The chemical industry is not an attractive place for students who refuse to work hard or who do not want to learn how and why things work. The program emphasis on safety further promotes the importance of knowing how things work for personal health reasons.

According to the industrial feedback that we receive, there are no really major competitors to the FSU / ICT program in our area.

C – Program Relevance

Varied career opportunities are available to Industrial Chemistry Technology graduates. Graduates may develop careers with pharmaceutical, plastics, electronics, dairy, agricultural, and mining industries. The Dow Chemical Company, Eli Lily, Ticona Plastics, Dow-Corning Sciences, Pfizer, Intel, SC Johnson, and Mosaic Potash have hired chemical technologists. Representatives from these companies routinely visit the campus to discuss career paths. With an increased interest in sustainability and emphasis on environmental issues, it is also reasonable for graduates to find employment with companies involved with pollution control, and cleaner energy sources.

According to a presentation by Dr. H.N. Cheng, Hercules Incorporated, *Equipping the 2015 Chemical Technology Workforce Identifying Job Opportunities*, "technician hiring is projected to grow by around 5% over the next decade. Part of the growth will come from an aging workforce, a large segment of which is due to retire. Additionally, pharmaceutical manufacturing and analytical testing are projected to grow 20-30% in the coming decade."

Strength

A report from the Bureau of Labor Statistics anticipates employment of chemical technicians increasing by 7 percent from 2010 to 2020. "Chemical technicians will continue to be needed in scientific research and the development (R&D) and to monitor the quality of chemical products and processes. Job opportunities are expected to be best for graduates of applied science technology programs who are well trained on equipment used in laboratories or production facilities." *Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2012-13 Edition, Chemical Technicians, Publish Date: Thursday, March 29th, 2012.*

The Dow Chemical company has been a supporter of the Industrial Chemistry Technology program. Technologists with Dow have opportunities in research and development, manufacturing, analytical sciences, and health and environmental services.

Opportunities with Eli Lily and Indianapolis, IN, include work in research and development, quality control, and environmental. The Ferris Industrial Chemistry Technology program prepares graduates for work at Eli Lily.

SC Johnson in Racine, WI has recruited Ferris graduates to work in such areas as analytical, packaging, process development, and product development.

Mosaic Potash, a crop nutrient company, with locations throughout the United States and Canada, has recruited ICT graduates. Career opportunities include work in quality control, and environmental, health, and safety. On occasion, summer internships may be available with Mosaic.

Intel, Dow Agro Sciences, Leprino Foods, and Michigan Dairy have recruited Ferris graduates.

In addition to campus recruiting, graduates may find careers through job fairs, networking, placement agencies, and on-line postings through sites such as Monster.com. An American Chemical Society 2005 starting salary survey indicates the most common methods for finding employment are networking, agencies, and online services.

The program is very flexible in its responses to industrial needs and trends. When a certain industry is "hot" and the companies are looking for technicians, we invite more visitors to the campus to speak and advertise the job opportunities that they have. More Specifics

The students, past and present, are happy with the program. Those students that are in the program are not only excited about the classes and materials, but they recruit other students to join. They see the value of recognizing and solving a problem using critical and analytical thinking. The student feedback is taken through regular class evaluations as well as through this student survey. Also, students of the program spend a lot of time in the ICT rooms, where they interact heavily with each other as well as the program coordinator, Mr. Killian. This they do of their own accord. The real forces of change for the program are based on returning students, employers, and the advisory board.

Numbers?

More Specifics

D – Program Value

Instrument holdings in the program are essential: the current state of instruments in the ICT program is of a useful but aging status. There is a strong need to put instruments on a 5 year or so term of replacement as technology advances, so the training of student can be maintained at a high level.

The program, facilities, and faculty are very helpful to the Sciences in training of good ICT students. The higher the quality of the student that the University pushes through the better the university's name recognition will be. The largest advantage is to the students enrolled, however. The program is really very good; the faculty associated with it encompass a number of the professors in the chemistry department. This is an incredible collection of teachers, and each of them is not only interested in individual student progress, but also equipped to affect it.

Numbers?

The employers that we hear from are very happy with the quality of our program. They come here to meet with our students and actively recruit them for positions in the industry. This is one indication that they like what we do. Another is the survey used to construct the program review. The employers indicated that they want our students and that they are happy with the students that they have hired in the past. A final way to evaluate the value of the program to the employers is by keeping close ties with the industry itself, which Mr. Killian does through personal relationships and through maintaining relationships with past students. More Specifics

The FSU ICT program has maintained representation with the ACS. This body offers students opportunities and funding. Maintaining this representation keeps a professional standard for the program as well as benefiting many groups outside of the University community. The Ferris State University ACS chapter of student affiliates is heavily involved with the ICT program. This ACS group, with ICT support, has engaged in many different social activities to better the general community. Among these are the "SafeRide" program, adopt a highway, walk for warmth, volunteering (at recycling center, for instance). This group also recently judged science fair projects at a local school and will be doing a science demonstration for grade school children, is responsible for contacting ICT grads to return to campus and speak. In addition, Ferris State professors including as recently as last summer have been requested to be a part of National ACS activities. Pasquale Di Raddo has served on the ACS committee on technician affairs, now Dr. Thomson is on that national committee.

Section 2:

Collection of Perceptions

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Opp Improve

The data was collected using surveys. The current students were given their surveys during class time, and the recent grads who are still around were just chased down and handed theirs. The chief program employers were contacted via phone. Past ICT program reviews have had difficulty in getting responses, and so we selected people coming back to the ICT reunion to get a diverse group of grads from the 1960's through the 2000's for the past graduate survey.

A – Graduate Follow Up Survey

The graduate survey was designed to gauge the level of preparedness that the ICT graduate had when entering the job market. We attempted to foresee the areas that may be commented on by gearing the questions in that direction, and we also left a few open-ended questions for the graduates to give their own interpretations. We also generated a quick survey on a proposed ICT BS in chemistry. Overall, the graduates were impressed with their level of job readiness. Their comments are included as per requirements; the names have been deleted.

We distributed (22) graduate responses. The strengths that were most often outlined were basic lab competence and the ability to find answers or help when needed. The selection of class work to real life situations was also cited. Genuine interest by the faculty and availability was noted.

The actual results of the graduate survey are included below. The recent grads as well as the past grads.

For gridded questions, the number of responses is filled into their respective box while with the straight questions and option sections, the number of responses is listed behind the selection. Finally, for the open-ended questions that included blanks, the responses are listed, as they were written, and in randomized order.

1 = poor
2 = below expectations
3 = acceptable
4 = good
5 = excellent

	1	2	3	4	5
1. Courses in the ICT program were: • Available and conveniently located	0	0	1	7	14
•Based on realistic prerequisites	0	0	1	6	15
•Available at moderate cost	0	0	1	5	16

2. Teaching methods, procedures, and course content: •Met your needs, interests, and objectives	0	0	0	5	17
•Provide supervised practice for developing job skills	0	0	0	2	20
3. Related courses (such as English, Mathematics, Science) were: •Pertinent to occupational goals	0	0	0	13	9
•Current and meaningful to you	0	0	2	11	9
4. Career planning information: •Met your needs and interests	0	0	5	2	15
•Helps you plan your program	0	0	4	8	10
•Helps you make career decisions and choices	0	0	3	6	13
5. Job success information on former students in ICT: •Is provided to help you make career decisions	0	0	2	7	13
•Indicates how many job opportunities there are in your occupation	0	0	6	5	11
•Identifies where these job opportunities are located	0	0	2	10	10
•Tells about job advancement opportunities	0	1	8	5	8
6. Placement services were available to: •Help you find employment opportunities	0	0	5	7	10
•Prepared you to apply for a job	0	0	5	9	8
7. ICT instructors: •Know the subject matter and occupational requirements	0	0	0	6	16
•Are available to provide help when you need it	0	0	1	3	18
•Provide instruction so it is interesting and understandable	0	0	0	7	15
8. Instructional support service (such as tutoring, lab assistance) were: •Available to meet your needs and interests	0	0	0	7	15
•Provided by knowledgeable, interested staff	0	0	0	7	15
9. Instructional lecture and laboratory facilities: •Provide adequate lighting, ventilation, heating, power, and other utilities	0	0	2	8	10
•Include enough work stations for the number of students enrolled	0	0	0	6	14
•Are safe, functional, and well-maintained	0	0	0	8	12
•Are available on an equal basis for all students	0	0	0	6	14
10. Instructional equipment was: •Current and representative of industry	0	0	2	9	10
•In sufficient quantity to avoid long delays in use	0	0	1	9	11
•Safe and in good condition	0	0	1	7	13
Comments: 1. Enjoyed the experience!!! 2. ICT is probably the best career decision I ever made. 3. Very good program. 4. Prepared me for my life in industry. 5. Exemplary individual 6. Over the last 50 years things have changed drastically.					

7. A lot has changed since 1975. 8. An excellent preparation for manual execution of scientific experimentation in a university without existing/expensive research (undergrad) programs. 9. Great instructors.					

Bachelor's in Applied Chemistry Survey

11. Attaining a bachelor's in applied chemistry would have interested me when I was in school.
    Very much (11)   Somewhat (6)   Not at all (4)

12. Attaining a bachelor's in applied chemistry interests me now.
    Very much (1)   Somewhat (6)   Not at all (9)

13. Ferris should offer both an associate's and a bachelor's in applied chemistry.
    Yes (17)   No (0)   Maybe (4)

14. I perceive that a need for a bachelor's in applied chemistry exists in industry.
    Very much (14)   Somewhat (4)   Not at all (1)

15. Do you believe a GPA or experience requirement should be enacted to limit the people considered for such a degree?
    Definitely (10)   No, not at all (9)

16. Please express any observation or feelings you have that were not covered in these questions.

1. I have attended classes at a number of school and Ferris remains my favorite.
2. Good to be back with those with which I had my beginnings in the professional world.
3. Norm was great!
4. All degrees over the year require additional time at college to meet changing industry needs, i.e. pharmacy 4 years – 7 years, physical therapy 4 years-7 years, etc. ICT needs to move to an applicable chemistry 4 year degree for industry.
5. Mr. Peterson is an outstanding teacher not just for school but for life. Great person.
6. Got BA at SVSU, did not get me to where I am, ICT did it.

B – Employer Follow Up Survey:

A group of common employers were distributed surveys. Their perceptions of the graduates and the current program were largely favorable. The employer sample size is smaller, but that should come as no surprise as multiple technicians work at any one site. They seemed largely pleased with the program and recognized an FSU ICT student as a reasonably valuable commodity. The five employers surveyed were Michigan Dairy/Kroger Foods, Dow Chemical, Mosaic, Pfizer, and Aerotech. The data is compiled below.

A note on Aerotech, it is a chemist placement service. Over the last 5 years it has become common for many employers to take on recent grads as temps, essentially a trial period and then offer a full time position. Aerotech has been the most reliable placement service for our students.

Employers ICT Survey

1. What are the major strengths of the ICT program?

Hands on.
Preparation.
Instruction, know students and talk to their strengths.
Lab work and variety vs BA people we get with less lab work.
The program take s practical approach which helps prepare students to work in an actual lab setting. Repeated work with calculations prepares the student for the work place. (i.e. the students understand how to set a titration calculation). Repeated lab work is great training for the work place. Students understand test set up and techniques (titrations, gravimetric analysis etc.) The program does introduce lab safety and an understanding the chemical information from the Material Safety Data Sheets.

2. What are the major strengths of ICT students?
Students are prepared to work in a lab setting. They have an understanding how lab techniques from set up; performing the test; and completing the calculations. The students have used several pieces of lab equipment and are ready to start work with minimal explanation of how equipment operates.
Lab skills, hands, note book record keeping, safety importance very important.
Hard workers, responsible, good.
Respond to work environment, expect to use tools they develop.

3. What are the major needs for improvement in the ICT program?
Go to a 4-year program.

Program Response?

Presentation skills group to group, various formats what you worked on.
Students could use more work with data analysis and interpretation of results. Compiling data into business reports and presenting work to upper management.

4. Do you have additional comments or suggestions for the program?
Look at business/manufacturing and stats, apply to lab work.
More safety training – laboratory safety paramount. More work with equipment troubleshooting or maintenance, (this would potentially require more training such as

lockout/tagout). Practice working with company technicians for troubleshooting. Adding an environmental component to the training, how these incidents affect the work place and different governing bodies involved.
More detail on section work. Any writing.

5. How do you view an ICT bachelor's program?
Great ideas, would have continued on if available. Keep AAS to work.
Move to bachelors in chem. 2 year still useful. Better proof of work. BA ICT better than chemistry more experience. "Better known." Website and contractor.
It depends on what additional coursework would be required. More lab based work, perhaps with a biochemistry component would be beneficial.

C – Graduating Student Exit Survey

Six current grads were given the same survey as the historical group of 22. Their results and comments are collected below:

1 = poor
2 = below expectations
3 = acceptable
4 = good
5 = excellent

	1	2	3	4	5
1. Courses in the ICT program were: • Available and conveniently located	0	0	0	0	6
•Based on realistic prerequisites	0	0	0	0	6
•Available at moderate cost	0	0	2	2	2
2. Teaching methods, procedures, and course content: •Met your needs, interests, and objectives	0	0	0	0	6
•Provide supervised practice for developing job skills	0	0	0	0	6
3. Related courses (such as English, Mathematics, Science) were: •Pertinent to occupational goals	0	0	1	2	3
•Current and meaningful to you	0	0	1	3	2
4. Career planning information: •Met your needs and interests	0	0	1	1	4
•Helps you plan your program	0	0	1	1	4
•Helps you make career decisions and choices	0	0	1	1	4
5. Job success information on former students in ICT: •Is provided to help you make career decisions	0	0	1	3	2
•Indicates how many job opportunities there are in your occupation	0	0	3	1	2

•Identifies where these job opportunities are located	0	1	2	2	1
•Tells about job advancement opportunities	0	1	2	2	1
6. Placement services were available to: •Help you find employment opportunities	0	0	2	1	3
•Prepared you to apply for a job	0	0	3	0	3
7. ICT instructors: •Know the subject matter and occupational requirements	0	0	0	1	5
•Are available to provide help when you need it	0	0	0	1	5
•Provide instruction so it is interesting and understandable	0	0	0	0	6
8. Instructional support service (such as tutoring, lab assistance) were: •Available to meet your needs and interests	0	0	0	1	5
•Provided by knowledgeable, interested staff	0	0	0	1	5
9. Instructional lecture and laboratory facilities: •Provide adequate lighting, ventilation, heating, power, and other utilities	0	0	0	2	4
•Include enough work stations for the number of students enrolled	0	0	0	1	5
•Are safe, functional, and well-maintained	0	0	0	4	2
•Are available on an equal basis for all students	0	0	0	1	5
10. Instructional equipment was: •Current and representative of industry	0	0	2	2	2
•In sufficient quantity to avoid long delays in use	0	1	0	4	1
•Safe and in good condition	0	0	1	3	2
Comments: 1. Killian is great! 2. Great program.					

Bachelor's in Applied Chemistry Survey

11. Attaining a bachelor's in applied chemistry would have interested me when I was in school.
    Very much (6)   Somewhat (0)   Not at all (0)

12. Attaining a bachelor's in applied chemistry interests me now.
    Very much (4)   Somewhat (1)   Not at all (1)

13. Ferris should offer both an associate's and a bachelor's in applied chemistry.
    Yes (5)   No (0)   Maybe (1)

14. I perceive that a need for a bachelor's in applied chemistry exists in industry.
    Very much (5)   Somewhat (1)   Not at all (0)

15. Do you believe a GPA or experience requirement should be enacted to limit the people considered for such a degree?

Definitely (3) No, not at all (3)

16. Please express any observation or feelings you have that were not covered in these questions.
BS in ICT sounds like a great idea and I would love to see it happen.
ICT helps students find their path.

D – Current Student Program Evaluation

Finally, a different survey was given to current ICT students. This survey was given to students in the manufacturing "capstone" class. The students had a few comments to add, but they gave their impressions. A copy of the survey with results is included below:

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

	1	2	3	4	5
1. Expectations for graded assignments were clearly communicated	0	0	0	1	8
2. Course activities (lectures, projects, etc.) helped me learn the course material	0	0	0	1	8
3. Examinations, papers and other graded projects were returned in a reasonable amount of time.	0	0	0	3	6
4. The course was well organized.	0	1	0	1	7
5. The instructor helped me make connections between the content of this course and real life situations.	0	0	0	1	8
6. The instructor generally followed the stated course outline.	0	0	0	4	5
7. The instructor prevented material in a clear and understandable manner.	0	0	1	2	6
8. Graded materials and activities covered the major points of the course	0	0	0	1	8
9. The instructor gave helpful illustrations and examples in explaining application of the course material.	0	0	0	4	5
10. The instructor seemed to be genuinely interested in hat she/he was teaching.	0	0	0	1	8
11. The instructor was well prepared for classes.	0	0	1	1	7
12. I was able to get help in this course if I needed it.	0	0	0	1	8
13. I felt that the instructor put considerable effort into teaching this class.	0	0	1	1	7

14. The instructor was available outside of the regularly scheduled class time.	0	0	0	0	9
15. The instructor displayed an interest in students and their learning.	0	0	0	0	9
16. I really had to work to successfully complete the requirements in this course.	0	0	1	5	3
17. The instructor was enthusiastic about the subject matter of this course.	0	0	0	1	8
18. The instructor was receptive to the expression of student views.	0	0	1	1	7
19. The instructor stimulated my interest in the subject.	0	0	1	1	7
20. The subject matter in this course is difficult.	0	0	6	3	0
21. I was interested in the subject matter before I took this course.	0	0	1	1	7
22. Overall, I rate this as an excellent course.	0	0	1	0	8
23. Overall, I rate this instructor as an excellent teacher.	0	0	1	0	8
For item #24, mark cell 1 for "yes", or cell 2 for a "no"					
24. I was required to take this course.	8	1			
What did you like about this course? 1. The application. 2. The course represented an 8 hour lab day. It was very realistic and requirements were straight forward. 3. I liked the skills you learned from it. 4. I liked that it was run like a normal work day would be run. 5. Killian Industries is the best. 6. I like the organization of the course. 7. Killian is the best teacher at FSU. 8. I liked that we were able to spend a whole day in lab to get experience working on different projects. What changes would you recommend? 1. Organize the materials in the lab better. 2. Longer hours.					

E – Faculty Perceptions

The final group of surveys were given out to faculty members who have a reasonable amount of dealing with ICT students. There were four surveys sent out and four returned. The comments supplied were less directed than those of the graduates and employers, but the feeling was that the program is where it needs to be.

A copy of the survey results is given below:

Note:

For gridded questions, the number of responses are filled into their respective box while with the straight question and option sections the number of responses is listed behind the selection. Finally, for the open-ended questions that include blanks, the responses are listed, as they were written, and in randomized order.

1. How would you rate each of the following skills of typical ICT students relative to other FSU students? Please indicate one rating for each skill.

	Much Better	Somewhat better	About the same	Somewhat Worse	Much Worse
Written Communication Skills	2	1	1		
Verbal Communication Skills	2	1	1		
Quantitative Skills	2	1	1		
Problem Solving Skills	3		1		
Work Ethic	3		1		
Laboratory Skills	3		1		

2. How would you describe the preparation of the typical ICT student for the amterial of yoru course as compared to other FSU students?

Much Better Prepared	1
Somewhat Better Prepared	1
About The Same	2*
Somewhat Less Prepared	0
Much Less Prepared	0

* Comment: "Unsure. In my course they have usually not chosen ICT yet."

3. Please use this space to make any additional comments regarding how you would describe the ICT student's preparation and approach to your class.

"ICT students are excellent at teamwork and solving practical problems. They are unafraid to attempt to solve difficult tasks in the lab or lecture."

“By the time ICT students are taking Organic Chemistry, they have only a maximum of 2 credits of Chemistry that is different than their peers, so consequently haven’t had time to be shaped by the program.”

“N/A. In General Chemistry, they have not yet selected ICT. That usually comes along later after they realize its value.”

“Better independent thinking in lab. Enjoys hands on work.”

4. The following is a simplified list of the current ICT graduation requirements. Please identify the areas that you feel are either particularly important or are not as important. If you have no opinion, feel free to leave an entry blank.

	Very Important	Somewhat Important	Neutral	Somewhat Unimportant	Very Unimportant
ENGL 150 & 250, or equiv.	4				
PHYS 211 & 212	2	2			
MATH 120	3	1			
CHEM 121 & 122, or equiv.	4				
CHEM 321 & 322, or equiv.	4				
A Social Awareness Course	1	2	1		
A Cultural Awareness Course	1	3*			

* Comment: “Learning to read in a foreign language can be helpful.”
“ISYS needs to be dropped. ICT courses are very important. CHEM 231 is very important.

5. Please use this space to identify any courses or requirements that you think should be added.

“I would like to see an advance organic lab added.”

“Internship, PChem, Inorganic = BS in ICT.”

“More communication classes.”

6. Please describe the extent of your experiences with ICT students or make any other comments.

"I have done research projects with ICT students."
"I have had a few ICT students in my Organic Chemistry class. They typically enjoy lab work more than the average student and excel in the lab portion of the course."

"My experience with ICT students has been very positive. They are excellent self-starters and self-motivators. When they are given a task, there is no more need to think about. It will be finished. This will happen in a timely and professional manner. They will find the help they need to accomplish it. I have been very impressed with the way ICT students have carried and presented themselves at professional conferences with very few exceptions."

"-Pleasure to work with.
-Participate fully in ACS club.
-Should be even more involved in chemistry (ACS) club.
-Should become student members of ACS (strongly urge)."

F – Advisory Committee Perceptions

Advisory board members and employers are basically one and the same. Most employers surveyed are members of the Advisory Board. Therefore, refer to the employer perceptions section to revisit their input.

ICT Program Advisory Board			
Nelson	Bob	S & T Technician	Dow Corning Corporation
Kelley	D'arcy	Chemist	Cytec Corporation
Frank	David	Department Head	Ferris State University
Weaver	R. James	Adjunct Instructor – Physical Sciences	Ferris State University
Palmer	John B.	Manager, Human Resources	Michigan Dairy
Templin	Kelley	EHSS Coordinator	Mosaic Potash – Hersey
Schultz	Scott	Manager	Pfizer / Animal Science Division
Churchfield	Mechelle	R & D Technologist, Interfacial Science	The Dow Chemical Company
Wright	Michelle	Supervisor, Quality Control Laboratory	Eli Lilly & Co.
Di Raddo	Pasquale	Professor of Organic	Ferris State University

		Chemistry	
Littich	Ryan	Organic Research Chemist	Elevance Renewable Science Inc.
Miller	Tom	Automotive OEM Manager, Engineering	BASF Corporation
Killian	William	Professor of Industrial Chemistry	Ferris State University
Fu	Wallace	Retired Professor	Hope College

Section 3:

Program Profile

Section 3: Program Profile

A – Profile of Students

For reference purposes, a copy of the latest yearly Administrative Review (from December 2012) has been attached as an appendix.

1 – Student Demographics

The ICT student breakdown is often similar to the University-wide demographics for science classes. Male – female percents traditionally are in a 55/45 ratio/ Minority students are generally recognized to be in the 12-15% range. These numbers correspond closely with FSU as a whole. The classes for our program are offered during the day. There are no online course offerings. Most of the courses are traditional in style, and we recruit from within the Ferris State University student population.

Numbers?

2 – Quality of Students

Over the last several years, the GPA range of our students is 2.8-3.8, with an average of about 3.2. This is a reasonable grade point range, and shows a competent and serious student enrollment. Historically, any GPA over 2.0 is acceptable for graduation. All Ferris State University students are welcome to join the program, so there are no other methods used to measure the incoming students' potential. Many students do get financial awards. We regularly have students who earn academic aid. ICT students are very active in the student chapter of the ACS. This is a program that allows for interaction with some of the campuses strongest students. It also makes available many opportunities for volunteering. These activities are chemistry related, which makes the fit even better for students engaged in earning chemical technician degrees. A number of ICT students have been presenters at regional and national ACS meetings.

3 – Employability of Students

Evidence?

ICT graduates have a great reputation for being industry ready. 100% of the ICT graduates who desire to be employed upon graduation are. There are students who decide to go on with their education instead of joining the labor force immediately. We make introducing the chemical industry a regular part of the educational process in the ICT program and accommodate the human resource departments of companies that may be interested in hiring ICT graduates. Our system works very well for those who want to take a job upon graduation.

Evidence?

The average starting salary for someone with an ICT degree is $30,000 to $35,000. This obviously depends on the area that the student goes into and the company that they go to work for. Due to the trend of working through a placement service, many students begin as temps at a company. Upon a 6 month to 1 year time frame, most get hired in as full time employees.

There are some graduates who find part-time employment, but this is generally only on a short-term basis in times of a slumping job market, and once full-time positions are available they get picked up.

There is a lot of interest in career assistance and job placement within the program. Students come at times outside their regular meeting times to hear talks given by recruiters for different companies. The students have expressed that they are pleased with the career assistance that the program offers.

Very nearly all of our graduates are employed within the field. Those that are not have been promoted to the point that they do a slightly different job than that which they left Ferris State University trained to do. We are basing this on the graduate surveys that we received in which the average time employed in the field was very nearly that of the average time since graduation from the program.

Still, many of our graduates work in Michigan. There are graduates at companies in the Big Rapids, Grand Rapids, and Zeeland area, such as Mosaic, Corium, and Gentex. In the past, Midland/Saginaw area has always been a mainstay for the ICT program as it houses companies like DOW. At present and the foreseeable future, our grads are going to many small Michigan companies that rely heavily on ICT graduates as well.

Quite a few of our graduates go on for or combine while here, continued education. The estimated, conservative, average is about 90%. Many of the chemical companies also offer tuition reimbursement programs, and so we likely have plenty of students who have gone on to further degrees, although we would not have that information at hand. The majority of the known advanced degrees – largely chemistry bachelors – have come from here, at Ferris State University.

B – Enrollment

One factor that differentiates the ICT program from most others on campus is that it attracts more students after they are admitted to Ferris rather than before. Many students in the program are taking courses for other degrees (such as pre-pharmacy), and some students transfer into the ICT program once they learn about the industrial opportunities. One of the anomalies of the ICT program has been that the number of graduates over a two year period can actually exceed the official two-year enrollment in any given fall semester. Our enrollment strategies for the ICT program typically focus more on internal recruitment than retention, because once students enroll in the program, they typically stay in it.

Evidence? Numbers?

1 – Anticipated Fall Enrollment

The anticipated fall enrollment will be higher than the last few years' enrollment numbers. The ICT introduction class, CHEM 140, has 14 students enrolled. The ICT calculations class, CHEM 240, is a 2nd year class and has 13 students enrolled. These numbers would be good indicators as to the 1st and 2nd year students for this year. As a rule, we always gain an additional 1 or 2 students from in house recruiting during the year.

2 – Enrollment and Credit Hour Production

Enrollment has been steady and is now increasing since the last program review. The credit hour production has also been steady. This years' marked improvement in numbers is a good indicator of future growth.

3 – How Many Students Apply Annually?

Again, the application for enrollment is a little shy of ten students a year. However, it is not uncommon to have a slightly higher number of students in the higher level courses than this as some students stretch their time in the program over a four year period. Also, there are students who transfer into the program having taken enough of the classes to move very quickly through the program.

4 – How Many Admittances / Applications?

All students that apply are admitted. The program is built on the concept of improving laboratory ability, no matter the level of improvement necessary. At this time, the program can absorb more students. Increasing opportunities in the chemical industry entice more students into the program. Currently, the climate in Michigan is very positive for chemical technicians.

5 – Of Those Admitted, How Many Enroll?

Likely 75% of the students that are admitted actually enroll.

6 – What are the program's enrollment goals, strategy, and efforts to maintain / increase / decrease the number of students in the program?

The recruitment done for the ICT program is almost exclusively in-house. The best, and most consistent, results have been maintained using this approach. The program coordinator visits the general and organic chemistry classes to make students aware of the ICT program. The students that are currently enrolled in ICT are also often enrolled in other science majors.

C – Program Capacity

1 – What is the appropriate program capacity?

The capacity for the ICT program is likely about 15 students in a given graduating class (That is, a total program capacity of 30 over two years). The largest reason for this is lab space.

With that many students, it gets to be difficult to move around the lab very freely. Safety hazards begin to become a larger concern. The level of "realism" begins to drop off, as most industrial or research institutions will have adequate bench space for each chemist. The physical needs of each student begin to be met less with a great enrollment. For instance, the ease of getting on an instrument decreases substantially with even a few extra students added.

The capacity is higher than the current enrollment. This year's enrollment of 13 students (in the second year of the program) would be a large class. That is this year's projection.

D – Retention and Graduation

1 – Give the Annual Attrition Rate

The attrition rate for the ICT program is a loss of no more than one or two students (if any), in a given year. Once the program attracts students, they tend to stay. The program is designed to walk students through and help them along in their practical, applicable growth as technicians. As such, the program coordinator is able to spend a lot of time with each student and can give them a hands-on type of mentoring that is unlike what is found in most other programs. This allows the students to place a lot of personal stock in their own growth, partly because they answer to the instructor directly and partly because of the applicability of the work they do; it is very rewarding to learn to do things better and then go and continue to use that new skill.

2 – What are the program's goals, strategies, and efforts to retain students?

As stated, the highly personal level of the program allows the program coordinator to engage each student individually. The engaged students can take what they learn and apply them directly to both this program, and to any lab components that they have for other courses as well. Personal contact is a retention feature that ICT maintains. The engaged student is the start of the process to a successful professional.

3 – Note any trends in number of degrees awarded in the program.

The number of degrees awarded is very similar to the number of enrolled students; because the attrition rate is so low, the number of enrolled students is nearly the number of degrees awarded. We keep closer track of the number of degrees awarded than we do the number of enrolled students, because in the end, that is what matters.

4 – How many enrolled students graduate within the prescribed time?

The average time for a student to graduate from the ICT program is actually likely lower than what would be expected. Many students come into ICT having already taken some of the basic prerequisites, such as the chemistry sequences and physics, which allows them to save a lot of time. A student who is in a related program, such as applied biology, chemistry, or pre-pharmacy can almost expect to finish the ICT courses within a single year of joining the program.

5 – How many years are taken to graduate from ICT?

As stated, a student who has take some of the background classes can very possibly come into ICT and finish the degree in a year. A student who starts out with ICT and does not have some other classes taken care of can finish the degree in 2 years. This would be a fairly heavy 2 years, and some students may prefer to stretch that over 3 to separate some of the tougher courses. Few ICT students come directly to the program, so few ICT students need to take courses like general chemistry as ICT students. Because of this, it is common to take not more than 2 years to graduate the program.

E – Access

1 – Describe the program's attempts to make it accessible to students.

There are some summer courses that fit into the ICT required courses. For the most part, however, the course load is pretty traditional. The accessibility of the program comes from the fact that so many students have to take the prerequisites for the program anyway that they do not need to add too many more semesters of schooling to earn the degree. Also, the program, as designed by the program coordinator, is flexible in its handling of students. ICT seeks to accommodate students however possible. Students can enter the program in any semester.

2 – Discuss what effects the actions above have had on the program.

The methods described above do not directly impact enrollment as much as retention. The "personality" of the ICT program is one of its great strengths to the students. The learning environment is great because the students see each other often and work together as a group regularly.

3 – How do the actions from above advance or hinder program goals?

Many students are drawn to the program because of the real-world, work oriented learning atmosphere it has. The style of learning in the IT program is both one of its greatest strengths and the thing that students like about it so much.

F – Curriculum

Please refer to the attached checksheet for the ICT program as you read this section.

1 – Program Requirements:

The program has only 4 courses (10 credits) that are unique to this program, the entire remainder of 63 credit hours being courses that overlap with a wide variety of BA, BS, and pre-professional courses in the sciences. The unique courses, CHEM 140, CHEM 145, CHRM 240, and CHEM 245 are described in the current syllabi that are attached to this review. They provide the specific safety, calculation, and laboratory skills required of technical chemistry professionals. The remainder of the course work includes a full year each of general chemistry (quantitative analysis and instrumental analysis) and physics. The balance of the requirements satisfy the AAS general education requirements. MATH 120 is the only directed general education requirement and is specified because it is a pre-requisite for CHEM 121 and PHYS 211.

This set of course requirements provides several advantages. Because of the overlap, the program remains an attractive alternative for students starting these other programs who come to realize that finishing such degrees are beyond their interest, ability, or financial means. This program also serves as an excellent starting point for students ready for college who are not yet ready for a full 4 year commitment. They can start the ICT program and transition to a BA or BS program in the sciences and almost all the course work will also apply toward satisfying the requirement for the second degree. Students of ICT have even seen the unique courses transfer to chemical engineering programs at Northwestern and MSU.

2 – Program Revision:

The curriculum for this program has remained unchanged curing the current review period.

3 – Current Program Changes:

No, there are no current program changes currently in the review process.

4 – Plans for Future Revision

Yes, there are future plans developing and being discussed to revise this program. Graduates and employers suggest that computer system skills gained in the chemistry coursework is sufficient and that ISYS 105 is unnecessary. In the past year, discussions have initiated between faculty, members of the advisory board, and representatives from the American Chemical Society regarding the changing role of technical chemistry professionals. While many industries hire two-year graduates, it is evident that the potential employer pool would increase if students had a four-year degree. Discussions with Hemlock Semiconductor (outside of Saginaw MI) revealed their interest in bachelor-level students. At this point, it would be prudent and appropriate to develop a BS program in Industrial Chemistry Technology. This proposal, with appropriate additional courses, will be submitted in the next 2-3 years.

G – Quality of Instruction

1 – Discuss student and alumni perceptions on the quality of instruction.

This can be found above in both the student and graduate collection of perceptions.

2 – Discuss advisory board and employer perceptions.

This was done in the employer perception collection, the noted response was overwhelmingly favorable. Members of the advisory board are also contacted on a regular basis (they frequently are the employers of our students), so we have regular input on the performance of each year's graduating class.

3 – What departmental individual efforts have been made to improve the learning environment, add and use appropriate technology, train and increase the number of undergraduate and graduate assistants, etc.?

A high quality GC-MS was purchased with a combination of funds and put into immediate use. Also, effort has been made to integrate computer simulations and examples into the coursework as a supplement to the instrumentation. These add depth and breadth to the currently available instrumentation in the ICT program. At the same time, the proper care and maintenance of the existing instrumentation – the physical hardware – is both time intensive and costly. Without the real instruments, the simulations would lose validity and the students would lose valuable exposure.

4 – Describe the types of professional development the faculty have participated in, in efforts to enhance the learning environment?

ACS (American Chemical Society) sponsored technician workshops, both national and local have been attended, by Prof. Thomson, Di Raddo, Killian, and Frank. Prof. Killian and Frank have been invited to present papers and serve on discussion panels on issues related to the education of technicians at national meetings. Dr. Thomson is currently a member of the national board of Chemical Technicians of the ACS; he brings back information from national meetings to keep us updated of recent developments in the field.

5 – What efforts have been made to increase the interaction of students with faculty and peers?

ICT students are heavily involved in the on-campus ACS chapter of student affiliates. B.Q. Wiercz, an ICT graduate, for example, has served as president of the club. Nearly every year, an ICT student is an officer in the club. Also, guest lecturers, former grads, ICT students speaking on their research, local ACS on campus speakers are a regular part of the group.

6/7 – Discuss the extent to which current research and practice regarding inclusive pedagogy and curriculum infuse teaching and learning in this program, and what effects have these actions had on the learning in the program.

ICT has always been heavily student driven. There is a strong focus on student led activities, including meetings and presentations. The responsibility of many of the laboratory experiences, such as data sharing, notebook collection, project cooperation and completion, and the maintenance of a professional work area have always been essential parts of the ICT program and philosophy.

Other comments about the broad science portion of the program (including general and organic chemistry) have been made above,

H – Composition and Quality of Faculty

Program faculty (Bill Killian). The four key courses in the ICT program (CHEM 140, CHEM 145, CHEM 240, and CHEM 245) are all taught by Prof. Killian. He brings a unique background to this program. Not only does he have a degree in organic chemistry, but he also has worked in the chemical industry, thus developing an expertise with a broad range of instrumentation. His instruction has been consistently rated highly by students. Please refer to the attached vita for more information about Prof. Killian's experience. Prof. Killian is currently a tenured full professor in the department.

Other chemistry faculty in the Physical Sciences Department are active participants in educational seminars. As a result, they have brought chemical learning strategies to campus and exposed ICT students to these new methods.

Workload. Bill Killian teaches a full workload in the department, which roughly translates to fourteen-to-sixteen contact hours in lecture and laboratory combined. Prof. Killian has 0.25 FTE release time during the Fall and Spring semesters; his duties are to coordinate the ICT program. In addition, Bill usually accepts a lecture of laboratory overload assignment each semester. He does this willingly, because he wants to teach some of the general chemistry courses in order to educate and recruit students for the program.

Recruitment. Not applicable, since there are no plans to expand or replace the ICT faculty member.

Orientation. Not applicable.

Reward structure. The ICT coordinator has been eligible for promotion and has take advantage of that process. He also has access to departmental faculty development funds, and has used them for attendance at meetings. At this time, neither off-campus incentive funds nor recruiting new faculty are an issue for this program.

Graduate instruction. Not applicable.

Non-tenure-track and adjunct faculty. Over the last five years, all of the program-specific courses (CHEM 140, CHEM 145, CHEM 240, and CHEM 245) have been taught by Prof. Killian, a tenured full professor. Therefore, 0% of this instruction has been provided by non-tenure-track faculty. However, in the chemistry side of the Physical Sciences Department, the following non-tenure track faculty have taught one or more of the lectures for basic science classes in the program over the past year: Tracy Kerr, Gary Hiel, Francis Burns, and James Weaver. Typically, these faculty teach in multi-section courses. In particular, one of our non-tenure-track faculty members, James Weaver, is a graduate of the ICT program and can provide students in our basic science classes with a program perspective. In addition, Gary Hiel brought a wealth of experience in the chemical industry to his teaching. In the case of this program, the skills of our non-tenure-track faculty were a welcome addition.

I – Assessment and Evaluation

1 – Student learning outcomes at the course level.

The curriculum map shows that the required courses for the ICT program come from the areas of chemistry (CHEM), physics (PHYS) and math (MATH). There are five key courses in the program that provide the professional preparation of the students. These courses, along with their learning outcomes (as taken from TracDat), are listed below.

CHEM 140 – Orientation to Industrial Chemical Technology

• Understand the role of technicians in industrial chemistry.
• Identify and use the available chemical literature.
• Demonstrate a working knowledge of the basic and fundamental concepts of general and organic chemistry.
• Delineate the roles of basic research, engineering and common sense in chemistry.
• Identify the areas of current concern in industrial chemistry.
• Communicate effectively in a scientific context.

CHEM 145 – Safety – The Chemical Lab

• To continue the development of the attitude and background a successful technologist displays.
• To become keenly aware of the chemical laboratory from a safety standpoint, through not only recognition, but also appropriate calculations.
• To be able to make sound judgments from a safety standpoint on what types of materials are compatible.

• To be able to safely work with hazardous material, limit one's overall exposure to them, and correctly dispose of such materials.
• To realize and begin to think about the large safety and heat problems facing laboratories and the world.

CHEM 240 – Industrial Chemical Calculations

• To master basic chemical calculations used by virtually all industrial chemists including stoichiometry concentration, and gas law problems.
• To sharpen our basic problem solving skills and apply those skills in unique situations.
• To expand our understanding of units beyond the traditional system.
• To solve basic chemical engineering and technological type problems.
• To learn strategy and attach problems with fundamental sound judgment.
• To use the basic statistics and traditionally relied upon in laboratory work.
• Understand statistical process control and its place in industry.

CHEM 245 – Chemical Manufacturing & Analysis

• Reap the rewards of an independent thinker and worker, as well as learning to cooperate with and be part of a team.
• Gain a broader understanding of basic analytical and synthetic chemistry while working with real world samples.
• Become safely familiar with a variety of new reagents and new analytical techniques and to integrate this knowledge with basic wet chemical and instrumental skills to solve laboratory problems.
• Interpret as well as follow directions and produce reliable data, using methods standard to a wide variety of industries as well as less defined synthetic procedures.
• Maintain a high quality laboratory notebook in content and form.
• Complete projects in a timely fashion with presentable results.

CHEM 317 – Instrumental Analysis

• Become familiar with basic working instrumental theory of a survey of a number of common laboratory instruments.
• Solve problems related to these instruments, mathematical as well as technical.
• Gain expertise in instrument operation through laboratory exercises.
• Be able to recognize, record and analyze analytical instrumental data.
• Be critically able to evaluate an instrument's performance and an analyst's performance.
• Become independent in thought and action while working on open ended lab exercises.
• Compile professional lab reports.
• Be a safe worker in the lab.

2–Student learning outcomes at the program level.

The overarching goal of the program is that students have the ability to work in a laboratory in the chemical industry upon graduation. In order to do this, students must possess basic knowledge about their profession, know how to work in a laboratory and be able to communicate with others on their working team. Specifically, the program outcomes are:

• Content Knowledge – Students should demonstrate a working knowledge of chemistry through problem solving, application, and critical evaluation of resources.

• Lab Skills – Students should work in a chemistry laboratory in a safe and effective manner, applying the scientific method to the design, execution and interpretation of experiments and experimental data.

• Effective Communication – Students should effectively communicate and present technical information in a clear, concise, scientifically appropriate manner in a variety of formats.

3- Curriculum map and explanation of how program outcomes are achieved through the course curriculum.

A download of the curriculum map is included in the appendix.

Most of the chemistry and physics content that students need for their program is taught in these courses: general chemistry (CHEM 121/122), organic chemistry (CHEM 321/322), analytical chemistry (CHEM 231), general physics (PHYS 211/212). A strong knowledge of general and organic chemistry is especially important, so that students can apply this knowledge in upper-level classes.

Relevant laboratory skills are taught in all of the courses with labs, and even in one non-lab course (CHEM 145, which teaches students concepts about safety and working in a lab in an industrial setting). These skills are assessed in CHEM 245. In upper-level courses students are expected to work in groups and communicate their results. In particular, oral and written communication is assessed in CHEM 245 and CHEM 317, both of which are taught in the last semester of the program.

4/5 – Learning outcomes at the course/program level.

Because these outcomes are more global, we have given most attention to outcomes at the program level. A TracDat report for program outcomes is attached in the appendix.

According to our assessments, students as a whole are meeting our expectations of future laboratory technicians.

6 – Describe how assessment results at the course and program levels have assisted in making decisions about pedagogy, learning outcomes, and other course and/or program level actions.

When we implemented TracDat, we basically used our old program goals (fifteen of them) as the program outcomes. But when we thought about conducting program assessment, we realized that many of these goals were no longer appropriate. For example, one referred to the ability of students to use word processing software. While this was appropriate a decade ago, when students didn't necessarily know how to use such software, nowadays most freshmen have the level of computer competence required. For another, many of our goals were too narrow, more descriptive of a specific course outcome rather than a program outcome. We realized this in creating the curriculum map, in which a goal might be introduced and assessed all in the same course. So we reduced our set of outcomes to three important goals, all of which could be touched on in several courses, and all of which are important skills for our graduates to have.

Strength

7 – Describe variables tracked when assessing the effectiveness of the program.

In evaluating the program, we use this information:

• students' performance in coursework, including their performance on program outcomes;
• student retention; and
• student placement upon graduation.

8 – Provide trend data for the variables.

One of the assessment measures for the program (in terms of content knowledge) is an American Chemical Society (ACS) standardized exam. On the year-end general chemistry exam, students have performed at an average score of the 70^{th} percentile or above. There is little pattern to the scores from year to year, other than the fact that students consistently score higher than the national average.

Other trends have been discussed earlier in this section. Once students commit to the program (keeping in mind that many students transfer into the program in their second, or final, year), typically all but one or two graduate annually. And last year (as in most years) all of the students were placed either into a job or further education.

9 – Describe how the trend data in (2) are used to assess the rigor, breadth, and currency of the degree requirements and curriculum.

The three program outcomes are characteristics that are desired by our employers; therefore, we chose to monitor them. As mentioned earlier, these outcomes don't apply to just one course, but are developed across the curriculum. Our assessments provide a snapshot of how well the students are doing in the most important outcomes at various points in the curriculum.

10 – Describe how the trend data in (2) are used to assess the extent to which program goals are being met.

As demonstrated earlier, our graduates are meeting / exceeding the standards we have set in assessment.

J – Service To Non-Majors

Many of the courses incorporated into the major (CHEM 121, CHEM 122, CHEM 321, CHEM 322, for example) serve a wide variety of students, including biology, pre-health professions (pharmacy, optometry, medicine), and others. However, the ICT-specific courses serve primarily students interested in the chemical industry. One thing we would like to do in the future is to market the Chemical Safety course to a broader audience. It could be useful to anyone in a career where s/he will be handling chemicals, and the prerequisites are minimal.

K – Degree Program Cost and Productivity.

Most of the courses in the program are in chemistry (121, 122, 140, 145, 231, 240, 245, 321, 322 and 317). Productivity trends for this area from the five years covered by the 2007-20012 productivity report are listed below.

Chemistry (CHEM)	SCH/FTEE (Fall)	SCH/FTEE (Spring)
2007-08	421.61	326.81
2008-09	396.88	323.09
2009-10	393.65	361.58
2010-11	420.29	342.11
2011-12	447.69	355.12

These courses are among the most productive and least costly on campus.

Having said that, the four main program courses (140, 145, 240, 245) are dependent on the enrollment in the ICT program from year to year. The other chemistry courses are mostly filled with students from programs outside the department, as they serve biology, health professions, and several others. Typically, one section of CHEM 140 and 240 are run each fall; and one section of CHEM 145 and 245 are run in the spring.

L – Administration Effectiveness

1 – Discuss the adequacy of administrative and clerical support for the program.

Administrative support are provide primarily by the program coordinator, Bill Killian, and the department head, Dave Frank. Bill Killian handles most of the direct work with students, including advising and program clearance. Other duties performed by Prof. Killian include networking with potential employees and overseeing program assessment. Graduate placement has become more of a one-on-one effort. Five or ten years ago many of our graduates were hired by just a few companies. Now, graduates are placed with a larger array of small to mid size companies.

Other assistance is provided by the department office and department stockroom. Our secretary, along with her student workers, provide ongoing support for the program. Our (now-retiring) laboratory technician has more than two decades' experience in assisting the program with chemical preparation and other needs associated with the laboratory.

2 – Are the program and/or department run in an efficient manner?

In a word, yes, the program is run efficiently and flexibly. In fact, it's possible for students to join the program at the beginning of Year Two and still complete the program by the end of that year, assuming that the student has completed other chemistry and math courses at the time of entry. This would be the case, for example, for a pre-pharmacy student switching to ICT. That student could take the main program courses (140, 145, 240, 245) during Year Two, and still fit in the other requirements by the end of spring or summer semester.

3 – Are class and teaching schedules effectively and efficiently prepared?

For many of the courses in the program, there are multiple opportunities throughout the day to sign up for classes. The program coordinator and the department head work closely with each other to ensure that the one-section courses in the program will meet the needs of all the students. Especially during Year Two, certain times of day are avoided to allow students to register for organic chemistry, analytical chemistry and either of the two physics classes. Occasionally this has required off-grid scheduling for a specialty ICT class, but the dean has always been supportive of schedule construction that allows students to progress on time.

One of the classes, Chemical Manufacturing & Analysis (CHEM 245), is treated as a professional work day. Students are expected to devote one entire day to this class, with the understanding that they may leave for an hour or two to attend other schedules classes on that day. This forces students to practice good time management for their projects; this is similar to a work environment where a chemist carrying out a reaction needs to schedule time during the day for a group meeting.

4 – Are students able to take the courses they need in a timely manner?

All of the required courses in the program are scheduled at least once a year, so as long as students maintain satisfactory progress in their classes, they can complete the program within a two year time frame.

Section 4:

Facilities and Equipment

Section 4: Facilities and Equipment

A – Instructional Environment

For a hands-on program such as ICT, the most critical part of our instructional environment is our laboratory. In addition to the labs, we do have access to classrooms, especially in the Science and Starr Buildings. Our two large lecture halls in Science have an array of instructional technology, including computers and document cameras. These rooms are set up so that professors can use clickers. However, the most important part of our facility for this program is the laboratory, and those facilities will be addressed in this section.

The following list shows the equipment holdings in our department that may be accessed by students taking courses in the ICT program.

Room	**Area**	**Instrument**
SCI 301	ICT	2 Büchi Rotovaps/waterbath
SCI 309	ICT	Griffith Technologies mass spectrometer
		Perkin-Elmer atomic absorption spectrometer 3100
		FT-nmr (nuclear magnetic resonance) spectrophotometer with Anasazi upgrade
		Nicolet 6700 FT-IR (Thermo Scientific)
		Carey 1E UV-visible spectrophotometer (Varian)
		Nicolet 5 DXC FTIR spectrophotometer
		Nicolet 510P FTIR spectrophotometer
		Hitachi auto sampler L – 7200
		Varian pro star solvent delivery model 210 with UV-vis Detector model 320
		Varian 3300 gas chromatograph (2)
		Varian 430 gas chromatograph
SCI 313	Research lab	Beckman 327 solvent module system gold-166 detector
		Beckman 1108 solvent module
		Waters associate model 441 absorbance detector
		Hitachin column oven L7300 (uv detector L-7400; RI detector L-7490)
		HP 6890 series GL system
SCI 321A	Quant	Waters 501 HPLC pump (model 430 conductivity detector)
		Beckman 1108 solvent delivery module
		Millipore waters-differential refractometer R401 (differential

		electronic unit; Waters model 441 absorbance detector)
SCI 330	Organic	Perkin Elmer IR spectrophotometer 297 Agilent 6850 network GC system Perkin Elmer FTIR spectrophotometer (Pantoon 1000)
SCI 328	Organic	5 Büchi rotovap R-3000
SCI 328A	Organic	Varian 3300 gas chromatograph SRI 8610C gas chromatograph
SCI 332	Organic	Büchi RC 120 rotovap
SCI 332A	Organic	Heidolph rotovap

1 – Are current classrooms, lab, and technology adequate?

Early in this report, we mentioned that there are two types of programs in chemical technology. One emphasizes chemical processes (not the type of program that we have). We do not have the simulators to train students in chemical processing. We do cover it in our lecture courses. Some of our students have gone into processing work by being trained after they find employment. However, this is not our emphasis.

Given the type of program that we have, the breadth of equipment that we possess for a two-year program is not only adequate, but it is excellent. Our department has adequate equipment for our four year programs in chemistry and biochemistry, so there is clearly sufficient equipment for a two-year program. Our latest equipment purchase was a mass spectrometer. This purchase, in essence, completed our holdings in terms of equipment typically used to characterize chemical compounds, both in small research settings and in industry.

2 – How does the condition of current facilities impact program delivery?

The facility set-up is favorable for developing strong relationships among students in the program. The main ICT area is a suite of rooms (SCI 301, 307, 309). SCI 301 is a lab prep area, SCI 307 is the coordinator's office space, and SCI 309 is an instrument and library area. SCI 309 is left open to students most of the day, so they have access to the library and a common area where they can work with each other. Students in the program also have ready access to their program coordinator. This set-up has been extremely useful for students in the program.

3 – Describe the program's projected needs with respect to instructional facilities.

While our equipment is adequate in terms of its breadth, there are two considerations that we keep in mind with respect to needs.

One is that we keep equipment working as long as possible; however, there is a life-span to all instruments, and at some point it is no longer possible to find replacement parts. Our equipment is expensive, and we need to keep track of which items may need to be replaced in the near future.

The other limitation occurs when we have a number of students that is near the maximum for the program. The instrumental analysis class (CHEM 317) is particularly difficult to run with maximum students and limited equipment. While it would be prohibitively expensive to purchase duplicates of the most expensive equipment items (nuclear magnetic resonance spectrometer, mass spectrometer), it would be helpful to have more of the mid-grade pieces of equipment on hand. This would increase students' ability to have hands-on access to all the items of equipment.

4 – Describe plans for facilities improvements and indicate their status.

At this time, there is no plan for a facility upgrade. However, with regard to equipment, we do keep a running list of items that we need to replace or purchase. We make requests when money is available for equipment purchases. Also, as we maintain and strengthen our ties with industry, we will let our partners know what items would be particularly useful for us. In the past, we have received donations of items such as GCs (gas chromatographs) and HPLCs (liquid chromatography), and as mentioned already, even duplicate items will help some of our labs run more smoothly.

5 – Describe how proposed changes to facilities would enhance program delivery.

Again, no major change in facility is planned at this time.

B. Computer Access and Availablity

1 – Computer resources allocated to the program

Students have access to computers in two locations in the Science Building. One is the Reitz Reading Room on the first floor, where students can not only access books and journals in chemistry, but can also pull up more information online. The second, and more heavily utilized room, is an ICT open lab area in SCI 309. This room has a small library of books dedicatedo chemistry, organic chemistry and industrial chemistry; it also has computers that students can use to access information. This room is used by all our department students, including chemistry and biochemistry majors, not just ICT students.

2 – Use of computer resources

Students use the computers for several reasons. They can access ACS journals online through the FLITE library. They use chemistry software, including molecular modeling programs. They use Word, Excel and PowerPoint to prepare laboratory reports and presentations. Students also use instruments directly integrated with computers in the lab; they have access, for example, to libraries of infrared spectra to make comparisons with their own samples.

3 – Adequacy of resources.

We would characterize these resources as adequate for the program(s) involved.

4 – Acquisition plan

As stated above, our current resources are adequate. As office computers are upgraded, the Ferris IT department replaces computers in our student labs with working computers that used to be in faculty offices. This replacement (which takes place throughout our entire department, not just in areas or labs accessed by ICT students) has been sufficient to meet our needs.

5 – Efficacy of online services

These are adequate for our needs. This is more of a department-wide issue for our service courses, but there is not other specific impact on our program.

6 – Adequacy of computer support

Again, for the students working on courses that are devoted only to the program have adequate computer support for what they're doing.

C. Other Instructional Technology

In our previous program review, we reiterated in this section the importance of instrumentation to this program. In this program review, the instrumentation needs have already been addressed in Part A of this section. Other than what has been described for instrumentation usage in the first part and student computer usage in the second part, little other instructional technology is used by students when they are doing work directly related to this program.

That being said, students are exposed to a variety of technology in courses such as general chemistry, organic chemistry, mathematics and general physics. Exactly what technology they use depends on the professor who is teaching the class. In general chemistry classes, professors have used Ferris Connect, online homework, online journaling, clickers, wikis, and Tegrity cameras, among other technologies. As is the case with the rest of the College of Arts and Sciences, these forms of instruction very much enhance a student's education when they work properly. Over the past year, we have had increasing problems with aging computers and associated equipment (such as docucams), and failure of these technologies during the semester is detrimental to instruction. Some professors have even abandoned the use of certain technologies (clickers, for example), because they had difficulty using them reliably. While these technologies positively impact the education of ICT students when they work properly, the impact is felt in the large service courses that they take. Again, it has not been a problem for the ICT courses, per se.

D. Library Resources

1 – Adequacy of print, electronic, and other resources provided by FLITE

At the time of our last program review, Ferris had obtained on-line access for the major journals of the American Chemical Society (ACS). Since that time, this has benefitted not only our ICT students, but also students in chemistry and biochemistry bachelor's degrees. Students have ready access to recent and older journals, and they prefer the accessibility that online access allows. This is also good training for students who find employment in industry, where articles are typically downloaded.

2 – Service by library faculty and staff

We feel that we receive excellent service from FLITE. Our liaison librarian, Rick Bearden, has a background in chemistry himself, so he often anticipates our needs. Bill Killian takes his students to the library for an orientation to the use of its resources every fall.

3 – Adequacy of budget allocation provided by FLITE

Library resources have been adequate for this program.

Section 5:

Conclusion

Section 5: Conclusion

A – Relationship to FSU Mission

According to the University's mission statement, students who graduate from Ferris should be prepared for successful careers, responsible citizenship and lifelong learning. Program graduates and advisory board members indicated that our graduates, indeed, pursue successful careers. Graduates clearly are lifelong learners, as their ICT degree gave them a start at their career. They have continued to learn, whether on the job or by pursuing further education. For the last 55 years, the program has graduated students who fulfill the characteristics of FSU's mission.

B – Program Visibility and Distinctiveness

While the American Chemical Society no longer approves chemical technology programs at the two-year level (the approval service was discontinued in 2012), our program had previously been one of the first five nationally to gain such approval. And this recognition of our program still exists in the American Chemical Society. For example, our students have been (for the last three years) invited to national meetings to make presentations and attend career-oriented workshops. This speaks to the national recognition of our program. Ours is one of the few chemical technology programs associated with a university rather than a two-year college.

C – Program Value

In their responses to our surveys, graduates have seen great value from their ICT degrees over the past 55 years. In fact, one respondent said that his ICT was of more value to him in his work than his subsequent bachelor's degree.

One facet of the program that has developed recently is the combination of the two-year ICT degree with a four-year bachelor's degree in chemistry. At the time of the last program review, about 60% of the graduates were doing this combination. At the present time, this has risen to nearly 100% of the graduates. Clearly students see value in enhancing their chemistry degree with the industrial experience provided by the ICT program. In addition, throughout the responses from the advisory board, graduates and students, there is a common thread that a four-year degree in industrial chemistry would be of value. Our dean is very supportive of this idea. Therefore, we are already beginning work on a bachelor's degree in chemical technology, with an emphasis on preparing students for work related the types of careers outlined in the first section of this report.

D – Enrollment

Over the last 25 years (the time during which Bill Killian has been program coordinator), nearly 260 students have graduated with a degree in industrial chemistry technology. An average year, therefore, produces about ten to twelve graduates. In the past five years, due in part to a drop in employment possibilities in the chemical industry, our numbers have not been as high as before. However, this fall our two ICT classes have enrollments of 14 and 16 respectively, indicated a pickup of interest in this program. We believe that with a new bachelor's program in (industrial) chemical technology, we will have a unique four-year degree in the state that should attract greater numbers of students.

E – Characteristics, Quality and Employability of Students

Our students are a diverse group in terms of their basic background and preparation in math and science. One thing that they have in common is that they have discovered that they really enjoy doing hands-on work in chemistry, whether they knew this before coming to Ferris or they learned this while taking introductory chemistry classes. In fact many students switch into the ICT program at the end of their freshman year once they learn that such a program exists. Students are encouraged to learn as much as they can, while focusing on laboratory skills, teamwork, and other program outcomes. Some students truly excel when they are freed from the pressure of earning an A in as many courses as possible (to enter a program such as pharmacy). Our graduates possess the background to work in the chemical industry, and earlier in the report we have documented the variety of industries that hire them.

F – Quality of Curriculum and Instruction

The curriculum is designed to provide students with the content knowledge, lab skills, and communication skills to successfully work as part of a team in the chemical industry. Students have shown at Ferris that the accomplish these goals, and graduates report that they have been well prepared for their positions.

In particular, instruction in the portion of the degree directly related to careers has been largely provided by the program coordinators (first Norman Peterson and more recently Bill Killian). Graduates have cited both of these coordinators as being effective instructors and highly influential on their choice of careers. On occasion, an instructor outside the program coordinators has taught an ICT course; Prof. Weaver (a program graduate himself) has done this in the past and is teaching the introductory courses (CHEM 140) this fall. This has been beneficial for the program and the department, as more chemistry faculty get a better understanding of ICT students and their role as instructors in the program, even when they are teaching service courses.

G – Composition and Quality of Faculty

As can been seen from Bill Killian's resume, our program coordinator has both the educational background and industrial experience to be an excellent leader for the program. We feel that the success of our graduates can be attributed to the quality of our faculty members. Other members of the chemistry faculty (including James Weaver and Dan Adsmond) have an industrial background as well. Other faculty also show a high interest in the program, by running an American Chemical Society (ACS) student organization and by their attendance and presentations at national and local meetings of the ACS.

Appendix A:

Resume for Bill Killian

Curriculum Vitae
William Killian
Department of Physical Sciences
Ferris State University
Big Rapids, MI 49307
231-591-2590

Education: North Park College, B.A. Biology, 1973. Magna Cum Laude Graduate.

Ohio State University, M.S. Chemistry, 1976.
Area of Research: Synthesis and Characterization of Substituted Dihydropyridines in Relation to NAD/NADH Models.

Representative Summer Experience

Summer 1998&1999: Taught at Packe-Davis and coordinated pharmaceutical chemical tech certificate program

Summer 1992&1993: Research Associate, The Upjohn Company, HPLC method development

Summer 1994: Visiting Scientist, Dow Chemical Company, Surfactant Research

Full Time:

1987-Present: Associate Professor, Industrial Chemistry Coordinator, Ferris State University
Courses Taught:

- General Chemistry
- Laboratory Safety
- Applied Analytical Chemistry
- Instrumental Analysis

1985-1986: Instructor, George Williams College.
College closed in March '86 due to financial exigency.

1984-1985: Instructor, Loop Junior College, part-time position.
Courses Taught:

- General Chemistry
- Environmental Science

1981-1985: Chemistry/Manager, Inland Steel.
2 years as an EPA compliance water/waste water chemist.
2 years as a quality control manager for chemical operations at a rolling mill.

Publications/ Presentations:	"N-ACYL-1, 4-Dihydropyridines by Acid Catalyzed Condensations," Tetrahedron Letters, 16, 1407-1410, 1978
	"Development of a Process for Treating Red Water by Organic/Inorganic Separation and Biodegradation," 14th Annual Army Environmental R&D Symposium, Williamsburg, VA, November 14-16, 1989
	"Detection of Chemical Plumes Utilizing Passive-Remote Fourice Transform FTIR Spectroscopy," 44th Annual Pittsburgh Conference and Exposition on Analytical Chemistry, Atlanta, GA, March 8-12, 1993.
	"The Role of an Industrial Advisory Board in a Chemical Technology Program," 15th Biennial Conference on Chemical Education, Waterloo, Ontario, August, 1998.
	"How to Obtain Accreditation For a Two-Year Industrial Technology Program," ACS Regional Meeting, Midland, MI, October, 1997.
	"A Mechanistic Representation For the Synthesis of Benzanthrone and Violanthrone," Journal of Polycyclic Aromatic Compounds, Vol 19, pp 179-187, 2000.
	"Roundtable Discussion of Curricular Issue in Chemical Technology Programs," BCCE in Lafayette, IN, 2006.
	ICT and BA Chemistry poster presented at National ACS Meeting, 2013.
Affiliations:	American Chemical Society Instrument Society of America

Appendix B:

Checksheet and Syllabi

ID: Name:

ASSOCIATE IN
APPLIED SCIENCE IN
INDUSTRIAL CHEMISTRY TECHNOLOGY

FERRIS STATE UNIVERSITY

PROGRAM COORDINATOR: MR. BILL KILLIAN

OFFICE: ASC 3093 PHONE: (231) 591-2590 E-MAIL: killianb@ferris.edu

Admission requirements: First year student admission is open to high school graduates (or equivalent) who demonstrate appropriate academic preparedness, maturity and seriousness of purpose. High school courses and grade point average, ACT composite score, and ACT Mathematics and Reading sub scores will be considered in the admission and course placement process. Transfer students must have at least 12 credits at the time of application with a minimum 2.0 overall GPA including an English and mathematics course or they will be considered as first year students.

Graduation Requirements:

1. Minimum 2.0 cumulative grade point average in all course work
2. 63 minimum credits including general education requirements
3. Residency requirement: 15 minimum FSU semester credits

Program requirements: effective for students entering Industrial Chemistry Fall Semester 2010

COURSE		COURSE TITLE – FOR PREREQUISITES NOT INDICATED, SEE FSU CATALOG COURSE DESCRIPTIONS		FSU S.H.	GRADE
MAJOR					
CHEM	121	General Chemistry 1	(MATH 115 AND prior high school CHEM)	5	
CHEM	122	General Chemistry 2	(CHEM 121)	5	
CHEM	321	Organic Chemistry 1	(CHEM 122)	5	
CHEM	322	Organic Chemistry 2	(CHEM 321)	5	
CHEM	231	Quantitative Analysis	(CHEM 122)	4	
CHEM	317	Instrumental Analysis	(CHEM 122 and CHEM 231)	3	
CHEM	140	Orientation to Industrial Chemistry Technology	(co = CHEM 121)	2	
CHEM	145	Safety and the Chemical Laboratory	(CHEM 121)	2	
CHEM	240	Industrial Chemical Calculations	(CHEM 140 And co- req. CHEM 321)	2	
CHEM	245	Chem Manufacturing and Analysis	(CHEM 231 and CHEM 321)	4	
MATH	120	Trigonometry	(MATH 115 or by placement)	3	
PHYS	211	Introductory Physics 1	(Math 120 with C- or higher grade)	4	
PHYS	212	Introductory Physics 2	(PHYS 211)	4	
ISYS	105	Intro Micro Systems-Software		3	
ENGL	150	English 1	(by placement)	3	
ENGL	250	English 2	(ENGL 150)	3	
		SOCIAL AWARENESS ELECTIVE		3	
		CULTURAL ENRICHMENT ELECTIVE		3	

GENERAL EDUCATION REQUIREMENTS

Courses which qualify in the Scientific Understanding (Z), Cultural Enrichment (C) and Social Awareness (S) categories are delineated in the General Education section of the FSU electronic catalog:

http://www.ferris.edu/htmls/academics/gened/courses.html

I. GENERAL EDUCATION REQUIREMENTS		
A. COMMUNICATION COMPETENCE		**6 Sem Credits**
Course	Grade	Credits
ENGL 150 - English 1		3
ENGL 250 - English 2		3
	TOTAL	
B. SCIENTIFIC UNDERSTANDING		**3 Sem Credits**
This category requirement is satisfied in the program requirements area.		
C. QUANTITATIVE SKILLS		
MATH 120 is required for Industrial Chemistry Technology.		
D. CULTURAL ENRICHMENT		**3 Sem Credits**
Only approved "C" courses may count toward this category. Requirements: maximum 3 credit hours of music and/or theater activities may apply.		
Course	Grade	Credits
	TOTAL	
E. SOCIAL AWARENESS		**3 Sem Credits**
Only approved "S" courses may count toward this category.		
Course	Grade	Credits
	TOTAL	

SAMPLE COURSE SEQUENCE: The following chart depicts one strategy to begin the program requirements. In order to complete this program in a four year plan, students must average 16-17 credit hours per semester. Students MUST consult their faculty advisor to develop a course sequence plan appropriate to their academic development and educational plans.

First Year

Fall Semester	
ENGL 150 English 1	3
CHEM 121 General Chemistry 1	5
MATH by placement	3
CHEM140 Orientation to Industrial Chemistry	2
Cultural Enrichment elective	3-4
Total	**16-17**

Spring Semester	
CHEM 122 General Chemistry 2	5
PHYS 211 Introductory Physics 1	4
ISIS 105 Microcomputer Applications	3
CHEM145 Safety & the Chemical Lab	2
Social Awareness elective	3
Total	**17**

Second Year

Fall Semester	
CHEM 321 Organic Chemistry 1	5
CHEM 231 Quantitative Analysis	4
PHYS 212 Introductory Physics 2	4
CHEM240 Industrial Chemistry Calculations	2
Total	**15**

Spring Semester	
CHEM 322 Organic Chemistry 2	5
CHEM 317 Instrumental Analysis	3
ENGL 250 English 2	3
CHEM245 Chem. Mfg. and Analysis	4
Total	**15**

NOTICE REGARDING WITHDRAWAL, RE-ADMISSION AND INTERRUPTION OF STUDIES

Students who return to the university after an interrupted enrollment (not including summer semester) must normally meet the requirements of the curriculum which are in effect at the time of their return, not the requirements which were in effect when they were originally admitted.

CHEMISTRY 140

Orientation to Industrial Chemistry Technology

Fall 2013

2 Credits (2+0)

Lecture: SCI 336 W, F 9:00

Instructor: James Weaver

The instructor reserves the right to make desired adjustments to this syllabus and the schedule at any time. Any changes will be announced in class and students are responsible for any such announcements.

Office Hours: Office ASC 3014 M 3:00, T,W, R 12:00

Contact Information: Telephone 591-3610 e-mail weaverj@ferris.edu

Course Description:

This course provides an overview of different aspects within the chemical industry. It includes development and practical applications of chemistry in an industrial setting. The role of the industrial chemist and technologist are discussed. Emphasis is also placed on the use of scientific literature that is available and the study of patents.

Requires:

Chemistry 121 as a co-requisite.

Required Materials:

Scientific calculator. Texas Instruments TI 36X Solar is ideal.

Bound journal

Banned Items:

No communication items allowed. Examples include, but are not limited to cellular telephones, i-pods, i-phones, laptops, pagers, programmable calculators.

No Graphing Calculators of any kind allowed in the classroom!

Special Instructions on Test Days:

On test days only essential items are allowed. Essential items are only items the instructor specifically approves. Nonessential items can be left at the front of the lecture room until the test is completed and handed in for grading.

Specific Course Outcomes:

This is a preparatory course designed to lay the foundation for further study in industrial chemistry. A successful student in this course should be able to:

1) Understand the role of technicians in industrial chemistry.

2) Interpret symbolic scientific language.

3) Analyze and create pictorial diagrams and graphs.

4) Demonstrate working knowledge of the basic concepts of general and organic chemistry.

5) Use library and computer resources in order to solve chemical problems and gain chemical information. Identify and use available chemical literature.

6) Delineate the roles of basic research, engineering, and common sense within an industrial chemistry setting.

7) Understand the basic principles of pollution prevention and identify areas of concern in industrial chemistry.

8) Demonstrate an understanding of accepted laboratory practices.

9) Communicate effectively in a scientific context.

Course Policies:

Attendance: On time attendance is mandatory. Students are required to attend all scheduled lectures. Obviously, this does not apply when the University cancels classes. It is the responsibility of each student to take notes and become informed of any announcements, as well as keep and maintain a journal, and complete weekly assignments that are given in class. If a student is absent for 3 or more lectures, a course grade of F will result. Attendance will be graded! Attendance is worth 30 points. In order to earn the credit for attendance, the student must be present!

It is the responsibility of each student to plan on how to safely attend lecture whenever classes are held!

It is not the instructor's responsibility to safely get students to class or make special grading exceptions for students due to traveling conditions.

Academic Integrity: Any form of academic dishonesty will result in a course grade of F. In order to help maintain an honest test environment, students are not allowed to bring nonessential items to tests.

All nonessential items brought to class on test days will be expected to be left at the front of the lecture room.

Situations where students attempt to bring banned or extraneous items into the classroom on testing days will be considered to be engaging in academic dishonesty and a course grade of F given.

Exams: Cumulative examinations will be given during the normal lecture period on the dates listed on the class schedule. Exams will include material discussed in lecture, assignments, and assigned readings. Failure to take the exam will result in a grade of zero. Make-up exams are only given on rare instances. In order to qualify to take a make-up exam, a student must provide written documentation of a University Excused Absence. University excused absences include university sponsored functions, illness, death in the family, etc. Additionally, a student may not take more than one make-up exam for the course during the semester. There will be 2 tests during the semester. Each test will be worth 100 points.

Assignments: Frequent assignments will be given. Twenty-one assignments must be turned in for a grade whenever the instructor decides and makes the announcement in class. The assignments will be completed in a bound journal.

Journal: A bound journal must be kept and turned in for grading at the time of the instructor's choosing. The journal is intended for homework assignments. This will be worth 120 points.

Written Report: One formally written report will be required that deals with various aspects on a chemical compound. The instructor will assign each person a different compound and discuss the format in class. This will be worth 100 points.

Final Exam: A cumulative final examination will given during the scheduled time. It is a course requirement to take the final exam. Failure to take the final exam will result in a course grade of F. There will be one final exam at the end of the semester. The final exam will be worth 100 points.

In class quizzes will be given at the instructor's discretion.

Point Total: 550

Attendance = 30 Points, Tests = 200 Points, Final Exam = 100 Points, Chemical Compound Report = 100 Points, Journal for assignments = 120 Points

No Graded Materials Are "Curved!"

Grade Determination:

Grade determination is based on a percentage scale. Your percentage is determined by dividing the number of acquired points by the number of points possible to obtain, then multiplying by 100%.

The percentage is then compared to the following scale in order to determine a letter grade.

Grading Scale:

Percentage	Letter Grade
93.00-100	A
90.00-92.99	A-
87.00-89.99	B+
83.00-86.99	B
80.00-82.99	B-
77.00-79.99	C+
73.00-76.99	C
70.00-72.99	C-
67.00-69.99	D+
63.00-66.99	D
58.00-62.99	D-
Less than 58.00	F

Class Schedule:

Week of:	**Lecture Topic:**
08-26	Role of the Chemical Technologist
09-02	Chemical Literature
09-09	Use of the Library
09-16	Computer Searching
09-23	Physical/Chemical Properties
09-30	Data/Graphing/**Test 1**
10-07	Introduction to Industrial Chemistry
10-14	Industrial Diagrams
10-21	Inorganic Process Chemistry
10-28	Organic Chemical Processes
11-04	Fermentation Processes
11-11	Pollution Prevention in Industry/**Test 2**
11-18	Notebook and Patents
11-25	**Chemical Compound Paper Due**/Specifications
12-02	Good Lab Practice

December 9, 2013 through December 13, 2013 Exam Week

The final exam for this class is Monday, December 9, 2013 from 8:00-9:40 a.m.

You must take the tests and final exam on the date and time scheduled.

Do not make plans that conflict with the tests (especially close to holidays) and final exam scheduled.

CHEM 145

Chemical Lab Safety

2 Credits

Mr. Bill Killian
T R 9:00-9:50 am
SCI 336

January 10, 2011
Spring Semester 2011

Textbook: "Chemistry of Hazardous Materials," Eugene Meyer; 5th Edition
Office Hours: M & T 8-9:00 W 9-11:00 am

Week Of	Topic	Assignment	Activity
1/10	General Safety and Lab Rules	M1	
1/17	MSDS Sheets	M1	
1/24	Physical Properties as Related to Hazards	M2	
1/31	Gases and Liquids	M2	
2/07	Basic Hazardous Matter	M3	Unit Test 1
2/14	Chem Rxs	M4	
2/21	Combustion	M4	
2/28	Chemistry of Some Common Elements	M7	
3/07	Spring Break		
3/14	Corrosives	M8	Unit Test 2
3/21	Water Sensitive Materials	M9	
3/28	Toxilogical Levels	M10	
4/04	Redox Hazards	M11	
4/11	Organic Materials	M12 & M13	Safety File Due
4/18	Explosives	M14	Unit Test 3
4/25	Radiation	M15	
5/02	Final Exam		

Requirements

Final Exam 100
Unit Tests 225
Homework/ Attendance 125
Safety File 50

Grading

> 92% A
90-92% A-
87-89 B+
83-86 B
80-82 B-
77-79 C+
73-76 C 70-72 C-
<70 D Low Attendance = F

Other Considerations

1. Homework Assignments will be assigned weekly and will be due 1 week after the assignment has been given! Please do not be late! Keep all homework in a notebook for study.
2. The Safety File is a compilation of at least 10 articles, preferable newspaper, on matters of safety. Details will be provided during class.
3. The course continues CHEM 140 Series as a central part of our curriculum.
4. Be able to demonstrate you are spending time reading the chemical literature.
5. Attendance is required.

Course Objectives

1. To continue the development of the attitude and background a successful technologist displays.
2. To become keenly aware of the chemical laboratory from a safety standpoint, through not only recognition, but also appropriate calculations.
3. To be able to make sound judgments from a safety standpoint on what types of materials are not compatible.
4. To be able to safely work with hazardous materials, limit one's overall exposure to them, and correctly dispose of such materials.
5. To realize and begin to think about the large safety and health problems facing laboratories and the world.

> " I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."
>
> Sir Isaac Newton (1642-1727)

BILL KILLIAN | **CHEM 240** | **AUGUST 2013**

INDUSTRIAL CHEMICAL CALCULATIONS
2 SEMESTER CREDITS

Lec: T 4:00 – 5:50
Loc: SCI-117
Office Hours: M 10-12, W 10-12, F 10-11

Office: SCI-307
Phone: x2590

FALL 2013 SEMESTER

Textbook: "SPC Simplified Practical Steps to Quality" Amsden

Week	***Assignment/Activity***	***Topic and Assignment***
8/26	*Introduction, Measurements and Nomenclature*	*N*
9/02	*Concentration*	*N*
9/09	*Practical and Advanced Problems*	*Max Quiz # I*
9/16	*Stoichiometry*	*N*
9/23	*Practical and Advanced Problems*	*N*
9/30	*Gases*	*Max Quiz # II*
10/7	*Redox*	*Handout*
10/14	*Statistics for Analytical Chemists*	*N Quiz # 1*
10/21	*Practical and Advanced Problems*	*N*
10/28	*Introduction to Statistical Process Control*	*A Quiz – 2*
11/04	*Graphs*	*A*
11/11	*Control Charts*	*A*
11/18	*Practical and Advances Problems*	*A Max Quiz # III*
11/25	*Basic Chemical Engineering Problems*	*Handout*
12/02	*Basic Chemical Engineering Problems*	*Handout*
12/09	*Finals Week*	*Quiz 3*

IMPORTANT CONSIDERATION:

*Your attendance in lecture is **MANDATORY**. You are expected to attend regularly attend and exhibit a good professional attitude in class and in lab.*

Requirements		**Grading**	
MAX Quizzes	*3 x 75*	*> 92%*	*A*
QUIZZES	*3 x 50*	*90-92%*	*A-*
		87-89%	*B+*
		83-86%	*B*
	375 points	*80-82%*	*B-*
		77-79%	*C+*
		73-76%	*C*
		70-72%	*C-*
		<70%	*D*

OTHER CONSIDERATIONS:

1. *Homework will be assigned and posted, practice practice practice or perish! You will receive many handouts.*
2. *However quizzes will come often and quiz grades of less than C- (70%) will require correct homework to be turned in until a quiz of over 70% is recorded.*
3. *The diet of problems in this class will hopefully contain a number of challenges. Be ready! Expect to expand your thinking.*
4. *The last two weeks will cover problems that constitute practical chemical, technological, and engineering situations.*
5. *Many analytical, instrumental, and general chemistry books can be consulted to try to help develop strategies to solve problems; use these sources.*

CLASS OBJECTICES/OUTCOMES:

1. *To master basic chemical calculations used by virtually all industrial chemists including stoichiometry, concentration, and gas law problems.*
2. *To sharpen our basic problem solving skills and apply those skills in unique situations.*
3. *To expand our understanding of units beyond the traditional system.*
4. *To solve basic chemical engineering and technological type problems.*
5. *To learn strategy and attack problems with fundamental sound judgment.*
6. *To use the basic statistics traditionally relied upon in laboratory work.*
7. *Understand statistical process control and its place in industry.*

"It is a truth very certain that when it is not in our power to determine what is true we ought to follow what is most probable."

Rene Descartes (1596-1650)
From Discourse on Method

CHEM 245

Chemical Manufacture& Applied Analysis
4 Credits Spring Semester 2012
Mr. Killian

Lecture: M 10-10:50 am SCI-309 (<u>mandatory</u> meeting time) January 9, 2012
Lab: M All Day (11:00 am- 6:00 pm)

Textbook: "Analytical Chemistry for Technicians 3[rd] Edition"
By: John Kenkel
Office Hours: M 8-10:00am W 9-11:00 am

WEEK OF:	TOPIC & LAB ASSIGNMENT
1/09	Introduction to Methodology: Physical Methods
1/16	Gravimetric Analysis: Gravimetric Iron
1/23	Tirimetrics: ASTM Methods
1/30	Redox Analysis: Pickle Liquor Anaylsis
2/06	Complexometric Titrations: Water Hardness
2/13	Quantitive IR: Aspirin Assay 2 Ways
2/20	Non-Aqueous Titrations
2/02	Midterm: Esterification Synthesis: Project 1
3/05	**Spring Break**
3/12	Pesticide-Active Ingredient Isolation: Project II
3/19	Project II
3/26	Dye Preparation: Project III
4/02	Project III
4/09	Polymer-Preparation & Characterization: Project IV
4/16	Project IV
4/23	Research Talk/Check Out
4/30	Final Exam Week

Requirements	Points
Lab Questions/1[st] Half	150
Midterm	100
Homework/Technique	50
Final	100
Lab Notebook/2[nd] Half	150
Talks	50

<u>Grading</u>
> 92% A
90-92 A-
87-89 B +
83-86 B
80-82 B-
77-79 C +
73-76 C
70-72 C-
<70 D
Low Attendance F

<u>IMPORTANT NOTE</u>: <u>***Eight (8) hours***</u> per week in lab is ***MANDATORY*** to pass this class. Those averaging less than that by March 26, 2012 ARE ADVISED TO <u>***DROP***</u> RATHER THAN FAIL.

GENERAL CONSIDERATIONS

1.) You will often have to consult "Vogel" and other texts in addition to ours to refresh your memory on techniques like distillation, recrystalization, etc.
2.) All projects are ongoing! That is when one is finished another starts, or often two are going at once. There is always something to do! Budget your time, and manage your projects.
3.) Homework assignments are assigned regularly, answers will be posted by selected individuals.
4.) Learn to cooperate as part of a small and a large group.

Analytical Portion: 1st Half

1.) No lab reports are required. However, a set of related questions are required upon completion of each analytical exercise. A portion of the grade will be determined by how accurate and precise your analysis are.
2.) Reading in addition to your text is recommended and any of the analytical chemistry or quantitative analysis books in our room are available.
3.) A lab notebook is required and attention must be paid to entries.

Manufacture Portion: 2nd Half

1.) The text and handouts must be read, consulted, and followed in regard to the 4 projects as well as lab book form. The notebook is essential. KEEP UP!!
2.) The lab notebook grade will be evenly divided between form and content. The content centers on observations, results, preparation and product.
3.) The lab notebook should be a hard bound traditional lab book with numbered pages, not the same one used the first half of the term.
4.) It is expected that you read independently on the topic of each project from esterification to polymer production, etc.
5.) The last lab week, we will meet and have everyone deliver a talk. It will be from one of our projects or methods, i.e.: an technique or idea we contacted that you choose to research further and present your findings to the group. Many of our grads consider this to be an important part of our preparation. The times will be short and the meeting places announced.

OVERALL OBJECTIVES

1.) To reap the rewards of an independent thinker and worker, as well as learning to cooperate with and be part of a team.
2.) To gain a broader understanding of basic analytical and synthetic chemistry while working with real world examples.
3.) To become safely familiar with a variety of new reagents and new analytical techniques then integrating this knowledge with your basic wet chemical and instrumental skills to solve laboratory problems.
4.) To be able to interpret as well as follow directions and produce reliable data, using methods standard to a wide variety of industries as well as less defined synthetic procedures.
5.) To maintain a high quality laboratory notebook in content and form.
6.) To complete projects in a timely fashion with presentable results.
7.) To gain experience with delivering a talk in front of a group.
8.) To always, above all else, work safely in the lab.

"What is the meaning of it all, Mr. Holmes?" "Ah, I have no data. I cannot tell," he said.
Arthur Conon Doyle, The Adventure of the Copper Beeches, 1892.

Appendix C:

Trac-Dat: Curriculum Map and Program Outcome Assessment

Program - Industrial Chemistry Technology (A.A.S.) - Curriculum Map

Legend: (A) - Program Assessment, (I) - Introduced, (M) - Mastery, (R) - Reinforced

Outcomes	CHEM 121	CHEM 122	CHEM 140	CHEM 145	CHEM 231	CHEM 240	CHEM 245	CHEM 317	CHEM 321	CHEM 322	PHYS 211	PHYS 212
Content Knowledge	I	A, R			R	R		R	I	A, R	R	R
Lab Skills	I	R		I, R	I	R	A	R	I	R		
Effective Communication			I	R	I, R		A	A, R				

**Unit Assessment Report - Four Column

Ferris State University

Program - Industrial Chemistry Technology (A.A.S.)

Mission Statement: The mission of the Industrial Chemistry Technology (ICT) program is to provide students with the practical, analytical and synthetic skills needed to work successfully in the chemical (or related) industries.

Advisory Board/Committee Meetings: Once every two years

Next FSU Academic Program Review: 2013-2014

College: CAS

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
Program - Industrial Chemistry Technology (A.A.S.) - Content Knowledge - Students should demonstrate a working knowledge of chemistry through problem solving, application, and critical evaluation of resources. **Outcome Types:** Learning **Outcome Status:** Active	**Assessment Method:** Students will take a version of the ACS (American Chemical Society) one-year general chemistry standardized examination at the end of CHEM 122. **Assessment Method Category:** Test - External - Post or Pre/Post **Criterion for Success:** The mean score of FSU students taking this exam will be at or above the 50th percentile.	05/15/2010 - 27 CHEM 122 students took the 2007 version of the Full Year ACS General Chemistry Exam with an average of 54 out of a possible 70 points, placing the average at the 88th percentile nationally. **Classification:** Criterion Met **Action:** 1 - No Action Required	
		05/15/2010 - 60 CHEM 122 students took the 2003 version of the Full Year ACS General Chemistry Exam with an average of 48 out of a possible 70 points, placing the average at the 76th percentile nationally. **Classification:** Criterion Met **Action:** 1 - No Action Required	
		05/15/2010 - 13 CHEM 122 students took the 1999 version of the Full Year ACS General Chemistry Exam with an average of 56 out of a possible 70 points, placing the average at the 93rd percentile nationally. **Classification:** Criterion Met **Action:** 1 - No Action Required	
		05/08/2009 - 116 CHEM 122 students took the 2003 version of the Full Year ACS General Chemistry Exam with an average of 54.65 out of a possible 70 points, placing the average at the 88th percentile nationally. **Classification:** Criterion Met **Action:** 1 - No Action Required	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
		05/08/2009 - 75 CHEM 122 students took the 1995 version of the Full Year ACS General Chemistry Exam with an average of 43 out of a possible 75 points, placing the average at the 70th percentile nationally. **Classification:** Criterion Met **Action:** 1 - No Action Required	
	Assessment Method: Students will take a version of the ACS (American Chemical Society) one-year organic chemistry standardized examination at the end of CHEM 322. **Assessment Method Category:** Test - External - Post or Pre/Post **Criterion for Success:** The mean score of FSU students taking this exam will be at or above the 50th percentile.		
Program - Industrial Chemistry Technology (A.A.S.) - Lab Skills - Students should work in a chemistry laboratory in a safe and effective manner, applying the scientific method to the design, execution and interpretation of experiments and experimental data. **Outcome Types:** Learning **Outcome Status:** Active	**Assessment Method:** Representative lab notebooks of majors in CHEM 245 will be evaluated using a rubric. The rubric consists of three parts: content, style and organization, with a particular emphasis on the proper execution of laboratory work in a safe manner. **Assessment Method Category:** Written Product (essay, research paper, journal, newsletter, etc.) **Criterion for Success:** Over 75% of the majors will have satisfactory or better lab notebooks.	05/15/2013 - In Spring 2013, 87% of the notebooks evaluated in CHEM 245 achieved a satisfactory score in the rubric. This meets the criterion of 75% of the majors having satisfactory or better lab notebooks. **Classification:** Criterion Met **Action:** 1 - No Action Required	
Program - Industrial Chemistry Technology (A.A.S.) - Effective Communication - Students should effectively communicate and present technical information in a clear, concise, scientifically appropriate manner in a variety of formats. **Outcome Types:** Learning **Outcome Status:** Active	**Assessment Method:** Assess representative lab reports in Instrumental Analysis (CHEM 317) using a rubric. The rubric consists of theory, evaluation of data and organization. **Assessment Method Category:** Written Product (essay, research paper, journal, newsletter, etc.) **Criterion for Success:** Over 75% of the majors will have satisfactory or better lab reports.	05/15/2013 - In Spring 2013, 85% of the lab reports evaluated met the criterion for success, according to the rubric. **Classification:** Criterion Met **Action:** 1 - No Action Required	

Outcomes	Means of Assessment & Criteria for Success / Tasks	Results	Action & Follow-Up
	Assessment Method: A rubric will be used to evaluate the lab notebooks of students in Chemical Manufacturing & Analysis (CHEM 245). This rubric will put a focus on the proper recording of work carried out in the lab. **Assessment Method Category:** Written Product (essay, research paper, journal, newsletter, etc.) **Criterion for Success:** Over 75% of the majors will have satisfactory or better lab notebooks.		
	Assessment Method: Representative oral presentations of majors in CHEM 245 (Chemical Manufacturing & Analysis) will be evaluated using a rubric. The rubric consists of theory, evaluation of data and organization. **Assessment Method Category:** Presentation(Oral) **Criterion for Success:** Over 75% of the majors will have satisfactory or better presentations.	05/15/2013 - In Spring 2013, 100% of the student oral presentations in CHEM 245 were satisfactory or better. **Classification:** Criterion Met **Action:** 1 - No Action Required	