

SIMON FRASER UNIVERSITY

MEMORANDUM

5.76-162

To SENATE

From SENATE COMMITTEE ON UNDERGRADUATE STUDIES

Subject COURSE AND PROGRAM CHANGES -
DEPARTMENT OF CHEMISTRY

Date NOVEMBER 18, 1976

Action taken by the Senate Committee on Undergraduate Studies at its meeting of November 9, 1976 gives rise to the following motion:

MOTION

That Senate approve, and recommend approval to the Board of Governors, proposed changes in Chemistry, as set forth in S.76-162, including:

- i) program for students intending to specialize in Chemistry
- ii) Chemistry Major program
- iii) Chemistry Honors program
- iv) Chemistry Minor program
- v) prerequisite changes to CHEM 101, 106, 362, 464, 482
- vi) description change for CHEM 481
- vii) title change for CHEM 482.

Daniel R. Birch
Daniel R. Birch

SIMON FRASER UNIVERSITY

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MEMORANDUM

F-76-14

to J. M. Webster, Dean of Science

From D. Ryeburn, Chairman, Faculty of

Science Undergraduate Curriculum Cttee

Subject Calendar revisions, Chemistry

Date 7 October 1976

Course and Program Changes

At the meeting of 23 September 1976, the F.U.G.C.C. approved the revised Calendar entry for Chemistry, as shown below. Subsequently, at the meeting of 30 September Dr. Peterson presented a rationale paper for the proposed changes. This is appended.

Calendar entry to replace section entitled "Chemistry Program for Students Intending to Specialize in Chemistry" (pp 359 - 362 inclusive in current Calendar).

PROGRAM FOR STUDENTS INTENDING TO SPECIALIZE IN CHEMISTRY

The point at which a high school or regional college student enters the Chemistry program is governed by his/her knowledge of the subject. CHEM 101-3 and CHEM 106-2 are not required courses for the B.Sc. degree. They are available as electives to those students who have no knowledge of chemistry or who are starting from B.C. High School Chemistry 11. Students who have taken B.C. High School Chemistry 12 (or equivalent) normally start with CHEM 104-3 and 115-2. Chemistry major and honors students must fulfill the program requirements listed below and are expected to maintain a grade of C or better in their Chemistry courses. Whether majoring in Chemistry or not, students are not normally permitted to enrol in any Chemistry course for which a grade of D was obtained in any prerequisite.

CHEMISTRY MAJOR PROGRAM (120 semester hours)

Required courses (58 semester hours)

CHEM 104-3, 115-2, 105-3, 117-2, 232-3, 251-3, 256-2, 252-3, 261-3, 336-2, 356-2, 366-2. (30 semester hours).
 PHYS 15 semester hours, to include 201-2, 203-2, 204-2, 205-2, and a minimum of 2 semester hours of 200 level laboratory credit.
 MATH 151-3, 152-3, 253-4, and either 310-3 or 316-3. (13 semester hours)

Electives

- i) An additional 19 hours of upper division credit in Chemistry to include a minimum of 3 credits in each of the following three groups:
 - GROUP I (Organic Chemistry) CHEM 357-3, 455-3
 - GROUP II (Inorganic Chemistry) CHEM 332-3
 - GROUP III (Physical Chemistry) CHEM 361-3, 362-3, 460-2, 461-2.
- ii) An additional 16 hours of upper division credit in any courses of the student's choice (excluding EDUC 401, 402, 405) to complete the B.Sc. requirement of 44 hours upper division credit (see Faculty of Science requirements)
- iii) 27 semester hours of free electives to include a minimum of 6 hours in the Faculties of Arts, Education (excluding EDUC 401, 402 and 405) or Interdisciplinary Studies.

Students entering with Chemistry 12 and Physics 12 (or their equivalents) are advised to take the following lower division program (students who have not

completed Physics 12 should first take PHYS 101-3 and 102-3, and then follow a similar program):

Level 1	CHEM 104-3, 115-2 MATH 151-3 Electives
Level 2	CHEM 105-3, 117-2 MATH 152-3 PHYS 131-2 (optional), 201-2 Elective
Level 3	CHEM 251-3, 256-2, 232-3 MATH 253-4 PHYS 204-2, 233-2
Level 4	CHEM 252-3, 261-3 MATH 310-3, or 316-3 PHYS 203-2, 205-2

The Mathematics and Physics courses should be taken as early as possible so that they will be of benefit in the study of Chemistry. Students intending to specialize in physical or theoretical chemistry are advised to take more Mathematics and Physics courses than specified above.

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CHEMISTRY HONORS PROGRAM (132 semester hours)

Required courses (80 semester hours)

CHEM	104-3, 115-2, 105-3, 117-2, 232-3, 251-3, 256-2, 252-3, 261-3, 332-3, 336-2, 341-3, 356-2, 357-3, 361-3, 362-3, 366-2, 367-2, 481-5 (or 483-15 subject to approval) (52 semester hours)
PHYS	15 semester hours to include 201-2, 203-2, 204-2, 205-2, and a minimum of 2 semester hours of 200 level laboratory credit.
MATH	151-3, 152-3, 253-4, 310-3 (13 semester hours).

Electives

in Chemistry and 12 hours of upper division credit.

i) An additional 17 hours (or 7 hours if CHEM 483-15 is chosen) of upper division credit in any courses of the student's choice, excluding EDUC 401, 402 and 405, to complete the B.Sc. Honors degree requirement of 60 hours of upper division credit (see Faculty of Science regulations).

ii) 23 credits of free electives to include a minimum of 6 hours in the Faculties of Arts, Education (excluding EDUC 401, 402 and 405) or Interdisciplinary Studies.

Students may enter the Honors program at any level after the fourth level with the approval of the Department. Graduation with an Honors degree requires completion of 132 semester hours and an average Grade Point Average of 3.0 or higher (see General Regulations p.. and Faculty of Science regulations p....)

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For full details of major-minor program regulations, see Section 1.3 of this Calendar (p...). To qualify for a Minor in Chemistry, students will be required to complete a minimum of 14 hours of upper division credit in Chemistry, together with all the prerequisites.

Typical course combinations providing emphasis in three specific areas of interest are listed below; other variations are possible.

Chemistry Minor (Organic Chemistry)

CHEM 104-3, 105-3, 115-2, 251-3, 256-2, 252-3, 356-2, 357-3, and three courses from 453-3, 455-3, 458-3, BICH 301-3, BICH 302-3.

Chemistry Minor (Inorganic/Radiochemistry)

CHEM 104-3, 115-2, 105-3, 117-2, 232-3 (or 233-2), 332-3, 336-2, 341-3 and six credit hours from 416-3, 432-3, 437-2, 442-3, 446-2.

Chemistry Minor (Physical and Nuclear Chemistry)

CHEM 104-3, 105-3, 115-2, 261-3, and 14 credit hours from 341-3, 361-3, 362-3, 366-2, 367-2, 416-3, 442-3, 446-2, 460-2, 461-2, 462-3, 464-2, 472-3.

OTHER CALENDAR REVISIONS

The F.U.G.C.C. also approved the following changes:

(edit)

CHEM 101	Addition to prerequisite statement, "Students <i>with credit for</i> CHEM 104-3 or a succeeding chemistry lecture course may not take CHEM 101 for <i>further credit</i> "
CHEM 106	Addition to prerequisite statement, "Students <i>with credit for</i> CHEM 115-2 or a succeeding chemistry laboratory course may not take CHEM 106 for <i>further credit</i> "
CHEM 362	Prerequisite changed from, "CHEM 261, MATH 253" to, "CHEM 261 and MATH 253, or PHYS 341."
CHEM 464	Prerequisite changed from, "CHEM 362" to, "CHEM 362 or PHYS 341".
CHEM 481	Course description changed to, "Experimental and/or theoretical research, and preparation of thesis for Major or Honors degree in Chemistry. " Prerequisite changed to, "Permission of the Department; knowledge of Chemistry at an advanced level. Normally taken during the fourth year of study."
CHEM 482	Course title to read, "Directed study in Advanced Topics of Chemistry." Prerequisite to read, "Permission of the Department. Normally taken during the fourth year of study."

D Ryeburn
PP N. Heath.

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SIMON FRASER UNIVERSITY

MEMORANDUM

F-76-14 Supplement

to Faculty of Science

From L.K. Peterson

Chemistry

Subject Rationale for Calendar Changes

Date 12 October 1976

The Major Program

The proposed Calendar changes from the Department of Chemistry are the outcome of a fairly detailed analysis of the structures of degrees within the Faculty of Science, and of the changing role of the Chemistry Department (and of other Science departments) within the University context. The "old" structure of the Chemistry Major program (see appendix, "Structures of Degrees") was substantially out of line with programs in Biochemistry, Biological Sciences and Mathematics, in terms of more restrictive upper division science requirements and substantially less flexibility in the area of upper division electives. The highly structured nature of the Physics program, in terms of LD and UD science requirements, is compensated to some extent by its free elective component, which is more than 50% greater than the corresponding component in the Major programs of other departments in the Faculty of Science. The "new" Chemistry Major structure brings our program into line with other departments' programs. As a result, the discipline of Chemistry can now more readily be combined with substantive studies in other disciplines, and hence caters better to needs for educational breadth in an academic career. The elective structure provides the flexibility that also allows for extensive specialization in Chemistry, in a form that is distinct from that of the Honors program. The new format caters better to the distinguishable goals of both academic interests, and career-oriented interests, in the chemical discipline.

Briefly, the desirable goals of the "new" program are structured by the following conditions:

- i) Minimum requirements for breadth of exposure to Organic, Inorganic and Physical Chemistry in LD courses;
- ii) Minimum Calculus requirements in Mathematics, coupled with a choice of 300 level Mathematics in Differential Equations (MATH 310) or Numerical Analysis (MATH 316), depending on the courses selected in the Chemistry program;
- iii) Minimum requirements in Physics to provide an understanding of the basic concepts of heat, energy, work, simple harmonic and rigid body motion, elementary optics and acoustics, electricity and magnetism (15 semester hours of Physics);
- iv) Minimum requirements for laboratory studies in Organic, Inorganic and Physical Chemistry;
- v) Minimum requirements for exposure to the Organic, Inorganic and Physical Chemistry sub-disciplines in UD courses (selected courses have been arranged in Groups I-III, and opportunities for choice within groups have been developed);
- vi) A flexible approach to the development of the Chemistry component of the Program, embodied in elective provisions;
- vii) An opportunity for undertaking substantive studies in other areas of science or in the Faculties of Arts or Education is provided for in the elective structure.

The Honors Program

The structure of the Honors program is essentially unchanged. The revised description of requirements and electives presents the program in a clearer format, and clearly shows the established practice that an Honors thesis is a requirement of the program. The latter condition may be satisfied by taking CHEM 481-5, or CHEM 483-15 (new course proposal, Individual Study Semester).

Rationale re. Mathematics requirement

Many problems of practical chemistry are not susceptible to analytical solutions. The advent of the digital computer makes it feasible to solve such problems numerically, rather than ignoring their existence, as has been customary in the past. Some common examples of such problems are:

i) Equilibrium: (a) very simple equilibrium problems (e.g, pH of ammonium acetate solutions) lead to algebraic equations of order higher than 2nd, or to simultaneous non-linear equations. In present chemistry courses we pretend that such problems do not exist, or we solve them under conditions where simplifying solutions can be made;

(b) solution of ionic equilibria with Debye-Huckel expressions for activity coefficients leads to strongly non-linear equations;

ii) Kinetics: (a) very simple reaction mechanisms, such as the consecutive 2nd order system



lead to systems of differential equations which have no analytical solutions. Again, we either ignore such problems, or discuss very simple cases qualitatively.

(b) a serious kinetic problem such as calculation of effects of atmospheric pollutants is completely beyond the reach of present chemistry graduates;

iii) Thermodynamics: most non-trivial thermodynamic problems involve numerical integration, about which students have the haziest ideas from calculus courses;

iv) Data Collection and Reduction: Numerous problems in linear and non-linear least squares, interpolation and integration arise. The advent of cheap digital data acquisition systems would allow the development of sophisticated problems, but students are generally not mathematically prepared for these advances in our courses.

A course in numerical analysis would lay the foundation for students to tackle the above types of problem. The present move is toward a liberalization of the Major program in Chemistry, allowing more choice and a broader interpretation of basic requirements. The justification of MATH 310 (Introduction to Differential Equations) as a prerequisite to CHEM 361 (Quantum Mechanics) still exists, and students choosing CHEM 361 will continue to take the appropriate Math. course. The only other significant use of differential equations in chemistry is in solving kinetic mechanisms, where we find that most differential equations are (a) trivial (soluble by quadratures) or (b) not soluble analytically. There is only one counter-example to the above in the whole present undergraduate chemistry curriculum, viz. the consecutive 1st order system.

For students not taking CHEM 361, the more useful mathematics course is MATH 316 (Numerical Analysis I). It is desirable to maintain some element of 300-level expertise in mathematics in the chemistry program, and in keeping with the concepts described above, the choice between MATH 310 and MATH 316, and subsequent different routes in the program, is left open.

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Other Changes

The prerequisite change for CHEM 362, to read CHEM 261-3 and MATH 253-4, or PHYS 341-4, was proposed by the Chemical Physics Committee, and was acceptable to the Department of Chemistry. The change improves flexibility in the Chemical Physics program, while leaving the Chemistry program essentially unaffected (chemists do not take PHYS 341).

The prerequisite change for CHEM 464, to read, CHEM 362-3 or PHYS 341-4, proposed by the Chemical Physics Committee, was also acceptable to the Department.

The above prerequisite changes have been supported by E.D. Crozier and J. Walkley. Extracts from the relevant memoranda are reproduced below:

Crozier to Peterson, 6 Feb. 76

"...the Chemical Physics Committee agreed that the pre-requisite for CHEM 362, CHEM 261, could be waived if the student has taken PHYS 341. The rationale for this waiver is that a student who has taken PHYS 206 and PHYS 341 is better qualified to take CHEM 362 than a student who has taken only CHEM 261."

Walkley to Crozier, 25 Feb. 76

" I can see no reason why PHYS 341 cannot act as a prerequisite for CHEM 464. It is as good a base as CHEM 362, and obviously sets up sufficient thermodynamics and statistical mechanics for CHEM 464. I am quite happy to accept Chem-Phys students into CHEM 464 with PHYS 341 as prerequisite and would even suggest that this could be generalised for any Physics student - thus making the Calendar entry a general one of CHEM 362 or PHYS 341 as prerequisites."

Crozier to Peterson, 23 Mar. 76

" The (Chem-Phys) Committee decided that as far as Chemical Physics students are concerned, the prerequisite for CHEM 464 could be CHEM 362 or PHYS 341. Some members felt that the Chemistry Department might wish to consider making CHEM 362 or PHYS 341 the prerequisite course for CHEM 464. Thus students in Physics, Biophysics and Mathematical Physics who have taken PHYS 341 would be eligible for CHEM 464. (Chemistry students, because of their core program requirements, would be forced to take CHEM 261 and CHEM 362; they, of course, could take PHYS 341 in addition. "

L. K. Peterson

Structures of Majors Degrees in Science

LD Science	LD Arts Elective	UD Science	UD Elective, Arts or Sciences	Free Elective
"Old" Chem. 49 (24C, 15P, 10M)	6	36 (33C, 3M)	8	21
"New" Chem. 49 (24C, 15P, 10M)	6	28 (25C, 3M)	16	21
Biology 51 (20B, 13C, 9M, 6P, 1E)	6	30 (30B)	14	19
Biochem. 50 (11B, 23C, 10M, 6P)	6	28-29 (17-18BC, 9B, 2C)	16	20
Maths 25-28 (19-22M, 6Sc)	6	30 (30M)	14-15	41-43
Physics 37 (18P, 13M, 6C)	6	29 37 (30P, 7M)	8	32