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ABSTRACT

In an effort to provide nontraditional students with the same opportunity as traditional students to reach the highest level of skills and competencies associated with hi-tech, high-wage employment, the Community College of Rhode Island (CCRI) offers alternatives to its historically successful full-time day program in chemical technology. Certificate as well as associate in applied science (AAS) degree programs have been established. Of those who complete the certificate course, 28% remain in the program and matriculate to upper-division general education courses and eventually receive enough credits to be awarded the associate degree in chemical technology. The programs are laboratory intensive, with a three-to-one ratio of laboratory time to lecture time, and may be taken as a full- or part-time day program, or as a part-time night and weekend program. Rather than focusing on the traditional sub-disciplines of chemistry, the laboratory-driven approach to program delivery utilizes a "continuum of chemical information" model which centers the development of operative (i.e., laboratory and technique) and cognitive (i.e., conceptual chemistry) skills. Students receive individual attention when they have difficulty grasping the conceptual aspects of the program. Customized courses, and full degree programs have also been designed through CCRI to meet the needs of individual companies and their employees, with classes held in either the workplace or in college facilities. Requirements for the AAS and the certificate in Chemical Technology, a chart of the continuum of chemical information model, and lab experiment listings are attached. (MAB)

Chemical Technology at the Community College of Rhode Island: Curricular Approaches Designed to Reflect the Demands of a Diverse Population Entering Chemical Technology Programs.

Harry Hajian

Paper presented at the 12th Biennial Conference on Chemical Education (Davis, CA, August 2-6, 1992).

Enclosed you will find a paper intitled, Chemical Techology at The Community College Of Rhode Island; Curricular Approaches Designed to Reflect The Demands Of A Diverse Population Entering Chemical Technology Programs.

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DO NOT USE →

Chemical Technology at CCRI; curricula approaches designed to reflect the demands of a diverse population entering ChemTec programs. H. G. Hajian, Department of Chemistry, Community College of RI, 400 East Avenue, Warwick, RI 02886.

Over the past decade, the population base that community colleges serve has become highly diverse. The days of freshmen entering directly from high school continues but has been augmented to a great degree by those who are returning for initial or further education and training after being away from formal education in some cases for over 10 years. Socio-economic reasons on the part of this diverse population dictates curricula strategies be developed to meet their needs. At CCRI, the Chemistry Department, in its efforts to deliver its ChemTec Program to this diverse population, has designed a number of pathways. These alternatives will be discussed.

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In an interim report of the task force on women, minorities and the handicapped in Science and Technology entitled "Changing America: The New Face of Science and Engineering", a number of recommendations were highlighted that impact the Industrial workforce in the United States. The recommendations were drawn from the task force's summary of a number of critical issues that effect the quality of the american workforce.

I will present here a few of these issues and recommendations and then extend some curricular models that we in the Community College of Rhode Island's Chemical Technology Program have devised to address these issues as they effect the education and training of future chemical technicians.

Their are societal changes taking place in the United States, for example, there is a high influx of foreign nationals; women have been entering the work force at all levels, and early retirements are causing reentry into the work force.

These Societal changes, plus many others , have profound effects on industry and certainly our systems of education grades K Through Graduate School.

The diversity of the population is especially evident in two year Colleges, Minorities, women and older group representation are on the increase.

Demographics

At the community College of Rhode Island the number of students of hispanic origin grew by 40% between 1989 and 1991 according to the College's Department of Research and Institutional Planning. Other major changes to the school's student population are:

A 32% increase in the number of women (1988*-1991). Presently 63% of the student body are women.

The number of students under 20 years old in the same period of time increased from 2,800 to 2,879 (Essentially no change)(22.8%)

But the number of students between the ages of 25-44 years increased from 5,410 to 8,200 (Approximately 51% increase)(I Had a student that graduated last year at the age of 76. He had a previous BA in science and is now doing research at a sister institution)

Minority numbers increased from 842 to 1732 in the same period of time.

Now lets consider recommendations drawn from the report that were chosen as they impact our mission in technical educational.

Certainly, we as educators in the United States have to deliver quality education, including a

good grounding in mathematics, Science and Technology so all have THE CHANCE To develop to their full potential. We should also be augmenting these basics with skills that are essential to fulfillment in life and productivity at work.

Industry should continue to sound the alarm about how weak educational preparation contributes to the declining economic competitiveness of the United States, and they should support the goal to raise the quality of mathematics, science and technological system instruction and student achievement for all.

Industry should also provide incentives such as summer work and research opportunities to students from under-represented groups so they can obtain hands-on experiences and see practical applications of the technical theories taught at academic institutions. This can be achieved by bridging efforts between industry and academia. We have a number of these.

At the community college of Rhode Island, our philosophy is that everyone that enrolls in the chemical technology program must have the opportunity to reach the highest level of skills and competencies possible for that individual found to be associated with Hi-Tech, High-wage jobs.

To be able to deliver what we promise has meant revisions to our historically successful full time day program.

(view Graph 1)
What you see here is the fifth major change to the chemical technology curriculum. (Instituted in 1966)

The total number of credits required for the associates degree is 64, including:

(General Education Credits Distribution)

8 Credits, in Biology (including 4 in zoo, and in micro)

8 credits, in Physics

3 credits, in English Composition (or fundamental of writing, which includes individualized instruction because of special needs.)

6 credits, Electives

6 credits, Mathematics (minimum Tech. Algebra I & II)

3 credits, Introduction to computers.

The General Education requirements add up to 38 Credits.

(Major Requirements)

The remaining 30 credits are attributed to lecture /laboratory studies in chemistry designed to relate to the chemical technicians role in industry, government and academic laboratory settings.

6 credits, Chemical Technology I

6 credits, Chemical Technology II

10 credits, Chemical Technology III

8 credits, Chemical Technology IV

Notice that the number of laboratory hours are in a ratio of approximately 3 to 1 with theory sections (in the freshman year the ratio is 4 to 1. This is a major change from the traditional mix of 1 to 1). This unusually high number of hours designated for laboratory exposure emphasizes that we are committed to the initiative that chemical technology programs are laboratory based. But it does pose scheduling problems for many of the Students. Even when spread over a two year period, we have found that many potential students cannot cope with the full-time day commitment that such a curriculum design demands. Their is no question that the non-traditional population that enters the program needs alternative routes to the high technology, High wage goal.

Education specialists have found that since the 1970's curriculum reforms broadened and allowed students to take non-academic courses and prepared them to enter the work- place. Others questioned using academic courses as a barometer of success in education. Statements such as these and one by Jacqueline Ancess of Columbia University's National Center for Restructuring education, schools and teaching, " You may force more academic standards but it does not mean that anyone is going to learn any more," indicates building flexibility in curricular design to allow a more practical focus on laboratory competencies.

In accordance to these educational positions, many program offerings at CCRI extended Certificate Programs that minimized academic General Education requirements.

View Graph 2

Here are examples of a number of these offerings.

Notice that the chemical technology offerings include both certificate and associate degree alternatives. Again, this is to insure reaching a diverse population. The students that opt for the certificate option we found have full or part time jobs to support families, in many instances these are single parent families.

View Graph 3
This is the certificate curriculum. Notice, the chemistry offerings are essentially the same as those for in full time day associates program. Their is a marked difference in the general education requirements. Only the essential reading, writing and mathematics skills are required. It is to be noted that many students that remain in the certificate course matriculate to upper division general educations courses, and eventually receive enough credits to be awarded the associate's in chemistry technology. (28% do this)

The idea here is to offer a sequence of courses that will allow the short term student to complete the chemistry and not have to immediately deal with all 30 General Education Courses). These students come to us with a very basic request; "What do I have to do, and how long will it take me to enter the chemistry work force?" This, the certificate curriculum for us and the student has been one of the answers. The placement record for these graduates and their productivity in the industry is excellent.

Further explanation of the method used to deliver the certificate program is necessary.

(much of the approach is also used in the associates program)
This approach allows for the flexibility mentioned earlier.

View Graph #4

What is delivered here is entitled "A continuum of chemical information." (A departure from the traditional sub-disciplines of chemistry>

The approach is broken down to two major skills:

The operative skills (laboratory & technique skills)

Cognitive skills (conceptual chemistry)

These skills are delivered in courses called chemical technology I, II, III, and IV. (remember View Graph 1) The textual materials used allows us to emphasize the laboratory component of the studies. From this approach with the laboratory experience built into the text, the flexibility of the text works smoothly.

View Graph (5,6,7 Here -Quick explanation)

(Back to View Graph 4)

This continuum approach becomes personalized. The major setting is the laboratory. For

example, A student masters a laboratory skill
(or set of skills) such as use and care of analytical instrumentation and glassware, run an analytical procedure, collect
data, well tabulated, and may stumble when it is time to manipulate calculations or understand concepts. At this point, individual attention is given to the student when necessary. Much cognitive information such as explaining of Beer's law and its applications and proper problem set-up and calculation methods are explained. Thus cognitive skills are developed. When articular calculation scheme need to be explained a number of times, the student is introduced to a P.C. and proper interesting software to expedite matters. A very flexible and non-threatening approach. This experience many times leads the certificate student on to higher level mathematics courses, (they see their deficiencies a
self motivated approach).

The focus of this approach is that it is a laboratory driven

Full time day program (with all the bells whistles)

Broken down to an AAS approach or certificate

Part time day program (AAS or certificate)

Part time nights and weekends. (AAS or certificate)

These indicate 6 schedule approaches - and by the way if day students make a change in their work schedule (or something in their private life) that forces them out of their day commitments, - they may at any time move into the evening and week-end mode. As you can imagine not only do these alternatives allow more people to enter the chemical technology program our retention rate after the first semester is 90%.

There is another initiative in our delivery system that is logistically complex but extremely effective because it reaches a
large non-traditional population. They are the working technicians that want the experiences of our offering but are not able to take personal time away from the work place. This curriculum design is sometime referred to "in-house training programs." At CCRI,we refer to them as "off campus programs and/or offerings." To pursue this initiative, the college has established a center for business and industry training/offering a variety of programs on a contract basis for business, industry and government agencies in the state (and in some cases, region). Customized courses or full degree programs can be designed through the center to meet the needs of individual companies and their employees. Classes can be held at the workplace or in college facilities throughout the state (region).

The chemical technology program has been very active in the industrial arena. The logistics of a chemistry (laboratory) based program are not difficult to solve with close cooperation

between the industry being served and academe. Here is a chance to form a true partnership because equipment availability and space may require some clever scheduling between the two facilities. We do this on a routine basis.

Critical to the various (7) approaches that we at CCRI use to deliver our program to this diverse population is the flexibility of scheduling. This many time puts an extra burden on the faculty, because of time commitments. Its a decision that we make as professionals.

Chemical Technology

The chemical industry is one of the fastest growing industries in the United States. Its need for trained technicians in quality control, analysis, and research and development laboratories is extensive. The two-year Chemical Technology Program prepares the student to enter the chemical field in any one of a variety of capacities: chemical research technician, laboratory assistant, chemical production technician, junior chemist or analytical technician. The program is structured to develop a fundamental understanding of general, organic and analytical chemistry, with emphasis on laboratory applications and techniques. Consistent with the program's philosophy of unifying practice and theory, lecture and laboratory hours are not specified independently.

Students who successfully complete this program will receive an Associate in Applied Science (A.A.S.) degree.

General Education Requirements

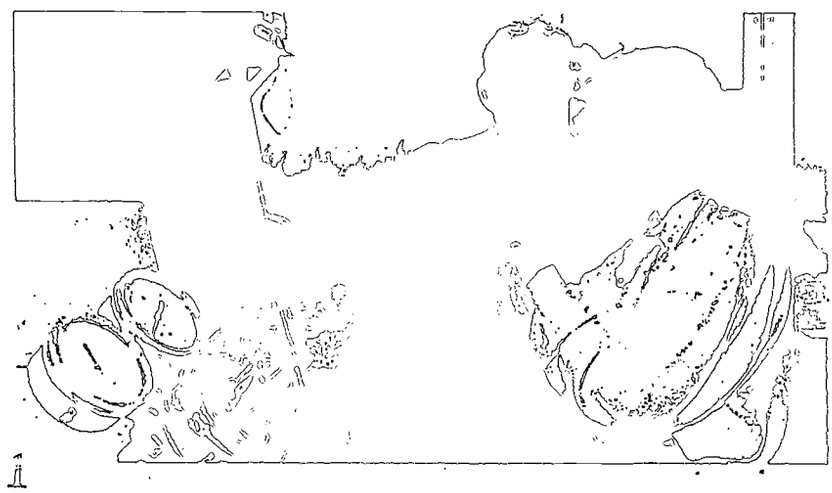
Course No.	Course Title	Credits	Class Hours	Lab Hours	Prerequisites	Recommended Semester for Full-Time Students or sequence for Part-Time Students
MATH 1700	Algebra for Technology	3	4	0	MATH 0600 or the equivalent	1
BIOL 1040	General Biology — Zoology	4	3	2		1
	Liberal Arts or Social Sciences elective	3	3	0		1
MATH 1710	Trigonometry for Technology	3	4	0	MATH 1700 or the equivalent	2
PHYS 1120	Modern Technical Physics I	4	3	2		2
ENGL 1010	Composition I*	3	3	0	Placement test	2
PHYS 1220	Modern Technical Physics II	4	3	2		3
COMI 1100	Introduction to Computers	3	3	3		3
BIOL 2480	General Microbiology	4	2	4	One year of chemistry and one semester of biology	4
	Liberal arts elective or any non-science or math course	3	3	0		4

Major Requirements

CHMT 1120	Chemical Technology I	6	2	8		1
CHMT 1220	Chemical Technology II	6	2	8	CHMT 1120 or its equivalent	2
CHMT 2320	Chemical Technology III	10	4	12	CHMT 1220 or its equivalent	3
CHMT 2420	Chemical Technology IV	8	4	8	CHMT 2320 or its equivalent	4
		64	43	49		

Note to Full-Time Students: It is recommended that full-time students take a minimum of 15 credits each semester.

* If Placement test indicates, ENGL 1050 will also be required and may be used as a liberal arts elective.



Programs of Study

The programs listed in this section give suggested patterns which students will follow in the various curricula. Students should enter the programs after careful counseling, both from the secondary school and from the College's counseling service. The College reserves the right to cancel a program or course offering. Although some programs cannot be completed in their entirety during the evening, many required courses in a variety of disciplines are available during evening hours.

ALLIED HEALTH PROGRAMS	CODE	DEGREE	CERTIFICATE	CAMPUS	DAY	EVENING
*Cardio-Respiratory Care	RESP	A.A.S.		FL	X	
Medical Laboratory Technology	MLTC	A.A.S.		FL	X	
*Radiography (X-Ray)	XRAY	A.A.S.		FL	X	
•Phlebotomy Certificate	PHLE		X	PV FL	X	X
Physical Therapist Assistant	PHTA	A.A.S.		NE	X	

*June is start date for this program.
•Day program only begins each January and September.
Campus location for day and evening programs may vary by semester

BUSINESS ADMINISTRATION PROGRAMS						
Accounting	ACCT	A.S.		KN FL	X	X
General Business	GBUS	A.S.		PV KN FL	X	X
Law Enforcement	LAWS	A.S.		KN FL	X	X
Management	MNGT	A.S.		PV KN FL	X	X
Fashion Merchandising-Retail Management	FASH	A.S.		KN FL	X	X
Mass Merchandising-Retail Management	MASS	A.S.		KN FL	X	X
Real Estate	RLST	A.A.S.-T.S.		KN FL	X	X
Management Certificate	MGTC		X	KN FL	X	X
CHEMISTRY PROGRAM						
Chemical Technology	CHMT	A.A.S.	or X	KN	X	X
COMPUTER STUDIES & INFORMATION PROCESSING PROGRAMS						
Computer Science	CPRG	A.S.		KN	X	X
Computer Programming Certificate	CPRC		X	KN	X	X
Office Automation Certificate (Word Processing)	OFFA		X	KN FL	X	X
DENTAL HEALTH PROGRAMS						
Dental Assisting Certificate	DENT		X	FL	X	
Dental Hygiene	DHYG	A.A.S.		FL	X	
ENGINEERING PROGRAMS						
Computer Engineering Technology	CETC	A.S.		KN	X	X
Engineering	ENGN	A.S.		KN	X	X
Electronic Engineering Technology	EETC	A.S.		KN	X	X
Mechanical Engineering Technology	METC	A.S.		KN	X	X
FINE ARTS PROGRAMS						
Art	ARTS	A.F.A.		KN FL	X	X
Drama	DRAM	A.F.A.		KN FL	X	
Music	MUSC	A.F.A.		KN	X	
Jazz Studies	JAZZ	A.F.A.		KN	X	
GENERAL PROGRAMS						
General Studies	GENS	A.A.		PV KN FL	X	X
Liberal Arts	LIBA	A.A.		PV KN FL	X	X
Labor Studies	LABR	A.A.		KN FL	X	
Urban Affairs	URBA	A.A.		KN FL	X	X

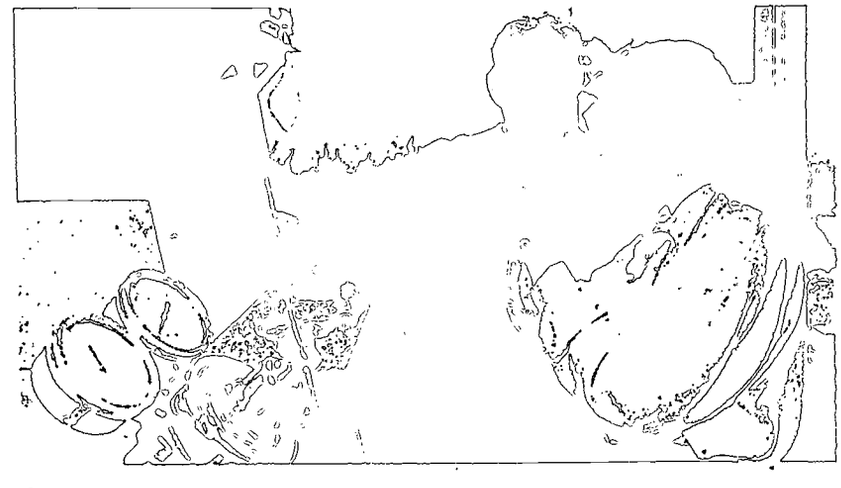
Chemical Technology

CERTIFICATE

Course No.	Course Title	Credits	Class Hours	Lab Hours	Prerequisites	Recommended Semester for Full-Time Students or sequence for Part-Time Students
Major Requirements						
CHMT 1120	Chemical Technology I	6	2	8		1
CHMT 1220	Chemical Technology II	6	2	8	CHMT 1120 or its equivalent	2
CHMT 2320	Chemical Technology III	10	4	12	CHMT 1220 or its equivalent	3
CHMT 2420	Chemical Technology IV	8	4	8	CHMT 2320 or its	
ENGL 1010	Composition I*	3	3	0	Placement test	2
MATH 0800 — Elementary Algebra*	*Credits In-House*	3				3

Note to Full-Time Students: It is recommended that full-time students take a minimum of 15 credits each semester.

* If Placement test indicates, ENGL 1050 will also be required and may be used as a liberal arts elective.



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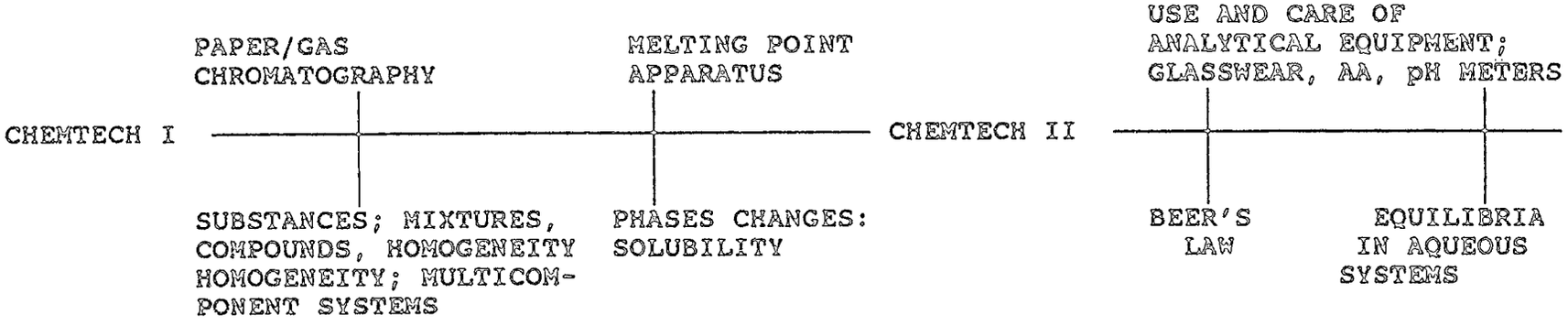

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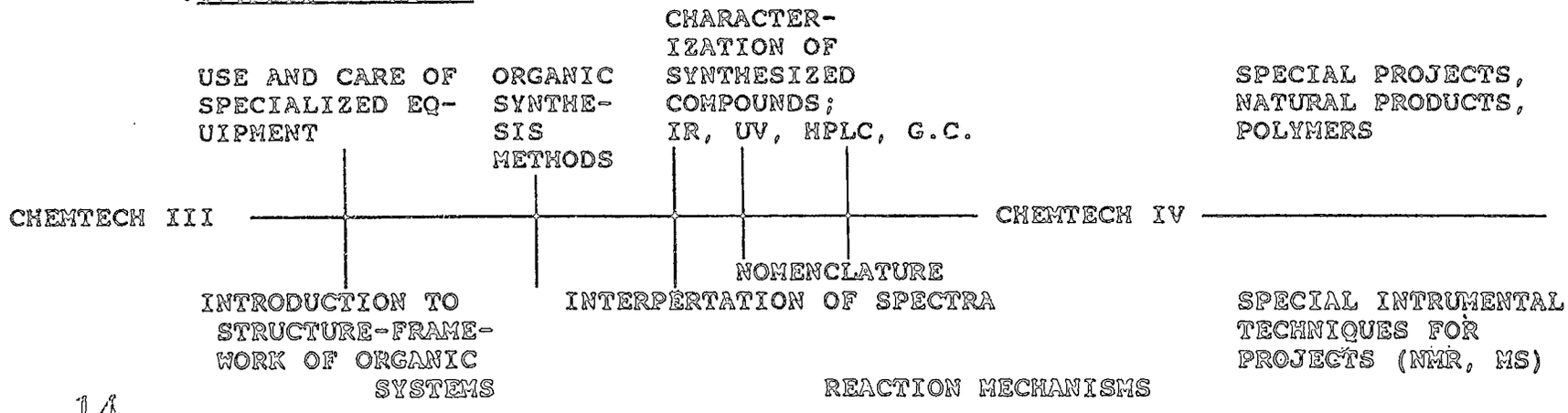

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