Industrial Chemistry Technology

APRC 2001-2002

Section 1 of 2

Report of the ICT (Industrial Chemistry Technology) Program Review Panel

September 28, 2001

Members of the Program Review Panel:

- William Killian, ICT coordinator & PRP chair
- Mechelle Churchfield, Chemical Technologist at Dow Chemical & Program graduate
- Pasquale Di Raddo, Professor of Chemistry
- David V Frank, Physical Sciences Dept Head
- R James Weaver, Chemistry Instructor & Program graduate

Report of the ICT (Industrial Chemistry Technology) Program Review Panel

Section 1: Program Overview

The Industrial Chemistry Technology (ICT) program is nearing the half-century mark here at Ferris State University. It is the only associate degree-granting program offered by the Department of Physical Sciences. The program has and continues to provide chemical technicians who are hired by companies in Michigan and the Midwest. Since its inception, the ICT program has been geared toward developing the skills that a chemical technologist needs to succeed in industry. The skills of experiment planning, safety consciousness, defined calculating, teamwork and overall laboratory technique development have always been and remain central to the program. These are quite simply the skills that have kept the ICT placement levels so high and Fortune 500 companies returning year after year to hire the graduates. A total of 184 people have graduated from this program in the last 15 years (please see the enclosed list for details).

The students in the program are a diverse group. One characteristic that they all have in common, though, is that they enjoy working in the laboratory. During their two years on campus, they complete the same basic science courses that a four-year chemistry major would complete at any other university. However, the variety of math and science courses at Ferris makes it possible for a student to arrive underprepared in mathematics and still complete the program in two years and a summer. The program also attracts some transfer students from other two- and four-year institutions who wish to enter this very focused program of study.

Faculty members in the Department of Physical Sciences provide most of the instruction in the ICT program. The greatest percentage of the credit hours are in chemistry, physics and industrial chemistry courses. One faculty member of the department, William Killian, serves as the program coordinator. Since the most time intensive industrial chemistry courses are taught during the winter term, he usually teaches a large general chemistry course in the fall to balance his load. However, there are times when other professors within the department have shared responsibility for some of the professional ICT courses. This has been a benefit for the department as a whole, as more faculty members gain a better appreciation of the overall program, as well as exposing the students to more than one point of view during their professional experience.

The American Chemical Society (ACS) provides certification for programs in chemistry across the nation. At the bachelor's level, they certify mainstream chemistry degrees (typically leading to graduate study) as well as degrees with an emphasis in specialty areas, such as biochemistry. However, only over the past ten years, the ACS has also been approving two-year programs. Currently, the Ferris ICT program is one of seven nationally approved programs. This sets the Ferris ICT program in very select company.

Since the ICT coordinator has taught all of the professional courses in the program, the major responsibility for revision rests with him. He regularly consults with graduates and employers to see if course material is appropriate. In addition, an ICT advisory board (consisting of ten members from both industry and secondary-level education, several of them graduates of the Ferris program) also provides feedback. The ICT advisory board has been actively involved in curricular review, semester conversion, instrument acquisition and other issues of importance to ICT. Advisory board members are involved with the program on many levels. The results of the advisory panel evaluation are enclosed later in this report.

Finally, ICT has begun to represent itself beyond the Big Rapids campus in the last six years. Recently, a certificate of industrial chemistry was awarded to four technicians from Pfizer Pharmaceuticals in Holland MI as an outcome of a series of Ferris industrial chemistry courses they completed over the last several summers. More Pfizer technicians are currently involved in this joint Ferris/Pfizer venture. Ongoing collaborative efforts with Dow Chemical and Dow Corning complement the Pfizer efforts and further represent the breadth of ICT and local industrial relationships. Ferris ICT has developed its own website, up and running, with over 1200 hits in its first year alone. Ferris ICT has been represented at several national and international conferences in the past few years. Please see the attached articles for more details on these latest extensions of Ferris ICT.

#	Year	Term	Name	Where They Went
113	**1996**	W	John Albaugh	Dow Corning
114		W	Larry Miller	BA Education
115		W	Scott Brown	BS Plastics
116		W	Anita Bialek	Dow Corning
117		W	Suzette Hoisington	Laprino Foods
118		W	D'arcy Kelley	Cytec Industries
119		W	Rochelle Lockyear	Dow Corning
120		W	Connie McCutcheon	Eli Lilly
121		W	Robert Nelson	Dow Corning
122		W	Jason Sturm	Dow Corning
123		W	Robert Peters	BS Chemistry
124		S	Jill Wood	BS Plastics
125		S	Mark Hartmann	Dow Corning
126		S	Ghenet Mogus	Rollins Environmental
127		F	Heather Kowalski	Dow
128		F	Glenda Rehkoph	Dow
129		F	Frank Fuss	BS Chemistry
130		F	Julie Riodan	Hitachi Magnetics
131		F	Rachel Van Stratton	BS Chemistry
132	**1997**	W	Donald Love	Dow
133		W	Duane McManns	Plastics Engineering, Ferris
134		W	Joe Neuman	Dow
135		W	Ryan Powell	Essex Products
136		W	Julie O'lone	BS Industrial Hygiene
137		W	Julie Ward-Buzois	Dow
138		S	Michael Moore	Dow Corning
139		S	Josh Schroder	Dow Corning
140		S	Angelia Tiderington	Dow
141		F	Chris Bobbio	BS Plastics
142	**1998**	W	Terry Flynn	Traverse City Fire Dept.
143		W	Edyta Boron (Woodzianski)	Dow
144		W	Edna Glaza	Procter & Gamble
145		W	Travis Hein	Dow Corning
146		W	Clayton Jaques	Tube lite
147		W	Aaron Maxey	Laprino Foods
148		W	Jason Maurer	Essex Products
149		W	Paul Wolf	BS Plastics
150		S	Jacob Remacle	Eli Lilly
151		F	Ed Langworthy	Michigan Dairy
152		F	Rhadonna Denson	Eli Lilly
153	**1999**	W	Bob Standhardt	Upjohn
154		W	Yvette Berger	Dow Corning
155		W	Mark Tilford	Dow
156		W	Allison Larson	BS Chemistry
157		W	Dan Champeau	Michigan Dairy
158		S	Travis Lemanski	BS Education
159		S	Mark Cooper	BS Education
160		F	Stacie Jankewicz	BS Education
161		F	Marge Smith	Hendrix College
162	**2000**	W	Carla Buechler	FSU
163		W	Amy Goodwin	Eli Lilly
164		W	Bob Hodgson	Intel
165		W	Sara Jaster	Dow
166		W	Brad Pasquantonio	Michigan Tech
167		W	Trent Springer	S.C. Johnson
168		S	Greg Gardenhire	Dow
169	**2000 Con't.**	S	John Phommavongsa	Intel
170		S	Rick Martin	Holly Cement
171		F	Trisha Hyden	Eli Lilly
172		F	Kelly Messing	Dow Corning
173		W	Gabriel Rigor	E-Q
174	**2001**	W	D'Andre Payne	Pharmacia
175		W	Daniel Tomes	Eli Lilly
176		W	Alitha Allbee	Dow Corning
177		W	Aimee Kiviniemi	Dow Corning
178		W	Amy Wetzel	Dow
179		W	Nathan Kroll	Pharmacia
180		S	Adrieane Butera	FSU Pharmacy
181		S	Salina Peoples	Care Co. Pharmaceuticals
182		S	Tramel Willis	Western Michigan University
183		S	Terri Ladner	Michigan Dairy
184		F	Komal Patel	
185		F	Lashonda Bracey	

February 2001

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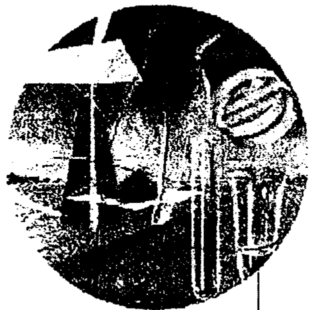

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What is Industrial Chemistry Technology?

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Dow Chemical Foundation Donates to ICT Program

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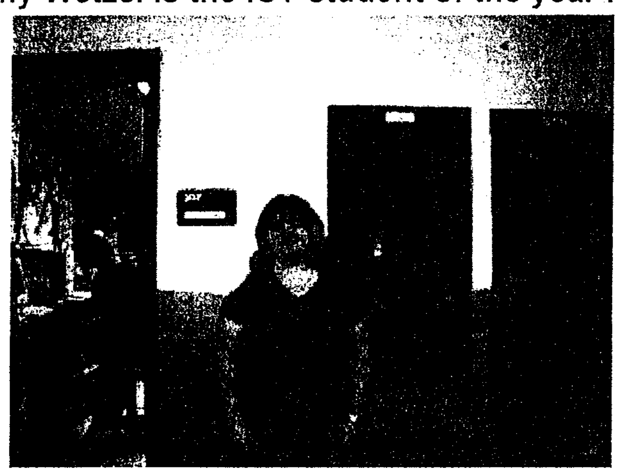
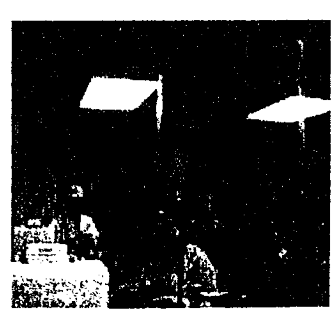
Amy Wetzel is the ICT student of the year for 2001



Click here to read about Amy



INDUSTRIAL CHEMISTRY TECHNOLOGY

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This is a partial list of the companies that have hired ICT graduates.

To learn more about a company listed click the button next to the company nan

- The Dow Chemical Company
- Dow Agro Sciences
- Intel
- Pfizer
- Consumers Energy
- Eli Lilly
- Cytec
- Dow Corning
- Kroger - Michigan Dairy
- Proctor and Gamble
- Pharmacia & UpJohn
- Amway
- SC Johnson Wax

INDUSTRIAL CHEMISTRY TECHNOLOGY

Ferris State University

How the ICT program can prepare you for employment

The following was submitted by John Engelman (AS 1964). Mr. Engelman is the national chair of the Division of Chemical Technicians of the American Chemical Society.

> "How did the ICT program prepare me for my present job"? The snap answer is quite we thanks!

When I was asked to answer this question by Bill Killian and Dr. Pasquale DiRaddo it brought to mind that in the last year, just by coincidence, I have been asked a similar question tw(times previously. The first time I was asked to present a paper at the 219th National American Chemical Society Meeting in a symposium entitled "Roles and Responsibilities of the Professiona Technician in the 21st Century." The second time the question posed came from Norman Petersoı my major instructor in the ICT program. The question was "Could you have done all the things yoı have done had you gotten a Bachelor's degree in Chemistry?" Both of these questions had me looking to my past and this question does the same.

I graduated from the ICT program in 1964; we had slide rules for calculators and pen and paper for everything else. There were no personal computers, Internet, voice mail, Xerox, cell phones, or pagers. Computers were room size, which used punch cards or tape to feed the data and programs. Phones were dial, secretaries took messages and all reports and graphs were dor by hand.

I went from Ferris State College (I was in the first graduating class for FSC) to the Dow Corning Corporation working in the Radiation and Radiochemical labs of the Physical Chemistry Department. This is a field that few if any, undergraduate or graduate level chemists were trained work. I not only survived in this atmosphere, I thrived. The program had given me all the tools I needed to get started in my first chemical technician job.

The interesting thing is that the tools I arrived at Dow Corning with seem antiquated by today's standard but in those days 36 years ago, they were as advanced as the instruction is today. The backbone of the program is unchanged in the years since I graduated; however the content of the course work has changed. I arrived for my first day of work with a working knowled(of chemistry, physics and mathematics. The ICT course work, whose intent was to simulate industrial labs, had given the necessary skills to properly document experiments and write reports I had learned to research experiments and the use of a slide rule to perform the calculations required. I had been exposed to different instrumentation. And maybe, at least in my opinion, I ha acquired from Norman Peterson the most valuable tools; work ethic, a thirst for more chemical knowledge, and a curiosity for the chemical reaction.

Carbon chemistry was translated into Silicon chemistry. Calculations used to prepare lab samples in school were exchanged for Radio assay or Radiation dosimetry. The grounding in the use of instruments led to the use of more sophisticated and delicate instruments; and I might add without fear because of the experience of using them at FSU. Oral and written reports became easier with each succeeding effort. The secret to this success was the ICT program and the habit it instills in its graduates.

During the 25 years since I left the Radio and Radiation Chemistry group I have held a number of different positions, in a number of different fields. I have been an inspector at the construction of a nuclear power plant, quality control manager and development chemist. I have worked with thermoset molding compounds, thermoplastics, adhesives, and cleaning products foı both soft and hard surfaces. Each of the moves has built upon the basic building blocks that I received from my initial education at Ferris and the ICT program. I have also gone on to take a number of courses in the years I have been out of school. All were aimed at furthering my usefulness as a technician. Over the years I have taken Polymer and Physical Chemistry, Biochemistry, Applied Surfactant Chemistry, Calculus, Statistics, Computer programming in PL1, COBOL, FORTRAN, and BASIC, several business courses and a large number of instrument sho courses.

Today, I am a Technician Specialist. My primary function is to use my 36 years of experience to solve problems, which keep manufacturing from operation under normal conditions. In addition, I chair the Division of Chemical Technicians, Inc. of the American Chemical Society. How did the ICT program prepare me for my present position? In short it gave me the basics and the thirst to learn. It prepared me to join the laboratory team. It gave me the start of my self-esteem, self-confidence, and my work ethic. I value above all my integrity developed from its beginnings in the ICT program.

Many thanks to Norman Peterson, Bill Killian and Pasquale DiRaddo! You are the reason I am what I am today.

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INDUSTRIAL CHEMISTRY TECHNOLOGY
Ferris State University

A HISTORICAL LOOK AT ICT'S FIRST THIRTY YEARS

PICTURE THIS: A chemist working in the laboratory of a large paint company. Happy, he enjoys his work, he is challenged every day to create and observe as part of a team.

That is where I was in the summer of 1957 when I received a letter announcing an opening to lead an AAS degree program in Industrial Chemistry Technology (ICT) at Ferris Institute. This program would train chemical technicians. Where was Ferris Institute? Where was Big Rapids, Michigan? Should I apply for that teaching position?

While working as a chemical technician in Quaker Oats research center in Chicago, I decided to become a chemistry teacher. After three semesters of teaching high school and freshman college chemistry at the University of Illinois Extension Center in Waukegan, I left for graduate studies in chemistry at DePaul University.

After DePaul University I became a chemist at a paint company. In my laboratory work I was challenged every day. My responsibilities were to create components for industrial paints, evaluate and write about them. Hopefully my work would lead to commercial products. As a development / research chemist I was part of a product development team. I enjoyed my work. I loved working at the chemistry bench.

I was intrigued by the opportunity at Ferris Institute; in my laboratory work I often wanted a college trained chemical technician to work with me. Please note I say, "work with me" I did not say "work for me". A good chemical technician will be a participating team member.

I joined the faculty at Ferris Institute the fall term of 1957 welcomed by 33 students in the ICT curriculum. A few of these had started their curriculum in the 1956-57 academic year but lacked a lead teacher to work with them. In June 1958 seven students completed the required ICT courses. Would they find employment? A goal was employment in industry? The state of Michigan had never had an academic program to train AAS degree chemical technicians. Would Michigan industry accept our ICT graduates?

At about this time, Dow Corning Corporation in Midland, Michigan received a questionnaire from a federal educational agency. One question to be answered was "how many chemical technicians will you hire this year?" Their answer was, "we will not hire chemical technicians this or any year." In 1964 Dow Corning Corporation of Midland hired all of the Ferris ICT graduates; in 1965 they hired all but one. What or who made them change their mind? The answer is they heard from other companies about the high quality work the AAS degreed chemical technician at Ferris Institute do.

Some 25 years later, when Dow Chemical Company defined the academic training that should be given to AAS chemical technology students, their answer included a statement something such as "a background equal to that received by the AAS students in the ICT curriculum at Ferris State College."

During the thirty years I lead the ICT curriculum, acceptance of ICT students by industry grew, the variety of companies hiring students grew, and responsibilities given to graduates grew. The increase in responsibilities assigned our graduates was possible because graduates had proven themselves capable of assuming a wide variety of demanding positions in an industrial setting. One graduate told me that on their first day in the laboratory they were told, "look at that box, the instrument inside is new, no one in our laboratory has ever used it or anything like it, you will teach yourself how to use it and become our company expert."

Upon graduation from Ferris, graduates may find employment in industry or continue their education in a chemical related area, education, or a non-science. Many graduates when they are working discover that a few additional courses are helpful in their work. Many times these few helpful courses grow into BS degrees.

One ICT class had two of its graduates upon graduation go immediately to work in industry, and while working, both took sufficient classes to eventually receive a BS degree in chemistry. Later these two Ferris graduates left their chemistry employment, returned to a university and earned the PhD degree.

When leading the ICT curriculum I was able to fulfill an idea of mine, that was to academically prepare a technician that I would like to have work with me in my laboratory work. I helped to prepare these technicians, but never had the privilege to have them work directly with me. I did spend a number of summers at the industrial laboratory bench where my ICT graduates worked nearby, I saw that they did a great job, and had a rewarding career in the laboratory.

A few years after graduating one told me "if I could have designed a career for myself when I started at Ferris I would not have had the nerve to create one so rich and beautiful as the one I live today."

Working in a chemistry laboratory is FUN; yes the ICT graduate with an AAS degree will have fun after they graduate, their salary will be rewarding. The ICT chemical technician will be treated well by their employer. .

There are wonderful success stories to be told about many that graduated 1957-1987. One young man came to Ferris only to leave after his first year in order to serve in the military. Three years later he returned, and told me "when I graduate next year I am going to move to New Orleans and find a job". After he graduated I didn't hear from him for several years, then he telephoned to tell me, "My boss likes my work so much he asked me to call you to see if you can help our company hire some Ferris graduates to work in New Orleans." New Orleans had probably never heard of an AAS degreed chemical technician before this graduate went there. One November a supervisor called and told me that he needed a chemical technician right now. On the other hand he would hold the position open if I could almost guarantee that he would be able to hire one of our ICT graduates in May.

The opportunity is there, fun and challenge of working in chemistry is exciting.

If you wish you may write me so that I may answer your questions.

Norman G. Peterson
Emeritus Professor of Industrial Chemistry Technology

INDUSTRIAL CHEMISTRY TECHNOLOGY

Ferris State University

Pharmaceutical Chemical Technician Certificate

PROPOSAL AND RATIONALE

Over the past four years, the Department of Physical Sciences has offered training at the plant of Pfizer (formerly Parke Davis) of Holland, MI for current employees. These employees serve as chemical technicians for the company. Unlike other employers, Pfizer does not hire technicians directly from a community college or university. Rather, they identify employees from within who have the skills to become good laboratory workers. They then train the workers on the specific instruments that they need to run.

While the employees have learned how to perform certain tasks, they do not necessarily have the broader background provided by a college education. Pfizer would like to offer these employees an opportunity to receive additional education that would directly impact their ability to perform their jobs.

Initially, Drs. Brummel and Hoekstra, officials at Pfizer inquired about the Industrial Chemistry Technology (ICT) program, the only two-year chemistry degree in the state of Michigan accredited by the American Chemical Society. This program is designed to take students who have just a high school education and equip them with the skills to work in any industry as a chemical technician. Upon reviewing the program (with the assistance of Bill Killian, ICT program coordinator and Dave Frank, Physical Sciences Department head), it was concluded that a full-blown ICT program would not be in their best interests. Already possessing some training from Pfizer, the target employees could benefit from a subset of the typical program. Quite frankly, they do not need some of the "hands-on" training that the ICT program provides, because they have already developed those skills.

Instead, working in conjunction with Pfizer, four courses were identified that would provide a working background knowledge that is most closely related to the employees' jobs. These courses are CHEM 114, Introduction to General Chemistry; CHEM 124, Introduction to Organic and Biochemistry; CHEM 317, Instrumental Analysis; and INCT 220, Industrial Chemistry Calculations. FSU packaged these courses as a certificate. Those employees who complete the certificate are recognized for completing the professional development requirements in the Pfizer promotion schedule.

Courses for this certificate are offered in the summer. Pfizer is expected to pick up the full tuition bill for the students. Enrollments are expected to be in the range of eight to fifteen students. Classes will be offered with the assistance of Extended Learning.

This certificate program will be administered through the Department of Physical Sciences. It is hoped that the establishment of this certificate can lead to closer ties between the ICT program and the chemical industry in Michigan. It is also hoped that this certificate may serve as a "model" for the cooperative ventures between the FSU program and industry. This particular model is appropriate for a pharmaceutical company such as Pfizer. The first degrees in the program were awarded in August 2000.

Other certificate programs could be developed to suit a company's needs. Contact Bill Killian at 591-2590 or e-mail at killianb@ferris.edu.

See related article on Pfizer graduates

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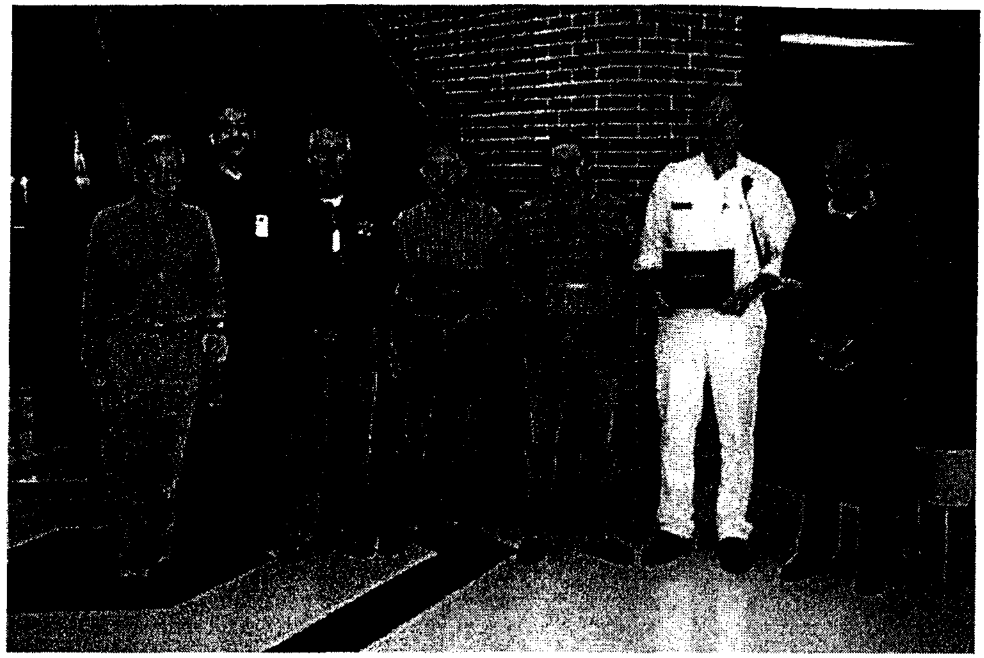
Ferris State University

Pfizer Employees Receive New Ferris Certificate

Last August a group of students employed as chemical technicians at Pfizer Pharmaceuticals (formerly Parke-Davis) in Holland, received Pharmaceutical Chemistry certificates form Ferris, the first such certificate granted through the Division of Arts & Sciences.
The educational experience was the brainchild of Pfizer's Dr. Roger Brummel, vice president of Chemical Operations, and Dr. Marvin Hoekstra, in consultation with Nick Coso, FSU's former Dean of Continuing Education, and Bill Killian, professor of Chemistry and director of the Industrial Chemistry Technology program. They felt that members of the Pfizer technical staff would benefit from augmenting their understanding of various areas of chemistry, such as general chemistry, quantitative, instrumental, organic chemistry, and biochemistry, and so proposed a set of courses for the certificate program taken from those already available to Ferris' ICT students.
At Pfizer's request, it was decided that the preferred mode of distance education would not be via interactive TV or Web-based in any manner, but would simply involve face-to-face teaching. "That group of students was as serious and committed about their coursework and their advancement as I've seen in my teaching career," said Killian.
Congratulations are extended to the newest Ferris alumni, Guillermo Flores, Randy Geurink and Rick Kamerman. A number of technicians are currently "in the pipeline." In appreciation for Ferris' efforts, Pfizer has contributed financially to ICT for several years. In further demonstration of their close relationship to the University, a Ferris flag-raising ceremony is being planned for the near future at the main lobby of the Pfizer plant.
Discussions are underway for establishing similar certificate programs at other chemical companies in the Midwest.



From left to right: Marvin Hoekstra - Reasearch Group Leader; Pasquale Di Raddo - Prof. of Organic Chemistry; Bill Killian - ICT Director & Prof. of Chemistry; Rick Kamerman, Guillerm Flores, Randal Geurink - Graduating Class & Pfizer Technicians; Roger Brummel - VP of Chemical Operations, Pfizer.

See related article on the Certificate Program

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INDUSTRIAL CHEMISTRY TECHNOLOGY

September 21, 2000

Dow Chemical Foundation Donates to ICT Program

Alumni David Dellar (AS'83), Research Specialist, and Mechelle Churchfield (AS'93), Research and Development Technologist at Dow Chemical in Midland, visited the Physical Sciences department last week and spoke with a number of freshman and sophomore students. Dellar and Churchfield repeated their 20-minute presentation, "Ferris' Best Kept Secret: The Two-Year ICT Program," in chemistry classes throughout the day.

"Statistics compiled by the American Chemical Society show the next 10 years will witness a growth in the need for technicians, with demand far outpacing supply," said Bill Killian, professor of Chemistry and director of Industrial Chemical Technology. "Opportunities for our graduates abound at many chemical companies."

On behalf of The Dow Chemical Company Foundation, Dellar and Churchfield announced the granting of a donation of almost $15,000 for the ICT program, renewable for up to three years. The award will be used three ways. Part of the monies will be used to set up a scholarship program for ICT students who are excelling in their studies. Another portion will fund the establishment of a Web site to be coordinated by Pasquale Di Raddo, professor of Chemistry. The remainder will fund additional lab sections for the Chemistry 317, "Instrumental Analysis," class.

"This grant acknowledges the superior quality of the tech program here, one of only six nationally approved by the ACS," said Dellar.

Dellar is a 1995 winner of the Dow "Outstanding Technologist Achievement Award and the 1996 Ferris Distinguished Alumnus Award. He has been recruiting FSU graduates for many years, including Tom Miller (AS'89) and Churchfield.

Website Coordinator; Dr. DiRaddo, ICT Program Director; Prof. Killian, Physical Science Dept. Head; Dr. Frank, Assist. Dean (Arts/Science); Matt Kline, Dow Chemical Reseach Specialist; Mr. David Dellar, and Dow Reseach and Development Technologist; Ms. Mechelle Chruchfield

Prof. Killian, David Dellar and Mechelle Chruchfield

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INDUSTRIAL CHEMISTRY TECHNOLOGY

Ferris State University

Dow Corning Program Offers Students a Fast Start

Dow Corning Corporation representatives met with Industrial Chemistry students of Bill Killian, associate professor of Physical Sciences, on October 17 to discuss Dow Corning's Fast Start program, which prepares students for chemical processing careers. One of the representatives, Greg Gardenhire, is a graduate of the Industrial Chemistry Technology program and the first Ferris student to complete the Fast Start program.

Dow Corning developed the program to address the high demand for Chemistry associate-degree graduates entering positions of chemical technician and process operations. Chemical manufacturing plants, pulp and paper plants, and pharmaceutical companies. Ferris has been in partnership with Dow Corning to better prepare students for careers in chemical processing for the past three years.

The Fast Start program includes an intensive, two-week summer workshop in chemical process technologies at Michigan Technological University. Students selected for the workshop are awarded full scholarships for participation, and those who successfully complete the workshop are eligible for a two-year scholarship at Ferris.

Students in the program may apply to work at a Dow Corning facility for a 10- to 12-week probationary period during the summer to determine if the employment match is satisfactory for both the students and the company.

INDUSTRIAL CHEMISTRY TECHNOLOGY

Ferris State University

The article, "A Mechanistic Representation for the Syntheses of Benzanthrone and Violanthrone," co-authored by Pasquale Di Raddo and Bill Killian, both professors of Physical Sciences, was published in the latest issue of the journal *Polycyclic Aromatic Compounds, PAC 19, 179 (2000)*. The paper was originally presented at the 4th Biennial Meeting of the International Society of Polycyclic Aromatic Compounds in Bordeaux, France.

The paper describes the reaction mechanism involved in making the dye dibenzanthrone. This experiment is done by all the ICT students in the industrial chemistry lab course. You may receive a reprint of the article by simply contacting via e-mail Professor Killian at killianb@ferris.edu or Professor Di Raddo at diraddop@ferris.edu.

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In favor of Ferris

Published on Mon, Jul 9, 2001

With honors from alma mater, duo spread word on FSU

Bulldogs to the end, Brighton residents and Ferris State University graduates Tom Miller and Bob Scranton were honored as special alumni at the annual Spring Reunion Banquet, held by the FSU Alumni Association.

Miller and Scranton both say they're proud and humbled to receive the honors from FSU, and both are spreading the word in Livingston County that their alma mater is a top-notch school.

"Ferris is one of the best-kept educational secrets in the state," said Scranton, pointing out that his hometown high school (Brighton) and college (Ferris) both carry the Bulldog nickname.

Tom Miller

Miller was one of two people to receive the 2001 Pacesetter Award by the FSU Alumni Association. The Pacesetter Award recognizes distinguished alumni who are recent graduates of the University (12 years or less) and have demonstrated leadership and service to their profession, communities, service organizations and alma mater.

"I think it's great," said Miller of the award.

He went to Ferris for its pharmaceutical program but left with a two-year degree in chemistry.

According to Miller, Industrial Chemistry Technology (ICT) Professor Bill Killian, who nominated him for the Pacesetter Award, was an inspiration and provided aid in his choice of receiving the two-year degree before pursuing the four-year degree.

Because of his motivating force in Miller's career choices, Killian's nomination made winning the award very gratifying for him.

Miller is currently the Automotive Market Manager for Ticona Polymers in Auburn Hills.

Since graduating from Ferris, Miller has also earned his bachelor's degree in chemistry from Saginaw Valley State University and a master's in business administration from Keller Graduate School of Management in Chicago.

In addition, Miller holds a U.S. patent, has been published in multiple industry publications and has played key roles in the development of business and marketing plans for the Mossback Creek Company in Gaylord and the Double E buffalo ranch in Vanderbilt.

Miller holds a variety of professional organization affiliations, including the Society of Automotive Engineers, the Society of Manufacturing Engineers and serves on the Board of Directors for the Society of Plastics Engineers Detroit Section.

He was also responsible for bringing the PlastiVan to Brighton High School through the Society of Plastics Engineers.

His involvement with FSU continues as well, serving on the ICT Advisory Board. Since 1990, Miller has conducted an annual interview skill and resume writing workshop for ICT students at FSU.

"I share my story at the workshop," Miller said. "The message of that seminar that I give every year on career preparation and resume writing is that the future is theirs to create. That's a good message for any high school student, or anyone who is early on in their careers in college."

Bob Scranton

Scranton was identified as one of four 2001 Distinguished Alumni by the FSU Alumni Association, an award given to individuals who have demonstrated leadership and service to their professions, communities, service organizations and alma mater.

"It was very gratifying," said Scranton, the husband of state Rep. Judie Scranton, R-Brighton. "I felt that it was an obvious honor to win the award. I've always been a very strong supporter of Ferris State because the school itself has done a tremendous amount for me over the years."

Scranton holds an associate's degree and a bachelor's degree from FSU, a Certificate of Training from the University of Oklahoma and a master of Public Health degree from the University of Michigan.

He is currently the director of the division of Community Health in the Michigan Department of Community Health, Community Public Health Administration, working to coordinate the areas of the HUD Lead Abatement Program, Local Health Services and the Office of Minority Health.

For more than 40 years, Scranton has been working to better the health of his community. He has been involved in health administration, teaching, research and planning activities, and continues his involvement with his alma mater by serving on the Environmental Health Curriculum Advisory committee, as well as actively participating in the Alumni Association.

He has also served in a variety of other professional and volunteer roles.

Scranton lists among his proudest accomplishments his management of the Minority Health program, which distributes funds to address issues including heart and cardiovascular disease and cancer in minority populations where disparities in health and healthcare exists, teen pregnancy and infant mortality.

Both Scranton and Miller credit Ferris as being the foundation for their successful careers.

Although Miller went on to complete his education at various other schools, he said, "I still view that associate's degree and my Ferris training as the cornerstone for launching a successful career. Ferris is a great institution for higher learning that offers career options that range from doctorate in optometry and pharmacy on down to two-year degree programs in industrial chemistry and other skilled trades like dental hygiene, welding, heating ventilation and air conditioning."

By Julie Holton
HOMETOWN NEWSPAPERS

Ferris State University President Bill Sederburg presenting Tom Miller with the 2001 Pacesetter Award

INDUSTRIAL CHEMISTRY TECHNOLOGY

Ferris State University

Ferris Alumnus is National Chemical Technician of the Year

David Stickles of Midland, a 1974 Industrial Chemistry Technology graduate, has received the National Chemical Technician Award presented by the American Chemical Society Division of Chemical Technicians.

Stickles has worked at Dow Corning Corporation in Midland for more than 25 years where he helped develop the company's first commercial solventless paper coating system. Currently a Senior Science and Technology technologist, Stickles is a recognized expert in release coatings and conducts training for Dow Corning customers and employees. He serves as a director of the Midland Section of the American Chemical Society.

The National Chemical Technician Award, sponsored by The Dow Chemical Company Foundation, is presented annually to a chemical technician who has demonstrated an extremely high degree of professionalism. Award criteria include technical and communication skills, safety, reliability, leadership, teamwork, publications and presentations. Professional and community activities also are considered.

For several years, Stickles has chaired "Sci-Fest," an annual event held in conjunction with National Chemistry Week. The five-county science festival drew an estimated 2,000 students, parents and teachers this year.

Another Ferris State alumnus, John Engelman (AS'64), presented the award to Stickles at the recent national meeting of the ACS in San Francisco.

Section 2: Graduate Follow-up Survey

The graduate satisfaction and information survey for ICT was distributed this Fall through the use of key people at sites where a number of ICT graduates work. Most notably this includes people from Dow Chemical and Dow Corning; others were contacted by phone. In 1996 this review was done using mass mailing; that resulted in only about a 10% return rate. In this case, we were able to get upwards of a 20% response rate from graduates of the past fourteen years.

The graduates recognized two areas to be the program's greatest strengths. The major coursework that prepared the graduates to work in this field, as well as how to apply that coursework and solve problems was recognized as a major strength. Secondly, the ICT coursework positively affected the attitude, sense of responsibility, and confidence of the graduates. Included in this attitude area, it was also noted that self-respect, as well as respect for all individuals, was an important part of their ICT work. The area of greatest concern (with the fewest excellent versus the most poor responses) was the graduates' concern for preparation in integrating their courses and personal goals.

■ Student Follow-up Survey Results: Graduates

The results of 33 returned INCT graduate surveys are compiled below:

Knowledge

How do you feel your MAJOR coursework at FSU was in preparing you in the following areas?	N/A	Poor	Fair	Good	Excellent
1. Subject matter and processes of your specialty (major)	0	0	2	13	18
2. Issues and trends pertinent to your specialty	3	0	4	19	7
3. Concepts of human growth/development pertinent to your specialty	2	1	4	17	9
4. Theories pertinent to your specialty	2	0	6	16	9
5. Alternative strategies for applying skills of your specialty	2	0	6	16	9
6. Management and organizational skills of your specialty	2	1	10	14	6

Attitude

How do you feel your MAJOR coursework at FSU was in preparing you in the following areas?	N/A	Poor	Fair	Good	Excellent
1. Believing that learning is a life-long process	0	0	3	12	18
2. Respecting the uniqueness and worth of each individual	0	1	3	14	15
3. Accepting responsibility of preparing for the future	0	0	2	10	21
4. Confidence in your personal competence	0	0	2	11	20

Ability

How do you feel your MAJOR coursework at FSU was in preparing you in the following areas?	N/A	Poor	Fair	Good	Excellent
1. Apply knowledge in defining problems and solving them	0	0	3	10	20
2. Establish a productive environment on and off the job	0	0	3	17	13
3. Respond to people from different social and cultural backgrounds on formal and informal occasions	1	0	11	13	8
4. Formulate plans and make appropriate applications	0	0	4	16	13
5. Select and use appropriate materials/aids	0	0	2	16	14
6. Evaluate success of performance in career	0	1	12	14	6
7. Communicate ideas clearly and simply in correct English	2	0	4	21	7
8. Find information; interpret and apply findings	0	0	2	18	14
9. Identify values and respond ethically	0	2	6	18	7
10. Integrate career and personal goals	2	3	7	17	4
11. Meet responsibilities of citizenship	4	0	8	14	7

■ Graduates Survey: Additional Comments

"No poor grades here! I felt that I was better prepared coming to Dow from Ferris with my 2 year degree than many of the 4 year graduates from 'other' schools (even better than a few PhD's." – Anonymous

"I now have a B.S. in Chemistry. I felt [the] ICT program was good preparation, very comprehensive. [I] Probably learned more in [the] ICT program than in the rest of [my] B.S. coursework" – Greg Becker

"ICT provided a tremendous foundation for me to build upon in future career development. Excellent program!" – Gary Homan

"The ICT program, which I have been a part of at FSU, is a very well balanced program in all aspects. I feel I have received an excellent training, which prepared me for my position in industry technically, through determining goals and through emphasis on continuous learning. Through the great efforts of the program director, Mr. Killian, and through the overall specialization of the program, I have received a solid background in ICT, which has attributed tremendously to my professional career." – Anita Bialek

"I will never forget all that you have done for me! I think about you often." – Margie Smith

"ICT has given me tremendous opportunity at Dow Corning. I have been promoted at an accelerated pace because of the excellent training." – Bob Nelson

"I wish more time had been spent analyzing instrumentation, as well as theory and usage. Need to focus on ion chromatography instrumentation. Seems to be an important analytical tool for the electronics industry. I could also have used a few management courses to understand why management does some of the things they do. At least make it a suggestion for elective coursework." – Y-Berger-Hein

"First I would like to thank you for the job tip. I started here at Lilly two weeks ago. I am mostly doing paperwork right now, but will soon be getting my hands on some real work." – Daniel Tomes

"I am working as a supervisor now and learning how to manage my personal time and projects which being organized is extremely important...Dealing with a wide variety of people in a management role is difficult in certain situations. In project labs, we got paired up with people that would clash personalities. This helped [us] learn how to deal with that in a manner to be productive...Mr. Killian gave direction but not necessarily a detailed road map. This made me rely on personal growth and accountability to get what is expected by self-starting and self-motivation...People have different backgrounds and...Having to explain in different terms and examples will allow me to communicate directions and ideas to hourly workers that are trying to complete a task." – Anonymous

"Thank you for everything. You've been a great teacher. I'm so glad that I went through the ICT program."- Stacie Jankewicz

"I often look back at my notes from school and appreciate all that I had learned in my ICT program. I think I put Instrumental and Quant to great use at Dow." – Edyta M. Boron-Wodzianski

"I just got all my background check and medical examination cleared with Dow Corning, and I'll be starting Monday, the 25th of June. Thanks for all your help throughout my education at Ferris." – Alitha A. Allbee

"I graduated in Spring of 1997 from ICT. I transferred to Michigan State University into Chemical Engineering. I'm glad to see that you are still in charge of the ICT program there [at Ferris]. Thanks for pushing me on to bigger and better things. Take care! And let me know if I can ever be of assistance to you in anyway." – Rachel Van Stratton-Kirk

Section 3: Employer Follow-up Survey

Our employers have already been surveyed for two other sections of this report.

Most of the members of our advisory board represent our programs largest employers. We have already sent them a written survey for this program review.

In addition, our Labor Market Analysis was conducted through telephone contacts with our employers to find out what the expected hiring trends will be.

Consistent with the last time we completed a program review, we have decided *not* to distribute yet another survey to this same group of people. (This would have made the third contact for many of them for *one* program review.) Instead, the information that we would have reported in this section is described in Section 6 (Advisory Committee Perceptions) and Section 7 (Labor Market Analysis).

Section 4: Student Evaluation of Instruction

The student ICT survey was administered in Fall of 2001. It was passed out to all returning ICT students, but not to any of these who are just entering the program in Fall 2001. As a result, this year's survey was completed by all eight returning students (i.e., a 100% response rate).

The areas the students cited as excellent include teaching and course content, as well as job and placement information. The areas of tutoring, equipment and overall cost were of greatest concern to these students, with cost questions being the only ones that elicited a poor response.

Student Perceptions of Occupational Education Programs - Survey Results

College: FSU Arts & Sciences
Title of Program: INCT

6 of 8 students surveyed said their objective for joining this college is to prepare to get a job. 1 of 8 said their objective was personal interest. The last did not respond to this question.

Please rate each item below:	Keypunch	Poor	Below Expectations	Acceptable	Good	Excellent	Don't Know
1. Courses in your occupational program are:							
Available and conveniently located.	**1**	0	0	0	5	3	0
Based on realistic prerequisites.	**2**	0	0	0	5	3	0
Available at moderate cost.	**3**	0	2	4	2	0	0
2. Written objectives for courses in your occupational program:							
Are available to students.	**4**	0	0	0	3	5	0
Describe what you will learn in the course.	**5**	0	0	0	4	4	0
Are used by the instructor to keep you aware of your progress.	**6**	0	0	0	7	1	0
3. Teaching methods, procedures, and course content:							
Meet your occupational needs, interests, and objectives.	**7**	0	0	0	2	6	0
Provide supervised practice for developing job skills.	**8**	0	0	0	1	7	0
4. Related courses (such as English, Mathematics, Science) are:							
Pertinent to occupational instruction.	**9**	0	0	2	3	3	0
Current and meaningful to you.	**10**	0	0	2	3	3	0
5. Work experience (or clinical experience) in your occupational program is:							
Readily available at convenient locations.	**11**	0	0	2	4	2	1
Readily available to both day and evening students.	**12**	1	0	2	0	2	3
Coordinated with classroom instruction.	**13**	0	0	0	4	2	2
Coordinated with employer supervision.	**14**	0	0	0	3	3	2
6. Career planning information:							
Meets your needs and interests.	**15**	0	0	0	3	5	0
Helps you plan your program.	**16**	0	0	0	3	5	0
Helps you make career decisions and choices.	**17**	0	0	0	3	5	0
Helps you understand your rights and responsibilities as an employee.	**18**	0	0	1	4	4	0
Helps you evaluate job opportunities in relation to salary, benefits, and conditions of employment.	**19**	0	0	0	3	5	0
Is provided by knowledgeable, interested staff.	**20**	0	0	1	3	4	0
Explains nontraditional occupational opportunities for both sexes.	**21**	0	0	2	1	5	0

Continued...

	Keypunch	Poor	Below Expectations	Acceptable	Good	Excellent	Don't Know
7. Job Success information on former students in your occupational program:							
Is provided to help you make career decisions.	**22**	0	0	0	2	6	0
Indicates how many job opportunities there are in your occupation.	**23**	0	0	0	2	6	0
Identifies where these job opportunities are located.	**24**	0	0	0	1	7	0
Tells about job advancement opportunities.	**25**	0	0	0	2	6	0
8. Placement services are available to:							
Help you find employment opportunities.	**26**	0	0	0	0	8	0
Prepare instruction so it is interesting and understandable.	**27**	0	0	0	1	7	0
9. Occupational instructors:							
Know the subject matter and occupational requirements.	**28**	0	0	0	1	7	0
Are available to provide help when you need it.	**29**	0	0	0	1	7	0
Provide instruction so it is interesting and understandable.	**30**	0	0	0	2	6	0
10. Instructional support services (such as tutoring, lab assistance) are:							
Available to meet your needs and interests.	**31**	0	0	2	3	2	1
Provided by knowledgeable, interested staff.	**32**	0	0	3	3	2	0
11. Instructional lecture and laboratory facilities:							
Provide adequate lighting, ventilation, heating, power, and other utilities.	**33**	0	0	0	3	5	0
Include enough work stations for the number of students enrolled.	**34**	0	0	2	2	4	0
Are safe, functional, and well maintained.	**35**	0	0	1	4	3	0
Are available on an equal basis for all students.	**36**	0	0	0	4	4	0
12. Instructional equipment is:							
Current and representative of industry.	**37**	0	0	3	2	3	0
In sufficient quantity to avoid long delays in use.	**38**	0	0	3	4	1	0
Safe and in good condition.	**39**	0	0	2	3	2	0
13. Instructional materials (e.g. , textbooks, reference books, supplies) are:							
Available and conveniently located for use as needed.	**40**	0	0	0	1	7	0
Current and meaningful to the subject.	**41**	0	0	0	3	5	0
Not biased toward "traditional" sex roles.	**42**	0	0	0	2	5	0
Available at reasonable costs.	**43**	2	1	3	1	1	1

■ Current Students Survey: Additional Comments

Work experience (or clinical experience) in your occupational program is "not required and is based on summer internships."

"CHEM 221 and 231 are not offered during the winter term, and CHEM 222 is not offered fall term. [This is] not convenient for those who wish to take internships during the summer."

Courses in your occupational program are: based on realistic prerequisites: "Managerial courses would be a good addition to the course list."

"Ferris charges more per credit hour than any other public university in Michigan, so of course INCT is gonna be expensive too."

"All of the teachers involved with INCT are very involved and knowledgeable in their fields. They are also very helpful and easy to talk to. [They are] always willing to help students."

"It is hard to find a good, knowledgeable tutor for the higher chemistry classes."

"Some students don't clean up after themselves, which can cause hazards in the lab, but usually others' teamwork takes care of the small messes before a problem arises."

"For the budget available to INCT, the equipment is phenomenal."

Instructional equipment is: Insufficient quantity to avoid long delays in use. "Due to the nature of some of the testing, delays are inevitable."

"The ICT library on 3rd floor Science [Building] is full of information and very accessible during the day, but very crowded."

Instructional materials (e.g., textbooks, reference books, supplies) are: available at a reasonable cost. "Spending over $400 on books for 2 classes is ridiculous or how about the books that can fit in your back pocket, but cost like $70?"

Section 5: Faculty Perceptions

The questions 1-32 were responded to with a number of 1-3, with 1 signifying agreement or above expectation, with 2 signifying agreement, and with 3 signifying below expectation. These were averaged for the number of respondents and are reported to two significant figures. Those who chose not to respond for lack of information chose 4, or N/A. These are reported, but not weighed into the averages.

The faculty questionnaires were sent to 15 faculty members and 11 were returned.

Questionnaires were placed in the faculty's mailboxes. Respondents were encouraged to return forms at a departmental meeting and through personal contact.

The average scores to most responses indicate a positive, strong, agreement with the statements. The major faculty concerns are with the following:

#20 There may not be enough student aid and laboratory assistants available to ensure maximum program effectiveness.

#30 There may not be adequate funding allocated to the program.

#32 There may not be sufficient funding allocated for equipment maintenance and the purchase of new equipment.

■ Responses to Faculty Questionnaire

#	Question	Average	N/A Respondents
1	Written measurable objectives have been developed for all occupational courses in this program, and are used to plan and organize instruction.	1.0	3
2	Current data on labor market needs and emerging trends in job opening are systematically used in developing and evaluating this program.	1.3	2
3	Current data on job performance requirements and trends are systematically used in evaluating course content of this program.	1.2	1
4	Current follow-up data on graduates are consistently and systematically used in evaluating this program.	1.2	1
5	Instruction in all required courses recognizes and responds to individual student interests, learning styles, skills, and abilities through a variety of instructional methods.	1.4	2
6	Applicable supportive courses are closely coordinated with this program and are kept relevant to program goals and current to the needs of the student.	1.3	1
7	Opportunities are provided for related work experience, cooperative education or internship for students in the program. Student participation is well coordinated with classroom instruction and employer supervision.	1.4	1
8	Students and potential students of this program are identified through recruitment activities, treated equally in enrollment selection, and not discouraged by unrealistic prerequisites.	1.2	-
9	Instructors or other qualified personnel advise students on program and course selection.	1.1	-
10	Instructors or other qualified personnel providing career planning and guidance services have current and relevant occupational knowledge and use a variety of resources to meet individual student career objectives.	1.2	-
11	This program includes information which is valuable to students once they have entered the work force.	1.2	-
12	The University has an effective system for locating jobs and coordinating placement for students in this program.	1.1	-
13	Success and failure of program graduates are assessed through periodic follow-up studies. Information learned is used to modify this program.	1.3	2
14	An active and organized effort is made to inform the public of the program training objectives, to encourage community support.	1.2	2
15	Responsibility, authority, and accountability for this program are clearly identified and assigned.	1.1	2
16	All persons responsible for directing and coordinating this program demonstrate a high level of administrative ability.	1.5	1
17	Student to faculty ratio in this program permits optimum program effectiveness.	1.3	-
18	Faculty members in this program have five or more years in relevant employment and/or teaching experience.	1.0	-

#	Question	Average	N/A Respondents
19	The University encourages and supports the continuing professional development of faculty through such opportunities such as conference attendance, curriculum development, and work experience.	1.3	-
20	When appropriate, paraprofessionals (aids or laboratory assistants) are used to provide classroom help to students and ensure maximum effectiveness of instructors in this program.	2.0	2
21	Office and clerical assistance is available to instructors and used to ensure their maximum effectiveness.	1.4	1
22	Equipment used in this program is current, representative of what is used in jobs for which the students are being trained, and in sufficient supply to meet student's needs.	1.6	1
23	Equipment for this program is operational, safe, and well maintained.	1.3	-
24	Computer hardware and software used in this program are in sufficient supply to meet the needs of instructors and students.	1.3	1
25	Instructional facilities meet the program objectives and student needs, are functional, and provide maximum flexibility and safe working conditions.	1.2	-
26	Scheduling of facilities and equipment is planned and used in a manner consistent with quality instruction.	1.1	-
27	Instructional materials and supplies are readily available and in sufficient supply to support quality instruction.	1.2	-
28	Learning resources for this program are available and accessible to students, current and relevant to the occupation.	1.2	-
29	Library resources are adequate to meet the program needs.	1.2	2
30	Adequate funds are allocated in the University's operating budget to support achievement of approved program objectives. Allocations are planned to consider instructor input.	2.1	2
31	The advisory committee for this program is active and representative of the occupation.	1.3	1
32	Funds are allocated to provide for new equipment as well as equipment replacement and repair. Fund allocation is consistent with the objectives of this program and based on instructor input.	2.0	1

■ Faculty Survey: Additional Comments

a.) "My general impressions of the ICT program are that it is an excellent program, well run and well organized. The design of the courses and laboratory experiences provides the student with a preparation for working in the chemical industry that is better than that provided by most 4-year chemistry degrees."

b.) "University could provide more funding given that up-to-date industrial grade equipment is very expensive.

c.) "The advisory committee has narrowly limited representation (Dow)."

d.) "This program [leads to] limited dead-end jobs."

e.) "Data used to prevent new programs from germinating."

f.) "Strong relations with employers and good follow-up with program graduates provide good feedback to the program. Changes in courses and the overall curriculum have been made in response to the suggestions received."

g.) "The program places students in a variety of positions and companies. Industrial demand for our graduates remains strong."

Section 6: Advisory Board Perceptions

The Industrial Chemistry Technology (ICT) Advisory Board was issued a questionnaire this past year at the annual board meeting in April. Other board members not in attendance were mailed the questionnaire. Members were contacted to remind them to mail their completed questionnaires.

The first section of the questionnaire, ***A***, consisted of items to be rated from 1-5, with the larger number indicating a more positive response. These items were divided into five categories. The second section of the questionnaire, ***B***, asked three open-ended questions on program strengths, needs for improvement and comments of a general nature for the program and the advisory committee.

The total number of respondents was eight.

Fifty percent or more of the advisory board members responded with a "five" to all of the questions *with this single exception:*

#2a Instructional equipment is well maintained.

■ Responses to Advisory Board Questionnaire

Percent (%) Response

	1	2	3	4	5	Don't Know
1. Instructional program content and quality are:						
Based on performance objectives that represent job skills and knowledge required for successful entry level employment	0	0	0	0	100	
Designed to provide students with practical job application experience	0	0	0	25	75	
Responsive to upgrading and retaining needs of employed persons	0	0	0	25	75	
Periodically reviewed and revised to keep current with changing job practices and technology	0	0	0	13	87	
2. Instructional equipment is:						
Well maintained	0	0	0	63	25	13
Current and representative of that used on the job	0	0	0	25	63	13
3. Instructional facilities:						
Provide adequate lighting, ventilation, heating, power, and other utilities	0	0	0	13	75	13
Allocate sufficient space to support quality instruction	0	0	0	25	63	13
Meet essential heath and safety standards	0	0	0	0	88	13

Percent (%) Response

	1	2	3	4	5	Don't Know
4. Placement:						
Services are available to students completing the program	0	0	0	0	88	13
Job opportunities exist for students completing the program or leaving with marketable skills	0	0	0	0	88	13
5. Follow-up studies on program graduates:						
Demonstrate that students are prepared for entry-level employment	0	0	0	0	63	37
Collect information on on-job success and failure of former students	0	0	0	13	50	37
Provide information used to review and, where warranted, revise the program	0	0	0	13	50	37

■ Advisory Board Survey: Additional Comments

1 *What do you perceive to be the major strengths of Ferris' associates program in chemistry?*

Flexibility and willingness to adapt to meet the needs of a given group of students.

The extensive laboratory time/training. Placement.

Students are well-prepared with the basic background to be successful in an entry level position. The amount of lab work required and the types of experiments are beneficial. Close contact with the professor/advisor helps keep students on the right track.

Very dedicated coordinator has student's best interest at heart. Many otherwise at-risk students are directed toward a degree and successful careers.

ICT graduates are recognized as setting the competitive standard. [ICT is an] excellent mix of theory and hands-on, practical lab experience. ICT labs are very well designed. Bill Killian's industry contacts in conjunction with Rankin services [are] the best. Bill Killian has established key relationships with industry leading companies.

2 *What do you perceive to be the major needs for improvement in Ferris' ICT program?*

The largest trouble area at this point seems to be the Quantitative Analysis course. I think the course needs to be evaluated due to the consistent poor grades by most students. Maybe it can be possible for the students to get outside help from someone other than the professor.

Could use greater financial support for instrumentation like a mass spectrometer and maintenance of warranties.

This program has been just about ideal for us, so I'd rather talk about maintaining the current quality of the program.

Allocate money to improve the ICT study room facilities next to Killian's office. More book-shelf space and desks for those ICT students that use the room for study and interaction with each other. Journals are still tied in bunches because there is no room. Subscribe to an ACS Chem Tech journal for the students to browse through. Add a Chemistry Communications class to the program to allow students ample opportunities to improve their speaking skills and journal reading abilities.

Extend support from alumni, such as career discussions/advice, equipment donations, job opportunities for ICT grads. Maintenance support for "dated" lab equipment. Integrate newer state of the art lab equipment.

It is difficult to find replacement parts for dated equipment. Technology is constantly changing and being updated.

[I] have not heard of any job failure stories.

3 *State any additional comments or suggestions for the program or for the involvement of this advisory committee.*

The advisory committee needs to establish annual goals and objectives with deliverables to be reviewed at the annual board meetings.

We at Pfizer are very appreciative of Dave and Pasquale for their openness to "non-standard" situations like ours, and especially to Prof. Bill Killian, whose willingness to travel and to teach our technicians has made the program here.

The only other area that I feel could be improved is making the students give more presentations. Many of the students are not involved in any activities where they need to give presentations. The one-on-one conversation is good but presentations to groups is an important part of the job.

[The] training program at Pfizer is the benchmark.

Section 7: Labor Market Analysis

Data was obtained from five major companies that have hired chemical technologists in the past several years and from one that is pursuing the idea. These companies include The Dow Chemical Company, Eli Lilly, Ticona Plastics, Dow Agro-Sciences, Intel and SC Johnson. Representatives from these companies were questioned regarding such areas as hiring outlook, preparedness of Industrial Chemistry Technology graduates and areas of employment for chemical technologists within their respective companies.

The demand for qualified technical individuals is continually on the rise. The National Science and Technology Council issued a report in April 2000 titled "Ensuring a Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century." In a statement regarding this report Neal Lane, Assistant to the President for Science and Technology, said "the increasing economic role of science, technology and engineering has increased demand for all types of scientific, technical and engineering workers, from technicians to Ph.D. research scientists and engineers; and we have some serious issues to address in that regard." The report also highlights information from the Bureau of Labor Statistics that estimates that from 1998 to 2008, "the job category with the second fastest estimated growth rate is technicians and related support occupations."

Hiring trends for *The Dow Chemical Company* have been very good, with the company hiring more than fifty new technologists over the past two years. Technologists at Dow work in areas such as Research and Development, Manufacturing, Analytical Sciences, and Health and Environmental Services. Due to the large demand for technical personnel, Dow has had to explore many avenues for recruiting qualified people. However, Dow continues to be an active supporter of the Ferris program by recruiting graduates, offering summer internship programs, and providing financial grants to qualified students. Ferris State University continues to be one of the few colleges from which Dow actively recruits chemical technologists.

Another company with a history of hiring Ferris INCT graduates is *Eli Lilly* in both Lafayette IN and Indianapolis IN. The outlook for hiring appears good and the Indianapolis facility is expecting to hire between 25 and 30 technologists. As with most chemical companies, annual hiring is variable making it difficult to predict future needs. Chemical technologists can expect to work in areas of Research and Development, Quality Control, and Environmental in both pilot plant and lab areas. Ferris Alumni have been well prepared for these positions graduating with the basic background they need.

Ticona Plastics, located in Auburn Hills MI, currently has no chemical technologists within their company. However, they do hire plastics graduates with a two-year degree. The company has an Analytical lab that could possibly use a few chemical technologists. This is an area that is going to be explored by the company for future hiring possibilities.

Dow AgroSciences (formerly Dow Elanco), located in Indianapolis IN, has recruited graduates from Ferris intermittently in the past. The majority of recent chemical technologist hires have been contract personnel that currently work within the company. Dow AgroSciences expects to coordinate its recruiting efforts and to develop contacts with more colleges from which to recruit. Areas of employment are in various parts of Research and Development such as Analytical or Biology.

Intel has just recently begun recruiting INCT graduates from Ferris. In 2000, Intel hired two graduates to work at their facility in Arizona. Intel would like to start routinely recruiting at Ferris; unfortunately a recent downturn in business has limited their hiring for now. Intel came to Ferris to recruit due to a suggestion by a manager at the company who is a Ferris alumnus. The two Ferris graduates have performed very well in the last year, which has shown Intel management that Ferris is an "excellent source for skills that they (we) are looking for." Chemical technologists work in the area of chemical analysis at Intel.

Another company new to Ferris recruiting is *SC Johnson*, with headquarters in Racine WI. Until approximately three years ago SCJ did not have a recruiting program. With help from yet another Ferris alumnus, SCJ has begun recruiting at a few schools with chemical technology programs. Currently the company has a hiring freeze but does plan to recruit at Ferris in the future. The company also offered summer internships to students this year and one student from Ferris accepted. The areas of employment at SCJ include Analytical, Packaging, Process Development and Product Development.

Although company representatives were not contacted for this survey, Dow Corning Corporation, Pharmacia (formerly UpJohn) and Michigan Dairy all recruited at Ferris for 2001 graduates. Other companies that regularly contact Ferris to request student resumes include Cytec, Laprino Foods and Environmental Quality.

Section 8: Facilities and Equipment

In this section the facilities (rooms) available to students in the ICT program are described, and a list of the chemistry equipment in the department is provided.

■ Facilities

These laboratory rooms and support spaces in the Physical Sciences Department are used to support instruction in the ICT program.

ICT complex

SCI 301: ICT laboratory
SCI 309: ICT instrumental laboratory
SCI 307: ICT prep/office/meeting space
SCI 301A: ICT storage

Physical Sciences Stockroom

SCI 317A: Stockroom prep area

Analytical Chemistry

SCI 321 Analytical chemistry laboratory
SCI 321A: Analytical chemistry balance room
SCI 313: Analytical chemistry research laboratory

General Chemistry

SCI 314: General chemistry laboratory
SCI 320: General chemistry laboratory
SCI 333: General chemistry laboratory
SCI 335: General chemistry laboratory
SCI 314A: General chemistry balance room
SCI 333A: General chemistry balance room
SCI 314B: General chemistry prep room
SCI 333B: General chemistry prep room

Organic Chemistry

SCI 328: Organic chemistry lab
SCI 332: Organic chemistry lab
SCI 332A: Organic chemistry research lab
SCI 330: Organic chemistry instrument room
SCI 328A: Organic chemistry prep area

■ Equipment

The following list details equipment available for use by ICT students.

Spectrometers

Varian EM 390 NMR Spectrometer
Perkin-Elmer Paragon 1000 FT-IR Spectrometer
Nicolet J10P FT-IR Spectrometer
Varian Cary 1E uv-vis Spectrometer
Perkin Elmer Atomic Absorption Spectrometer 3100

Gas Chromatographs

Varian 3300 GC (3)
SRI 8610C GC
HP 6800 GC system

HPLC Systems

Varian ProStar Model 210 Solvent Delivery System
Varian ProStar Model 320 uv-vis Detector

Polymer

Brookfield Synchro-lectric Viscometer Model LVF

Biochemical

Fisher-Scientific Accumet Model 15 pH Meter
Orion pH Meter Model 420A
Corning pH Meter 320

Supporting Equipment

- Mettler Toledo HG53 Halogen Moisture Analyzer
- HP 3300-A Function Generator
- Microscopes
  - Various (24)
  - National Stereomicroscope
  - Meiji Techno Stereomicroscope
  - AO Scientific Instruments One-fifty Stereomicroscope
- Glassware Ovens (4)
- Icemakers (3)
- Fisher Scientific Centrific Model 228 Centrifuge (10)
- Rotary Evaporators
  - Büchi Rotavapor R-3000 (5)

Büchi Rotavapor RE111
Büchi Flash-Evaporator

Refractometers
- Bausch & Lomb Abbe 33-45-58 (3)
- Bausch & Lomb Abbe 33-46-10
- Leica Mark II (3)
- Reichert-Jung Abbe Mark II

Laboratory Balances
- Mettler PB30
- Mettler BB240
- Mettler PB300
- Mettler PE300
- Mettler Toledo B2002-S (2)
- Mettler Toledo College B502 (6)
- Mettler Toledo College B1302 (2)
- Mettler Toledo College B303 (2)
- Acculab V-200

Analytical Balances
- Mettler College 150 (9)
- Mettler H64

Melting Point Apparati
- Fisher-Johns (3)
- Electrothermal 9100 (2)
- Electrothermal M.P.A.
- Mel-Temp (8)
- Sanyo Gallenkamp (2)

UV-lamps
- Gelman Instrument Company Model No. 51438
- Mineralight Lamp Model UVGL-15
- Mineralight Lamp Model UVGL-55

■ Comments on Facilities and Equipment

Our advisory board reviewed our facilities and equipment at its most recent meeting. Members of the board agreed that the facilities are far more than adequate to provide for the program. In addition, the current equipment list constitutes an impressive set of instrumentation for students in a two-year program to use.

Over the past five years, additions to our equipment have primarily come from these four sources:

1. Upon completion of the Arts and Sciences remodeling project, some of the remaining money was allocated towards equipment purchases. One purpose of this allocation was to provide adequate equipment for the new laboratory spaces in the Science Building.

2. We have received some one-time funding for equipment through the university itself.

3. Perkins funds have been applied towards equipment for the ICT program.

4. Finally, we have received equipment donations from industry. While these items may have outlived their usefulness in an industrial setting, they have proven valuable training devices for our students.

Furthermore, our department is attempting to upgrade our equipment holdings through grant requests. Earlier this year our organic chemistry faculty submitted a grant to the National Science Foundation (NSF) to support the purchase of an FT-NMR (Fourier transform nuclear magnetic resonance) spectrometer, permitting students to finish analyses in a matter of a few minutes rather than a half hour. One of the companies who regularly hires our employees has already signaled its willingness to provide part of the matching funds required to purchase this instrument (if the NSF provides the grant).

Please note, however, that regular departmental funding is *not* a source of equipment support, neither for purchases nor for maintenance. The department does not receive a regular allocation specifically for purchasing, upgrading or maintaining equipment for the ICT program.

At our last advisory board meeting, one of the industrial members made the point that his industry is willing to donate equipment to programs that have the faculty expertise to utilize the equipment and the administrative support to maintain it. Our current lack of regular budgetary backing for the equipment puts possible future donations at risk.

And sophisticated equipment requires funding to keep it running. Recently our department spent more than $4000 to refurbish our NMR spectrometer.

The advisory board strongly recommends that the university provide sufficient funding *on an annual basis* to support and maintain the department's chemistry equipment.

Section 9: Curriculum Evaluation

The purpose of the ICT curriculum is to prepare students to work as technicians in the chemical industry upon graduation. We view the curriculum as consisting of the following three components: (1) a strong background in chemistry and chemical technology; (2) the necessary supporting skills in science, math and computers; and (3) other classes in general studies that contribute to a well-rounded college education.

Feedback that we have received from graduates and employers suggests that our graduates are well prepared for their work. In fact, when asked why he recruits Ferris graduates, a former member of our advisory board stated that "Ferris students have a university education with their two-year degree." This is exactly the type of graduate that our employers seek. Most employers prefer a two-year degree to a four-year degree when hiring technicians. And since Ferris ICT students "rub shoulders" with pre-pharmacy, pre-optometry and other four-year students in their classes, they are challenged at a higher intellectual level and are accustomed to rigorous competition. This sets Ferris apart from other chemical technology programs in the state (all of which are at community colleges).

■ ICT Curriculum

The ICT curriculum currently consists of the courses described below. For classes in the chemistry and science/math/computer categories, the course name and description are provided. For the other general education courses, only the basic course information is provided. Attached at the end of this section is a copy of the program checksheet as it currently appears on the web.

Chemistry and Chemical Technology courses.

Note: A sample syllabus for every course in this section is attached as an appendix.

CHEM 121: **General Chemistry 1.** (4 + 3, 5 credit hours). Fundamental principles, laws and theories of general chemistry, including stoichiometry, gas laws, thermochemistry, atomic structure, chemical bonding, periodicity, liquids and solids, solution chemistry, and theories of acids and bases. Concurrent laboratory/workshop sessions will include exercises illustrating the principles discussed in lecture. Students who anticipate enrolling in chemistry courses at the 200-level or higher should take this course. This course meets General Education requirements: Scientific Understanding, Lab.

CHEM 122: **General Chemistry 2.** (4 + 3, 5 credit hours). Continuation of CHEM 121, including oxidation-reduction reactions, electrochemistry, chemical equilibrium, chemical kinetics, nuclear chemistry, thermodynamics, and descriptive chemistry of metals and nonmetals. Laboratory will involve some experiments illustrating topics discussed in lecture along with several sessions devoted to the qualitative analysis of common cations and anions. This course is a prerequisite for most 200-level or higher classes in chemistry. This course meets General Education requirements: Scientific Understanding, Lab.

CHEM 221: **Organic Chemistry 1.** (4 + 3, 5 credit hours). Modern bonding theory in organic molecules, theory of reactions, stereochemical principles, chemistry of alkanes, cycloalkanes, alkenes, dienes, alkynes, aromatics, and alcohols, with special emphasis on reaction mechanisms. Concurrent laboratory includes basic laboratory techniques, synthesis, TLC and GC, stereochemistry and spectroscopy workshops. This course meets General Education requirements: Scientific Understanding, Lab.

CHEM 222: **Organic Chemistry 2.** (4 + 3, 5 credit hours). Study of ethers and epoxides, carbonyl-containing compounds, aldehydes, ketones, carboxylic acids and their derivatives, carbanion chemistry, aliphatic and aromatic nitrogen-containing compounds, with special emphasis on bioorganic compounds, amino acids and polypeptides, carbohydrates and lipids. Concurrent laboratory includes multistep synthesis, spectroscopic analysis, and the systematic identification of organic compounds with emphasis on chemical separation and purification techniques. This course meets General Education requirements: Scientific Understanding, Lab.

CHEM 231: **Quantitative Analysis.** (3 + 4, 4 credit hours). Introduction to classical quantitative and modern instrumental methods of analysis, including data handling, statistics, volumetric and gravimetric techniques, potentiometry, spectroscopy, and liquid chromatography. Concurrent laboratory includes the topics referred to above. This course meets General Education requirements: Scientific Understanding, Lab.

CHEM 317: **Instrumental Analysis.** (2 + 4, 3 credit hours). The theory and instrumentation of modern analytical techniques will be explored, including potentiometry, infrared (IR) spectroscopy, nuclear magnetic resonance (NMR) spectroscopy, atomic absorption (AA) spectroscopy, and gas chromatography. Concurrent laboratory work includes projects involving these techniques. This course meets General Education requirements: Scientific Understanding, Lab.

INCT 120: **Orientation to Industrial Chemistry Technology.** (2 + 0, 2 credit hours). Overview of the chemical industry, including its development and practical applications of chemistry in an industrial setting. The role of the industrial chemist and/or technologist is discussed. Emphasis is also placed on use of the scientific literature available and the study of patents.

INCT 125: **Safety and the Chemical Laboratory.** (2 + 0, 2 credit hours). Introduction to the chemical lab and the safety related responsibilities of the practicing chemist and/or technologist. Emphasis is placed on the safe handling and storage of hazardous materials, recognizing non-compatible materials, understanding and interpreting safety documents such as MSDS sheets, and in general becoming a safety conscious lab worker.

INCT 220: **Industrial Chemical Calculations.** (2 + 0, 2 credit hours). A review of the stoichiometric and weight relations in the chemical industry with an emphasis on problem solving. This course also covers statistical process control, as well as statistical techniques for evaluating experimental results. Scale-up problems and the use of industrial units are emphasized.

INCT 230: **Chemical Manufacturing & Analysis.** (1 + 8, 4 credit hours). A laboratory intensive course stressing the preparation and analysis of various materials including plastics, pesticides, and petroleum products, as well as a variety of pure substances. Characterization by instrumental methods, testing by use of American Society Tests and Materials (ASTM) methods, and notebook keeping are also emphasized. Lecture topics include polymer synthesis and characterization as well as special topics in analysis.

Other Science/Math/Computer courses.

PHYS 211: **Introductory Physics 1.** (3 + 3, 4 credits). Basic concepts and applications of motion, force, energy, fluids, heat and sound. This course meets General Education requirements: Scientific Understanding, Lab.

PHYS 212: **Introductory Physics 2.** (3 + 3, 4 credits). Continuation of PHYS 211. Basic concepts and applications of electricity, magnetism, light and modern physics. This course meets General Education requirements: Scientific Understanding, Lab.

MATH 120: **Trigonometry.** (3 + 0, 3 credits).
An elementary course in plane trigonometry. Includes the trigonometric functions, their properties, solution of right and oblique triangles, radian measure, graphs, identities, trigonometry equations, vectors, and applications. Related topics in Geometry included. Calculators with trigonometric functions required.

ISYS 105: **Introduction to Microcomputer Systems and Software.** (3 + 0, 3 credits)
Use of common micro application software, including: windows type operating systems, word processing, spreadsheets, presentation software, and the Internet.

Other general education requirements.

ENGL 150: **English 1.** (3 + 0, 3 credits).

ENGL 250: **English 2.** (3 + 0, 3 credits).

Cultural enrichment elective (3 credits).

Social awareness elective (3 credits).

■ ICT End-of-Program Outcomes

Students who complete the prescribed curriculum are expected to have the skills, upon graduation, to work in the chemical industry. The following table shows the outcomes that students are expected to master in the program, along with the courses that provide instruction in those outcomes.

End-of-Program Outcome	Courses that meet outcome
a. Interpret and communicate basic chemical terminology.	CHEM 121, CHEM 122, CHEM 221, CHEM 222, INCT 120, INCT 125, INCT 220, INCT 230
b. Perform calculations involving chemical reactions that require the application of the mole and related concepts.	CHEM 121, CHEM 122, CHEM 231, INCT 220
c. Relate material and energy balances of chemical equations.	INCT 220
d. Predict the course of simple chemical reactions.	CHEM 121, CHEM 122, CHEM 221, CHEM 222
e. Prepare mixtures of specified compositions when the components of the mixtures are expressed in different quantitative units.	CHEM 121, CHEM 122, CHEM 231, INCT 220, INCT 230
f. Follow directions in the preparation of materials.	INCT 120, INCT 125, INCT 230
g. Use appropriate units with calculations.	CHEM 121, CHEM 122, CHEM 231, CHEM 317, INCT 220, INCT 230
h. Keep a laboratory notebook according to proper specifications, including the notation of unexpected occurrences.	CHEM 221, CHEM 222, INCT 230

i. Communicate chemical concepts and information clearly, both orally and in writing.	ENGL 150, ENGL 250, INCT 120, INCT 125, INCT 220, INCT 230
j. Prepare compositions or compounds, given the directions. Identify references that might provide appropriate directions.	CHEM 221, CHEM 222, INCT 230
k. Suggest the use of alternative materials in preparing compositions.	INCT 230
l. Conduct chemical analysis under supervision.	CHEM 231, CHEM 317, INCT 230
m. Use common scientific instruments (including, but not limited to, pH meters, IR and UV-vis spectrophotometers, liquid chromatography, gas chromatography) to analyze and characterize compounds.	CHEM 231, CHEM 317, INCT 230
n. Conduct laboratory procedures in accordance with the basic rules of laboratory safety.	INCT 125
o. Demonstrate competency in the use of computer software appropriate for the chemical industry, including word processing, spreadsheets and database management.	ISYS 105, INCT 120, INCT 125, INCT 220, INCT 230

■ Comments on Curriculum

1. The curriculum was designed to enable students to meet the program outcomes outlined above. Advice from program graduates, faculty members, industry employers and advisory board members is sought on an ongoing basis to make sure that the curriculum meets the needs of local industry.

2. The curriculum includes the coursework (both lecture and laboratory) expected by the American Chemical Society in chemical technology programs.

3. Partial evidence that the curriculum is working as intended is provided by recent program graduates and employers. Both groups say that Ferris ICT

graduates are well prepared to work in industry immediately upon graduation.

4. Over the past two years, CHEM 317 *(Instrumental Analysis)* has considerably evolved. With financial assistance from Dow Chemical, James Weaver has written a laboratory book that gives students detailed background into the instruments that they'll use and the types of analyses they will perform. Students are now expected to carry out extensive report writing. Not only does this give students valuable pre-employment training, but it also helps to "set up" the INCT 230 course (see description in next paragraph).

5. INCT 230 (*Chemical Manufacturing and Analysis*) provides students with a setting that is similar to what they will face on the job. It could be viewed as a course the provides a "capstone" experience for this two-year program. Two of the tasks that students must complete during the semester they take this course are (a) keeping a detailed laboratory notebook of their work and (b) making an oral report to all their classmates. The oral reports are evaluated by all their classmates and by several members of the Physical Sciences Department (not just the course instructor). The notebook serves as a "portfolio" of their project work in this class; many students take this notebook to job interviews to show prospective employers their ability to perform this critical job function.

6. Many students who complete CHEM 121 and CHEM 122 at Ferris State University take a standardized American Chemical Society examination at the end of the course. While we have not separately analyzed the test data for ICT students, the overall results on this exam (for *all* students) show that Ferris students obtain an average score at about the 55^{th} to 60^{th} percentile, slightly higher than all students nationally who take the exam.

7. A key component of this curriculum is its flexibility. Many other science programs at Ferris require a similar set of courses in chemistry, mathematics and physics. This makes it possible for students to readily transfer into the ICT program as late as the end of the freshman year and still complete the program in two years of college study.

8. At last spring's advisory board meeting, the curriculum was reviewed and discussed. Our industrial members of the board expressed overall satisfaction with most aspects of the curriculum. Two practical suggestions emerged from this meeting. First, students need to be well prepared to communicate their results to other members of their work teams or to their superiors. It was proposed that more oral communication work be incorporated into the professional part of the curriculum. Second, some of the chemistry courses appear to be tougher than others for these students to handle. It was proposed that ICT students be given appropriate support in such courses so that they can successfully handle the workload across the entire curriculum.

INDUSTRIAL CHEMISTRY TECHNOLOGY • ASSOCIATE IN APPLIED SCIENCE

Why Choose Industrial Chemistry Technology?

Students in the Industrial Chemistry Technology program are trained in general, organic, analytical and instrumental chemistry. In addition, specialty classes focus on the chemical industry, safety issues and statistical process control.

All classes are taught by faculty with many years of experience in industrial chemistry. The Ferris Industrial Chemistry Technology program is one of only a few such programs approved by the American Chemical Society.

Get a Great Job

Industries throughout Michigan and the Midwest are using increasingly sophisticated chemical procedures. Consequently, industrial leaders are becoming more concerned about health hazards and safety factors. These companies need better-trained chemistry technicians, and many managers seek Ferris graduates to fill the demand.

Graduates find jobs in a variety of industries, including chemical, plastics, pharmaceutical, environmental, paint, food, automotive, petroleum and personal care products.

Admission Requirements

First year student admission is open to high school graduates (or equivalent) who demonstrate academic preparedness, maturity and seriousness of purpose with educational backgrounds appropriate to their chosen program of study. High school courses and grade point average, ACT composite score, and ACT Reading and Mathematics subscores will be considered in the admission and 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 must provide their high school records and ACT scores for admission review.

Graduation Requirements

The Industrial Chemistry Technology program leads to an associate in applied science degree. Graduation requires a minimum 2.0 GPA overall. Students must complete all general education requirements as outlined in the General Education section of the University Catalog as well as all Industrial Chemistry Technology program coursework.

More Information

For more information about this program, write to
Department of Physical Sciences
Ferris State University
820 Campus Drive/ASC 3021
Big Rapids, MI 49307-2225
or call (231) 591-2580.

Required Courses

Required Courses		Credit Hours
General Education		
ENGL 150	English 1	3
ENGL 250	English 2	3
Electives:	Cultural Enrichment	3
	Social Awareness	3
Program		
CHEM 121	General Chemistry 1	5
CHEM 122	General Chemistry 2	5
CHEM 221	Organic Chemistry 1	5
CHEM 222	Organic Chemistry 2	5
CHEM 231	Quantitative Analysis	4
CHEM 317	Instrumental Analysis	3
INCT 120	Orientation to Industrial Chemistry Technology	2
INCT 125	Safety and the Chemical Laboratory	2
INCT 220	Industrial Chemical Calculations	2
INCT 230	Chemical Manufacturing and Analysis	4
ISYS 105	Microcomputer Applications	3
MATH 120	Trigonometry	3
PHYS 211	Introductory Physics 1	4
PHYS 212	Introductory Physics 2	4

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CHEMISTRY 121
General Chemistry 1
SYLLABUS

I. INSTRUCTOR

L. Jacobs Office: ASC-3007
Office Hours: 1:00 MTRF
(Other hours by appointment)
Phone: 591-2596

II. TEXT / REQUIRED MATERIALS

General Chemistry, 6th ed, by Ebbing & Gammon
Lab Workbook for Chemistry 121 & 122
by FSU Chemistry Faculty
Lab Handbook for Gen Chem by Griswold, et. al.
Chem 121/122 Lect/Lab Notes by Jacobs
Scientific Calculator
Eye protection. Glasses or goggles (meeting current OSHA standards) **MUST** be worn in the lab **AT ALL TIMES. Noncompliance will result in dismissal from the lab w/ an unexcused absence.** Safety glasses and/or goggles are available at the bookstore.
Contact lenses should NOT be worn in the lab.

III. COURSE OBJECTIVES

CHEM 121 is a study of the fundamental principles, laws and theories of general chemistry, including nomenclature, stoichiometry, gas laws, thermochemistry, atomic structure, chemical bonding, periodicity, liquids and solids, solution chemistry and theories of acids and bases.

IV. COURSE PREREQUISITES

Successful completion of one year of high school chemistry (or CHEM 103 - Prep Chem) and algebra (or MATH 110 - Fundamentals of Algebra) are prerequisites to CHEM 121.
Also, completion of, or concurrent enrollment in MATH 115 - Intermediate Algebra.
Reading, writing, and algebra at the college level are required.

V. COURSE REQUIREMENTS

Lecture: The lecture part of this course meets 4 hours each week (12:00 MTRF) in SCI - 102.
Attendance is required for every lecture and lab!
For each unexcused absence or tardiness, three (3) points will be DEDUCTED from your next test score.
Your first two (2) times of being tardy (before Test No. 1) will be automatically excused.
Participation is required for every lecture.
For each **unresponsive answer**, three (3) points will be DEDUCTED from your next test score.
I may occasionally give a bonus quiz.
There are NO MAKE-UPS for these bonus quizzes regardless of the reason for missing.
Tests are scheduled for the regular lect/lab periods and you are expected to take the tests at the scheduled times. If you have an acceptable reason for missing a test (e.g., acute illness or authorized school function), you **MUST** let me know **BEFORE** the test so that a make-up can be arranged.

The **FINAL EXAM** is scheduled for **Tue, Dec. 11 at 12:00 p.m. in SCI - 102.**
This will be an ACS First Term General Chem Exam. It **WILL COUNT** towards your grade in CHEM 121.
Do NOT make any plans that would prevent you from being present for this test!!!

Lab: The lab part of this course meets 3 hours each week. All lab sections meet in SCI - 333.

Sect 224 M 3-6,	Sect 223 T 3-6,
Sect 222 R 8-11,	Sect 221 F 8-11

ATTENDANCE IN LAB IS MANDATORY!
The instructor has the right to prevent anyone who arrives late for lab from attending that lab section.
If you have an acceptable excuse for missing lab (as determined by the instructor) you must let me know **BEFORE** the lab period so that make-up time can be arranged. The lab week runs from Mon to Fri.
If you have unexcused absences for TWO or more labs you will AUTOMATICALLY FAIL the course.
PRE-LAB REPORTS are due at the Fri lecture of the week PRIOR to your lab and POST-LAB REPORTS are due at the END of the lab period.
Failure to turn in the PRE-LAB REPORT on time is an automatic - 10 points. If you are absent from lecture FOR ANY REASON on the day that a PRE-LAB REPORT is due, your PRE-LAB REPORT must still be turned in on time to avoid the -10 pt penalty. Negative scores are possible on both the PRE-LAB REPORT and the POST LAB REPORT.
Lab reports are graded on accuracy, precision, sig. figs, units, clarity, set-ups, neatness, etc.
There may also be quizzes in the lab.

Homework: Homework consists of the questions and problems at the end of each textbook chapter plus any ques/prob handouts. Doing the homework represents one of the **MOST IMPORTANT PARTS** of the learning process in this course and therefore it is **ESSENTIAL** that you do the homework. To gain the most advantage from the homework ques/probs, be sure that you **TRY THEM BEFORE CLASS.** It will also be necessary for you to **PRACTICE** the various types of problems encountered in this course so that you can recognize them immediately on a test. **PRACTICE** on the homework problems (doing them over & over & over) is your best opportunity for **LEARNING** the material. It will also be advantageous for you to **REWRITE** your class notes and **REWORK** the problems done in class **ASAP** after class.

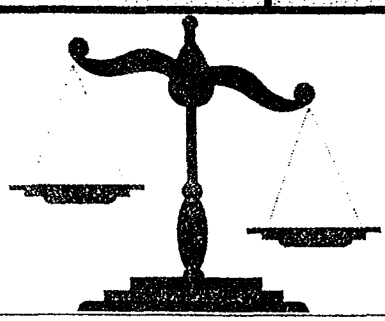
VI. GRADING

6 (1 hr) exams @ 100 pts each	= 600 pts
1 (2 hr) final exam on T Dec. 11	= 200
lab	= 150
non - bonus quizzes	= 50
total	= 1000 pts

A word of advice on taking tests Read (skim) all of the questions and problems first, quickly, before answering any of them. Then go back and **DO THE EASY ONES FIRST.** Do not waste time on the hard ones until you have all the easy ones finished.

Your final grade will be based on the following tentative scale:

	88% B+	76% C+	63% D+	
94% A	83% B	70% C	58% D	<55% F
90% A-	80% B-	65% C-	55% D-	



L. JACOBS OFFICE ASC-3007
CHEMISTRY PHONE EXT 2596

FALL SEMESTER 2001

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
8:00				Chem 121 lab	Chem 121 lab
9:00				SCI-333	SCI-333
10:00				(222)	(221)
11:00		Meetings		Meetings	
12:00	Chem 121 SCI-102	Chem 121 SCI-102		Chem 121 SCI-102	Chem 121 SCI-102
1:00	OFFICE	OFFICE		OFFICE	OFFICE
2:00					
3:00	Chem 121 lab	Chem 121 lab			
4:00	SCI-333	SCI-333			
5:00	(224)	(223)			
6:00					

CHEMISTRY 121

Fall Semester 2001

Monday	Tuesday	Thursday	Friday
First Day Aug 27 of Class Course Intro. Lab # 1 Safety Video Math Ck Up	Aug 28 Chap 1 Chem & Meas	Aug 30 Seating Chart Chap 1	Aug 31 Chap 1
Sept 3 Labor Day - No Classes	Sept 4 Chap 1	Sept 6 Chap 1	Sept 7 Chap 1
Sept 10 Chap 2 Atoms, Molecules, and Ions Lab # 2 Meas of Phy Prop	Sept 11 Chap 2	Sept 13 Chap 2	Sept 14 Chap 2
Sept 17 **TEST No. 1** Chap 1 & 2 Lab # 3 Form.of a Hydrate	Sept 18 Chap 3 Calc's with Chem Formulas and Equations	Sept 20 Chap 3	Sept 21 Chap 3
Sept 24 Chap 3 Lab # 4 Inorg. Nomen.	Sept 25 Chap 4 Chem Rxs: An Introduction	Sept 27 Chap 4	Sept 28 Chap 4
Oct 1 Chap 4 Lab # 5 Stoichiometry	Oct 2 **TEST No.2** Chap 3 & 4	Oct 4 Chap 5 Gaseous State	Oct 5 Chap 5
Oct 8 Chap 5 Lab # 7 Mol Wt Vol Liq	Oct 9 Chap 5	Oct 11 Chap 6 Thermochem	Oct 12 Chap 6
Oct 15 Chap 6 Lab # 8 Heat of Neutral.	**Mid-Term Oct 16 Grades** Chap 6	Oct 18 **TEST No. 3** Chap 5 & 6	Oct 19 Chap 7 Quantum Theory
Oct 22 Chap 7 Lab # 6 Iron Analysis	Oct 23 Chap 7	Oct 25 Chap 8 Electron Config & Periodicity	Oct 26 Chap 8
Oct 29 Chap 8 Lab # 9 Alum	Oct 30 Chap 8	Last Day Nov 1 for "W" Chap 8	Nov 2 **TEST No. 4** Chap 7 & 8
Nov 5 Chap 9 Ionic/Coval Bond Lab # 10 Lewis Formulas	Nov 6 Chap 9	Nov 8 Chap 9	Nov 9 Chap 9
Nov 12 Chap 10 Mol Geo/Bond Lab # 12 Acid/Base Tit'n	Nov 13 Chap 10	Nov 15 Chap 10	Nov 16 **TEST No. 5** Chap 9 & 10
Nov 19 Chap 11 Liqs & Solids Lab - No Lab	Nov 20 Chap 11	Nov 22 Thanksgiving Break No Classes	Nov 23 No Classes
Nov 26 Chap 12 Solutions Lab# 13 Mol Vol of N_2	Nov 27 Chap 12	Nov 29 Chap 12	Nov 30 **TEST No. 6** Chap 11 & 12
Dec 3 Chap 15 Acids/Bases Lab - Check Out	Dec 4 Chap 15	Dec 6 Review	Last Day Dec 7 of Class Review

FINAL EXAM on TUESDAY, DEC 11 at 12:00 pm in SCI - 102

Chemistry 121
Ebbing 6th ed
Assigned Homework Problems

Chapter 1 Chem & Measurement	**49 –56** **1 – 48**	**65 –72** **83 – 102**	**57 – 64** **103 – 132**	**73 – 82**	
Chapter 2 Atoms, Molecules & Ions	**1 – 48**	**49 – 82**			
Chapter 3 Calc's with Chem Formulas & Equations	**21 – 40**	**41 – 48**	**49 – 68**	**69 – 90**	**1 – 20**
Chapter 4 Chemical Reactions An Introduction	**21 – 40**	**41 – 70**	**71 – 82**	**1 – 20**	
Chapter 5 The Gaseous State	**31 – 48**	**49 – 82**	**89 – 94**	**1 – 30**	
Chapter 6 Thermochemistry	**33 – 48**	**49 – 62**	**63 – 78**	**1 – 32**	
Chapter 7 Quantum Theory of the Atom	**27 – 62**	**Lab Workbook for Chem 121 & 122** **Appendix E Nomenclature of Complexes**			
Chapter 8 Electron Configurations & Periodicity	**31 – 50**	**51 – 74**	**1 – 30**		
Chapter 9 Ionic & Covalent Bonding	**19 – 76**				
Chapter 10 Molecular Geometry & Chem Bonding Theory	**17 – 46**				
Chapter 11 States of Matter; Liquids & Solids	**1 – 9** **25 – 28**	**21 – 23** **41 – 44**	**29 – 40** **53 – 64**	**45 – 50** **71 – 84**	**10 – 19**
Chapter 12 Solutions	**41 – 58** **59 – 74**	**Conc probs in Chem 121/122 Lect/Lab Notes p38**			
Chapter 15 Acids & Bases	**21 – 28**	**35 – 42**			

Industrial Chemistry Technology

APRC 2001-2002

Section 2 of 2

FERRIS STATE UNIVERSITY
College of Arts and Sciences

TO: Arts and Sciences Faculty
FROM: Matthew A. Klein, Associate Dean
SUBJECT: Excused Absence Policy
DATE: January 30, 1995

All student requests to be excused from classes are the responsibility of the faculty member teaching the course. The only excused absence that is a part of University policy involves institutional travel which must be approved by the Vice President for Academic Affairs. Students participating on approved University related travel are to be excused from classes but are still responsible for making up any missed assignments and/or tests. It is up to the discretion of individual faculty members whether other extenuating circumstances should be considered for an excused absence. The Dean's Office does not make these judgments for faculty.

cc: S. K. Hammersmith
Dept. Heads

College of Arts and Sciences
Ferris State University
November 16, 1992

I. Disruptive Behavior Policy Statement

The College of Arts and Sciences strives to maintain a positive learning environment and educational opportunity for all students. Consequently, patterns of behavior which obstruct or disrupt the learning environment of the classroom or other educational facilities will be addressed.

1. The instructor is in charge of the course. This includes assignments, due dates, methods and standards of grading, and policies regarding attendance, tardiness, late assignments, outside conferences, etc.

2. The instructor is in charge of the classroom. This includes the times and extent to which they allow questions or discussion, the level of respect with which they and other students are to be treated, and the specific behaviors they will allow within their classes. Open discussion of an honest opinion about the subject of a course is encouraged, but the manner in which the class is conducted is a decision of the instructor.

3. An instructor is entitled to maintain order in his/her class and has an obligation to other students to do so. Toward that end, an instructor is authorized and expected to inform a student that his/her behavior is disrupting a class and to instruct the student to stop that behavior. If the student persists, the instructor is authorized to direct the student to leave the class. If the student fails to comply with a directive to leave the class, the instructor may call Public Safety to assist with the student's removal.

4. If a student persists in a pattern or recurrent disruptive behavior, then the student may be subject to administrative action up to and including an involuntary withdrawal from the course, following administrative review by the Arts and Sciences Dean's Office, and/or University disciplinary proceedings. (University disciplinary procedures are delineated in the "Student Conduct and Discipline Policy," reprinted in the FSU Student Calendar/Handbook.)

5. Disruptive behavior cannot be sanctioned by a lowered course grade (e.g., from a B to a C) except insofar as quality of classroom participation has been incorporated into the instructor's grading policy for all students. (Note: Academic misconduct, which is covered by other regulations, can be a legitimate basis for lowering a grade or failing the student).

6. Students as well as employees are bound by the University's policy against harassment, in any form. Harassment will not be tolerated.

7. The office of the student's dean will be notified of any serious pattern or instance of disruptive behavior.

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Chem 121
Chap Review Suggestions
(for General Chemisty, 6th Ed by Ebbing & Gammon)

Chap 1 Chem and Measurement

Read A Checklist for Review pp32,33
Know definitions of terms p32
UNDERSTAND and USE S.F. rules
See Sect 1.5 for notes
See op. skill 2 p33
Review density - see op. skills 4 & 5
Review factor-label method - see op. skill 6

Chap 2 Atoms, Molecules, and Ions

Read A Checklist for Review p80
Know definitions of terms p80
Know Dalton's Atomic Theory
Review atomic structure Sect 2.2
Review nuclear structure Sect 2.3
Review atomic weight and atomic mass units

- 1 mole C-12 ≡ 12 g
- 1 mole C-12 = 6.022×10^{23} atoms
- 1 atom C-12 = 1.993×10^{-23} g
- 1 atom C-12 ≡ 12 amu
- 1 amu = 1.661×10^{-24} g
- (1 amu ≡ 1/12 of a C-12 atom)

Review Periodic Table terms/sections
Review nomenclature
Practice balancing some chem equations
Be able to do op. skills p81

Chap 3 Calc w/ Chem Formulas and Equations

Read A Checklist for Review p118
Know definitions of terms p118
Know Key Equations p 118
Review all Example Probs
Redo all Exercise Probs
Know how to read (interpret) chem formulas
Know how to read (interpret) chem equations
Be able to do op. skills pp118,119

Chap 4 Chem Rxs: An Introduction

Read A Checklist for Review p170
Know definitions of terms p170
Be able to recognize types of rxs p135
Be able to recognize electrolytes Sect 4.1 p128
Review acid/base theory Sect 4.4 p139
Know how to write mol/ionic/net ionic eqs.
Know the 3 ways to drive metathesis rxs to products
Know Table 4.4 p147
Review Solutions
Know Molarity conc term & do Molarity probs
Be able to do op. skills p171

Chap 5 The Gaseous State

Read A Checklist for Review p221
Know definitions of terms p 221
Know how P, V, T, n vary relative to each other
Know the Ideal Gas Law
Know R in several "languages"
Be able to do stoichiometry probs w/ gases
Review partial pressures & mole fractions
Know KMT postulates & how to use them
Know difference between real vs ideal gas
Be able to do op. skills p 222

Chap 6 Thermodynamics

Read A Checklist for Review p265
Know definitions of terms p265
Know Key Equations p 265
Review Energy & Its Units Sect 6.1 p232
Know how to read/write thermochem eqs
Know how to manipulate thermochem eqs (two important rules)
Know how Heats of Rxs are obtained
Know how to use Heats of Rxs (Hess's Law)
Know how to set up standard formation rxs
Know how to calc ΔH_{rx}
Know how to use ΔH_f° values
Be able to do op. skills pp265, 266

Chap 7 Quantum Theory of the Atom

Read A Checklist for Review p303
Know definitions of terms p303
Review Bohr's Theory of the H atom
Know the 4 quantum nos & their allowed values
Be able to do op. skills p303

Chap 8 Electron Configurations & Periodicity

Read A Checklist for Review pp340,341
Know definitions of terms pp340, 341
Know how to make and read orbital diagrams
Know how to read/write electron configs
Know trends in: atomic/ionic radii, IE, EA
Review desc's of the Main-Group Elements
Be able to do op. skills p341

Chap 9 Ionic and Covalent Bonding

Read A Checklist for Review pp384, 385
Know definitions of terms p384
Know diff between ionic and covalent bond
Know how to read/write elec config for ions
Know trends in ionic radii and EN
Know how to predict bond polarity
Know how to read/write LEWIS DOT FORMULA
Know how to pred't the existence of resonance
Know how to calc & use formal charge
Know the use of bond length & bond order
Know how to calc bond energy
Be able to do op. skills p385

Chap 10 Molecular Geometry and Chemical Bonding Theory

Read A Checklist for Review p431
(MO Theory, pp419-428 is omitted)
Know definitions of terms p431
Be able to use VSEPR Theory to predict the geometry of electron pairs, bond angles, and molecular shapes
Know what effect lone pairs have on bond angles
Know how to predict whether a molecule will be polar or not
Know and be able to use the VB Theory
Know the diff between σ and Π bonds
Be able to do op. skills 1, 2, & 3 p432

Chap 11 States of Matter; Liquids & Solids

Read A Checklist for Review pp489, 490
Know definitions of terms p 489
Know diff on the atomic/molecular level, betw gases, liqs, and solids Sect 11.1 p438
Be able to read/write eqs for all phase transitions & predict if they are exothermic or endothermic
Know v.p. trends
Know relationship betw v.p. & b.p., m.p., ΔH_{vap}, ΔH_{fus}
Be able to read a phase diagram
Know & interpret the effect of intermolecular forces on liquid and solid properties
Know the types of solids, how to predict which type a given solid is, and what effect the type of solid has on the props of the solid (See Tables 11.5 & 11.6)
Know the 3 possible cubic unit cells & be able to do some calc's w/ unit cells
Be able to do op. skills p490 (omit # 2)

Chap 12 Solutions

Read A Checklist for Review pp541, 542
Know definitions of terms p 541
Know Key Equations p 541
Review the solution process Sect 12. 2
Know the effects of T & P on solubility
Know how to calc each of the 4 expressions of conc Sect 12.4 p512
Know & be able to use Raoult's Law
Know how to calc each of the colligative props
Know the effect of ions on the colligative props of solutions Sect 12.8 p531
Know the types of colloids
Be able to do op. skills p542

Chap 15 Acids and Bases

Read A Checklist for Review pp673, 674
Know definitions of terms in Sects 15.1 - 15.5
Know the 3 acid - base concepts
Know how to read/write eqs in terms of each of the acid-base concepts
Be able to predict relative strengths of acids based on molecular structure
Be able to do op. skills 1, 2, & 3 p674

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Significant Figures

1. There are two kinds of numbers:

   a. Exact numbers - numbers that are known to be absolutely accurate.
   (1) counted values (e.g., number of people in a room), or
   (2) exact conversions (e.g., 1 ft = 12 inches).
   Exact numbers do not influence the determination of sig figs in a calculated result.

   b. Inexact numbers - numbers that are obtained from actual measurements (data), or from estimation. In all measurements some estimation (uncertainty) is involved which leads to inexact values. The number of sig figs in the data for a problem determines the number of sig figs in the calculated result.

2. Significant Figures - digits that are believed to be correct by the person making the measurement. They indicate the degree of uncertainty in a measurement. The last digit in a reported measurement is assumed to be an estimation (uncertain figure) but it is considered to be significant. The more sig figs there are in a measurement, the more precise the measurement is, and the more accurate (closer to the true value) it is assumed to be.

3. The rules for COUNTING significant figures in a number are:

   a. Nonzero integers are always significant, e.g., 216.3 has four sig figs.
   b. ZEROS. There are three classes of zeros:
   Captive zeros. These fall between nonzero digits and are always significant, e.g., 206 has three sig figs.
   Leading zeros. These are zeros that precede all nonzero digits in a number. They are never significant, e.g., 0.00025 has only two sig figs.
   Trailing zeros. These are zeros at the right-hand end of the number. They are significant only if the number contains a decimal point, e.g., the number 1200 has only two sig figs, but 1200. has four sig figs.
   c. Scientific notation (powers of ten or exponential notation).
   All zeros in the base number are significant, e.g., 7.230×10^4 has four s f.

4. The rules for USING significant figures in calculations are:

   a. For multiplication and division, the number of sig figs in the result (answer) is the same as the number of sig figs in the measurement with the *smallest* number of sig figs, e. g., 1.23 cm x 12.34 cm = 15.2 cm^2.

   b. For addition and subtraction, the result (answer) can have only as many *decimal places* as the measurement with the *fewest decimal places*, e. g., 1.234 g + 56.7 g = 57.9 g.
   Also, if a number is known only to the tens place, e. g., 180 mL, then the result of addition or subtraction with that number can be known to no better than the tens place.
   E.g., 180 mL + 111.5 mL = 290 mL

5. The rules for ROUNDING a number are:

   a. A measurement is *never* rounded; only the results of calculations are rounded.
   b. When the digit to be dropped is *less than* 5, it is just dropped, e. g., 7.34 rounded to two sig figs is 7.3.
   c. When the digit to be dropped is 5 *or more*, the preceding digit is increased by l, e. g., 7.35 rounded to two sig figs is 7.4.

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Conversion Factors and Physical Constants

Length

1. 1 in ≡ 2.54 cm

   1 Å ≡ 10^{-10} m

Mass - Weight

2. 1 lb = 453.6 g
   1 lb ≡ 453.59237 g
   1 amu = 1.6605402 x 10^{-27} kg
   1 g = 6.022 x 10^{23} amu
   1 kg = 9.8 N

Volume

3. 1 L = 1.057 qt
   1 qt = 946.4 mL
   1 L ≡ 1 dm^3 ≡ 10^{-3} m^3

Force

4. 1 N ≡ 1 kg m / s^2 (F = m a)

Energy (heat - work)

5. 1 cal ≡ 4.184 J
   1 L atm = 101.325 J
   1 L atm = 24.2 cal

   1 J ≡ 1 kg m^2 / s^2 (K.E. = ½ m v^2)
   1 J = (1 N) (1 m) (W = F d)
   1 J = (1 Pa) (1 m^3)
   1 J = (1 volt) (1 coul) (W = Q V)

Pressure

6. 1 atm ≡ 760 mm Hg ≡ 76 cm Hg
   1 atm ≡ 760 torr
   1 atm ≡ 101,325 Pa
   1 atm = 14.7 lb / in^2 (psi)

   1 Pa ≡ 1 kg / m s^2
   1 Pa = 1 N / m^2 (P = F / A)

Electrical Units

7. 1 eV / molecule = 96.485309 kJ / mole

8. 1 MeV = 1.60217733 x 10^{-13} J

Amount

9. 1 coul = (1 amp) (1 sec) (Q = I t)

Pressure

10. 1 volt = (1 amp) (1 ohm) (V = I R)

Energy

11. 1 joule = (1 volt) (1 coul) (W = Q V)

Power

12. 1 watt = (1 joule / 1 sec) (P = W / t)
    1 watt = (1 amp) (1 volt) (P = I V)

1. Avogadro's number
   N_A = 6.0221367 x 10^{23} / mol

2. Electronic charge
   e = 1.60217733 x 10^{-19} C

3. Faraday constant
   F = 9.6485309 x 10^4 C / mol elec's
   1 F = 96500 couls

4. Molar gas constant
   R = 0.08205783 L atm / mol K
   R = 8.314510 kPa dm^3 / mol K
   R = 8.314510 Pa m^3 / mol K
   R = 8.314510 J / mol K
   R = 1.987216 cal / mol K
   R = 62.36 L torr / mol K

5. Molar volume of ideal gas at STP
   V_m = 0.02241410 m^3 / mol
   V_m = 22.41410 L / mol

6. Electron rest mass
   m_e = 9.1093897 x 10^{-31} kg
   m_e = 0.00055 amu

7. Neutron rest mass
   m_n = 1.6749286 x 10^{-27} kg
   m_n = 1.00866 amu

8. Proton rest mass
   m_p = 1.6726231 x 10^{-27} kg
   m_p = 1.00728 amu

9. Planck's constant
   h = 6.6260755 x 10^{-34} J s

10. Speed of light (in vacuum)
    c = 2.99792458 x 10^8 m / s

Eight Strong Soluble Bases

1. LiOH	lithium	hydroxide
2. NaOH	sodium	hydroxide
3. KOH	potassium	hydroxide
4. RbOH	rubidium	hydroxide
5. CsOH	cesium	hydroxide
6. $Ca(OH)_2$	calcium	hydroxide
7. $Sr(OH)_2$	strontium	hydroxide
8. $Ba(OH)_2$	barium	hydroxide

NH_3, ammonia, is very soluble but it is a weak base.

$NH_3 + H_2O \Longleftrightarrow NH_4OH \Longleftrightarrow NH_4^+ + OH^-$

NH_4^+ is the ammonium ion; OH^- is the hydroxide ion

l System Prefixes

	SIZE	TEN POWER
	1,000,000,000	10^9
a	1,000,000	10^6
	1,000	10^3
i	0.1	10^{-1}
ti	0.01	10^{-2}
li	0.001	10^{-3}
cro	0.000,001	10^{-6}
ano	0.000,000,001	10^{-9}
ico	.000,000,000,001	10^{-12}

Eight Derived Quantities

ANTITY	SYMBOL	FORMULA	COMBO UNITS	SI UNITS
a	A	$A = l^2$		m^2
me	V	$V = l^3$		m^3
ity	d,D,ρ	$d = \frac{m}{V}$		kg/m^3
ity	v	$v = \frac{d}{t}$		m/s
	a	$a = \frac{v}{t}$	m/s/s	m/s^2
	F	$F = ma$	$kg \cdot m / s^2$	N
		$P = \frac{F}{A}$	$kg / m \cdot s^2$	Pa
	KE	$KE = \frac{1}{2} m v^2$	$\frac{kg \cdot m^2}{s^2}$	J
	PE			

Rules for Assigning
Oxidation Numbers

ncombined) elements have an oxidation
er of zero.

ne *always*, and the other halogens *usually* an oxidation number of -1 in a cpd or ion.
(ox. nos. of +1, +3, +5, +7 are possible)

gen *usually* has an oxidation number of -2 cpd or ion. (ox. nos. of -1 and -1/2 are possible)

alkali metals *always* have an ox. no. of +1 ;
alkaline earth metals are *always* +2 ;
d aluminum is *always* +3 ; in a cpd or ion.

drogen is *usually* +1 in a cpd or ion.
(an ox. no. of -1 is possible)

he sum of all the oxidation numbers *for all the atoms* in a cpd (compound) is zero.

The sum of all the oxidation numbers *for all the atoms* in an ion is equal to the charge on the ion.

~~S~~even Strong Acids

1.	H_2SO_4	sulfuric	acid
2.	HNO_3	nitric	acid
3.	HCl	hydrochloric	acid
4.	$HClO_4$	perchloric	acid
5.	$HClO_3$	chloric	acid
6.	HBr	hydrobromic	acid
7.	HI	hydroiodic	acid

Some Weak Acids

1.	H_2CO_3	.......carbonic	acid
2.	HNO_2	.....nitrous	acid
3.	H_3PO_4	......phosphoric	acid
4.	H_2SO_3	......sulfurous	acid
5.	H_2S	.......hydrosulfuric	acid
6.	$HClO_2$	.......chlorous	acid
7.	HF	.......hydrofluoric	acid
8.	HClO	.......hypochlorous	acid
9.	HCN	.......hydrocyanic	acid
10.	$H_2C_2O_4$	....oxalic	acid
11.	$HC_2H_3O_2$	..acetic	acid

Eight Strong Soluble Bases

1.	LiOH	lithium	hydroxide
2.	NaOH	sodium	hydroxide
3.	KOH	potassium	hydroxide
4.	RbOH	rubidium	hydroxide
5.	CsOH	cesium	hydroxide
6.	$Ca(OH)_2$	calcium	hydroxide
7.	$Sr(OH)_2$	strontium	hydroxide
8.	$Ba(OH)_2$	barium	hydroxide

NH_3, ammonia, is <u>very</u> soluble but it is a <u>weak</u> base.

$NH_3 + H_2O \Longleftrightarrow NH_4OH \Longleftrightarrow NH_4^+ + OH^-$

NH_4^+ is the ammonium ion; OH^- is the hydroxide ion

CONVERSION FACTORS

1.	Length	1 in ≡ 2.54 cm (exact)
2.	Mass	1 lb ≅ 453. 6 g 1 lb ≡ 453.59237 g
3.	Volume	1 L ≅ 1.057 qt 1 qt ≅ 946.4 mL
4.	Energy	1 cal ≡ 4.184 J
5.	Pressure	1 atm ≡ 760 mm Hg 1 atm ≡ 760 torr 1 atm ≡ 101,325 Pa 1 atm ≅ 14.7 lb/in²

Eight Derived Quantities

QUANTITY	SYMBOL	FORMULA	COMBO UNITS	SI UNITS
1. Area	A	$A = l^2$		m^2
2. Volume	V	$V = l^3$		m^3
3. Density	d,D,ρ	$d = \frac{m}{V}$		kg/m^3
4. Velocity	v	$v = \frac{d}{t}$		m/s
5. Accel	a	$a = \frac{v}{t}$	m/s/s	m/s^2
6. Force	F	$F = ma$	$kg \cdot m/s^2$	N
7. Press	P	$P = \frac{F}{A}$	$kg/m \cdot s^2$	Pa
8. Energy	KE PE	$KE = \frac{1}{2}mv^2$	$\frac{kg \cdot m^2}{s^2}$	J
Work	W	$W = Fd$		

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Chemistry 121
The Crash Of Flight 143

In the cockpit, Captain Robert Pearson chatted amiable with his first officer, Maurice Quintal. The two men were among only a handful of pilots trained to fly the twin-engine 767, then the most advanced jetliner in the world. "Everything's straightforward once you learn it," Pearson told Quintal, nodding toward the plane's sophisticated instrument panel. The 767 had indeed simplified a pilot's life. Computer screens replaced dozens of instruments. The easy-to-read displays reduced pilot fatigue on long flights. On this four-hour trip to Edmonton, Pearson expected to relax a bit as he carried his 61 passengers to western Canada.

But his calm was broken suddenly as the plane passed over Red Lake. A warning buzzer gave four quick beeps, and an amber light flashed.

Quintal glanced at the indicators in front of him. "Something's wrong with the fuel pump."

"Left forward fuel pump," Pearson added. "I hope it's just the fuel pump failing, I'll tell you that."

The 767 has three fuel tanks, one in each wing and one in the plane's belly. For each tank, two pumps deliver a steady stream of fuel to the engines. The warning told Pearson and Quintal that the forward pump in the left wing was not working. This could mean that the pump had failed,-a fuel line was clogged, or that the tank was running dry -- although the fuel load had been ...ed and rechecked before takeoff.

...arson consulted the plane's reference handbook, which said that normal flight was possible with one defective fuel pump. A few seconds of wary calm passed. Then more alarms sounded. The second pump in the left wing tank was also failing. It was too much of a coincidence for two pumps to fail at the same time -- it was more likely that the left tank was running out of fuel.

"We've got to go to Winnipeg," Pearson said quickly, setting a course for the nearest large airport. Quintal radioed air traffic control, and they received immediate clearance to descend to 6,000 feet.

Pearson throttled back the engines and switched a computer monitor to display the descent into Winnipeg. But he began to doubt that the plane could even make it there.

The cockpit crew grew tense as the 767 nosed down toward the clouds below. More beeps blared the worst possible news: *all four* remaining fuel pumps were now failing. Pearson maneuvered the aircraft gently, trying to preserve every trace of fuel. Then the left engine stopped running.

Quintal radioed Winnipeg. "We've lost our number one engine." Preparing for a possible crash landing, he added, "We'll require all the trucks out."

The pilots set the flaps for the single-engine landing, hoping in spite of what they were witnessing that enough fuel remained. F... as they passed 26,000 feet, the remaining engine stopped. ... cockpit became quiet. The computer screens flickered off. ...out power the high-tech displays were dark and useless.

One hundred miles from Winnipeg, the massive jetliner was left with no electronic instruments and with fewer controls than a small single engine plane.

The world's most advanced aircraft was now a glider.

The unthinkable had happened: Flight 143 had run out of fuel.

How? How does a modern jetliner -- equipped with the latest technology and piloted by skilled people -- run out of fuel at 26,000 feet? As with most air disasters, there was no single cause. Flight 143 was brought down by a string of errors in technology, communication, and training, but at the heart of the crisis was a simple mistake in calculating the amount of fuel needed for the flight.

The plane's instruments should have quickly detected the error. The 767 boasts an advanced fuel quantity processor that accurately gauges fuel on board. But, on this particular plane, the fuel computer had never worked properly, and maintenance workers lacked a spare computer.

Because the 767 was a new addition to Air Canada's fleet, the written maintenance standards were still being revised. When the ground crew was preparing the plane for departure from Montreal, they found that the fuel gauge did not work. A maintenance worker assured Pearson -- incorrectly --that the plane was certified to fly without a functioning fuel gauge if the crew manually checked the quantity of fuel in the tanks.

The manual procedure, known as a "drip", is as old as flying itself. Each fuel tank contains a drip stick, which is similar to the dip stick used to check the oil in a car, except that it is mounted upside down. When a mechanic under the wing loosens the drip stick, it falls within the tank until a float at its tip bobs on the surface of the fuel. The mechanic reads the depth of the fuel from markings on the drip stick, then consults a handbook that gives the corresponding volume of fuel in the tank.

Two Air Canada mechanics, Jean Quellet and Rodrigue Bourbeau, had performed exactly this procedure of Flight 143 while it was on the ground in Montreal. They measured a fuel depth of 62 centimeters (cm) in one wing tank and 64 cm in the other. The manual showed that this corresponded to 3,758 and 3,924 liters (L) of fuel in the tanks, for a total load of 7,682 L.

It would seem simple to subtract this amount from the amount needed for the trip to get the amount that must be added to the tanks before takeoff. It would have been simple, but for three small complications.

For years, Air Canada pilots had computed the amount of fuel they would need in *pounds*, whereas the new 767's fuel consumption was expressed in *kilograms*. The metric specifications were in accord with the Canadian government's plan to introduce metric units nationwide. Secondly, the drip procedure told the pilots the amount of fuel on board not in pounds, or kilograms, but in *liters*.

What's more, on the earlier airplanes, the fuel had been calculated not by the pilot or copilot, but by the third person in the cockpit, the flight engineer. The 767 did not carry a flight engineer because the computers had reduced the cockpit workload. Now, it was unclear whether the ground crew or the pilots were primarily responsible for the fuel calculations.

Quellet and Bourbeau knew that the flight to Edmonton, which called for a brief stop in Ottawa without refueling, required 22,300 kilograms (kg) of fuel. Thus they faced this problem: If [illegible]82 L of fuel remained in the plane, how many liters had to be [illegible]ed to make a total of 22,300 kg? First Officer Quintal offered to help the mechanics sòlve the problem. "The number of liters times the weight of a liter will give you kilograms, right?" Quintal turned to a mechanic in charge of refueling and asked for the factor for converting liters into kilograms.

"1.77," the refueller answered.

Using that factor, Quintal and the mechanics figured that the plane now contained 13,597 kg and would need 8,703 kg more to reach the required 22,300 kg. This meant that the flight required an additiional 4,917 L. The refueller added fuel, and the mechanics repeated the drips until Pearson was satisfied that the plane was properly fueled.

Unfortunately no one had asked the crucial question: What units go with the conversion factor of 1.77 ?

After takeoff, Flight 143 made a short trip to Ottawa, where it stopped for 45 minutes without refueling. Then, with Quintal at the controls, the plane took off full throttle, rocketing toward Edmonton. The confusion of the preflight calculations seemed to slip away as the hugh aircraft raced toward Red Lake.

As the plane glided powerless toward Winnipeg, the pilots and air traffic controllers made some hasty calculations and reached a grim conclusion. Without engines, the craft's rapid descent would bring it in at least 10 miles short of the airport.

Pearson was directed to Gimli, an airport once used by the Royal Canadian Air Force. Long abandoned by the Air Force, the [illegible]ort had no control tower or fire trucks, It was unsuitable for landing a 767, but no other airport was in gliding range.

Swooping quietly over Lake Winnipeg toward Gimli, Pearson realized that the plane was coming in too high. The big plane would land too far down the runway and skid off the end. In a desperate move to lose altitude, Pearson tried a side slip -- a maneuver used in small planes but unheard of in a jetliner. Turning the wheel for a left turn and pushing the rudder for a right turn, the plane fought with itself and descended faster.

When the plane tipped sharply onto its side, the passengers gasped in horror, as they watched the ground grow closer in the windows. Then at the last moment, Pearson righted the plane at the proper height. But the strip of concrete was no longer a runway. It had been converted to an auto race track complete with fences, race cars and spectators. People on the ground dove to get out of the path of the rapidly descending plane.

The speeding 767 touched down at the right point, just 800 feet from the start of the runway but blew out two tires and threatened to skid off the runway. Ahead was a steel barricade that had been erected across the runway. Suddenly, the front landing gear collapsed. The nose of the plane scraped along the runway throwing dangerous sparks but dragging the plane slower. Miraculously the plane stopped just in front of the barrier.

Fearing fire, the flight attendants rushed the passengers down the emergency ramps. There were many scrapes and bruises but [illegible] a few real injuries. The passengers and crew of Flight 143 [illegible] made it.

After the Boeing 767 was thoroughly repaired, Air Canada put it back into service. Flight crews gave it an ignoble nickname but vowed that it will never earn that name again. They call it the Gimli Glider.

CRASH COURSE IN DENSITY/UNITS

When you refuel a car, the gasoline is measured by volume in units of gallons or liters. Because an airplane can lift only a certain amount of weight, its fuel must be measured in pounds or kilograms.

When the ground crew conducted the drip procedure they determined that the tanks contained 7,682 L. The crew knew that the flight required 22,300 kg, and they knew that volume should be multiplied by density to obtain weight. But the density of jet fuel can be expressed in various units such as pounds per gallon, pounds per liter, or kilograms per liter. The ground crew used the value 1.77 without being certain of its units.

They calculated:

7,682 L x 1.77 = 13,597 kg of fuel remaining on board

22,300 kg needed - 13,597 kg on board = 8,703 kg to be added

8,703 kg ÷ 1.77 = 4,917 L of fuel to be added

If they had kept track of the units and verified that the units canceled properly, they could have calculated:

7,682 L x 1.77 lb./L x 1 kg/2.205 lb = 6,167 kg remaining on board

22,300 kg needed - 6,167 kg on board = 16,133 kg to be added

16,133 kg x 2.205 lb/kg x 1 L/1.77 lb = 20,100 L of fuel to be added

The result was that they added about 5,000 L when they should have added about 20,000 L. At the time of takeoff Flight 143 had about 10,000 kg of fuel -- less than half the amount needed to reach Edmonton.

Why did the pilots and ground crew so readily accept the value 1.77? Because, when accompanied by the proper units, it is a valid conversion factor that they had all used in the past.

The density of jet fuel is 1.77 *pounds* per liter.

What conversion factor should they have used in order to calculate the kilograms of fuel remaining on board directly from the liters ?

From CHEM MATTERS Oct 1996

Handling Chemicals Safely
Summary Lab Rules

1. Work with small containers.
2. Mix chemicals only when your teacher says to.
3. Read and reread chemical labels.
4. Read instructions all the way through first.
5. Use a work tray if your lab has them.
6. Move carefully and deliberately when handling chemicals.
7. Add concentrated sulfuric or phosphoric acid to water.
8. Hold coin-top stoppers between your fingers while pouring.
9. Hold bottles with your hand over the label.
10. Replace stoppers immediately.
11. Keep chemicals away from your face.
12. Work with harmful volatile chemicals under a hood.
13. Keep chemicals as pure and uncontaminated as possible.
14. Draw out chemicals with a pipette filler - never by mouth.
15. Notify your teacher to clean up spills.
16. Put waste in the proper container.
17. Clean up when finished.

Bunsen Burner and Glassware Safety
Summary Lab Rules

1. Heat volatile organics in a heating mantle or steam bath in a hood - not over a Bunsen burner.
2. Check the gas hose for cracks.
3. Make sure the hose fits securely on the gas valve and Bunsen burner fittings.
4. Stand back from the burner while lighting it.
5. Strike matches away from you.
6. Turn on the gas after lighting the match.
7. Turn the gas off immediately if the flame sputters, flares, or goes out, or if you smell gas.
8. Check glassware for stars or cracks.
9. Clamp narrow-necked containers to the ring stand.
10. Move test tubes back and forth through the flame at an angle while heating.
11. Don't heat closed containers.
12. Hold hot glassware in beaker tongs or hot mitts.

Thermometer Safety
Summary Lab Rules

1. Don't shake thermometers
2. Use thermometers only in the range they're suited for.
3. Lay thermometers down on a towel or wire screen to cool, away from the edge of the bench.
4. Let your teacher clean up broken thermometers.

Glass Tubing Safety
Summary Lab Rules

1. Use an inserter to place glass tubing in a stopper or remove it.
2. Or, lubricate the tubing and protect your hands with leather gloves.

Centrifuge Safety
Summary Lab Rules

1. Place equally filled test tubes in a centrifuge to balance it.
2. Don't try to stop the spinning with your hand.

Dressing for Safety
Summary Lab Rules

1. Don't wear extremely loose clothing.
2. Fabrics should be sturdy and natural.
3. Wear older clothes and cover them with a lab apron.
4. Wear long pants or a long skirt to cover your legs.
5. Wear closed leather shoes to protect your feet.
6. Tie up long hair.
7. Remove rings and watches.
8. Take out contact lenses.
9. Cover your eyes with goggles with side shields.
10. Protect your hands with the right kind of gloves.

Behavior in the Laboratory
Summary Lab Rules

1. Don't fool around in lab.
2. Keep aisles clear of personal belongings.
3. Stand on a step stool when you have to reach.
4. Keep makeup in your purse.
5. Keep food and drinks outside.

Emergency Equipment
Summary Lab Rules

1. Clean and dry the skin around a cut before a bandage is applied
2. Rinse chemicals from your eyes in the eyewash fountain.
3. Rinse chemicals from your hands and arms with water in the sink.
4. Remove your clothes on the way to the safety shower to rinse large spills from your body.
5. Extinguish small fires in containers by covering them.
6. Let your teacher use an extinguisher to put out larger fires.
7. Put out clothing fires in the safety shower.
8. If there's no other way to put out a clothing fire, use a fire blanket carefully to keep flames away from the face and neck.

Periodic Classification of the Elements

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1 **H** 1.00794																1 **H** 1.00794	2 **He** 4.00260
3 **Li** 6.941	4 **Be** 9.01218					Transition Elements						5 **B** 10.811	6 **C** 12.011	7 **N** 14.0067	8 **O** 15.9994	9 **F** 18.9984	10 **Ne** 20.1797
11 **Na** 22.9898	12 **Mg** 24.3050											13 **Al** 26.9815	14 **Si** 28.0855	15 **P** 30.9738	16 **S** 32.066	17 **Cl** 35.4527	18 **Ar** 39.948
19 **K** 39.0983	20 **Ca** 40.078	21 **Sc** 44.9559	22 **Ti** 47.88	23 **V** 50.9415	24 **Cr** 51.9961	25 **Mn** 54.9381	26 **Fe** 55.847	27 **Co** 58.9332	28 **Ni** 58.6934	29 **Cu** 63.546	30 **Zn** 65.39	31 **Ga** 69.723	32 **Ge** 72.61	33 **As** 74.9216	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.4678	38 **Sr** 87.62	39 **Y** 88.9059	40 **Zr** 91.224	41 **Nb** 92.9064	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.906	46 **Pd** 106.42	47 **Ag** 107.868	48 **Cd** 112.411	49 **In** 114.82	50 **Sn** 118.710	51 **Sb** 121.757	52 **Te** 127.60	53 **I** 126.904	54 **Xe** 131.29
55 **Cs** 132.905	56 **Ba** 137.327	57 **La** 138.906	72 **Hf** 178.49	73 **Ta** 180.948	74 **W** 183.85	75 **Re** 186.207	76 **Os** 190.2	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.967	80 **Hg** 200.59	81 **Tl** 204.383	82 **Pb** 207.2	83 **Bi** 208.980	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)															

Lanthanide Series														
58 **Ce** 140.115	59 **Pr** 140.908	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.965	64 **Gd** 157.25	65 **Tb** 158.925	66 **Dy** 162.50	67 **Ho** 164.9303	68 **Er** 167.26	69 **Tm** 168.9342	70 **Yb** 173.04	71 **Lu** 174.967	

Actinide Series														
90 **Th** 232.038	91 **Pa** (231)	92 **U** 238.029	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)	

(Numbers in parentheses are the mass numbers of the most stable isotopes.)

ACS
FIRST TERM
GENERAL CHEMISTRY TEST
Form 1993

Section I — 13 items
States of Matter (Solids, Liquids, and Gases)
definitions; gases(ques & probs) ; gas laws; K. M.Theory; phase diagrams; density

Section II — 18 items
Stoichiometry and Thermochemistry
atoms; molecules; moles; empirical formulas; molecular formulas; mass percent; net ionic equation; balancing equations; theoretical yield; percent yield; nomenclature; limiting reactant; ΔH°_{f}; ΔH_{rx}

Section III — 14 items
Atomic Structure and Periodicity
classical experiments; spdf notation; quantum no's; orbital diagrams; trends (at. size, ionic size, metallic characteristics, I. E., E. A., E. N.) paramagnetism; diamagnetism; $^{A}_{Z}X$

Section IV — 14 items
Molecular Structure and Intermolecular Forces
Lewis diagrams; VSEPR Theory; H-bonding, Dipole-dipole, London forces

Section V — 11 items
Solutions and Lab
Concentrations (M, m, X, %(w/w)); ionic; electrolytes; Raoult's Law; Lab procedures; reasoning (critical thinking)

Rules for the ACS Final

1. You must use PENCIL.
2. You must NOT leave the room.
3. You must NOT have any extra papers out.
4. You must NOT make any marks on the test sheets.
5. You must make sure that any ERASURES on the answer sheet are clean.
6. You must STOP when time is up (70 items - 110 min).
7. You must turn in ALL papers.

THE KEYS TO GOOD GRADES

Why do some youngsters excel in schoo grades, and enjoy the learning process, wh ers lag behind, puzzled and frustrated? It's a tery to most parents, but not to Adam Robinson, educational authority and author of *What Smart Students Know* (Crown paperback).

In his book, Robinson shows how getting good grades and a better education is not a matter of having a higher IQ. It's actually more a matter of *attitude* and *method.*

"The attitude of a smart student is one of resourcefulness," says Robinson, a cofounder of The Princeton Review, a nationwide company that prepares students for taking standardized tests such as the SAT.

"If you're struggling with a difficult textbook, there's something you can do about it. If you're bored in class, there's something you can do about it. If you're taking a test and you've forgotten the answer to a question, there's something you can do about it. No matter what the problem, there's *always* something you can do."

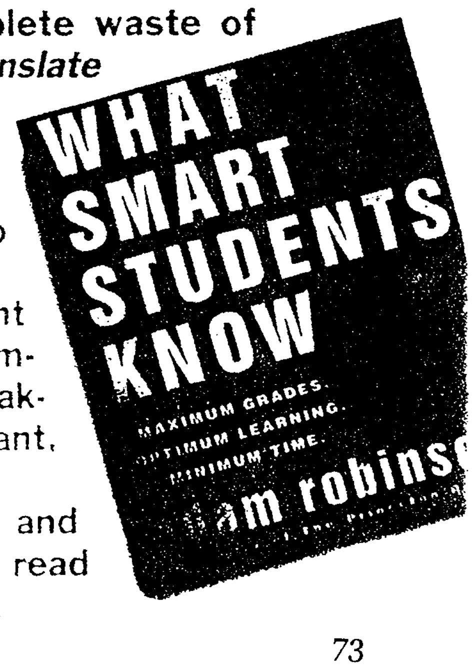
Robinson's book points out what he calls the "common denominator methods that most highly successful students find out sooner or later." Some examples are:

1. • If you're ever bored in class, when all else fails, try learning the subject. You always have a choice with a subject that seems boring: You can remain bored and learn little, or you can get interested.

The way to get interested is by asking *yourself* questions. The solution to boredom is not doing less work, but doing *more*. Think about it: The most boring situations are when you're standing around doing nothing.

2. • Work to understand rather than to memorize—it's easier and more interesting. Smart students spend 80 percent of their study time trying to *understand* their subjects and 20 percent or less trying to *memorize* information.

3. • Highlighting your textbook is a complete waste of time—you must take notes and then *translate* them if you expect to develop understanding.



4. • The most important skill of all—in terms of your grades—is knowing how to write an excellent essay.

Robinson's book helps boosts student morale with dozens of similar tips to improve study habits, writing skills, test taking, general learning, and, most important, using one's head.

Although his book aims at high school and college students, it can—and should—be read by younger readers, *and* by their parents.

CHEM 122 COURSE SYLLABUS: Winter 2001

CHEM 122 Sections 220 – 224
General Chemistry (5 Credits)
Instructor: C. Partigianoni

I. General Information

Instructor: C. Partigianoni Office: ASC 3095 Phone: 591 – 5038

Office Hours: Mon.: 1 — 2 PM Tues.: 11 — 12 PM
Weds.: 1 — 2 PM Thur.: 3 — 4 PM
AND BY APPOINTMENT

If the designated office hours are not convenient for you, please feel welcome to make an appointment for any time which the instructor is available.

Lecture: MTWF: 12:00 – 12:50 PM SCI 102

Labs (Rm SCI 335):

Sect 221: M 3:00 – 5:50 PM Sect 222: W 3:00 – 5:50 PM
Sect 223: Th 12:00 – 2:50 AM Sect 224: F 8:00 – 10:50 AM

Review Sessions (Optional): Mon: 7 – 8 PM (Rm 308)

The review sessions will be similar to SLA workshops, except that they are completely optional, and will be facilitated by the instructor. Students will be provided with worksheets extra practice problems to test their comprehension, and students will also have the opportunity to ask questions on the regular mandatory homework assignments. Solution manuals for the latter will be available during this time.

II. Text / Required Materials

Textbook: "General Chemistry", Sixth Edition; Ebbing & Gammon

Lab Manual:

"Partigianoni's Lab Manual for Chem 121 & 122" **OR**
Lab Workbook for Chem 121 and 122 by FSU General Chemistry Faculty

AND: Lab Handbook for General Chemistry by Griswold, et al.

Miscellaneous: Scientific calculator,
Eye Protection: Glasses and/or goggles meeting current OSHA standards.
Contact Lenses are NOT permitted in Lab!!!!

Course Prerequisites

Successful completion of CHEM 121 and Math 115 (or higher).
Students who received an F in CHEM 121 ARE NOT ELIGIBLE for this course. Students who received a C— or below in CHEM 121 will more than likely struggle with this course, and should expect to spend considerable amount of time studying for this course in order to pass the course.

III. Attendance Policy

A) Lab: ATTENDANCE IN LAB IS MANDATORY!!

MORE THAN 2 ABSENCES FROM LAB WILL RESULT IN FAILURE OF THE COURSE!! The instructor has the right to prevent anyone who arrives late for lab from attending that lab section. Persons having an acceptable excuse for being tardy or absent from lab, as determined by the instructor, may possibly attend a different section during the same week, (if there is sufficient lab space.) You must receive prior approval from the lab instructor to make-up a lab. Students are required to complete a lab report, regardless of whether or not they were able to attend lab. Data needed to complete the report must be obtained from the instuctor.

B) Lecture: Attendance will be taken during lecture periodically throughout the term (on random days). Attendance will contribute to the participation grade. Each absence will result in loss of 5 points from the participation grade. Students having perfect attendance will receive 5 BONUS points on their participation grade.

Extra handouts distributed during lecture will be left in the box outside Dr. P's office. If a student misses a lecture, it is the student's responsibility to get the handout(s) from the box. Old handouts will not be provided during lecture time.

IV. Assignments

A) Lab: You lab grade contributes 20% of your final overall grade for the course. The total lab grade is based on lab reports and prelab quizzes. Unannounced prelab quizzes will be given periocically **at the beginning of the lab**. Students should always read the lab and complete prelab worksheets before lab, in preparation for the prelab quizzes. The prelab worksheets will NOT be graded.

B) Lecture:

1) HOMEWORK: Weekly homework assignments will be given in lecture. **SOLUTIONS (not just answers) to the assignments will be on reserve in the main library and in the ASC tutor center.** Although they will NOT be collected and graded they are the MOST IMPORTANT part of the learning process. (Only "class participation problems" will be collected and graded.) PRACTICE MAKES PERFECT!! Many quizzes and exam problems will be very similar to the homework. You may also sign out the solutions from the instructor, but they must be returned within 1 hour. You will also have access to the solutions during the weekly review sessions held on Monday evenings.

2) PARTICIPATION GRADE: Participation grade is based on attendance during lecture, and completion of "class participation" problems.

V. Quizzes and Exams

A) Quizzes: Approximately 6 UNANNOUNCED 20 pt. quizzes will be given on **Tuesdays** in lecture. Your lowest 20 pt. quiz score will be dropped. You will also have a 50 pt. "Super Quiz" at the end of the semester. The Super Quiz score will NOT be dropped.

B) Exams: Exams are tentatively scheduled for the days listed below. Note that the point scale varies for each exam. The instructor reserves the right to change these exams days with 3 day notification. Some of the exams may be divided in 2 sections, given on separate days. The midterm exam will be administered during lab. The final exam and the midterm exam are both cumulative. If you have an acceptable reason for missing an exam, you must let the instructor know BEFORE the exam, so that a makeup can be arranged.

Prelim I: W (Jan. 31) (75 pts)
Midterm Exam: Week of Feb 19 — 23 IN LAB (150 pts)
Prelim II: Tue, Wed (Mar 20, 21): (120 pts)
Prelim III: Tue, Wed (April 10, 11): (100 pts)
Super Quiz: W, April 25 (50 pts)
Final Exam: 175 pts (cumulative)

VI. Make-Ups

There will be NOT be make-ups for missed 20 pt. quizzes. Anyone who has legitimate reason for missing a quiz, as determined by the instructor, will be excused and assigned a grade for the missed quiz equivalent to his/her average quiz grade end of the term. Anyone who has a legitimate reason for missing an exam or Super Quiz, as determined by the instructor, will be given the opportunity to make-up the exam or Super Quiz. **It is the student's responsibility to contact the instructor BEFORE the regularly scheduled quiz or exam date and receive prior approval for a make-up exam or excused absence for a quiz.** Anyone who has a legitimate reason for missing lab, as determined by the instructor, may be given the opportunity to make-up the lab.

VII. Grading:

3 Prelim exams	275 pts total
Midterm Exam	150 pts
Quizzes	100 pts total
Super Quiz	50 pts
Lecture Participation	25 pts
Final Exam	175 pts total
Lab	200 pts total

Grades will be based on the tentative grading scale below. If the class average AT THE END OF THE TERM is well below 75%, a curve may be applied which will lower the percentages needed for each grade, but will not raise. **That is, anyone receiving a 94.0% or above is absolutely guaranteed an A, regardless of class average.** If a curve appears necessary, a single curve will be applied at the end of the term. Curves are NOT applied to each exam individually.

You should be aware that it would be very UNWISE for anyone to rely on curve for passing this class. Decisions to withdraw should be based on the grading scale below.

Note that anyone receiving below 45% on the final exam will not receive higher than a D overall grade, REGARDLESS OF HIS/HER GRADE BEFORE THE FINAL EXAM.

GRADING SCALE:		94.0 % A	90.0 % A–
	88.0 % B+	83.0 % B	80.0 % B–
	77.0 % C+	72.0% C	68.0% C–
	60.0% total (or below 45% on Final exam): D		
	Below 60 % : F		

VIII. Extra Credit

The only source of extra credit that will be provided in this course are Bonus questions on exams and some optional "marathon" homework problems. There will NOT be any other opportunity for extra credit, so PLEASE do not even bother to ask or you will annoy the instructor!

SYLLABUS ATTACHMENT

COLLEGE OF ARTS AND SCIENCES -- FERRIS STATE UNIVERSITY

Winter 2001

ent Offices
591-2550
591-3675
591-2520
591-2565
591-2580
591-2735
591-3660

IT DATES:

hedule adjustment (drop/add)	1/10/01
King Day (no classes)	1/15/01
(no classes)	3/3 - 3/11/01
early registration begins	3/19/01
DROP or withdraw with "W"	3/23/01
s (no classes)	4/12 - 4/15/01
winter semester classes	4/27/01
AMS	4/30 - 5/4/01
ill early registration ends	5/2/01
nester commencement	5/5/01

RY HOURS:

hours for the main (Timme) library are as

y-Thursday	8:00 a.m. - 11:00 p.m.
	8:00 a.m. - 9:00 p.m.
lay	9:00 a.m. - 6:00 p.m.
ay	1:00 p.m. - 11:00 p.m.

(For verification of hours, call 591-2669)

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MPUTER LAB HOURS:

Arts and Sciences computer lab is located in ASC 15. The normal hours are listed below. Please call 1-3998 to verify the hours of operation. Please present our student ID when utilizing the lab.

Monday - Wednesday	7:30 a.m. to 10:50 p.m.
Thursday	7:30 a.m. to 7:50 p.m.
Friday	7:30 a.m. to 4:50 p.m.
Saturday	Closed
Sunday	4:00 p.m. to 10:50 p.m.

CLASS ATTENDANCE IS IMPORTANT!

There is significant research to show that students with daily attendance earn significantly higher grades than students who miss even a few class periods. Many instructors have mandatory attendance policies by which your grade will be affected by absences. Some instructors also have policies about class tardiness, to encourage students to be present for the full class period. Check your course syllabus or talk to your instructor about his/her policies.

HOW TO CONTACT A FACULTY MEMBER:

If you have questions or need help, talk to your instructor. Faculty office locations, phone numbers, and office hours can be obtained from the class syllabus, or the department office. Faculty directory notebooks are also located in the student lounges and in the dean's office (ASC 3052).

DROPPING CLASSES OR WITHDRAWING:

If you need to drop a class or withdraw from school, you must do so **OFFICIALLY**, through your dean's office, in order to avoid receiving an "F" grade in the course. The last day to withdraw or drop a class may be different for different classes. See dates listed under "Important Dates" above. In case of extenuating circumstances after these dates (e.g., a serious illness requiring you to withdraw from school), contact your dean's office. For Arts and Sciences students, call 591-3660).

INCOMPLETES:

The intent and appropriate use of the "I" grade is NOT to avoid student probation, dismissal, or unacceptable grades, nor should it be considered as an extended alternative to withdraw from a class (W). The "I" is only considered for extenuating circumstances that have led to a student's missing a portion of the course. Extenuating circumstances are generally defined as those situations over which the student has little or no control--e.g., illness, birth, jury duty, death of a parent, serious injury. Instructors may require suitable documentation.

Students must have completed at least 75% of the coursework at passing levels before an "I" will be considered, and they may be required to sign an agreement regarding course completion. An "I" grade automatically changes to an "F" after one semester (not counting summer) unless the faculty member files another grade or extends the incomplete.

WHERE TO GO FOR HELP:

Successful students are often those who seek help early, before little problems become big ones. Ferris State University offers a variety of services, **FREE OF CHARGE**, to help you. Details are on the next page.

(over)

WHERE TO GO FOR HELP

The following services are available to any Ferris student, free of charge. They are designed to help you succeed in your courses, in your career planning, and in meeting the challenges of college life. Don't hesitate to explore and use these services at Ferris.

Academic Support Center

Arts &Sciences Commons 1017 591-3543

The **Writing Center, Tutorial Services,** and **Academic Skills Center** join together to offer FSU students an array of academic support services, e.g.

- tutoring for many Ferris courses
- individual help with writing skills and writing assignments for English or other courses.
- help in developing better reading and study strategies
- workshops to help you meet the challenges of college life
- workshops to help you write more effectively and easily

Scholar Program

Arts &Sciences Commons 1027 591-5976

Provides FSU's minority students with academic assistance; information about campus, community life, and student organizations; and support programs for financial or personal problems.

Disabilities Services

Arts &Sciences Commons 1017 591-3772

Students with a documented disability (physical, learning, mental, emotional) requiring a classroom accommodation should contact Educational Counselor for Students with Disabilities, Eunice Merwin in the Disabilities Services Office.

Personal Counseling, Sexual Assault, Substance Abuse

Birkham Health Center 210 591-5968

Personal counseling is available confidentially and free of charge. Counselors are available to assist with personal and stress-related problems, family and relationship issues, substance abuse, sexual assault, depression, or other similar problems. Call or stop by to obtain an appointment.

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College of Arts & Sciences Department Offices		
Biology	ASC-2004	591-2550
Humanities	J-H-119	591-3675
Lang. & Lit.	ASC-3080	591-2520
Mathematics	ASC-2021	591-2565
Physical Science	ASC-3021	591-2580
Social Sciences	ASC-2108	591-2735
Dean's Office	ASC-3052	591-3660

ACADEMIC MISCONDUCT

Academic misconduct refers to dishonesty or misrepresentation with respect to assignments, tests, quizzes, written work, oral presentations, class projects, internship experience, or computer usage; violation of computer licenses, programs, or data bases; or unauthorized acquisition or distribution of tests or other academic material belonging to someone else. It includes such behaviors as cheating, presenting another person's ideas or work as your own, taking someone else's exam for them, violating computer software licenses or program/data ownership, etc. If you are uncertain about whether a particular behavior might represent academic misconduct, be sure to ask your professor for clarification.

Penalties for academic misconduct can include **FAILURE** of the assignment or the course, and/or disciplinary action up to and including probation or dismissal from the University.

DISRUPTIVE BEHAVIOR

The College of Arts and Sciences strives to maintain a positive learning environment and educational opportunity for all students. Consequently, patterns of behaviors which obstruct or disrupt the teaching/learning environment will be addressed. The instructor is in charge of his or her course (e.g., assignments, due dates, attendance policy) and classroom (e.g., behaviors allowed, tardiness). Harassment, in any form, will not be tolerated. Some instructors have special requirements for their classes (e.g., lab safety procedures). If so, they will review those with you.

Penalties for disruptive behavior can include involuntary withdrawal from the course and/or disciplinary action up to and including probation or dismissal from the University.

ORGANIC CHEMISTRY 221

Fall 2001 (05 Credit Hours)

Instructor:	Dr. P. Di Raddo
Office (room number/building):	ASC 3011
Office Phone:	591-2584
Office Hours:	M, W, F 10:00-11:15

PREREQUISITE COURSES/SPECIAL SKILLS:

GENERAL CHEMISTRY 121, 122

COURSE DESCRIPTION:

Modern bonding theory in organic molecules; group functions; chemistry and stereochemistry of alkanes; cycloalkanes, alkenes and alkyl halides with special emphasis on reaction mechanisms in aliphatic systems. Study of aromatic compounds, dienes, alkynes, alcohols, ethers and organometallic compounds with emphasis on substitution-elimination and introduction to electrophilic aromatic substitution reactions. Concurrent laboratory includes basic laboratory techniques such as TLC and GC, recrystallization, distillation, workshops on stereochemistry, spectroscopic techniques such as UV, IR, NMR and MS, and their applications to structure determination. Prerequisite: CHEM 121 and 122

COURSE OBJECTIVE/FOCUS:

A Introduction to organic chemistry via a functional group approach

B Introduce students to organic reactions with an emphasis on reaction mechanisms

C Emphasize the biological applications of organic chemistry

REQUIRED COURSE MATERIALS:

1. Textbook(s):	J. McMurry, *Organic Chemistry* 5th ed.
2. Other Materials	McMurry, *Study Guide and Solutions Manual to Organic Chemistry*
3. Lab Manuals	Williamson, *Macroscale and Microscale Organic Experiments* 3rd ed.
4. Lab Notebook	
5. Other/Optional	Lab Reports to be typed

COURSE SCHEDULE:

Lecture	M, W, Th, F	9:00-9:50
Labs	T	8:00- 10:50
	Th	12:00-2:50

LAB WORK:

Lab reports to be typed and submitted in the manner outlined in lab. Worth 10 points each. A tentative lab schedule is provided below:

I	Nomenclature Rules in Organic Chemistry (2 weeks)
II	Laboratory Safety Considerations, Video, Check-in
III	Melting Point and Recrystallization
IV	Simple and Fractional Distillation (2 weeks)
V	Conformational Analysis of Cyclohexane Derivatives
VI	Thin Layer Chromatography of Analgesics
VII	Stereochemistry of Chiral Compounds
VIII	Dehydration of Cyclohexanol to Cyclohexene
IX	Bromination of tert-Butanol
X	Intoduction to Spectroscopy (2 weeks)
XI	Check-out and Review for Final

PERFORMANCE CRITERIA:

Grade is determined by exam and laboratory scores. Attendance is strongly recommended.

EXAMS AND HOMEWORK:

EXAM	*DATE*
I	September 21
II	October 19
III	November 16
IV	Finals Week

GRADING POLICIES:

Exams I-III	100 points each	300
Labs (Reports, Workshops, Preparation, Participation, No late makeup labs!)		150
Final		200
TOTAL		**650**

A/A-	90-100%
B/B-	79-89%
C/C-	68-78%
D/D-	57-67%
F	Below 57%

ATTENDANCE, TARDINESS AND ANY SPECIAL CONDUCT POLICIES:

You are encouraged to be early for class and begin copying your notes at this time. In class you will be expected to be attentive and polite in your dealings with others. Feel free to ask questions as we proceed through the lecture.

OPTIONAL WORK:

Homework problems will be assigned from the end of each chapter. That list of problems will be passed out in class.

ADDITIONAL COMMENTS:

The lecture portion of this class meets 4 hours per week and labs are up to 3 hours in length. A diligent student is expected to study a minimum of 2-3 hours per hour of lecture. No kidding! Attendance and participation may be factored into your final grade if yours is a borderline case. The suggested problems provided in class have been selected to reinforce your understanding of some of the topics covered in class. Feel free to do additional problems. Remember that your organic texts are not meant to be read as novels. Rather as you read (slowwwwly) and study you ought to work out on your own as many problems, reactions as possible with pencil and paper close at hand. The use of (yellow) notecards may prove particularly effective for you in condensing the key points of the material at hand and will facilitate your studies. Don't hesitate to write in your book or even to rewrite your lecture notes. ENJOY ORGANIC CHEMISTRY!!!!!

CHEMISTRY 222
ORGANIC CHEMISTRY 2
WINTER 2001

Instructor: Dan Adsmond E-mail: adsmondd@ferris.edu
Office: 3009 Arts and Sciences Complex, Phone: 591-5867
Office Hours: Mon 10-12, Wed 10-12, and Thu 10-11
or by appointment or whenever the door is open.

Text: Organic Chemistry, Fifth Edition
John McMurry, Brooks/Cole Publishing Company, Boston.

Course Objectives: The objectives of Chem 222 may be classified under the three headings listed below. A student successfully completing this course will:

FACTUAL KNOWLEDGE AND FUNDAMENTAL PRINCIPLES

1) become familiar with the structure, nomenclature, physical properties and chemical reactions of aromatic compounds, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, acid derivatives, amines, and sugars.
2) understand the relationship between the structure and physical properties as well as the relationship between structure and chemical reactivity of the aforementioned compounds.

THINKING AND PROBLEM SOLVING

3) be able to propose reasonable mechanisms for reactions of the aforementioned compounds.
4) be able to design multistep syntheses of organic compounds.
5) be able to understand, modify,, and follow laboratory procedures for the synthesis, separation, purification, and analysis of organic compounds as well as being able to apply the underlying principles in developing and selecting appropriate procedures.

EFFECTIVE COMMUNICATION

6) learn to communicate effectively using the vocabulary of organic chemistry both orally and in written form.

Grading:

3 Exams (100 pts each)	300 pts
Group Puzzles	040 pts
Group Quizzes	060 pts
Individual Quizzes	060 pts
Laboratory	190 pts
Final Exam	150 pts
	800 pts

A	720-800
A-	680-699
B+	660-679
B	620-659
B-	600-619
C+	580-599
C	540-579
C-	520-539
D+	480-519
D	440-479
D-	400-439
F	below 400

Attendance: Regular attendance in lecture is expected. In-class assignments and quizzes (announced and unannounced) will be given ranging in value from 4 to 20 points. Missed assignments and quizzes will result in a zero gradė. (At least one quiz grade may be dropped). Attendance at exams and laboratory sessions is mandatory. Make a note of exam dates immediately! NO MAKEUP EXAMS WILL BE GIVEN. In the event of an excused absence on an exam the final exam score will be multiplied by 1.67.

Exam 1: Fri, Feb 9; Exam 2: Fri, Mar 16; Exam 3: Wed, Apr 11

Unexcused **lab** absences will dramatically lower your final grade in the course.

# of unexcused lab absences	1	2	3	4	5
points lost from final grade	20	40	80	160	200

AN ABSENCE IS EXCUSED IF:'1) you were ill and have a written doctor's excuse, 2) you need to attend a required university function (previous notification and permission from the Academic Vice Presidents Office required), 3) there is a death in the immediate family, or 4) you are required to serve on jury duty or are subpoenaed for court testimony (previous notification required).

Reading: Daily reading assignments are listed on the course schedule which follows. It is expected that students will have read the appropriate textbook pages and/or handouts before coming to lecture.

Homework: Homework problems will be assigned each class day and should be completed before the next class meeting. Some of the problems will relate to material already discussed in lecture and some will relate to the reading assignment, which usually will not have been discussed. My expectation is that you will make a good attempt to solve each problem and that if you get stuck, you will write down a specific question that you need to have answered in order to complete the problem. Since exam questions will be similar to those seen in the homework, doing the homework regularly is a prerequisite to your success in the course.

Group work: During the second week of class you will be assigned to a group of 4. You will work together as a group on weekly Friday puzzles and group quizzes. Your experience working together on the Friday puzzles should greatly aid in your ability to perform on group quizzes.

My expectations are that students arrive at class at 9:00 AM sharp with textbook in hand, prepared to THINK and PARTICIPATE. My teaching style requires that students participate in class by asking and answering questions, working in groups, solving problems at the board, and participating in class discussion. Students should feel free to ask questions at any time and are encouraged to do so. My job is to help you learn. Take advantage of the opportunity!

Classroom Ground Rules:
1. Address the instructor in an appropriate manner.
2. Respect the views and opinions of the other students.
3. Work only on material/homework pertaining to the class.
4. No swearing or use of profanity.
5. No headphones.
6. No children allowed.

Note: I reserve the right to make changes in the course that are appropriate within the context of the class.

Tentative Reading Schedule
Chem 222 Winter 2001

Date	Chapter	Reading Assignment (read before class)	Topic
Jan 8			Course Intro
10	16	592-605	**Benzene:** Electrophilic Aromatic Substitution
11	"	605-616	Benzene: EAS substituent effects
12	"	616-617	Benzene: additivity of substituent effects, synthesis
15		NO CLASSES	MARTIN LUTHER KING JR DAY
17	"	618-627	Benzene: nucleophilic aromatic substitution, benzyne, oxidation, reduction
18	"	627-636	Benzene: synthesis
19	"		Friday Puzzle
22		645-652	**Reaction and Mechanism Review**
24	17	654-663	**Alcohols and Phenols:** naming, physical properties, acidity & basicity
25	"	664-672	A&P: alcohol preparation by addition and reduction
26			Friday Puzzle
29	"	673-683	A&P: alcohol reactions
31			A&P: multistep Grignard synthesis
Feb 1	"	684-697	A&P: phenols, spectroscopy
2			Friday Puzzle
5	18	708-714	**Ethers:** naming, properties, & preparation
7	"	714-718	Ethers: synthesis and reactions
8	"	718-724	Ethers: epoxides
9		EXAM #1	
12	"	724-734	Ethers: spectroscopy, thiols, sulfides. applications
14		743-752	**Carbonyl Preview**
15	19	753-760	**Aldehydes & Ketones:** naming, preparation, & oxidation
16			Friday Puzzle
19	"	760-769	A&K: nucleophilic addition of carbon, oxygen, and nitrogen nucleophiles
21		770-780	A&K: nuc add'n cont'd
22	"	780-791	A&K: Wittig, Cannizzaro, and conjugate addition
23			Friday Puzzle
26	"	791-801	A&K: Spectroscopy and synthesis
28	20	814-825	**Carboxylic Acids:** naming, physical properties, and acidity
Mar 1		825-827	Carboxylic Acids: synthesis
2			Friday Puzzle

5-9		NO CLASSES	SPRING BREAK
12	"	827-835	Carboxylic Acids: reactions, spectroscopy
14	**21**	843-853	**Acid Derivatives:** nomenclature, nucleophilic substitution (addition/elimination)
15	"	853-863	Acid Derivatives: nucleophilic substitution cont'd
16		**EXAM 2**	
19	"	863-873	Acid Derivatives: nucleophilic substitution cont'd
21	"	873-882	Acid Derivatives: nitriles, thiol esters & polymers
22	"	882-890	Acid Derivatives: spectroscopy, synthesis
23			Friday Puzzle
26	**22**	901-910	**Carbonyl alpha substitution reactions:** enols
28	"	911-917	CASR: enolates
29	"	918-929	CASR: malonic ester & acetoacetic ester syntheses
30			Friday Puzzle
Apr 2	**23**	937-945	**Carbonyl Condensation Reactions:** aldols
4	"	945-949	CCR: aldol syntheses
5	"	949-955	CCR: Claisens
6			Friday Puzzle
9	"	955-967	CCR: Michaels, Storks, & Robinsons
11		**EXAM 3**	
12-13		NO CLASSES	EASTER BREAK
16	"		CCR: Enolate synthesis - putting it all together
18	**24**	976-989	**Amines:** naming physical properties, basicity
19	"	989-998	Amines: preparation
20	"	998-1007	Amines: reactions
23	"		Amines: synthesis
25	"	1007-1019	Amines: spectroscopy
26	**25**	1030-1040	**Carbohydrates:** monosaccharide structure
27	"	1041-1046, 1055-1060	Carbohydrates: disaccharide and polysaccharide formation

CHEM 231
Quantitative Analysis
4 Credits

Instructor :	Dr. Prabhakara Shetty	Fall 2001
Office:	ASC 3097	STR 233
Telephone:	592 2589	MWF 10:00 - 10:50 AM
Office Hours:	T 10am-12pm, R 10am-12pm	

Goals and Objectives:

To enable students to understand the concepts of classical and modern quantitative analysis involving both wet and instrumental methods.

To develop ability to draw reasonable inferences from observations, and to improve problem solving skills

Requirements:

Four hourly tests	400 points (100 pts. each)
Final Exam	100 points (cumulative)
Laboratory	150 points.

Grading Scale:

92.5 % and above	A
89.5 to 92.4 %	A-
86.5 to 89.4 %	B+
82.5 to 86.4 %	B
79.5 to 82.4 %	B-
76.5 to 79.4 %	C+
72.5 to 76.4 %	C
69.5 to 72.4 %	C-
66.5 to 69.4 %	D+
62.5 to 66.4 %	D
59.5 to 62.4 %	D-

Text book: Quantitative Chemical Analysis by Daniel C. Harris, Fifth edition

Laboratory Manual: Laboratory Manual for Chemistry 231

Topics:

1. Introduction to chemical analysis
2. Statistical approaches to error in analysis and data handling.
3. Chemical equilibrium: concept and calculations.
4. Acids, bases and buffers
5. Volumetric analysis: titrations and equivalence points.
6. gravimetric analysis: the limits of solubility
7. Introduction to Instrumentation.
8. Molecular spectroscopy.
9. Chromatography.
10. Electrochemistry.

Lab Schedule:

Week of 08/27: Check in and Experiment # 1, Making Measurements
Week of 09/03: No Lab
Week of 09/10: Experiment # 2, Acid-Base Titrations
Week of 09/17: Experiment # 3,Determination of Acid-NeutralizingStrength of Antacids
Week of 09/24: Experiment # 4, Standardization of Tiosulfate
Week of 10/01: Experiment # 5, Analysis of Vitamin C
Week of 10/08: Experiment # 6, Gravimetric Analysis of Chloride
Week of 10/15: Experiment # 6, Gravimetric Analysis of Chloride
Week of 10/22: Experiment # 7, Measuring pH
Week of 10/29: Experiment # 8, Introduction to Spectrophotometry
Week of 11/05: Experiment # 9, Reverse Phase HPLC Analysis of Hydrocarbons
Week of 11/12: Experiment # 10, HPLC Analysis of Sugars
Week of 11/19: No Lab
Week of 11/26: Experiment # 11, UV/VIS Analysis of a Binary mixture

Attendance Policy: If a student misses more than three lectures in a semester he/she loses one percentage point from the final numerical grade for each missed lecture. One percentage point will be added to the final numerical grade if a student maintains a perfect attendance.

Policy on Tardiness: Students are expected to be on time, and stay till the end of the lecture. If a student comes in late or leaves early, he/she will be marked absent for that day. Due to health hazards associated with some of the chemicals used in the lab, if a student misses even a part of the pre-lab lecture, he or she will not be allowed to work the lab that day.

CHEM 317 WINTER SEMESTER 2001

INSTRUMENTAL METHODS OF ANALYSIS

Mr. Bill Killian | January 8, 2001
lecture: M/F 10-11:00 am SCI-336 | Winter Semester

Mr. James Weaver | 3 credit course
lab: R 12-3:50 PM SCI-321 | Text: Essential Guide to Analytical Chemistry By Schwedt

Lecture Topics:

Data manipulation, graphing, units, sample preparation, methodology. Specific ion electrodes, pH, potentiometry. Refractometry, use of radiant energy in analysis. Traditional spectroscopy including uv-vis, ir, and fluorimetry. Emission spectroscopy and atomic absorption techniques. Nuclear magnetic resonance, including ^{13}C, as well as mass spectrometry. Chromatography, special emphasis on gas chromatography.

Lab Topics:

Statistics, potentiometric methods, specific ion electrode, uv-vis spectroscopy, viscometry IR Spectroscopy, NMR, AA, mass spec workshop, chromatography gas and liquid.

Requirements:

Final exam	1 x 100 =	100
Quizzes	4 x 40 =	160
Lab reports	=	240
Total		500 points

Grading:

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

Other Considerations:

1. Problem sets will be assigned after each class and reading will be assigned.

2. Lab reports are to be typed with the form and number to be designated by Mr. Weaver.

3. A lab notebook is required with attention paid to entries according to Mr. Weaver's direction.

Course Purpose:

An attempt will be made to cover important aspects of a number of instrumental techniques, emphasizing practical instrumental application to problems. Lab will be especially important in developing through "hands on" experience, the fundamentals of instrument usage.x

Course Objectives:

1. To become familiar with basic working instrumental theory of a survey of a number of common laboratory instruments.

2. To be able to solve problems related to these instruments, mathematical, as well as technical.

3. To gain expertise in instrument operation through laboratory exercises.

4. To be able to recognize, record, and analyze analytical instrumental data.

5. To be critically able to evaluate an instrument's performance and an analyst's performance.

6. To become independent in through and action while working open ended lab exercises.

7. To compile professional lab reports.

8. Above all....be a safe worker in the lab.

"Science is not technology, it is not gadgetry, it is not a great mechanical monster. Science is an adventure of the human spirit. It is essentially an artistic enterprise, stimulated largely by disciplined imagination, and based largely on faith in the reasonableness, order, and beauty of the universe of which man is a part." Warren Weaver

BILL KILLIAN

INCT 120
ORIENTATION TO INDUSTRIAL CHEMICAL TECHNOLOGY
2 SEMESTER CREDITS

AUGUST 2001

Lec: MR 9-9:50
Loc: SCI-336

Office: SCI-307
Phone: x2590

FALL 2001 SEMESTER

Textbook: "Dynamics of the US Chemical Industry"
Sheldon B. Greenbaum

Week and Assignment	***Topic***
8/27 *Handouts*	*Role of Chemical Technologist*
9/03 *Chapt. #1*	*Chemical Literature*
9/10 *Handouts*	*Use of the Library*
9/17 *Handouts*	*Computer Searching*
9/24 *Handouts*	*Physical/Chemical Properties*
10/01 *Exam I & Handouts*	*Data /Graphing*
10/08 *Chapt. #2*	*Introduction to Industrial Chemistry*
10/15 *Chapt. #2*	*Diagrams and Drawings*
10/22 *Chapt. #2 & #4*	*Inorganic Process Chemistry*
10/29 *Chapt. #2 & #4*	*Organic Chemical Processes*
11/05 *Exam II & Handout & Chapt. #6*	*Pollution Prevention in Industry*

11/12 Chapt. #5	*Notebook and Patents*
11/19 Handouts	*Specifications*
11/26 Paper due & Handouts	*Good Lab Practice*
12/03 Handouts	*Personal Protective Equipment*
12/10	*Finals Week*

"Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information in it."

Dr. Samuel Johnson (1709-1784)

IMPORTANT CONSIDERATION:

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

Requirements		***Grading Scale/Total Points***	
Journal Work	*120*	*A >506*	*C+>424*
Exams	*300*	*A->495*	*C >401*
Paper on a chemical Compound	*100*	*B+>478*	*C->369*
Attendance	*30*	*B >462*	*D >330*
		B->440	*E <330*

INCT 125

Chemical Lab Safety
2 Credits

Mr. Bill Killian
T, F 9:00am
SCI-336

January 8, 2001
Winter Semester 2001

Textbook: **"Chemistry of Hazardous Materials," Eugene Meyer 3rd Edition**

WEEK OF	TOPIC	ASSIGNMENT	ACTIVITY
1/8	General Safety & Lab Labels	M1	
1/15	MSDS Sheets	M1	
1/22	Physical Properties as Related to Hazards	M2	
1/29	Compressed Gases & Liquids	M2	
2/5	Flammables	M3	Unit Test 1
2/12	Hazardous Matter	M4	
2/19	Chemical Reactivity & Combustion	M5	
2/26	Chemistry of Some Common Elements	M7	
3/5	**Spring Break**		
3/12	Corrosives	M8	Unit Test 2
3/19	Water Sensitive Materials	M9	
3/26	Toxilogical Levels	M10	
4/2	Redox Hazards	M11	
4/9	Organic Hazards	M12 & 13	Safety File Due
4/16	Explosives	M14	Unit Test 3
4/23	Radiation	M15	
4/30	**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-

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 INCT 120 and will often reference the text "Modern Chemical Technology" by Pecsok. (available in our library)

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 | **INCT 220** | **AUGUST 2001**

INDUSTRIAL CHEMICAL CALCULATIONS
2 SEMESTER CREDITS

Lec: WF 9-9:50am
Loc: SCI-336

Office: SCI-307
Phone: x2590

FALL 2001 SEMESTER

Textbook: "Chemical Problem Solving" Nakon
"SPC Simplified Practical Steps to Quality" Amsden

Week	Assignment/Activity	Topic and Assignment
8/27	Introduction, Measurements and Nomenclature	N
9/03	Concentration	N
9/10	Practical and Advanced Problems	Max Quiz # I
9/17	Stoichiometry	N
9/24	Practical and Advanced Problems	N
10/01	Gases	Max Quiz # II
10/08	Redox	Handout
10/15	Statistics for Analytical Chemists	N Quiz # 1
10/22	Practical and Advanced Problems	N
10/29	Introduction to Statistical Process Control	A Quiz – 2
11/05	Graphs	A
11/12	Control Charts	A
11/19	Practical and Advances Problems	A Max Quiz # III
11/26	Basic Chemical Engineering Problems	Handout
12/03	Basic Chemical Engineering Problems	Handout
12/10	Finals Week	Quiz 3

IMPORTANT CONSIDERATION:

Your attendance in lecture and lab 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*

INCT 230

Chemical Manufacture & Applied Analysis

4 Credits Winter Semester 2001

Mr. Killian

Lecture: M 12:00 Sci-336 January 8, 2001
Lab: M/W 8 hours to be determined Sci-309

Textbook: **"Analytical Chemistry for Technicians," 2nd Edition**
by: John Kenkel

WEEK OF:	TOPIC & LAB ASSIGNEMENT	READING ASSIGNMENT
1/8	Introduction to Methodology: Physical Methods	2
1/15	Gravimetric Analysis: Gravimetric Iron	1
1/22	Titrimetrics: ASTM Methods	5
1/29	Redox Analysis: Pickle Liquor Analysis	8
2/5	Complexometric Titrations: Water Hardness	7
2/12	Quantitive IR: Aspirin Assay 2 Ways	6, 12
2/19	Non-Aqueous Titrations	Handout
2/26	Midterm: Esterification Synthesis: Project I	4, 16
3/5	Spring Break	
3/12	Pesticide-Active Ingredient Isolation: Project II	15
3/19	Project II	13
3/26	Dye Preparation: Project III	19
4/2	Project III	11
4/9	Polymer-Preparation & Characterization: Project IV	Handout
4/16	Project IV	Handout
4/23	Research Talk/Check Out	Handout
4/30	Final Exam	

Requirements

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

IMPORTANT NOTE:

Eight (8) hours per week in the laboratory is MANDATORY to pass this class. Those averaging less than that by ***March 23, 2001*** ARE ADVISED TO ***DROP*** RATHER THAN FAIL.

Section 10: Enrollment Trends

In this section we will first present the enrollment figures over the last five years. Next we will list the number of graduates. Finally, we will comment on the trends that these numbers suggest.

■ Five-Year Enrollment History

Listed below are the ICT enrollments as reported in last fall's administrative program review.

	Fall 1996	Fall 1997	Fall 1998	Fall 1999	Fall 2000
Freshman			2	4	5
Sophomore	7		6	6	6
Junior	1	4	1	3	1
Senior	4	3	2	1	3
TOTAL	**12**	**10**	**11**	**14**	**15**

Please note that the totals may occasionally exceed the sum of the freshmen, sophomores, juniors and seniors due to the fact that some students are unclassified.

■ Five-Year Graduate History

Listed below is the graduate information reported on last fall's administrative program review.

	AY 95/96	AY 96/97	AY 97/98	AY 98/99	AY 99/00
Graduates	12	14	12	12	12
Placement rate	100%	92.9%	100%	100%	N/A
Average starting salary	$24-$27K	$24-$27K	$24-27K	$28-$31K	N/A

■ Comments on Enrollment Trends

1) We do not believe that the enrollment figures reflect the number of the students in the program. For example, in the Fall of 1996 the university reported 12 enrollees; that next spring (AY 96/97) there were 14 graduates. Again, in the Fall of 1997 the university reported 10 enrollees; in the spring (AY 97/98) there were 12 graduates. And once again there were more graduates (12) than enrollees (11) in the following year. If both sets of figures are accurate, then one would have to believe that this program consistently graduates more students than are actually in the program. Furthermore, the enrollment figures represent the enrollment over *two years* of the program, not just the students who graduate. For example, if there are 12 graduates in Spring 1999 and another 12 graduates in Spring 2000, then there should be just under 24 students in the program in the Fall of 1998. For these reasons, we do not believe that the enrollment figures are accurate. Internally, we use the number of graduates as a reflection of the size of the program.

2) There are a number of reasons for the anomalies reported in the preceding paragraph. First, some ICT students are enrolled in other four-year programs, such as chemistry education, plastics, biotechnology, or hazardous waste management. These students may not enroll as ICT students until shortly before graduation. Second, many ICT-students-to-be initially enroll in other programs, such as pre-science or pre-pharmacy. They are taking the same courses as other ICT students, but do not officially switch over to the program until later in the year. In fact, we target recruitment efforts at this "undecided" population, trying to identify students who enjoy laboratory work but may not necessarily have the desire to complete a four-year (or longer) degree program. Dow Chemical now sends out Ferris graduates as program recruiters (not as Dow recruiters) in the fall, explaining the benefits of this two-year degree to students in general and organic chemistry. The program coordinator has found a heightened interest in the program following these visits.

3) The placement rate for students has been essentially 100%, either into appropriate employment or into a four-year degree program.

4) According to a Dow recruiter this fall, expected starting salaries this year will be around $31,000, with advancement to salaries of $45,000 after approximately five years on the job and without any further education.

5) Over the past five years, program enrollment (as reflected by the graduation numbers) has remained fairly steady at about twelve to fourteen graduates per year.

6) As reported at the Biennial Conference on Chemical Education (BCCE) held last year in Ann Arbor MI, enrollments in chemical technology programs have been dropping over the last five years, in spite of an increasing demand for graduates by the chemical industry. Even many ACS-approved programs are

facing a downturn in enrollment. Measured against this national statistic, the steady enrollment pattern in FSU's program is actually a better-than-average statistic.

7) One of the topics discussed at last spring's advisory board meeting was the recruitment and retention of students. It was the feeling of the board members that the main problem is recruiting students into science programs as a whole. Furthermore, as one of the board members stated, many parents prefer their children to pursue four-year degrees rather than two-year degrees. Only when the students come to Ferris do they learn that they can contribute to a professional work team with an associate's degree in science.

These steps have recently been taken to recruit more students:

- We have a one-plus-one articulation agreement with Alpena Community College, whereby students take the first year of classes at Alpena and transfer to Ferris to complete their program in the second year. Last year we had two students in our program who transferred from Alpena.

- Chemical company recruiters (*especially* Ferris graduates) have been invited on campus in the fall to acquaint students with what a chemical technologist does.

- We have asked secondary school teachers to become members of our advisory board. This step, in fact, has been recommended by the American Chemical Society to its approved programs. These teachers can provide input about strategies that can more effectively recruit high school students, and the teachers will become more informed about the opportunities afforded by a degree in chemical technology.

These steps are either just underway or could be taken in the near future to recruit more students:

- Offer larger scholarships to attract and retain students in chemical technology. The Dow Chemical Company, which formerly sponsored four $500 scholarships per year, is now funding four $2200 scholarships this year.

- Produce, maintain and upgrade a website related to the chemical technology program at Ferris. Again, Dow has provided seed money (last year and this year) to promote this initiative.

- Target schools for recruiting activities. For example, in Midland there is already a high awareness of the chemical industry, so students in high schools in this area may be ready to listen to a message about two-year degrees in chemical technology.

- Involve members of the ICT advisory board itself in recruiting, especially in their local areas. At our last meeting, many of them expressed a willingness to help.

- Finally, to have time to do more effective recruiting, we may need to eliminate steps that have not historically yielded any students to the program. (For example, not a single student who has entered the program over the last decade has been attracted by our Autumn Adventure displays.)

8) Finally, we should mention that there is an off-campus certificate program in industrial chemistry. At the invitation of the former Parke-Davis (now Pfizer) Corporation, we tailored a certificate specifically for their employees. Pfizer internally hires and trains chemical technicians by identifying well-motivated employees in other areas of the plant. While these employees know how to carry out the functions of their jobs, they do not have the educational background to fully appreciate what they are doing.

Being acquainted with the reputation of the Ferris ICT program, plant managers from Pfizer approached Ferris regarding the possibility of on-going training. From these discussions, the certificate program emerged. For the last few summers, we have taught INCT and CHEM courses on-site in Holland MI to between six and ten students. At the end of Summer 2000 the first few employees completed the certificate. We look forward to continuing this mutually beneficial relationship with Pfizer.

Section 11: Program Productivity and Costs

As you read in the curriculum section, the ICT program consists of three components: (1) a professional core of chemistry (CHEM) and industrial chemistry (INCT) courses; (2) supporting math, science and computer courses; and (3) other general education courses. For the purposes of program productivity, we will examine the professional core. For the purposes of program costs, we will look at the university's published data for overall programs.

■ Program productivity

Program productivity is difficult to quantify. According to Mitzi Day, the Office of Institutional Studies does not keep data on *program* productivity. Instead, the office reports data on *college* productivity, *department* productivity and *course prefix* productivity.

Which data do we use, then, to represent the productivity of the Industrial Chemistry Technology program? The INCT courses have the same name as the program, but they represent only 10 credits of a 63-credit program. It would not be reasonable to judge the productivity of the entire program on the basis of 16% of its coursework.

Furthermore, our employers have emphasized that our students' strong preparation in *chemistry* is one of the reasons they hire our graduates. However, while our students complete many CHEM courses, there are several CHEM courses that they are not required to take; therefore, the CHEM productivity, by itself, may not be a good measure of the program's productivity either.

So in this section we will do the best we can by combining the most recent productivity figures for chemistry and industrial chemistry courses. According to the Fall 2001 Productivity Report released by Institutional Research & Testing, the productivity over the 2000-2001 academic year was 621.19 SCH/FTEF for CHEM courses and 202.62 SCH/FTEF for INCT courses.

Since the core of the program consists of 27 credit hours (73.0%) of chemistry (CHEM) and 10 credit hours (27.0%) of industrial chemistry technology, an estimate of the most recent program productivity may be given by:

$$(0.730 * 621.19) + (0.270 * 202.62) = 508.18 \text{ SCH/FTEF}$$

■ Program cost

The Office of Institutional Research also produces a cost report. Unlike their productivity report, the cost report is *not* issued annually. It does have a section, however, that lists overall program costs.

The most recent cost report lists data for the 1998-1999 academic year.

According to this report, the total cost per SCH of the Industrial Chemistry Technology program is **$146.35**.

Among this ranking of 183 programs, the ICT program ranked 138th out of 183 programs listed. That is, the ICT program is among the bottom third of programs in terms of cost (one of the university's *least* expensive programs).

The table listing all of the program costs for the 1998-99 academic year is attached to this section.

■ Comments on productivity and cost

1) Because the program has so few courses with the prefix INCT, the productivity of these courses alone is not a fair reflection of the overall program productivity.

2) The program cost data take into account *all* of the courses that are listed on a program's checksheet. Because the students are required to take courses with several different prefixes, in the case of the ICT program this number may better reflect the overall "efficiency" of the courses in the program.

3) We identified a "peer" group of non-pre-professional, lab intensive (or clinic intensive) associate degree programs on the cost report. We highlighted twenty-eight such programs with an asterisk. In this peer group, *the ICT program is the second least expensive.* Only the radiography program has a lower cost per SCH.

4) We therefore conclude that given the laboratory-intensive nature of the ICT program, it provides an excellent value to the university in terms of its cost.

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
Optometry OD (Yrs 3,4,5 & 6)	163	$436.15	$33.34	$91.51	**$561.00**
Public Relations Certificate	12	$430.15	$45.38	$10.28	**$485.81**
Pharmacy/All Options Pharm.D (Yrs 6 & 7)	71	$364.05	$39.72	$42.87	**$446.64**
Real Estate Certificate	9	$352.69	$27.72	$13.16	**$393.57**
Quality Improvement for Managers Certificate	9	$338.04	$39.99	$10.28	**$388.32**
Opticianry AAS	68	$231.61	$69.01	$61.84	**$362.46**
Insurance Certificate	12	$302.98	$25.92	$12.44	**$341.34**
Quality Technology Certificate	12	$244.38	$76.09	$20.34	**$340.82**
Indust & Environ Hlth Mgt (Gen Env Hlth option) BS	134	$241.04	$71.51	$21.15	**$333.70**
Advanced Studies in Investment Analysis Certificate	12	$291.78	$20.51	$10.28	**$322.57**
Printing & Digital Graphic Imaging Technology AAS	65	$236.24	$60.58	$17.09	**$313.91**
Criminal Justice Administration MS	30	$253.80	$39.46	$17.91	**$311.17**
Info Systems Mgt/Quality Improvement Emphasis MS	31	$245.33	$37.46	$11.95	**$294.74**
Indust & Environ Hlth Mgt (Haz Waste option) BS	130	$207.50	$64.66	$19.18	**$291.34**
Computer Networks & Systems BS (Embedded Systems	136	$233.09	$42.46	$14.36	**$289.91**
Info Systems Mgt/Information Systems Emphasis MS	31	$217.24	$37.36	$11.12	**$265.72**
Automotive Service Technology AAS	68	$194.84	$53.38	$17.33	**$265.56**
Heavy Equipment Technology AAS	67	$191.88	$51.19	$16.68	**$259.75**
Indust & Environ Hlth Mgt (Indust Safety option) BS	121	$185.39	$51.98	$17.09	**$254.46**
Medical Laboratory Technology AAS	69	$149.39	$79.44	$22.99	**$251.83**
Indust & Environ Hlth Mgt (Indust Hyg option) BS	127	$178.40	$55.07	$17.38	**$250.85**
Manufacturing Engineering Technology BS (Yrs 3 & 4)	79	$172.00	$59.68	$17.06	**$248.74**
Dental Hygiene AAS	77	$113.08	$105.77	$23.01	**$241.86**
Elect/Electron Engr Tech BS (Yrs 3 & 4) (Communication	69	$180.75	$44.71	$14.78	**$240.24**
Elect/Electron Engr Tech BS (Yrs 3 & 4) (Indust Automati	69	$180.75	$44.71	$14.78	**$240.24**
Computer Networks & Systems BS (Communications Tra	136	$181.94	$42.46	$14.36	**$238.77**
Computer Networks & Systems BS (Indust Automation Tr	136	$180.62	$42.46	$14.36	**$237.44**
Automotive Body AAS	63	$165.02	$53.17	$17.09	**$235.28**
Advertising Certificate	14	$179.43	$45.38	$10.28	**$235.09**
Nursing AAS	72	$147.07	$63.38	$23.33	**$233.77**
Technical Drafting and Tool Design AAS	67	$160.31	$55.82	$15.93	**$232.06**
Quality Engineering Technology BS (Yrs 3 & 4)	68	$164.72	$49.68	$15.03	**$229.44**
Plastics Engineering Technology BS (Yrs 3 & 4)	64	$158.56	$54.48	$16.10	**$229.14**
Automotive Service Technology AAS (Ford ASSET opt)	68	$157.50	$53.38	$17.33	**$228.21**
Automotive Service Technology AAS (General Motors AS	68	$157.50	$53.38	$17.33	**$228.21**
Automotive Service Technology AAS (Chrysler Apprentic	68	$157.50	$53.38	$17.33	**$228.21**

* Instructor Cost - *Salary & Fringe*
** Depatment Cost - ***Departmental Level Non Instructor Compensation, Supplies and Equipment***
*** Dean's Cost - ***Dean's Level Non Instructor Compensation, Supplies and Equipment***

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
Biotechnology BS	130	$196.18	$24.37	$7.45	**$228.01**
Career and Tech Educ/Postsecondary Admin MS	31	$159.43	$45.68	$21.30	**$226.42**
Career and Tech Educ/Human Resource Dev MS	31	$163.03	$43.09	$20.13	**$226.24**
Career and Tech Educ/Career & Tech Instr MS	32	$158.90	$45.33	$21.06	**$225.29**
Manufacturing Tooling Technology AAS	68	$148.04	$60.06	$16.76	**$224.86**
Computer Networks & Systems BS (Information Systems	137	$169.06	$41.16	$14.12	**$224.34**
Medical Technology (Integrated) BS	136	$137.19	$67.26	$19.88	**$224.34**
Elect/Electron Engr Tech BS (Yrs 3 & 4) (Digital)	69	$164.91	$44.17	$14.78	**$223.85**
Welding Technology AAS	67	$148.72	$58.01	$16.49	**$223.22**
Television Production BS	128	$126.60	$77.55	$14.69	**$218.84**
Respiratory Care AAS	69	$160.81	$30.90	$25.24	**$216.95**
Industrial Electronics Technology AAS	67	$153.04	$46.63	$15.74	**$215.40**
Facilities Management BS (Yrs 3 & 4)	66	$163.05	$37.35	$14.48	**$214.88**
Surveying Engineering BS	138	$160.27	$39.14	$15.14	**$214.56**
Heavy Equipment Service Eng Tech/Maint Opt BS (Yrs 3	66	$156.28	$42.46	$14.38	**$213.13**
Architectural Technology AAS	66	$149.78	$43.80	$16.42	**$210.00**
Advanced Studies in Global Logistics Certificate	12	$157.47	$39.16	$10.28	**$206.91**
Marketing Certificate	12	$150.70	$45.38	$10.28	**$206.36**
Marketing Sales Certificate	12	$159.51	$37.00	$9.56	**$206.08**
Pharmacy BS (Yrs 3,4 & 5)	94	$128.17	$38.14	$38.71	**$205.01**
Marketing Research Certificate	12	$157.93	$36.70	$10.28	**$204.91**
Food Service Management Certificate	12	$148.95	$45.38	$10.28	**$204.61**
Visual Communication BS (Yrs 3 & 4)	64	$155.06	$37.92	$10.01	**$202.99**
Surveying Technology AAS	61	$150.77	$36.45	$14.34	**$201.57**
Advanced Construction Management Certificate	12	$125.60	$55.30	$20.34	**$201.24**
Health Information Technology AAS	63	$133.32	$41.38	$24.15	**$198.85**
Ornamental Horticulture Technology AAS	60	$159.00	$30.18	$8.30	**$197.48**
Medical Technology (Career Mobility) BS (Yrs 3 & 4)	72	$129.46	$51.03	$16.18	**$196.67**
Mechanical Engineering Technology AAS	65	$136.64	$45.61	$14.00	**$196.26**
Career and Tech Educ/Administrative Cert MS	32	$126.87	$45.82	$21.39	**$194.09**
Wage Earning Home Economics Education BS (Yrs 3 & 4	98	$142.87	$35.11	$15.48	**$193.46**
Career and Tech Educ/Educational Technology MS	32	$129.42	$44.02	$19.51	**$192.96**
HVACR Technology AAS	67	$134.61	$42.66	$15.68	**$192.95**
Legal Assistant AAS	64	$157.01	$24.45	$10.84	**$192.31**
Product Design Engineering Technology BS (Yrs 3 & 4)	68	$123.12	$52.46	$15.59	**$191.17**
Technical Education BS (Yrs 3 & 4)	98	$140.65	$34.84	$15.50	**$190.99**

* Instructor Cost - *Salary & Fringe*
** Depatment Cost - *Departmental Level Non Instructor Compensation, Supplies and Equipment*
*** Dean's Cost - *Dean's Level Non Instructor Compensation, Supplies and Equipment*

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
International Business Certificate	12	$159.08	$20.51	$10.28	**$189.88**
Welding Engineering Technology BS (Yrs 3 & 4)	73	$125.31	$49.64	$14.88	**$189.83**
Allied Health Education BS (Yrs 3 & 4)	99	$139.23	$34.49	$15.69	**$189.41**
Rubber Engineering Technology BS (Yrs 3 & 4)	62	$130.48	$43.37	$15.29	**$189.14**
Small Business Management Certificate	12	$144.23	$31.60	$10.28	**$186.11**
Nursing BSN (Yrs 3 & 4)	84	$120.63	$47.85	$17.17	**$185.65**
Hospitality Management BS (Yrs 3 & 4)	63	$142.41	$33.57	$9.32	**$185.30**
*Plastics Technology AAS	62	$126.80	$44.42	$13.49	**$184.70**
Direct Marketing Certificate	12	$126.99	$44.57	$12.44	**$184.00**
Retailing Certificate	12	$127.66	$45.38	$10.28	**$183.32**
Health Information Management BS	123	$122.33	$37.74	$21.84	**$181.91**
Business Education/General Business BS	155	$132.40	$34.93	$13.74	**$181.06**
Public Relations BS	124	$139.69	$31.16	$10.08	**$180.93**
Accountancy/Finance BS	137	$145.02	$26.10	$9.75	**$180.87**
Health Care Systems Administration BS	128	$126.51	$35.83	$18.50	**$180.84**
Heavy Equipment Service Eng Tech/Mfg Opt BS (Yrs 3 &	66	$119.99	$45.98	$14.86	**$180.83**
HVACR Engineering Technology BS (Yrs 3 & 4)	64	$124.70	$39.81	$15.50	**$180.00**
Hospitality Management Certificate	12	$123.02	$45.38	$10.28	**$178.68**
Food Service Management AAS	64	$133.13	$33.27	$10.19	**$176.59**
Business Education/Marketing/Distributive Edu BS	155	$127.02	$35.89	$13.57	**$176.48**
*Rubber Technology AAS	64	$127.11	$35.84	$12.99	**$175.94**
Insurance/Real Estate BS	124	$139.42	$24.38	$10.34	**$174.14**
Construction Field Engineering Certificate	12	$98.15	$55.30	$20.34	**$173.79**
Mainframe Computer Certificate	13	$120.75	$39.99	$10.28	**$171.03**
Automotive and Heavy Equipment Mgt BS (Yrs 3 & 4)	68	$114.33	$41.62	$14.29	**$170.25**
Accountancy (Public Accounting Track) BS	124	$129.48	$29.70	$10.69	**$169.86**
*Civil Engineering Technology AAS	63	$113.71	$40.41	$15.45	**$169.57**
CJ/Law Enforcement Option BS (Yrs 3 & 4)	67	$111.44	$39.02	$18.52	**$168.98**
Accountancy (Cost/Managerial Track) BS	124	$125.76	$31.01	$11.35	**$168.12**
International Business BS	127	$132.28	$24.66	$10.32	**$167.26**
Actuarial Science BS	120	$134.54	$21.34	$11.08	**$166.95**
Accountancy/Computer Information Systems BS	140	$125.63	$31.49	$9.60	**$166.73**
Construction Administration Certificate	12	$90.43	$55.30	$20.34	**$166.07**
Midrange Computer Certificate	14	$115.70	$39.99	$10.28	**$165.98**
Human Resource Management BS	122	$133.46	$22.27	$9.78	**$165.51**
Printing Management BS (Yrs 3 & 4)	64	$107.00	$44.24	$13.76	**$165.00**

* Instructor Cost - *Salary & Fringe*
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*** Dean's Cost - *Dean's Level Non Instructor Compensation, Supplies and Equipment*

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
Accountancy (Professionally Directed Track) BS	124	$123.83	$29.71	$10.78	**$164.32**
Construction Management BS from Arch Tech (Yrs 3 & 4	83	$110.21	$38.49	$15.08	**$163.77**
Computer Literacy Certificate	12	$113.09	$39.99	$10.28	**$163.36**
Building Construction Technology AAS	63	$106.54	$40.41	$15.45	**$162.40**
Real Estate AAS	63	$129.50	$23.24	$9.60	**$162.33**
Forensics Sciences/Clinical Crime Investigation Certificat	12	$122.43	$29.02	$10.28	**$161.73**
Athletic Coaching Certificate	13	$102.71	$38.75	$19.93	**$161.39**
Computer Information Systems/Marketing BS	146	$117.91	$33.02	$10.29	**$161.22**
Construction Management BS (Highway/Bridge Track)	130	$108.58	$37.80	$14.71	**$161.09**
Insurance BS	124	$123.20	$26.42	$11.32	**$160.94**
CJ/Corrections Option BS (Yrs 3 & 4)	65	$107.81	$35.09	$16.53	**$159.42**
Computer Information Systems/Management BS	154	$119.82	$28.44	$10.34	**$158.59**
Finance BS	125	$125.14	$22.47	$10.08	**$157.69**
onstruction Management BS (Commercial/Industrial Tra	130	$105.11	$37.80	$14.71	**$157.61**
Collegiate Skills Program AA	60	$87.93	$28.41	$38.58	**$154.92**
Applied Speech Communication BS	126	$116.62	$25.38	$11.97	**$153.96**
Nuclear Medicine Technology BS	125	$103.35	$30.15	$19.63	**$153.13**
Multimedia Production Certificate	12	$96.79	$45.38	$10.28	**$152.45**
Advertising BS	125	$110.42	$31.30	$10.03	**$151.75**
Marketing/Sales BS	124	$110.59	$30.13	$9.92	**$150.64**
Computer Information Systems BS	129	$111.55	$29.50	$9.55	**$150.60**
Nuclear Medicine Technology AAS	66	$92.77	$31.94	$24.94	**$149.65**
Management BS	123	$114.87	$24.45	$10.30	**$149.61**
Technical and Professional Communication BS	121	$119.98	$20.20	$9.40	**$149.58**
Operations Management BS	125	$114.19	$24.08	$10.06	**$148.33**
Mathematics Education BS	144	$107.57	$27.69	$12.64	**$147.90**
CJ/Generalist Option BS (Yrs 3 & 4)	64	$96.39	$35.04	$16.33	**$147.76**
Quality & Productivity Management BS	124	$110.33	$25.92	$11.46	**$147.71**
Marketing BS	124	$108.06	$29.19	$9.96	**$147.21**
Industrial Chemistry Technology AAS	63	$118.12	$20.65	$7.57	**$146.35**
Professional Golf Management BS	124	$102.58	$32.52	$10.17	**$145.27**
Professional Tennis Management BS	124	$101.74	$32.28	$10.13	**$144.15**
Applied Mathematics BS	120	$116.06	$18.73	$8.97	**$143.76**
Small Business Management BS	123	$107.65	$25.65	$10.19	**$143.49**
usiness Administration BS	123	$107.61	$24.59	$10.68	**$142.88**
Recreation Leadership & Mgt/Corp Fitness-Well Track BS	128	$96.48	$30.42	$15.24	**$142.14**

* Instructor Cost - *Salary & Fringe*
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*** Dean's Cost - *Dean's Level Non Instructor Compensation, Supplies and Equipment*

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
Public Administration BS	124	$100.50	$26.56	$13.99	**$141.05**
Career Exploration AA	60	$87.61	$24.95	$28.34	**$140.90**
Training in Business and Industry BS (Yrs 3 & 4)	99	$94.97	$30.74	$13.36	**$139.07**
Biology Education BS	122	$94.64	$32.14	$12.20	**$138.98**
Recreation Leadership & Mgt/Sports Management Track	128	$94.30	$29.45	$14.46	**$138.21**
English Education BS	144	$95.20	$30.52	$12.40	**$138.13**
Music Industry Management BS	124	$96.90	$31.28	$9.53	**$137.71**
Child Development AAS	67	$92.75	$29.72	$15.06	**$137.54**
Recreation Leadership & Mgt/Outdoor-Adv Edu Track BS	128	$92.86	$29.53	$15.07	**$137.46**
Recreation Leadership & Mgt/Leisure Service Track BS	128	$92.79	$29.75	$14.72	**$137.26**
Retailing BS	124	$97.80	$29.90	$9.16	**$136.86**
Visual Communication AAS	66	$89.93	$34.45	$9.32	**$133.70**
Retailing AAS	67	$91.57	$31.24	$9.91	**$132.73**
AS/400 Programming Certificate	14	$81.54	$39.99	$10.28	**$131.82**
Pre-Teaching (Elementary or Secondary) AA	63	$90.81	$26.90	$11.88	**$129.59**
Chemistry Education BS	152	$88.83	$28.81	$11.91	**$129.55**
Directed Studies AA	60	$87.92	$23.51	$18.10	**$129.53**
General Business AAS	63	$93.44	$25.04	$9.33	**$127.81**
Applied Biology (Vision Science Track) BS	120	$88.92	$24.56	$12.72	**$126.20**
Pre-Criminal Justice AA	64	$85.07	$28.64	$11.92	**$125.63**
Radiography AAS	78	$61.27	$32.15	$27.98	**$121.40**
Social Work BSW	128	$92.60	$19.93	$8.64	**$121.17**
Applied Biology (Pre-Medicine Track) BS	120	$85.22	$23.95	$9.60	**$118.76**
Applied Biology (Sports Medicine Track) BS	120	$85.22	$23.95	$9.60	**$118.76**
Applied Biology (Pre-Dentistry Track) BS	120	$85.22	$23.95	$9.60	**$118.76**
Applied Biology BS	120	$85.22	$23.95	$9.60	**$118.76**
Applied Biology (Pre-Veterinary Medicine Track) BS	120	$84.94	$24.02	$9.48	**$118.44**
Applied Biology (Pre-Physical Therapy Track) BS	120	$84.36	$24.11	$9.50	**$117.98**
Pre-Public Administration AA	60	$82.91	$21.16	$11.39	**$115.47**
Liberal Arts AA	60	$79.92	$20.32	$11.29	**$111.53**
Pre-Law AA	60	$79.63	$20.32	$11.29	**$111.24**
Pre-Social Work AA	60	$79.70	$20.41	$11.13	**$111.24**
Pre-Pharmacy AS	60	$81.55	$19.98	$9.55	**$111.08**
Pre-Engineering AS	60	$81.55	$19.98	$9.55	**$111.08**
Applied Speech Communication AA	60	$81.55	$20.29	$9.19	**$111.03**
Pre-Optometry AS	60	$81.26	$19.98	$9.55	**$110.79**

* Instructor Cost - *Salary & Fringe*
** Depatment Cost - *Departmental Level Non Instructor Compensation, Supplies and Equipment*
*** Dean's Cost - *Dean's Level Non Instructor Compensation, Supplies and Equipment*

Table III

Degree Program Costing
Total Cost per SCH Ranked High to Low
1998-99

Program Name	Program Credits Required	Instructor Cost per SCH	Dept Cost per SCH	Dean's Cost per SCH	**Total Cost per SCH**
Pre-Mortuary Science AS	60	$81.26	$19.98	$9.55	**$110.79**
Pre-Technical & Professional Communications AA	60	$79.58	$19.65	$10.82	**$110.05**
Pre-Science AS	60	$81.50	$19.31	$9.08	**$109.89**

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* Instructor Cost - *Salary & Fringe*
** Depatment Cost - *Departmental Level Non Instructor Compensation, Supplies and Equipment*
*** Dean's Cost - *Dean's Level Non Instructor Compensation, Supplies and Equipment*

Section 12: Conclusions

These are the conclusions of the Program Review Panel regarding the thirteen criteria specified by the Academic Program Review manual.

■ Centrality to FSU mission

As posted on the web, "Ferris State University will be a national leader in providing opportunities for innovative teaching and learning in career-oriented, technological and professional education." The Industrial Chemistry Technology (ICT) program prepares students for positions as technicians in the chemical industry, both in the state and throughout the Midwest. This program readily fits with the current mission statement.

■ Uniqueness and visibility

The ICT program is the *only* degree providing training in chemical laboratory technology housed within a university in the state of Michigan. (Michigan Technological University offers a two-year degree in Chemical Engineering Technology, but that degree emphasizes the chemical processing industry and our degree emphasizes chemical technology.) Large chemical employers in the state of Michigan look to the Ferris program as a model for chemical technology.

The Ferris ICT program is the only one in the state that has been approved by the Chemical Technician Program Approval Service (CTPAS), an arm of the American Chemical Society.

■ Service to state and nation

For more than four decades Ferris ICT graduates have been highly sought by chemical employers across the state of Michigan. For the past decade, graduates of the ICT program have been increasingly recruited by companies throughout the Midwest (Indiana, Wisconsin, Illinois and Ohio). And over the last two years recruiters from elsewhere in the United States have also visited our campus and hired our graduates.

■ Demand by students

Student demand has been steady, yielding approximately twelve to fourteen graduates per year over the last five years. This is in the face of declining student demand reported by other programs nationwide.

The program would like to increase its annual graduation rate by approximately 25% to 50% (i.e., to about fifteen to eighteen graduates per year).

■ Quality of instruction

The quality of instruction provided in the professional courses is consistently rated very high by students.

■ Demand for graduates

Currently the industrial demand for graduates outpaces the ability of this program (and others statewide) to produce graduates. With an employer base that is more diversified now that it was ten years ago, a downturn by one employer is likely to be offset by the ability of other employers to provide jobs.

■ Placement rate and average salary of graduates

The placement rate over the past five years is essentially 100%. Good students frequently receive offers of employment from more than one company. Presently starting salaries average around $31,000 annually at the larger employers, with salaries rising to $45,000 or more after five years of experience.

■ Service to non-majors

Students in other programs (most notably chemical education, biotechnology and plastics) have added an ICT degree to their four-year program to enhance their background and employment prospects. The orientation course (INCT 120) gives undecided students an overview employment in the chemical industry. The safety course provides students in chemical education with more information about maintaining a safe laboratory environment than they receive in other courses.

■ Facilities and equipment

Facilities and equipment are currently adequate to provide the training and laboratory experience that our students need. Over the past five years the department has received funding from diverse sources to improve its equipment.

However, a major concern of the review panel is the expense to maintain and upgrade the equipment. Recent repairs to the departmental nmr consumed nearly 10% of the annual S/E budget. Donors have made it clear that they will not provide funding for equipment maintenance; they view that as a function of the university.

This Program Review Panel recommends that the university provide an ongoing annual line item of $10,000 for maintenance, repair, and upgrading of departmental equipment. This will help ensure that future students continue to receive the instrumental instruction that they require.

■ Library information services

The journal and book collection of FLITE is more than adequate to meet the needs of this program. Furthermore, FLITE recently obtained the ability to provide online access to all of the ACS (American Chemical Society) journals. This provides our students with up-to-date information for the projects that they carry out. Now our graduates will also leave with an enhanced ability to carry out online searches for information.

■ Cost

According to the most recent list of Degree Program Costing produced by the Office of Institutional Research (1998-99), the Industrial Chemistry Technology program has a total cost per SCH of $146.35. The ICT program is among the bottom 33% of programs ranked in this report (i.e., it is one of the least expensive). Furthermore, among all the laboratory- or clinical-intensive non-preprofessional two-year programs listed in this report, the ICT program is the second least expensive. Only the radiography program has a lower cost per student credit hour.

■ Faculty: professional and scholarly activities

Bill Killian, Pasquale Di Raddo, and Dave Frank are the three faculty/administrators who are most closely associated with the ICT program. They all have maintained a full array of professional and scholarly activities, many of which are directly related to the program itself. Please see the resumes attached to the section for more information.

■ Administrative effectiveness

The program is jointly administered by the program coordinator and the department head, who cooperate closely to ensure that all the administrative tasks are completed. The dean's office is supportive of the program. Overall, the administrative effectiveness is very good.

Vita

William Killian
Professor of Chemistry

Education.

M.S. in Chemistry, The Ohio State University, Columbus OH, 1976.

B.A. in Biology (*magna cum laude*), North Park College, Chicago IL, 1973.

Work Experience.

Summer 1996-2001, Coordinate and teach at Pfizer Pharmaceuticals in the Technician Certification Program

Summer 1994, Visiting Scientist, Dow Chemical Company, Surfactant research

Summer 1992-93, Research Associate, Argonne National Lab, FTIR, HPLC, and Safety Studies

Summer 1991, Research Associate, The Upjohn Company, HPLC method development

1987-present, Professor and Industrial Chemistry Coordinator, Ferris State University

1985 – 1986, Instructor, George Williams College, Chicago IL.

1984 – 1985, Instructor, Loop Junior College, Chicago IL.

1981-1985, Chemistry/Manager, Inland Steel.

Publications/Presentations.

"Meeting the Challenges For Chemical Technicians With an Innovative Certificate Program," 33rd Central/Great Lakes Joint Regional Meeting of the American Chemical Society, Grand Rapids, MI, June 2001.

"A Mechanistic Representation For the Synthesis of Benzanthrone and Violanthrone," *Journal of Polycyclic Aromatic Compounds*, Vol. 19, pp. 179-187, 2000.

"A Mechanistic Representation For the Synthesis of Benzanthrone and Violanthrone," 17th International Symposium on Polycyclic Aromatic Compounds, Bordeaux, France, October 1999.

"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.

"Detection of Chemical Plumes Utilizing Passive-Remote Fourier Transform FTIR Spectroscopy," 44th Annual Pittsburgh Conference and Exposition on Analytical Chemistry, Atlanta, GA, March 8-12, 1993.

"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.

"N-ACYL-1, 4-Dihydropyridines by Acid Catalyzed Condensations," *Tetrahedron Letters*, 16, 1407-1410, 1978.

Affiliations.

American Chemical Society
Chem Tech Division of the American Chemical Society
Western Michigan Section of the American Chemical Society

Vita

Pasquale R. Di Raddo
Professor of Chemistry

Education.

Ph.D., Organic Chemistry, McGill University, Montréal QC, 1983.

B. Sc., Biochemistry, McGill University, Montréal QC, 1976.

Work Experience.

Associate/Full Professor of Chemistry, 1994-present, Ferris State University.

Assistant Professor of Chemistry, 1989-1994, Carthage College, Kenosha WI.

Lecturer, 1988-1989, University of Wisconsin-Oshkosh.

Instructor, 1988, Roosevelt University, Chicago.

Research Associate, 1984-1988, University of Chicago (synthesis of polycyclic aromatic hydrocarbons and metabolites).

Publications (recent).

A Mechanistic Representation for the Synthesis of Fluoroantipyrine, a Vinyl Fluoride of Biomedical Significance (2002). Published in *The Insider*, Ferris State University.

A Mechanistic Representation for the Syntheses of Benzanthrone and Biolanthrone (2000). Published in *Polycyclic Aromatic Compounds,* 19, pp. 179-187.

A Facile Esterification of Fatty Acids (1993, Dec.). Published in *The Journal of Chemical Education.*

Spectroscopic Properties of Polycyclic Aromatic Compounds (1993). Published in *Analyt. Chim. Acta, 278,* p. 269.

Presentations (recent).

2002, 33rd ACS Great Lakes Regional Meeting, Grand Rapids MI.

2001, 86th Canadian Society of Chemistry National Meeting, Montréal QC.

2000, 16th Biennial Conference on Chemical Education, Ann Arbor MI.

2000, 2000 International Chemical Conference, Honolulu HI.

1999, International Symposium on Polycyclic Aromatic Compounds, Bordeaux (France).

1999, 31st ACS Central Regional Meeting, Columbus OH.

1998, 15th Biennial Conference on Chemical Education, Waterloo ON.

Involvement in Professional Development.

2000, *Pharmacology for Chemists*, Course, Boston.

1999, Faculty Mentoring Program.

1998-present, ICT Advisory Board Member.

2000-2001, Editorial Board Member for FSU's *The Insider*.

1998-2000, Reviewer, *Organic Chemistry* (Third Edition), McGraw-Hill.

1999-2001, Sponsored student research projects for: John Borsellino, Carolyne Fritz, Nathan Kroll, Kelley Templin, Monica McGill

Vita

David V. Frank
Physical Sciences Department Head

Education.

Ph.D., Chemistry Education, Purdue University, W. Lafayette IN, 1985.

M.S., Chemistry, Purdue University, W. Lafayette IN, 1980.

B.A., *summa cum laude*, Chemistry (major), mathematics and biology (minors), Macalester College, St. Paul MN, 1976.

Work Experience.

Physical Sciences Department Head, 1992 – present, Ferris State University.

Assistant/Associate Professor of Chemistry, 1985-1992, Ferris State University.

Chemistry Teacher, W. Lafayette (IN) High School, 1981-1982.

Teaching Assistant, Chemistry Department, Purdue University, 1978-1984.

Publications (recent, selected).

Padilla, M. J., Miaoulis, I. & Cyr, M. (program authors). Frank, D. V., Little, J. G., Miller, S. (book authors) (2000). *Prentice Hall Science Explorer: Chemical Building Blocks*. Prentice-Hall, Inc., Upper Saddle River NJ.

Padilla, M. J., Miaoulis, I. & Cyr, M. (program authors). Frank, D. V., Little, J. G., Miller, S. (book authors) (2000). *Prentice Hall Science Explorer: Chemical Interactions*. Prentice-Hall, Inc., Upper Saddle River NJ.

Frank, D. & Killian, W. (1999, Spring). "Highlighted Program: The Industrial Chemistry Technology Program at Ferris State University." Article appearing in *Newsletter for Chemistry Technician Instructors,* Volume 11, No. 1, p. 4.

Herron, J. D., Frank, D., Sarquis, A., Sarquis, J., Schrader, C. & Kukla, D. (1996). *Heath Chemistry* (Third Edition). D. C. Heath and Company: Lexington MA.

Plus four other publications since 1996.

Presentations (recent, selected).

Killian, W., Di Raddo, P., Frank, D. & Hoekstra, M. (2001, June). Meeting the challenges for chemical technicians with an innovative certificate program. Presented at the 33rd Central/Great Lakes Joint Regional Meeting of the American Chemical Society, Grand Rapids MI.

Frank, D., Christafferson, J. & Heck, F. (2001, June). Cooperative-learning and inquiry-based science courses for preservice teachers. Presented at the 33rd Central/Great Lakes Joint Regional Meeting of the American Chemical Society, Grand Rapids MI.

Frank, D. & Goosen, R. (2000, August). Connecting with the learner: A diversity toolkit for Michigan's Teachers. Presented at the 16th Biennial Conference on Chemical Education (BCCE), University of Michigan, Ann Arbor MI.

Spille, J., Kenkel, J., Frank, D., Whitfield, T., Hauer, H., Hunter, K. & Mines, T. (1998, August). Developing chemical technology programs for the 21st Century. A panel discussion presented at the 15th Biennial Conference on Chemical Education (BCCE), University of Waterloo, Waterloo ON.

Frank, D. V. & Killian, W. (1997, May). How to obtain accreditation for a two-year chemical technology program: The experience of FSU. Paper presented at the 29th Central Regional Meeting of the American Chemical Society, Midland MI.

Plus eight other presentations since 1997.

Memberships in professional/honorary organizations.

American Chemical Society
Division of Chemical Education of the American Chemical Society.
Chem Tech Division of the American Chemical Society
Western Michigan Section of the American Chemical Society
National Science Teachers' Association (NSTA)
Michigan Science Teachers' Association (MSTA)
National Association for Research in Science Teaching (NARST)
Phi Beta Kappa

Section 13: Recommendations

In this section, the members of the Program Review Panel summarize the program's strengths, the challenges facing the program and the recommendations that we set forth regarding the continuation of this program.

■ Program Strengths

1. For more than forty years, the Industrial Chemistry Technology program has prepared students to work as technicians in the chemical industry.

2. The program's curriculum evolves to meet the changing needs of industry. Graduates and employers alike rate highly the quality of the curriculum and the preparation of the students for employment.

3. The quality of instruction provided in the program is high.

4. This program has a steady graduation rate. Other programs nationwide have had declining graduation rates.

5. Demand for program graduates by employers remains strong. Placement rates are 100%.

6. Program graduates earn good salaries. At large chemical companies, salaries start at $31,000 annually, rising to about $45,000 annually after five years.

7. Over the last ten years, the circle of employers has extended well beyond the state of Michigan to encompass several employers throughout the Midwest and even some outside of the Midwest. This has led to increasing national attention for the program.

8. Many companies (including, but not limited to, Dow Chemical Company, Dow Corning, Michigan Dairy and Pfizer) have demonstrated their strong support for the program through increased financial contributions, applied towards scholarships, equipment and other needs.

9. Considering the laboratory-intensive nature of this program, it produces high-quality graduates at a low cost to the institution. Compared to the university's other non-preprofessional lab-intensive two-year programs, Industrial Chemistry Technology is the second least expensive program.

■ Challenges

1. An investment by the university to maintain, upgrade and replace departmental equipment is absolutely vital to provide the instrumental training that is necessary for our graduates.

2. The program coordinator needs expanded opportunities to remain current in the field. Recent summer employment at Pfizer in Holland MI keeps him in touch with current chemical plant operations. But he and other key faculty must remain in touch with other professionals in the chemical technology industry.

3. The demand for trained chemical technicians nationwide currently *exceeds* the ability of community colleges and universities to produce the graduates.

■ Recommendations of the Program Review Panel

1. The university must provide $10,000 annually for the base budget of the Physical Sciences Department. These funds will be used to maintain, repair, replace and upgrade the equipment holdings in all lab-intensive courses related to the ICT program (both CHEM and INCT courses). (*Note:* this budget request is needed just to maintain the program, not to expand it.)

2. The university must provide $1000 annually for professional development activities related to the program. This money will be used by the program coordinator and other faculty closely associated with the ICT program to keep up with trends and developments in industrial chemistry.

3. The program would like to carry out the steps outlined earlier in this report in an effort to increase the annual graduation rate. Our target is a 25% to 50% increase over the current 12 graduates per year (i.e., we would like to graduate 15 to 18 students per year.)

4. However, in order to do this, the university must support the increased teaching costs associated with the following: (a) one additional laboratory section of CHEM 317 per year and (b) one additional laboratory section of INCT 230 per year. Neither of these courses would require an additional lecture section, however. Other courses in the program could incorporate the extra students without additional sections (unless, of course, an influx of students in *other* programs also causes these course enrollments to grow.)

Program Review Panel Evaluation Form

(PRP: complete this form and include with your report)

Program: Industrial Chemistry Technology

Instructions: Circle the number which most closely describes t he program you are evaluating.

1. Student Perception of Instruction **Average Score** 4.8

5	4	3	2	1

Currently enrolled students rate instructional effectiveness as extremely high.

Currently enrolled students rate the instructional effectiveness as below average.

2. Student Satisfaction with Program **Average Score** 4.4

5	4	3	2	1

Currently enrolled students are very satisfied with the program faculty, equipment, facilities, and curriculum.

Currently enrolled students are not satisfied with program faculty, equipment, facilities, or curriculum.

3. Advisory Committee Perceptions of Program **Average Score** 4.4

5	4	3	2	1

Advisory committee members perceive the program curriculum, facilities, and equipment to be of the highest quality.

Advisory committee members perceive the program curriculum, facilities, and equipment needs improvement.

4. Demand for Graduates **Average Score** 5.0

5	4	3	2	1

Graduates easily find employment in field.

Graduates are sometimes forced to find positions out of their field.

5	4	3	2	1

5. Use of Information on Labor Market **Average Score** 4.0

The faculty and administrators use current data on labor market needs and emerging trends in job openings to systematically develop program. and evaluate the program.

The faculty and administrators do not use labor market data in planning or evaluating the

Approved by Academic Senate, April 24, 2001

Program Review Panel Evaluation Form (page 2)

6. Use of Profession/Industry Standards **Average Score** 4.4

5	4	3	2	1

Profession/industry standards (such as licensing, certification, accreditation) are consistently used in planning and evaluating this program and content of its courses.

Little or no recognition is given to specific profession/industry standards in planning and evaluating this program.

7. Use of Student Follow-up Information **Average Score** 4.4

5	4	3	2	1

Current follow-up data on completers and leavers are consistently and systematically used in evaluating this program.

Student follow-up information has not been collected for use in evaluating this program.

8. Relevance of Supportive Courses **Average Score** 3.9

5	4	3	2	1

Applicable supportive courses are closely coordinated with this program and are kept relevant to program goals and current to the needs of students.

Supportive course content reflects no planned approach to meeting needs of students in this program.

9. Qualifications of Administrators and Supervisors **Average Score** 4.8

5	4	3	2	1

All persons responsible for directing and coordinating this program demonstrate a high level of administrative ability.

Persons responsible for directing and coordinating this program have little administrative training and experience.

10. Instructional Staffing **Average Score** 4.8

5	4	3	2	1

Instructional staffing for this program is sufficient to permit optimum program effectiveness.

Staffing is inadequate to meet the needs of this program effectively.

Program Review Panel Evaluation Form (page 3)

11. Facilities **Average Score** 4.4

5	4	3	2	1

Present facilities are sufficient to support a high quality program.

Present facilities are a major problem for program quality.

12. Scheduling of Instructional Facilities **Average Score** 5.0

5	4	3	2	1

Scheduling of facilities and equipment for this program is planned to maximize use and be consistent with quality instruction.

Facilities and equipment for this are significantly under-or-over scheduled.

13. Equipment **Average Score** 4.4

5	4	3	2	1

Present equipment is sufficient to support a high quality program.

Present equipment is not adequate and represents a threat to program quality.

14. Adaption of Instruction **Average Score** 4.5

5	4	3	2	1

Instruction in all courses required for this program recognizes and responds to individual student interests, learning styles, skills, and abilities through a variety of instructional methods (such as, small group or individualized instruction, laboratory or "hands on" experiences, credit by examination).

Instructional approaches in this program do no consider individual student differences.

15. Adequate and Availability of Instructional Materials and Supplies **Average Score** 4.0

5	4	3	2	1

Faculty rate that the instructional materials and supplies as being readily available and in sufficient quantity to support quality instruction.

Faculty rate that the instructional materials are limited in amount, generally outdated, and lack relevance to program and student needs.