S.95-5

SIMON FRASER UNIVERSITY

MEMORANDUM

To:	Senate	**From:**	J.M. Munro, Chair Senate Committee on Academic Planning
Subject:	Curriculum Revisions - Faculty of Science	**Date:**	December 13, 1994

Action undertaken by the Senate Committee on Undergraduate Studies and the Senate Committee on Academic Planning gives rise to the following motion:

Motion:

"that Senate approve and recommend approval to the Board of Governors the curriculum revisions for the Faculty of Science as set forth in S.95-5 as follows:

S.95-a	Department of Biological Sciences
S.95-b	Department of Mathematics and Statistics
S.95-c	Department of Physics
S.95-d	Earth Sciences Program
S.95-e	B.Sc. Program in Environmental Science

In all cases agreement has been reached between the Faculty and the Library in the assessment of library costs associated with new courses.

Department of Biological Sciences

SCUS Reference: SCUS 94 - 9 a, 94 - 12
SCAP Reference: SCAP 94 - 58 a

For Information:
Acting under delegated authority of Senate, SCUS has approved the following revisions as detailed in SCUS 94 - 9 a:

Change of requirements for Major and Honors Program
Change of number and title: BISC 321 to BISC 331
Prerequisite changes: BISC 306, 329, 333, 402, 431, 453, 457

SIMON FRASER UNIVERSITY
MEMORANDUM

To: R. Heath
Secretary to Senate

From: C.H.W. Jones, Dean
Faculty of Science

Subject: **Biological Sciences**

Date: November 1, 1994

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At its meeting on 27 October 1994, The Faculty of Science Undergraduate Curriculum Committee approved the following curriculum changes for the Department of Biological Sciences:

- Program changes to reflect the introduction of required BICH courses into the curriculum, plus various inconsistencies in the present calendar (attached).

- Prerequisite changes for BISC 306, 329, 333, 402, 431, 453 and 457 (attached).

Would you please place the above items on the agenda of the next meeting of SCUS.

Thank you.

CHW Jones

C.H.W. Jones

CHWJ:rh:Encl.

c. B.A. McKeown

PROPOSED CHANGES TO CALENDAR (EDITORIAL)

1. Page 154 - "Major Program" section: change basic credit hour requirements to read BISC/BICH (lower division) - 20 hours; Non-BISC/BICH lower division - 30 hours; BISC/BICH upper division - 40 hours (in light of the inclusion of BICH courses in the BISC program requirements).

2. Page 155 - "Honors Program" section: suggested change to the following:

   "The B.Sc. honors degree in Biological Sciences requires the following:
   - maintenance ...
   - an additional 60 hours of upper division Biological Sciences or related subjects which will include BISC 490-5, 491-5 and 492-5 (Individual Study Semester); these latter to constitute the honors thesis, and
   - ..."

   to:

   "The B.Sc. ...
   - maintenance ...
   - **Completion** of 60 hours of upper division Biological Sciences or related subjects, which will include **the core courses required for the major plus** BISC 490-5, 491-5 and 492-5 ..."

S.95-5b

Department of Mathematics and Statistics

SCUS Reference: SCUS 94 - 9 b, 94 - 13
SCAP Reference: SCAP 94 - 58 b

i)	Management and Systems Science program - change of requirements	
ii)	New course -	
	STAT 403 - 3	Intermediate Sampling and Experimental Design
iii)	New courses -	
	MATH 332 - 3	Introduction to Applied Algebraic Systems
	MATH 380 - 3	History of Mathematics
iv)	Deletion of -	
	MATH 180 - 3	The History of Mathematics

For Information:
Acting under delegated authority of Senate, SCUS has approved the following revisions as detailed in SCUS 94 - 9 b:

Change of prerequisites: MATH 408, 438, 439, 440
Change of vector: STAT 270
Change of title and vector: MATH 171, 172

F5C8-94

RECEIVED
SEP - 8 1994
DEAN OF SCIENCE
OFFICE

SIMON FRASER UNIVERSITY

MEMORANDUM

To: Faculty of Science Undergraduate Curriculum Committee	From: Brian Alspach MSSC Coordinator
Subject: Requirement Changes	Date: 8 September 1994

The MSSC Steering Committee has unanimously passed motions that the following two recommendations be implemented and included in the next calendar.

RECOMMENDATION 1. The requirement that students take a 100 level economics course should be removed.

RATIONALE. This requirement was in place when ECON 200 and ECON 205 were required courses for the program, and at the time the Department of Economics had a requirement that students take a 100 level economics course prior to taking the two 200-level courses. The Department of Economics has now changed 200 and 205 to 103 and 105, respectively, and have dropped the requirement that their own majors take another 100-level economics course. Since MSSC students are required to take ECON 103 and ECON 105, it is reasonable that we follow the Department of Economics and remove the requirement that they do another 100 level course.

RECOMMENDATION 2. The requirement that students take CMPT 205 and MATH 243 should be replaced by the requirement that students take MACM 101 and MACM 201.

RATIONALE. The two MACM courses are being introduced by the School of Computing Science and Department of Mathematics and Statistics as replacements for CMPT 205 and MATH 243.

F-SC 10(b)-94

RECEIVED
SEP 21 1994
DEAN OF SCIENCE

SFU SIMON FRASER UNIVERSITY

MEMORANDUM

To: C.H.W. Jones, Dean Faculty of Science	Date: September 20, 1994 From: Katherine Heinrich, Chair Department of Mathematics & Statistics
Subject: **STAT 403**	

The enclosed documentation supports the introduction of a new course STAT 403 as part of the Environmental Science Program. While initially approved at the UGSC with a proviso that additional support be necessary for approval, the department has approved the course (September 19, 1994) without that proviso. Nevertheless, I feel some comments are in order.

We currently offer approximately 28 statistics courses per annum (21 undergraduate, 5 graduate for this department and 2 graduate service courses). This is the bare minimum needed to support an undergraduate program in statistics, co-operative education and a viable graduate program, as well as to meet the statistics needs of students in other programs. We have only eight faculty members in statistics. These faculty also have responsibility for the statistics component of the CIDA project in Indonesia and the co-ordination of the Statistics Consulting Service, amongst all other regular faculty responsibilities.

Clearly, we do not have the faculty needed to teach one more course. However, I am certain that we have sufficient sessional funds to accommodate one more course. The department strongly supports the particular stream of environmental science that this course is part of and is committed to finding necessary resources, should they not be forthcoming from elsewhere.

Kathy

KH:jc

cc: R. Routledge
D. Ryeburn, UGSC

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
COURSE PROPOSAL FORM

1. Calendar Information . Department: Mathematics and Statistics
Abbreviation Code: STAT Course Number: 403 Credit Hours: 3 Vector: 3-0-2

Title of Course: Intermediate Sampling and Experimental Design

Calendar Description of Course: A practical introduction to useful sampling techniques and intermediate-level experimental designs.

Nature of Course: Three hours of lectures and two hours of laboratory work.

Prerequisite: STAT 302. Students with credit for STAT 410 or STAT 430 may not take STAT 403 for further credit. [Mathematics minor, major, and honors students may not use this course to satisfy the required number of semester hours of upper division mathematics credit. However, they may include the course to satisfy the total number of required hours of upper division credit.]

What course (courses), if any, is being dropped from the calendar if this course is approved: none.

2. Scheduling

How frequently will the course be offered? Once per year.

Semester in which the course will first be offered? Possibly Fall of 1996, depending upon implementation of the Environmental Science Programme.

Which of your present faculty would be available to make the proposed offering possible:
Drs. Dean, Eaves, Lockhart, Routledge, Schwarz, Sitter, Swartz, and Weldon.

3. Objectives of the Course: Students completing the course should be able to: a) design, implement, and analyze efficient surveys of heterogeneous or clustered populations, and b) design, implement, and analyze informative experiments involving phenomena that are strongly influenced by several competing factors.

4. Budgetary and Space requirements (for information only)

What additional resources will be required in the following areas:

Faculty: one-third full time faculty member.

Staff: none.

Library: none — the Library already maintains a solid collection in applied statistics at this level.

Audio Visual: none.

Space	)	The laboratory component of the course will carry space and equipment requirements. These will be outlined in a separate proposal, as the space and equipment will be shared over several courses.
	)	
Equipment	)	

5. Approval

Date: 20 Sept 94 | Oct. 14 1994 | Dec 19/94

Department Chair	Dean	Chair, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline.)

Proposal for STAT 403-3

Intermediate Sampling
and
Experimental Design

Rationale

This new course will be required by students in the proposed Environmental Science programme who choose as an area of concentration, one of biology, chemistry, or pollutant transport. Sampling and experimentation are major components of most environmental investigations, and STAT 403 will develop practical expertise in techniques in these areas. The course is designed to take students beyond the basic concepts introduced in earlier courses, and to familiarize them with intermediate-level designs that are commonly deployed. Successful graduates would, for example, be able to work with the sampling schemes currently being used to monitor shell fish populations on the B. C. North Coast. They should also have gained practical experience designing experiments that involve more than one level of grouping of experimental units (e.g., nested designs), or that assess the impact of more than one factor in reasonably creative ways (e.g., split-plot designs).

The prerequisite for the course is STAT 302, a course in regression analysis and basic experimental design. STAT 403 will extend and thereby also reinforce this base. Emphasis will be on practical aspects of sampling and experimentation. Although there is some overlap with STAT 410 and 430, these courses provide more emphasis on the underlying mathematical and statistical theory, and introduce a wider array of techniques in each of their respective areas.

Calendar Description

* **STAT 403-3 Intermediate Sampling and Experimental Design.** A practical introduction to useful sampling techniques and intermediate-level experimental designs. (3-0-2) *Prerequisite: STAT 302. Students with credit for STAT 410 or 430 may not take STAT 403 for further credit.* [Mathematics minor, major, and honours students may not use this course to satisfy the required number of semester hours of upper division Mathematics credit. However, they may include the course to satisfy the total number of required hours of upper division credit.]

Objectives

Students completing the course should be able to

1. design, implement, and analyze efficient surveys of heterogeneous or clustered populations, and
2. design, implement, and analyze informative experiments involving phenomena that are strongly influenced by several competing factors.

Computing

Students will gain experience with one or more of the heavily used statistical analysis packages, SAS and Systat.

Practical Experience

This course will have a laboratory component, to be used for developing practical experience in sample surveys and experimental design. This is part of a general initiative, being developed both in our department and in several statistics departments across the country, to improve the practical skills of students in statistics courses. Funding for start-up costs will be sought from innovation funds. Laboratory exercises for STAT 403 will be devised to explore procedures and basic concepts for simple random sampling, stratified sampling, double sampling, capture-recapture studies, randomization and blocking in experiments, and two-factor, hierarchical, and split-plot designs. Further details can be provided on request.

(3 i)

SFU SIMON FRASER UNIVERSITY

MEMORANDUM

To: C.H.W. Jones, Dean Faculty of Science	Date: October 6, 1994 From: Katherine Heinrich, Chair Department of Mathematics & Statistics
Subject: **New courses**	

Please find enclosed documentation for two new courses: MATH 332, MATH 380; and for course changes to three courses: MATH 438, 439 and 440. We also propose the cancellation of MATH 180.

These changes were approved on June 20th but we inadvertently failed to forward them to you. I hope very much that we can find a way to have them approved by the faculty as soon as possible so they can be included in the 1995/96 calendar. Your assistance will be very much appreciated.

This is particularly important as the changes regarding MATH 332, 438, 439 and 440 are an important rationalization of our algebra sequence and present a much better program for the students. Course scheduling has been rearranged and teaching assignments tentatively made for 94/95 and 95/96 so that all teaching responsibilities will continue to be met within our existing resources.

Finally, the department accepts the library report for the new courses and $50 will be made available to cover the purchase of required materials.

Thanks Kathy

KH:jc

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
COURSE PROPOSAL FORM

1. Calendar Information — Department: Mathematics and Statistics

Abbreviation Code: MATH Course Number: 332 Credit Hours: 3 Vector: 3-1-0

Title of Course: Introduction to Applied Algebraic Systems

Calendar Description of Course: An introduction to groups, rings and fields with applications to cryptography, codes and counting techniques based on permutation groups

Nature of Course: Lecture/Tutorial

Prerequisites (or special instructions):
Math 232

What course (courses), if any, is being dropped from the calendar if this course is approved:

None, but the frequency of offering of Math 438 and 439 will be reduced.

2. Scheduling

How frequently will the course be offered?
Once per year

Semester in which the course will first be offered?
95-3

Which of your present faculty would be available to make the proposed offering possible:
J.L.Berggren, T.Brown, H.Gerber, N.Reilly.

3. Objectives of the Course

To introduce students to algebraic structures with important applications

4. Budgetary and Space requirements (for information only)

What additional resources will be required in the following areas:

Faculty
Staff
Library
Audio Visual
Space
Equipment

} NONE

5. Approval

Date: July 15, 1994	14 Nov 94	Dec 19/94
Department Chair	Dean	Chair, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline.)

MEMO

TO: H.Gerber, Chair Undergraduate Studies Committee

FROM: N.Reilly

DATE: 2nd June, 1994.

TOPIC: Introduction to Applied Algebraic Systems

I wish to propose the introduction of a new course

Math 332-3 Introduction to Applied Algebraic Systems.

The introduction of this course would necessitate some changes in the syllabus of Math 439 and changes in the prerequisites for Math 438, 439 and 440 would become appropriate. Thus the specific recommendations are as follows:

(I) The introduction of Math 332-3 Introduction to Applied Algebraic Systems (A new course proposal form, Calendar entry and detailed syllabus are attached).

(II) A change in the prerequisites for Math 438 Linear Algebra:

From: Math 232
To: Math 332 or Math 339 or permission of the instructor.

(III) A change in the title and syllabus for Math 439 (forms attached).

(IV) A change in the prerequisites for Math 439:

From: Math 232
To: Math 332

(V) A change in the prerequisites for Math 440:

From: Math 438 and Math 439
To: Math 332.

The rationale for these changes is as follows:

(I) NEW COURSE: MATH 332-3 INTRODUCTION TO APPLIED ALGEBRAIC SYSTEMS

(1) The general objective.

The main objective in introducing the proposed Applied Algebraic Systems course is to make available to students, in a manner that is reasonably accessible, an introduction to those basic algebraic structures such as groups, rings and fields that have become of increasing interest in computing, coding and cryptography in recent years and to do so in an applied manner with an emphasis on applications. With our courses as currently organized, it is necessary for students to take TWO four hundred level courses before they can take the field theory course!

(2) As a platform for other courses.

An introduction to algebraic systems like this early on in our upper levels programme will provide a basis for courses on a whole variety of topics in addition to the courses that we currently have at the four hundred level. The possibilities would include algebraic geometry, algebraic number theory, algebraic topology, cryptography, permutation groups, monoids, algebraic theory of automata, lattices and Boolean algebras, ring theory and topological algebra. It is not proposed that we actually introduce all these courses, but Math 332 would provide an appropriate background to make it possible to offer such courses occasionally should the appropriate opportunities present themselves.

(3) As a sequel to 232 (Lin Alg).

In Math 232 students are introduced to a variety of algebraic systems but that course is too busy for them to spend much time on that aspect. Of course they encounter vector spaces, but usually just over the real or complex numbers with some allusion to the possibility of more exotic things called "fields". They are introduced to rings of matrices and rings of linear transformations, but that is not the place to tell them that these constitute the best examples of non-commutative rings. They are introduced to the group of invertible matrices, but again that is not the place to tell them that this is probably the most studied of all classes of groups. So one goal of the AAS course is to provide a respectable introduction to the algebraic systems of groups, rings and fields. It is a natural follow up to Math 232 and the intention would be to try to pitch it at a level appropriate to good students continuing from 232.

(4) As a sequel to Macm 201.

Many introductory level books on discrete mathematics include sections devoted to "algebraic methods" where they give a basic introduction to groups, rings and fields. (See Biggs, Gerstein or Liu, for example). The recently introduced Macm 101 and 201 focus on the non-algebraic aspects of introductory combinatorics, as did the old Math 243 and Cmpt 205 that they are replacing. It will be a very natural step then for the students in the 101/201 stream who are interested in the algebraic aspects to continue on to the AAS course where they will cover the algebraic aspects not covered in Macm 101 and Macm 201. I would expect that the syllabus for the AAS course will be of interest to students in the Theoretical Computing Science stream.

(II) CHANGE IN THE PREREQUISITE FOR MATH 438 (LINEAR ALGEBRA)

From: Math 232
To: Math 332 or Math 339 or the permission of the instructor.

Math 438 is a tough course and it is a common experience for the instructors in that course to find that many of the students are quite unprepared for a course at that level. The prerequisite is currently Math 232, which covers all the necessary prerequisite material. This rather low level requirement leads students to underestimate the level of sophistication of Math 438. The problem is that there is a huge jump in the rigour and mathematical maturity between these two courses.

Either of Math 332 or Math 339 (Groups and Symmetry) will provide a nice bridge between Math 232 and Math 438 by introducing students to some of the basic properties of abstract systems and to an element of rigour. The option of admission "by permission of the instructor" is left to make it possible for the student with an appropriately strong background to be able to make the progression directly from Math 232 to Math 438.

(III) CHANGE IN THE TITLE AND SYLLABUS FOR MATH 439

The introduction of Math 332 will necessitate some changes to the current Math 439 Introduction to Algebraic Systems. In particular, it would be desirable to change the title:

TITLE: From: Introduction to Algebraic Systems
To : Algebraic Systems

It would clearly be inappropriate to have two courses labelled "Introduction to Applied Algebraic Systems" and "Introduction to Algebraic Systems", since the former will certainly include an introduction to algebraic systems, albeit at a different level and with a different emphasis.

SYLLABUS: A revised syllabus is attached. The syllabus has always been flexible and the revision can be viewed as a change in emphasis with greater emphasis being placed on ring theoretic aspects than before.

CALENDAR ENTRY ? The existing Calendar entry ("Algebraic systems including, for example, groups, rings, polynomial theory") will still be appropriate.

(IV) CHANGE IN PREREQUISITE FOR MATH 439

From: Math 232
To: Math 332

With an introductory course on algebraic systems available at the 300 level, it seems only appropriate to make it a prerequisite for Math 439. This will open up a broader range of options in Math 439.

(V) CHANGE IN PREREQUISITES FOR MATH 440

From: Math 438 and Math 439
To: Math 332

The inclusion of Math 438 as a prerequisite for Math 440 is a little hard to justify. The amount of linear algebra required in Math 440 is quite minimal and will be covered in Math 332. In addition, since Math 332 provides a better introduction to rings and fields (the main topic in Math 440) than Math 439 as currently offered, Math 332 will be a much more appropriate prerequisite than Math 439.

To: Members of the Undergraduate Studies Committee
From: Len Berggren
Re: New Course Proposal
Date: May 16, 1994

Attached in a proposal for a new course, Math. 380 - 3 (History of Mathematics), to replace Math. 180 - 3, which would be dropped. After more than two decades of teaching Math. 180 I have come to the conclusion that history of mathematics is best taught to people with some knowledge of the subject. Although Math. 180 has had a steady enrollment over the years of around a dozen students each time it was offered, and the students' reactions show they have enjoyed the course, they have often felt, and I now agree, that it would be most appropriately offered as a 300-level course. To that end I have designed a new course that spends less time on the earlier period than did 180, and, unlike 180, treats the period from Newton to Gauss. I have adjusted the prerequisites, so that Math. 380 would now require at least 3 courses on the 100 - 200 level, so the mathematical background required is appropriate to the 300 level.

An additional reason for offering our history of math course on the 300 level is that it will encourage our major and minor students to take it, so I expect a substantially improved enrollment. Currently many of our majors and minors have told me that they would like to have taken Math. 180 but, by the time they have finished the courses we require at the 100 - 200 level they really need upper-level credits.

Finally, homework is an important part of the grade for the course and all three of the books that I consider appropriate for the course (Boyer, Eves and Katz) have a substantial number of problems in them which involve the student in doing non-trivial mathematics. This is especially true of the two I think are most likely to be used, Eves or Katz, so there is ample reason to give upper-level mathematics credit for such a course.

Len Berggren

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
COURSE PROPOSAL FORM

1. Calendar Information

Department: Mathematics and Statistics

Abbreviation Code: MATH Course Number: 380 Credit Hours: 3 Vector: 3-1-0

Title of Course: History of Mathematics

Calendar Description of Course: An account of the history of mathematics from ancient times through the development of calculus and the origins of modern algebra in the nineteenth century. Emphasis will be on developments which shaped the mathematics studied in high school and the first two years of university.

Nature of Course: Lecture course.

Prerequisites (or special instructions): Math 151, Math 232 and one of Math 152 or Math 113. Students who have taken Math 180 may not take Math 380 for additional credit.

What course (courses), if any, is being dropped from the calendar if this course is approved: Math 180-3.

2. Scheduling

How frequently will the course be offered? yearly.

Semester in which the course will first be offered? 95-3.

Which of your present faculty would be available to make the proposed offering possible: J.L. Berggren, P. Borwein, H. Gerber.

3. Objectives of the Course: To survey the history of mathematics from basic numeration systems through to calculus and modern algebra.

4. Budgetary and Space requirements (for information only)

What additional resources will be required in the following areas:

Faculty: None.

Staff: None.

Library: None — the library has a strong collection, built up to serve Math 180.

Audio Visual: None.

Space: None.

Equipment: None.

5. Approval

Date: July 15, 1994	14 Nov. 94	Dec 19/94
Department Chair	Dean	Chair, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline.)

Math. 380 - 3
Proposed Syllabus

Week 1: A survey of mathematics in the ancient civilizations of China, India, Babylon nad Egypt

Week 2: The Development of Mathematics in Greece up to Euclid's *Elements*

Week 3: Archimedes and Apollonius

Week 4: Mathematics in late Hellenistic times: The Origins of Trigonometry, Diophantus's *Arithmetica* and Pappus.

Week 5: Mathematics in Medieval China and India

Week 6: Mathematics in Medieval Islam and Medieval Europe

Week 7: Algebra in the Renaissance - the development of algebraic symbolism and the solution of cubic and quartic equations

Week 8: Mathematical Methods in the Renaissance - art, astronomy and the invention of logarithms

Week 9: Geometry, Algebra and Probability in the Seventeenth Century

Weeks 10 & 11: The Beginnings of Calculus

Week 12: Analysis, Algebra and Geometry in the Eighteenth Century

Week 13: Number theory and Algebra in the Early Nineteenth Century

Note: There are at least three good texts from which a course such as the above could be taught - those of Carl Boyer, Howard Eves and Victor Katz.

Department of Physics

SCUS Reference: SCUS 94 - 9 c
SCAP Reference: SCAP 94 - 58 c

i) New courses -
PHYS 437 - 0 Practicum V
PHYS 432 - 5 Physics Research Thesis
ii) Change of upper division requirements for Major
iii) Change of CMPT requirements for Applied Physics Major
iv) Changes to Honors program
v) Revisions to PHYS 234

For Information:
Acting under delegated authority of Senate, SCUS has approved the following revisions as detailed in SCUS 94 - 9 c:

Change of prerequisites: NUSC 442, 485
Change of title and prerequisite: PHYS 346

FSC 7-94

Department of Physics Curriculum Changes

The following items have been approved by the Physics department. I would ask that they now be placed before the Faculty of Science.

- (a) PHYS 437-0 Practicum V
- (b) i PHYS 432-5 Physics Research Thesis
- (b) ii Incorporation of PHYS 432-5 in the Honors Program
- (c) Physics Major Upper Division Requirements
- (d) Applied Physics Major Computing Requirements
- (e) i NUSC 442 and NUSC 485 Scheduling
- (e) ii Honors Physics program change
- (f) Physics Laboratory PHYS 234 Modification
- (g) PHYS 346-3 (Energy and the Environment)

=====

(a) Co-op Practicum V.

The rationale for a 5th Co-op practicum is as follows:

There are four Co-op courses in physics corresponding to the course requirements for a Co-op degree. From time to time a physics co-op position becomes available for which the only student available is a student who has completed the four courses. PHYS 437 would allow such a student to sign up for a fifth co-op work term. The advantages are:

1) we do not risk losing the position to a rival institution
2) the employer is pleased with the service we provide
3) the student receives further career related employment.

The proposed course is exactly analogous to CHEM 408-0 Practicum V, which is an optional semester of work experience and which has already been approved by the University.

Recommendation: that a fifth physics co-op practicum be created with the following Calendar entry:

PHYS 437-0 Practicum V.

This is an optional fifth semester of work experience in a co-operative education program available to students who are studying physics or related areas such as biophysics, chemical physics or mathematical physics. Prerequisites: PHYS 436 and a minimum cumulative GPA of 2.75. Students should apply to the department at least one semester in advance. A course fee is required. This course is evaluated on a P/W basis.

(b) i Undergraduate Honors Thesis: PHYS 432-5.

We recommend that a new course, PHYS 432-5, be created to allow for an undergraduate research project. The project would be performed at Simon Fraser University during a regular academic semester, and would not be part of a Co-op semester. The course grade would be determined on the basis of an undergraduate honors thesis to be written in the same semester as the course is taken. Letter grades would be given, not pass/fail. The proposed calendar entry is:

PHYS 432-5 Physics Research Thesis (0-0-10).

Undergraduate research and preparation of an honors thesis. The research project may be in experimental or theoretical physics. Prospective students must obtain agreement of a faculty member willing to supervise the project, and submit the project to the Physics Department for approval at least two months prior to registering for the course. The research must be done during the semester in which the student is registered for the course, and may not be part of a Co-op practicum. The course will be graded on the basis of the honors thesis, which must be submitted before the end of the semester. Prerequisites: All students interested in taking this course must consult with their faculty supervisor regarding prerequisites. Projects in experimental physics normally will require PHYS 431-4 as a prerequisite.

(b) ii Incorporation of PHYS 432-5 in Honors Program.

If this course is adopted, the following change should be made to include PHYS 432-5 in the honors physics program. From:

Three of :

PHYS 430-5	Digital Electronics and Interfacing
PHYS 455-3	Applied Optics
PHYS 465-3	Solid State Physics
PHYS 484-3	Nonlinear Physics

to

Three of:

PHYS 430-5	Digital Electronics and Interfacing
PHYS 432-5	Physics Research Thesis
PHYS 455-3	Applied Optics
PHYS 465-3	Solid State Physics
PHYS 484-3	Nonlinear Physics

(c) Physics Major Upper Division Requirements:

The department feels it is in the students' interest to have optics included in the upper level requirements for the Physics Major. It is thus recommended that the current upper division requirements for a Physics Major be changed from

MATH 310-3	Introduction to Ordinary Differential Equations
PHYS	Minimum 30 semester hours upper division credit (courses numbered 300 and above) including PHYS 326, 331, 385 and at least one other upper division Physics Laboratory.

to

MATH 310-3	Introduction to Ordinary Differential Equations
PHYS 326-3	Electronics and Instrumentation
PHYS 331-3	Electronics Laboratory
PHYS 332-3	Intermediate Laboratory
PHYS 355-3	Optics
PHYS 385-3	Quantum Physics

In addition, a minimum of 15 other upper division credits (courses numbered 300 and above) in Physics must be taken to fulfill the Physics subject area requirements for a majors degree.

(d) Applied Physics Major CMPT Requirements.
Several changes have been made to the lower division CMPT courses which are required for the Applied Physics Major: CMPT 291-1 has been abolished and CMPT 105-3 is required for the revised CMPT 290-3.

Recommendation: That the lower division CMPT requirements for the Applied Physics Major be changed from

CMPT 102-3	Introduction to FORTRAN for Science Students
CMPT 290-3	Introduction to Digital Systems
CMPT 291-1	Introduction to Digital Circuit Design

to

CMPT 102-3	Introduction to FORTRAN for Science Students
CMPT 105-3	Fundamental Concepts of Computing
CMPT 290-3	Introduction to Digital Systems.

The following statement should be deleted from the Calendar on Page 164 (1993-94 edition):
*CMPT 290-3 and CMPT 390-3 - The prerequisite CMPT 105-3 may be waived provided that CMPT 102-3 has been taken.

(e) i NUSC 442 and NUSC 485.
The scheduling of courses in a trimester system is made extremely difficult if a course has a co-requisite at the same level. NUSC 485 is the only remaining upper division course which still has "same-year" co-requisites.

Recommendation: that the prerequisites for NUSC 485 be changed from

Prerequisite: PHYS 385 or CHEM 361 for permission of the department. PHYS 415 is recommended.

to
Prerequisite: PHYS 385 or CHEM 361 or permission of the department.

The particle physicists in the department wish to offer NUSC 485 every year, and NUSC 442 only when demand warrants/resources permit. Under the current requirements, if only NUSC 485 is offered regularly, then it effectively becomes a compulsory course for Physics honors students.

(e) ii Following from (e) i, we recommend that the Physics Honors program be changed from:

Three of

PHYS 430-5	Digital Electronics and Interfacing
PHYS 455-3	Applied Optics
PHYS 465-3	Solid State Physics
PHYS 484-3	Nonlinear Physics

Either
NUSC 442-3 Subatomic physics
or
NUSC 485-3 Particle Physics

to
Four of

PHYS 430-5	Digital Electronics and Interfacing
PHYS 432-5	Physics Research Thesis
PHYS 455-3	Applied Optics
PHYS 465-3	Solid State Physics
PHYS 484-3	Nonlinear Physics
NUSC 485-3	Particle Physics

(f) Physics Laboratory PHYS 234 Modification.
Currently, PHYS 233 and PHYS 234 are based on the same suite of experiments. The student chooses at least one experiment from each of four categories. Each experiment is assigned difficulty points, and the total number of difficulty points amassed by the student must be 6 for PHYS 233 and 7 for PHYS 234.

Under the proposal, PHYS 233 would remain largely as it is. The choice of experiments would be reduced slightly to minimize overlap with PHYS 131 and the revised PHYS 234. PHYS 233 would remain largely a service course, since it is taken by a number of students in chemistry and engineering.

PHYS 234, on the other hand, is taken largely by physics honors/major students. Under the proposal, the content of PHYS 234 would become more strictly defined, and there would be an extra hour added to the lab, dealing with the Physics Laboratory use of computers, spreadsheets and electronic data acquisition. The Coop program has argued very strongly that more experience is required in computing applications for our students at the lower division level.

Revised Course Proposal: PHYS 234-3 (3 hour lab + 1 hour lecture), (1-0-3)

Week	Lab Title	Computational Topic
1	AC circuits I: measurement techniques	Intro. to the course & Phys. Fac.
2	AC circuits II: circuit theory	Introduction to UNIX
3	AC circuits III: AC circuits	Spreadsheets: Excel etc.
4	AC circuits IV: impedance & resonance	Maple I: introduction
5	AC circuits V: digital circuits	Maple II: algebraic & symbolic calculations
6	Heat transfer I	Maple III numerical mathematics
7	Heat transfer II	Data acquisition I
8	Hall effect - I	Data acquisition II: QBASIC
9	Hall effect - II	Error analysis
10	Radioactivity - I	Curve fitting
11	Radioactivity - II	Numerical derivatives
12	Forced oscillations - I	Numerical integrals
13	Forced oscillations - II	Simultaneous equations

Comments:

* The AC circuit labs will be in workbook format, and will include some material from the current third year lab.
* The Computational Topics will be covered in a one hour session, with applications to be performed by the students later. The applications will mirror the material in the laboratory experiments.
* Students will be evaluated on the basis of quizzes, personal evaluation, lab book evaluation and at least one formal report.
* General opinion is that Maple is easier to learn/use than Mathematica, so the emphasis will be on Maple. Further, SFU has a Maple site license, so the software acquisition cost is cheap.
* The experiments will be offered in lock step with the computational topics.

Reference texts:
Maple text
Numerical Recipes (William Press et al.) miscellaneous topics

Proposed revised Calendar description: (Calendar Description form attached.)
PHYS 234-3 Introductory Physics Laboratory B.
Introductory physics laboratory with experiments chosen from mechanics, heat, optics, electricity, magnetism, properties of matter, atomic and nuclear physics, along with lectures on the use of computers for data acquisition and data analysis in the physics laboratory (1-0-3). Prerequisite PHYS 233.

(g) ii PHYS 346-3 Energy and the Environment.

The Environmental Science program requires that Physics offer an "Energy and the Environment" course. We approved a new course title and prerequisites for PHYS 346 and recommend that the

Calendar entry title and prerequisites for PHYS 346 be changed from:
PHYS 346 (Energy Sources and Energy Conversion)
Prerequisites: PHYS 244 (or CHEM 261 and MATH 251),
or permission of the instructor.

to
PHYS 346 (Energy and the Environment)
Prerequisites: CHEM 103, PHYS 102 (or 121),
MATH 155 (or 152).

(Course title and prerequisite change form attached).

7.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE IN CALENDAR DESCRIPTION

1. Calendar Information

Department: Physics

Abbreviation Code: PHYS Course Number: 437 Credit Hours: 0 Vector: ____

Title of Course: Practicum V

Calendar Description of Course:

This is an optional fifth semester of work experience in a co-operative education program available to students who are studying physics or related areas such as biophysics, chemical physics or mathematical physics.

Nature of Course: Co-op

Prerequisites (or special instructions):

PHYS 436 and a minimum cumulative GPA of 2.75. Students should apply to the department at least one semester in advance. A course fee is required. This course is evaluated on a P/W basis.

What course (courses), if any, is being dropped from the calendar if this course is approved: none.

2. Scheduling

How frequently will the course be offered? As required.

Semester in which the course will first be offered?

Which of your present faculty would be available to make the proposed offering possible? A. Curzon

3. Objectives of the Course

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty

Staff

Library none

Audio Visual

Space

Equipment

5. Approval

Date:	June 21/94	Oct 14 1994	Dec 19/94
	Department Chairman	Dean	Chairman, SCUS

SCUS 73-34b:- When completing this form, for instructions see Memorandum SCUS 73-34a

8.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE IN CALENDAR DESCRIPTION

1. Calendar Information

Department: Physics

Abbreviation Code: PHYS Course Number: 432 Credit Hours: 5 Vector: 0-0-10

Title of Course: Undergraduate Honors Thesis

Calendar Description of Course:
Undergraduate research and preparation of an honors thesis. The research project may be in experimental or theoretical physics. Prospective students must obtain agreement of a faculty member willing to supervise the project, and submit the project to the Physics Department for approval at least two months prior to registering for the cours The research must be done during the semester in which the student is registered for the course, and may not be part of a Co-op practicum. The course will be graded on the basis of the honors thesis, which must be submitted before the end of the semester.

Nature of Course:

Prerequisites (or Special Instructions):
All students interested in taking this course must consult with their faculty supervisor regarding prerequisites, normally require PHYS 431-4

What course (courses), if any, is being dropped from the calendar if this course is approved:
none

2. Scheduling

How frequently will the course be offered? as required.

Semester in which the course will first be offered?

Which of your present faculty would be available to make the proposed offering possible? All faculty.

3. Objectives of the Course

To provide students with the opportunity to obtain independent research experience.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty
Staff
Library
Audio Visual — None.
Space
Equipment

5. Approval

Date:	R J Frindt	Oct 14, 1994	
	June 21/94	C H W Jones	
	Department Chairman	Dean	Chairman, SCUS

SCUS 73-34b:- When completing this form, for instructions see Memorandum SCUS 73-34a

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CHANGE IN CALENDAR DESCRIPTION

9.

1. Calendar Information — Department: Physics

Abbreviation Code: PHYS Course Number: 234 Credit Hours: 3 Vector: (1-0-3)

Title of Course: Introductory Physics Laboratory B

Calendar Description of Course:

Introductory physics laboratory with experiments chosen from mechanics, heat, optics, electricity, magnetism, properties of matter, atomic and nuclear physics, along with lectures on the use of computers for data acquisition and data analysis in the physics laboratory. (1-0-3) Prerequisite PHYS 233.

Nature of Course: Laboratory/lecture.

Prerequisites (or special instructions):

PHYS 233

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. Scheduling

How frequently will the course be offered? Every semester

Semester in which the course will first be offered? 95-2

Which of your present faculty would be available to make the proposed offering possible? Most faculty.

3. Objectives of the Course

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	None
Staff	None
Library	None
Audio Visual	None
Space	None
Equipment	An equipment request of $45,352 has been submitted to the Dean of Science.

5. Approval

Date:	June 21, 1994	Oct 14 1994	Dec 19/94
	R J Frindt	C.H.W. Jones	[signature]
	Department Chairman	Dean	Chairman, SCUS

SCUS 73-34b:- When completing this form, for instructions see Memorandum SCUS 73-34a

Earth Sciences Program

SCUS Reference:	SCUS 94 - 14
SCAP Reference:	SCAP 94 - 58 e

Earth Sciences Program, including

New courses -

EASC 101 - 3	Physical Geology
EASC 102 - 3	Historical Geology
EASC 201 - 3	Stratigraphy and sedimentation
EASC 202 - 3	Introduction to Mineralogy
EASC 203 - 3	Paleontology
EASC 204 - 3	Structural Geology I
EASC 205 - 3	Introduction to Petrology
EASC 206 - 1	Field Geology I

SIMON FRASER UNIVERSITY
MEMORANDUM

To: R. Heath
Secretary to Senate

From: C.H.W. Jones, Dean
Faculty of Science

Subject: **Earth Sciences**

Date: November 2, 1994

I understand, both from the President and the Vice-President, that SCAP's recommendation on the Academic Enhancement Fund have been approved for funding.

Please find attached the course proposals for the individual Earth Science courses. When Senate approved the establishment of the Earth Sciences programme, the courses to be offered were listed and briefly described and the overall programme structure was presented in some detail. However, Senate made clear that the full course proposals for each course would have to be brought forward at the appropriate time.

These course proposals will be reviewed by the Faculty Undergraduate Studies Committee this week and will be presented to Faculty on November 14. I am forwarding them to you now in anticipation of their approval by the Faculty.

CHW Jones
C.H.W. Jones

CHWJ:ln

c: M. Roberts
E. Hickin
M. Plischke

The Earth Sciences Undergraduate B.Sc. Programme

November 7, 1995

Introduction

The establishment of an Earth Sciences B.Sc. programme in the Faculty of Science was approved some years ago by Senate and the Board. While the programme was described in considerable detail in the original proposal, course descriptions had not been completed at that time. Senate requested that the individual courses described in the programme be brought forward for approval as the courses were to be introduced. Over the last four years, a number of attempts have been made to initiate this programme but the absence of a mechanism to provide the necessary designated base-budget funding prevented this. The establishment of the Academic Enhancement Fund in 1994-95 presented an avenue for such funding and in September the Faculty of Science submitted the Earth Sciences programme to the AEF as our number one ranked priority.

SCAP met on September 28 to consider the submissions to the Academic Enhancement Fund and based on the outcome of that meeting the V.P. Academic drafted recommendations which included funding for the Earth Sciences programme. At its meeting on October 5 SCAP voted to endorse the Vice-President's recommendations. On November 2 we were advised by the Vice-President that the President has now approved the recommended 1994-95 Academic Enhancement Fund allocation, together with the phasing-in of the allocations to future years.

Resources for the Earth Sciences Programme

The Academic Enhancement Fund will provide base-funding building over a five year time frame,1994-99, to $612,000 per annum.

Faculty Appointments

i) Drs. Roberts and Hickin will take up joint appointments between the Departments of Geography and the Earth Sciences programme;

ii) Five new faculty positions will be established through the AEF;

iii) The Faculty of Science will provide two positions to this programme from growth-funding and retirement replacements.

Staff Appointments

The AEF base-funding will provide the necessary administrative, secretarial and technical support for this programme.

Equipment

The Faculty of Science will provide $58,000 in equipment support for teaching equipment in 1994-95. Subsequent requests for equipment funding for the Earth Sciences teaching programme will be made to the University Equipment Budget each year.

Operating and T.A. Support

The AEF will provide a base operating budget ($60,000 p.a. in 1999) and an ongoing T.A. budget ($100,000 p.a. in 1999) to the Earth Sciences programme.

Space

Initially the first and second year laboratory sections will be accommodated in a refurbished 24-person teaching laboratory in the Faculty of Science. The University has made a commitment to provide ca. 4,000 sq. ft. for the Earth Sciences programme over the next three years.

Library

The initial course offerings presented here will not have any major library budgetary implications. The AEF has provided $25,000 to supplement the substantial library holdings in the area of Earth Sciences and the updated needs for the 300-400 level courses will be reviewed in the next several months.

Course Proposals

The course proposal forms and course descriptions are now presented for the lower level courses which were approved as part of the original programme submission. The offering of these courses will be initiated in Fall 95.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information   Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC**   Course #: **101**   Credit Hrs: **3**   Vector: **3-0-2**

Title of Course: **Physical Geology**

Calendar Description of Course: **An introduction to the origin and character of minerals, rocks, earth structure, earth-surface processes and plate tectonic theory.**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **None**

What course (courses), if any, is being dropped from the calendar if this course is approved: **Geog 112**

2. Scheduling

How frequently will the course be offered?
Twice yearly

Semester in which the course will first be offered?
95-3

Which of your present faculty would be available to make the proposed offering possible?

E.J. Hickin, and EASC faculty

3. Objectives of the Course: **To provide a foundation course in physical geology for the Earth Sciences Program**

4. Budgetary and Space Requirements

See accompanying memorandum

5. Approval

Date: 11/9/94	14 Nov. 94,	Dec 19 94
Michael Plotkke	CHW Jones	[signature]
(Department Chair)	(Dean)	(Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline*). Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 101
E.J. Hickin

Course Outline

PHYSICAL GEOLOGY

General

EASC 101 is an introduction to physical geology for those interested in pursuing further work in earth sciences and in physical geography. Although lectures will be concerned with developing theory, as much emphasis is placed on developing practical skills of mineral and rock identification in the field. Laboratory classes largely will be concerned with 'hands-on' experience in mineralogy and petrology and attendance of a one-day field trip late in the semester is required to obtain credit for the course.

Prerequisites

None

Course Topics

1. Seismicity and the internal structure of Earth: the nature of seismic waves, earthquakes, and seismic surveying; models of Earth's internal structure.
2. The theory of plate tectonics.
3. Time and Life: the nature and measurement of geologic time (the stratigraphic column, palaeontology and evolution, radiometric dating)
4. Minerals: atomic structure of crystals and the character of the common rock-forming silicates; a brief look at the non-silicates.
5. Rocks: the origin, character and classification of igneous, sedimentary and metamorphic rocks.
6. Structural geology: origin, character, and analysis of structures such as folds and faults.

Course Text

Plummer, C.C. and McGeary, 1993, Physical Geology, 6th Edition, Wm C. Brown Publishers.

Field-trip Fee

A fee of $20 will be collected to offset the cost of the Geog 112 field trip.

Film Series

A program of Earth science films will form an important part of the lecture component of this course and the film material is examinable.

Course Grade

Grades will be based on the following components:

(a)	Mineralogy examination	: 20%
(b)	Petrology examination	: 20%
(c)	Written laboratory assignments	: 10%
(d)	Field trip report	: 10%
(e)	Final theory examination	: 40%

Enquiries

Further information about this course can be obtained from the Instructor, Professor Ted Hickin, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **102** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Historical Geology**

Calendar Description of Course: **An introduction to the study of the evolution of the Earth; the geological time scale, fossils and evolution; stratigraphic concepts; geological history of western Canada.**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **None**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Twice yearly

Semester in which the course will first be offered?
95-3

Which of your present faculty would be available to make the proposed offering possible?

New faculty appointments

3. Objectives of the Course: **To provide a foundation course in historical geology for the Earth Sciences Program**

4. Budgetary and Space Requirements

See accompanying memorandum

5. Approval

Date: 11/9/94	14 Nov. 94	Dec 19/94
Michael Plischke	CHW Jones	[signature]
(Department Chair)	(Dean)	(Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline).* Arts 92-3 (*** note: a separate library report is now required**)

6.

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 102
Faculty

Course Outline

HISTORICAL GEOLOGY

General
EASC 102 is an introduction to historical geology. Although lectures will be concerned with developing theory, as much emphasis is placed on developing practical skills of fossil identification and classification and the interpretation of geological maps. Attendance of a one-day field trip late in the semester is required to obtain credit for the course.

Prerequisites

None

Course Topics

1. The principals of historical geology: palaeoenvironmental reconstruction and dating
2. Paleontology: Types of fossilization
3. Paleontology: Animal kingdom
4. Paleontology: Plant kingdom
5. Paleontology: Classification
6. Historical Geology: Methods of dating
7. Historical Geology: Stratigraphy
8. Geologic Maps

Course Text

Levin, H.L., 1983. The Earth Through Time. Saunders College Publishing

Course Grade
Grades will be based on the following components:

(a) Laboratory assignments	: 20%
(b) Mid-term examination	: 20%
(c) Field trip report	: 10%
(d) Final theory examination	: 40%

Enquiries
Further information about this course can be obtained from the Instructor, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **201** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Stratigraphy and sedimentation**

Calendar Description of Course: **An introduction to the nature, origin and interpretation of stratified Earth materials. Principles of lithostratigraphy, biostratigraphy and chronostratigraphy. Sequence stratigraphy. The facies concept.**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **EASC 101 or Geog 111; and EASC 102**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
95-3

Which of your present faculty would be available to make the proposed offering possible?

New faculty

3. Objectives of the Course: **To provide a foundation course in the principles of stratigraphy and sedimentation for the Earth Sciences Program**

4. Budgetary and Space Requirements

What additional resources will be required in the following areas:

See accompanying memorandum

5. Approval

Date: 11/9/94 14 Nov. 94 Dec 19/94

(Department Chair) (Dean) (Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline*). Arts 92-3 (*** note: a separate library report is now required**)

8.

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 201
E.ASC faculty

Course Outline

STRATIGRAPHY AND SEDIMENTATION

General
EASC 201 is a comprehensive introduction to the principles of stratigraphy and sedimentology.

Prerequisites
EASC 101 or Geog 111; and EASC 102

Course Topics

1. Introduction: Development and application of sedimentology and stratigraphy
2. Principles of sedimentology
3. Physical properties of sedimentary rocks
4. Composition and classification of sedimentary rocks
5. Diagenesis
5. Sedimentary environments - the link between sedimentology and stratigraphy
7. Principles of stratigraphy

Course Text

Boggs, S., 1987. Principles of Sedimentology and Stratigraphy. Merrill Publishing Co. Toronto.

Course Grade
Grades will be based on the following components:

(a) Lab assignments	: 20%
(b) Mid-term examination	: 30%
(e) Final examination	: 50%

Enquiries
Further information about this course can be obtained from the Instructor, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **202** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Introduction to Mineralogy**

Calendar Description of Course: **Introduction to crystallography, crystal chemistry and chemical properties and chemical principles necessary for the study of minerals**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **EASC 101; CHEM 102 and CHEM 115**

What course (courses), if any, is being dropped from the calendar if this course is approved: **Geog 112**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
95-3

Which of your present faculty would be available to make the proposed offering possible?

EASC faculty

3. Objectives of the Course: **To provide a foundation course in mineralogy for the Earth Sciences Program**

4. Budgetary and Space Requirements

What additional resources will be required in the following areas:

See accompanying memorandum.

5. Approval

Date: 11/9/94 14 Nov. 94. Dec 19/94

(Department Chair) (Dean) (Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline).* Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 202
EASC faculty

Course Outline

INTRODUCTION TO MINERALOGY

General
EASC 202 is an introduction to the principles of crystallography as a basis for studying minerals. Use of the polarizing microscope.

Prerequisites
EASC 101; CHEM 102 and CHEM 115

Course Topics

1. Introduction to Crystallography
   - Crystals
   - Crystal Systems
   - Cleavage, fracture and parting
   - Stereographic projection
2. Polarizing microscope
3. Principles of optical mineralogy
4. Flat stage techniques
5. Universal stage techniques
6. Mineral identification

Course Text

Shelley, D., 1975. Optical Mineralogy. Elsevier

Course Grade
Grades will be based on the following components:

(a) Written laboratory assignments	: 20%
(d) Mid-term theory exam	: 20%
(e) Lab examination	: 30%
(e) Final theory examination	: 30%

Enquiries
Further information about this course can be obtained from the Instructor, Earth Sciences Program.

11.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **203** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Paleontology**

Calendar Description of Course: **Principles of classification, morphology and development of the major groups of animals and plants in the geological record; the paleoecologic significance of fossils**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **EASC 102 and BISC 102**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
97-3

Which of your present faculty would be available to make the proposed offering possible?

EASC faculty

3. Objectives of the Course: **To provide a foundation course in paleontology for the Earth Sciences Program**

4. Budgetary and Space Requirements

What additional resources will be required in the following areas:

See accompanying memorandum

5. Approval

Date: 11/9/94	14 Nov. 94	Dec 19/94
(Department Chair)	(Dean)	(Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline*). Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Spring Semester, 1996

EASC 203
EASC faculty

Course Outline

PALEONTOLOGY

General

EASC 203 is an introduction to paleontology and will consider the principles of preservation, classification, and paleoecological interpretation, of the main fossil groups important to geology. Lectures will provide the necessary theoretical frameworks and discussion of analytical techniques and laboratory assignments will focus on identification.

Prerequisites

EASC 102 and BISC 102

Course Topics

1. Classification of life
2. Fossil groups important in the geologic record
3. Fossil preservation mechanisms
4. Major fossil groups in the:
   - Paleozoic
   - Mesozoic
   - Cenozoic
5. Fossils and paleoenvironmental reconstruction

Course Text

Moody, R., 1986, Fossils. Macmillan, New York.

Course Grade

Grades will be based on the following components:

(a) Midterm theory examination	: 20%
(c) Laboratory assignments	: 20%
(d) Laboratory Examination	: 30%
(e) Final theory examination	: 30%

Enquiries

Further information about this course can be obtained from the Instructor, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **204** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Structural Geology I**

Calendar Description of Course: **Description, classification and interpretation of Earth structures: folds, faults, joints, cleavage, and lineations. Elementary rock mechanics.**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **EASC 101 and EASC 102; PHYS 120**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
96-3

Which of your present faculty would be available to make the proposed offering possible?

EASC faculty

3. Objectives of the Course: **To provide a foundation course in structural geology for the Earth Sciences Program.**

4. Budgetary and Space Requirements

What additional resources will be required in the following areas:

See accompanying memorandum.

5. Approval

Date: 1/9/94 | 14 Nov. 94 | Dec 19 94

(Department Chair) (Dean) (Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline*). Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 204
EASC faculty

Course Outline

STRUCTURAL GEOLOGY I

General

EASC 204 is the first systematic course in the description and analysis of deformation of geological materials. Lectures will develop various aspects of the theory and analysis of deformation of geological materials. Laboratory assignments will focus on the analysis of stress strain relations from geological evidence in rock hand samples, aerial photographs, and geological maps.

Prerequisites

EASC 101 and EASC 102; PHYS 120

Course Topics

1. Nature of structural geology
2. Concept of detailed structural analysis
3. Structural analysis: descriptive, kinematic and dynamic
4. Structures: contacts, primary structure, faults, joints, folds, lineations

Course Text

Davis, G.H., 1984, Structural Geology of Rocks and Regions. Wiley, New York.

Field-trip Fee

A fee of $15 will be collected to offset the cost of the EASC 204 field trip.

Course Grade

Grades will be based on the following components:

(a)	Mid-term theory examination	: 20%
(b)	Laboratory examination	: 20%
(c)	Field trip report	: 20%
(d)	Final theory examination	: 40%

Enquiries

Further information about this course can be obtained from the Instructor, Professor EASC, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **205** Credit Hrs: **3** Vector: **3-0-2**

Title of Course: **Introduction to Petrology**

Calendar Description of Course: **Optical phenomena related to the use of the polarizing microscope in the identification of minerals in thin section. Petrogenesis and classification of igneous, sedimentary, and metamorphic rocks. Hand specimen and thin section identification of rocks and minerals**

Nature of Course: **Lecture/lab**

Prerequisites (or special instructions): **EASC 202; CHEM 103 and 115; PHYS 121 and 131**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
96-3

Which of your present faculty would be available to make the proposed offering possible?

EASC faculty

3. Objectives of the Course: **To provide an introductory course in optical petrology for the Earth Sciences Program**

4. Budgetary and Space Requirements

See accompanying memorandum.

5. Approval

Date: 1/9/94	14 Nov. 94	Dec 19 94
(Department Chair)	(Dean)	(Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline).* Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Fall Semester, 1995

EASC 205
EASC faculty

Course Outline

INTRODUCTION TO PETROLOGY

General
EASC 205 is a foundation course in optical petrology. Lectures will develop the theory of optical analysis and the genesis of selected groups of igneous, sedimentary and metamorphic rocks.

Prerequisites
EASC 202; CHEM 103 and CHEM 115; PHYS 121 and PHYS 131

Course Topics

1. Igneous petrology
   - Magma geochemistry and crystallization
   - Classification
   - Igneous rocks in hand specimen and thin section
2. Sedimentary petrology
   - Origin
   - Classification
   - Sedimentary rocks in hand specimen and thin section
3. Metamorphic petrology
   - Origin; regional contact and dislocation metamorphism
   - Classification
   - Metamorphic rocks in hand specimen and thin section

Course Text

Williams, H., Turner, F.J., & Gilbert, C.M., 1982. Petrography (2nd Ed). W.H. Freeman.

Field-trip Fee
A fee of $20 will be levied to offset the cost of the EASC 205 field trip.

Course Grade
Grades will be based on the following components:

(a)	Mid-term theory examination	: 10%
(b)	Laboratory examination	: 40%
(c)	Field trip report	: 10%
(d)	Final theory examination	: 40%

Enquiries
Further information about this course can be obtained from the Instructor, Earth Sciences Program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: **Earth Sciences Program, Faculty of Science**

Abbreviation Code: **EASC** Course #: **206** Credit Hrs: **1** Vector: **0-0-1**

Title of Course: **Field Geology I**

Calendar Description of Course: **Seven days of field excursions to demonstrate the geology of British Columbia.**

Nature of Course: **Field trips**

Prerequisites (or special instructions): **EASC 101 and EASC 102**

What course (courses), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling

How frequently will the course be offered?
Once a year

Semester in which the course will first be offered?
96-3

Which of your present faculty would be available to make the proposed offering possible?

All EASC faculty

3. Objectives of the Course: **To provide practical field experience in geological description and interpretation to complement the lower levels courses in the Earth Sciences Program.**

4. Budgetary and Space Requirements

What additional resources will be required in the following areas:

See accompanying memorandum.

5. Approval

Date: 11/9/94	14 Nov. 94	Dec 19/94
(Department Chair)	(Dean)	(Chair, SCUS)

SCUS 73-34b:-(*When completing this form, for instructions see Memorandum SCUS 73-34a. Attached course outline*). Arts 92-3 (*** note: a separate library report is now required**)

Simon Fraser University
Earth Sciences Program
Spring Semester, 1996

EASC 206-1
EASC faculty

Course Outline

FIELD GEOLOGY I

General
EASC 206 is a geology field school designed to give students practical experience in describing and interpreting geological phenomena and will involve field visits to various sites in British Columbia. The course will include survey technique development (field mapping) in addition to exercising interpretive skills.

Prerequisites
EASC 101 and EASC 102

Course Topics

1. The stratigraphy of Quaternary - Seymour Valley.
2. Coastal Mesozoic sections - Gulf Island stratigraphy
3. Coast Plutonic Complex
4. An Interior terrane

Course Text
None. Course handouts

Field-trip Fee
A fee of $100 will be collected to offset the cost of the EASC 206 field school.

Course Grade

A grade for this course will be based on a field trip report.

Enquiries
Further information about this course can be obtained from the Instructor, Earth Sciences Program.

S.95-5e

B.Sc. Program in Environmental Science

SCUS Reference: SCUS 94 - 9 d
SCAP Reference: SCAP 94 - 70

B.Sc. Program in Environmental Science including

New courses -

ENPL 100 - 3	Global Change
ENPL 200 - 3	Environmental Dynamics

SIMON FRASER UNIVERSITY
Office of the Vice-President, Academic
MEMORANDUM

TO: Senate

FROM: J.M. Munro,
Vice-President, Academic

SUBJ: B.Sc. in Environmental Science

DATE: December 15, 1994

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On the recommendation of the Senate Committee on Undergraduate Studies, the Senate Committee on Academic Planning has approved the establishment of a B.Sc. program, major in Environmental Science, in the Faculty of Science including the courses listed below:

ENPL 100-3	Global Change
ENPL 200-3	Environmental Dynamics

SCAP recommends approval of this program by Senate and the Board of Governors.

J.M. Munro

cc. W.R. Heath
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SIMON FRASER UNIVERSITY
MEMORANDUM

To: Ron Heath, Registrar

From: C.H.W. Jones, Dean
Faculty of Science

Subject: B.Sc. (Environmental Science)

Date: December 9, 1994

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The initiation of the proposed B.Sc. Environmental Science programme in 1995-96 will require that the courses ENPL 100 and ENPL 200 also be available. Because the approval of the REM proposal, which includes ENPL 100 and 200 as new courses, may delayed, we would request that these two courses, ENPL 100 and 200, be separated out from the REM proposal and that they be presented for approval to SCUS and SCAP at this time.

The Faculty of Science is willing to provide sessional funds of $11,000 to REM to allow for two offerings of ENPL 100 in the 1995-96 academic year. The Faculty of Science will take on the responsibility for teaching ENPL 200, as was originally proposed in the University-wide task force.

C.H.W. Jones

C.H.W. Jones

CHWJ:ln

c: J.M. Munro
J. Osborne
R. Marteniuk
C. Day

Amended Dec. 13, 1994

Proposed Undergraduate Curriculum in Environmental Science

Mandate of the Committee
To develop a coherent curriculum for a program in environmental science at the undergraduate level and within the Faculty of Science.

Restrictions
1. No new degree designation.
2. As few new courses as possible.
3. Administration of the program would be dealt with separately.

Aims of the Program
The proposed B. Sc. program in Environmental Science will:

1. develop an interdisciplinary perspective in environmental issues, by exposing science majors to introductory courses in social sciences, economics and management,

2. through a core program, provide students with a broad and solid background in the fundamentals of science in the first two years, and

3. allow the student to choose one of five different areas of emphasis in which to develop a strong, focused knowledge base in a specific area of environmental science.

The interdisciplinary instruction at the lower levels represents a quantum shift in the design of a "science" program. While the core program may appear more restrictive in terms of electives, this was necessary to provide the interdisciplinary breadth to ensure environmental scientists are familiar with relevant and associated social, economic and management dilemmas. The committee believes that this sort of shift in education is required for solving today's environmental problems which involve considerations beyond traditional academic boundaries. The intent is to develop problem-solvers, not technicians. As such, graduates with strong education in their chosen area of emphasis will be highly marketable to potential employers in the environmental field. By focusing on fundamental knowledge related to environmental issues, graduates will also find their education valuable in other areas of work or in future graduate study. Graduates from the program will be more likely and able to cross over between disciplines for post-graduate studies.

Major in Environmental Science

The Major in Environmental Science requires the completion of at least 120 credit hours, including (a) a minimum of 44 credit hours in courses numbered 300 and above, and (b) a minimum of 12 semester hours from outside the Faculty of Science. The courses must be selected according to the rules set out below. The minimum cumulative grade point average for continuation and graduation is 2.50. General University and Faculty of Science regulations as listed in the Calendar also apply.

Honors in Environmental Science

An honors degree requires completion of a minimum of 132 semester hours of credit. At least 60 credit hours must be at the upper division level and 12 credit hours must from outside the Faculty of Science. Of these 60 credit hours, at least 48 must be in one subject area. For the Environmental Science program, these 48 hours are normally to be selected from the 300- and 400-numbered courses listed as required or optional in the description for the major in any one area of emphasis. Exceptions are to be approved by a faculty advisor. Further specific requirements are listed in each area of emphasis. The minimum cumulative grade point average for continuation and graduation is 3.00. General University and Faculty of Science regulations as listed in the Calendar also apply.

The Lower Level Core

The programs, regardless of upper level emphasis, share an extensive, common, lower level core. The lower level core will educate a scientist who has a basic appreciation of the concerns of and approaches used by economists, social scientists and managers. This information will be of value for a more balanced approach to problem solving. The science education will be broad and solid in all sciences. Even though the lower level program has little to no room for electives, there is inherent flexibility. For example, students can enter a co-op program because the core courses are offered frequently, including summer offerings. In addition, the lower level core program is identical for three of the areas of emphasis (Biology, Chemistry, and Environmetrics), allowing for ease of transfer.

Students will generally be required to take courses in biology, chemistry, mathematics, physics, and statistics, plus geography and social issues, and in most instances, economics. Extra courses in economics and management theory are given in the quantitative techniques for resource management emphasis. As a result, basic chemistry laboratory courses are required only for the biology, chemistry, environmetrics and pollutant transport areas of emphasis.

The Upper Level Areas of Emphasis

There are 5 areas of emphasis. Although the final two years are more specialized, students will meet jointly at an evening seminar course (EVSC 401) to hear presentations on how representatives from government, industry, and public interest groups view environmental issues and how they put the theory being taught in the program to practical use. In addition, PHYS 346, BISC 312, STAT 302/330, and STAT 403/430 will be taken by most students in the program, regardless of emphasis.

The Areas of Emphasis

Biology: Students choosing to specialize in the field of environmental biology will develop a firm background in various aspects of ecology, whole-organism biology, and physiology. Courses in these areas will be given in conjunction with relevant chemistry and statistics courses required to provide students with the means to assess the potential impacts of human activities on terrestrial and aquatic ecosystems. The fate and effects of contaminants within aquatic and terrestrial systems frequently involve more than one population and more than one level of ecological organization. As result of this complexity, it is now recognized that a firm understanding of basic ecological principles is fundamental in elucidating environmental impacts. In response to this need, the biology area of emphasis provides students with an ecological background coupled with a basic understanding of the chemistry of pollutants. Workers in the private and government sectors routinely use such knowledge for the design and implementation of environmental impact assessment and monitoring studies.

Chemistry: The Chemistry stream provides a basic education in fundamental concepts of analytical, inorganic, organic and physical chemistry (to second or third year level). Students will receive extensive instruction in analytical chemistry with the view to quantitative detection of chemical species. The chemistry course content is similar to the existing "Environmental Chemistry Minor," but differs in that students will take additional courses which broaden their perspective on environmental issues. Focus is given to the global context of chemicals and chemistry in the environment. Graduates with a sound understanding of the complexities of the environment will have the tools for effective decision making.

Environmetrics: Beyond a basic background in biology, environmental analytical chemistry, and geography, students will receive solid training in the design and analysis of sampling schemes for environmental monitoring and related experiments. Graduates will be capable of designing monitoring networks and developing complex experimental designs related to environmental problems. People with this sort of background played a central role in assessing the environmental impact of the Exxon Valdez oil spill. Recent projects undertaken by both the provincial and federal environment ministries have also called for considerable expertise in this area. Graduates will also be well prepared for graduate study in more advanced statistical methodology used for example in quantitative studies of the effects of pollutants on human health.

Pollutant Transport: Students will learn, beyond the environmental science core, the fundamental mathematical and scientific skills required for the mathematical modeling of pollutant dispersal. These include differential equations, numerical analysis, statistics, mechanics, thermal physics, and aqueous and atmospheric chemistry. These concepts are used extensively in modeling such phenomena as sewage dispersal and air pollution, as well as in global circulation models and oceanographic models of the currents carrying immature cod on the Scotia Shelf. Graduates will be capable of contributing to such modeling exercises, and will also be well positioned for graduate training in this challenging area.

Quantitative Techniques for Resource Management: Students will obtain in-depth instruction in biological, economic, mathematical, and statistical skills useful in managing natural populations. Graduates will be able to develop schemes for estimating the sizes and dynamics of resource populations, and to apply optimization theory to investigate management strategies. Such estimates form a crucial part of the management of many key resources, certainly including the major fish and forest resources of Canada. Sophisticated estimation techniques are used in the monitoring of the Fraser River salmon runs by the Pacific Salmon Commission and the Department of Fisheries and Oceans. Complex optimization theory has been used in the B.C. Ministry of Forests to study the economic value of fire suppression and stand enhancement. Graduates will be in a strong position to contribute to such projects, and also to expand their quantitative studies in graduate school.

BIOLOGY, CHEMISTRY, AND ENVIRONMETRICS AREAS OF EMPHASIS

Core First and Second Years

Year 1

BISC 101-4 General Biology
BISC 102-4 General Biology
CHEM 102-3 General Chemistry I
CHEM 103-3 General Chemistry II
CHEM 115-2 General Chemistry Laboratory I
CHEM 118-2 General Chemistry Laboratory II
ENPL 100-3 Global Change
MATH 154-3 Calculus I for the Biological Sciences (or MATH 151-3 or 157-3)
MATH 155-3 Calculus II for the Biological Sciences (or MATH 152-3 or 158-3)
PHYS 101-3 General Physics I (or PHYS 120-3)

Year 2

CHEM 150-3 Organic Chemistry I
CHEM 155-2 Organic Chemistry Laboratory I
CMPT 102-3 or 103-3 Introduction to FORTRAN or PASCAL (required only for Environmetrics)
GEOG 111-3 Physical Geography
PHYS 102-3 General Physics II (or PHYS 121-3)
BICH 221-3 Cellular Biology and Biochemistry
BISC 204-3 Introduction to Ecology
CHEM 218-3 Introduction to Analytical Chemistry
ENPL 200-3 Environmental Dynamics

One of
STAT 270-3 Introduction to Probability and Statistics (required for Environmetrics), or STAT 301-3 Statistics for the Life Sciences.

BIOLOGY AREA OF EMPHASIS - Upper Division Requirements

The following lists also contain suggested years in the program for timely completion of the requirements.

Year 3
BISC 304-3 Animal Ecology
BISC 305-3 Animal Physiology or BISC 366 Plant Ecophysiology
BISC 312-3 Environmental Toxicology I
ECON 103-3 Principles of Microeconomics
ECON 105-3 Principles of Macroeconomics
PHYS 346-3 Energy and the Environment
STAT 302-3 Analysis of Experimental and Observational Data

Year 4
BISC 202-3 Genetics
BISC 404-3 Plant Ecology
BISC 414-3 Limnology
EVSC 401-1 Environmental Science Seminar
GEOG 316-4 Ecosystem Biogeochemistry
STAT 403-3 Intermediate Sampling and Experimental Design

And, in Years 3 and 4
Any three of the following courses:
Plant Biology
BISC 310-3 The Plants and Animals of British Columbia
BISC 326-3 Biology of Non-Vascular Plants
BISC 337-3 Comparative Morphology, Distribution and Evolution of Vascular Plants
BISC 366-3 Plant Ecophysiology
Invertebrate Biology
BISC 306-3 Invertebrate Biology
BISC 406-3 Marine Invertebrate Ecology
Vertebrate Biology
BISC 315-3 Vertebrate Biology
BISC 401-3 Population Dynamics
BISC 415-3 Ornithology
BISC 416-3 Fish Biology
BISC 419-3 Wildlife Ecology

BICH 221 (Cellular Biology and Biochemistry) and BICH 222 (Molecular Biology and Biochemistry) are complementary courses and together cover all aspects of cellular structure and function. We therefore strongly recommend that students take BICH 222 as an elective.

Electives

Additional electives are required to meet the total graduation requirement of 120 credit hours, including at least 44 at the upper division level.

HONORS ENVIRONMENTAL SCIENCE - BIOLOGY AREA OF EMPHASIS

To complete the required 48 semester hours of upper division courses in a specific subject, the student will normally take BISC 490-5, BISC 491-5 and BISC 492-5 (which together comprise the ISS program) and will choose further courses listed above as options in Years 3 and 4. Other courses may be substituted subject to the approval of a faculty advisor.

CHEMISTRY AREA OF EMPHASIS - Upper Division Requirements

Year 3

CHEM 232-3 Chemistry of Nontransition Elements
CHEM 250-3 Organic Chemistry II
CHEM 255-2 Organic Chemistry II Laboratory
CHEM 261-3 Physical Chemistry I
CHEM 316-3 Introductory Instrumental Analysis
CHEM 317-2 Analytical Environmental Chemistry
ECON 103-3 Principles of Microeconomics
ECON 105-3 Principles of Macroeconomics
STAT 302-3 Analysis of Experimental and Observational Data

Year 4

BISC 312-3 Environmental Toxicology I
CHEM 331-3 Practical Aspects of Inorganic Chemistry
CHEM 371-3 Chemistry of the Aqueous Environment
CHEM 372-3 Chemistry of the Atmospheric Environment
EVSC 401-1 Environmental Science Seminar
PHYS 346-3 Energy and the Environment
STAT 403-3 Intermediate Sampling and Experimental Design

And, in Years 3 and 4

At least 17 credit hours from the following list:

BISC 305-3 Animal Physiology
BISC 414-3 Limnology
CHEM 332-3 Chemistry of the Transition Metals
CHEM 357-3 Chemical and Instrumental Methods of Identification of Organic Compounds
CHEM 362-3 Physical Chemistry III (Requires substantial prerequisites)
CHEM 417-3 Advanced Instrumental Analysis

GEOG 316-4 Ecosystem Biogeochemistry
GEOG 317-4 Soil Geography
GEOG 419-4 Mass Transfer in the Biosphere
NUSC 341-3 Introduction to Radiochemistry
NUSC 342-3 Introduction to Nuclear Science (MATH 251 is a recommended prerequisite)
NUSC 346-2 Radiochemistry Laboratory

Electives
Additional electives may be required to meet the total graduation requirement of 120 credit hours, including at least 44 at the upper division level.

HONORS ENVIRONMENTAL SCIENCE - CHEMISTRY AREA OF EMPHASIS

To qualify for an Honors Degree through this option, the student must complete CHEM 481-5. In order to complete the required 48 semester hours of upper division courses in a specific subject area, the student normally will choose further courses listed above as options in Years 3 and 4. Other courses may be substituted subject to the approval of a faculty advisor.

ENVIRONMETRICS AREA OF EMPHASIS - Upper Division Requirements

Year 3
CHEM 261-3 Physical Chemistry I
CHEM 316-3 Introductory Instrumental Analysis
CHEM 371-3 Chemistry of the Aqueous Environment
ECON 103-3 Principles of Microeconomics
ECON 105-3 Principles of Macroeconomics
MATH 232-3 Elementary Linear Algebra
MATH 251-3 Calculus III (requires a grade of at least B in MATH 158 if used as the prerequisite)
STAT 330-3 Linear Models in Applied Statistics I
STAT 350-3 Linear Models in Applied Statistics II

Year 4
CHEM 317-2 Analytical Environmental Chemistry
EVSC 401-1 Environmental Science Seminar
PHYS 346-3 Energy and the Environment
STAT 402-3 Generalized Linear and Nonlinear Modeling
STAT 410-3 Statistical Analysis of Sample Surveys
STAT 430-3 Statistical Design and Analysis of Experiments

And, in Years 3 and 4
At least 3 courses from the following:
BISC 304-3 Animal Ecology
BISC 312-3 Environmental Toxicology I

BISC 414-3 Limnology
CHEM 372-3 Chemistry of the Atmospheric Environment
ENPL 410-4 Water and Air Quality Monitoring and Management
ENPL 412-4 Environmental Modeling
ENPL 414-4 Solid and Hazardous Waste Management
ENPL 445-4 Environmental Risk Assessment and Management of Hazardous Substances
GEOG 214-3 Climatology I
GEOG 316-4 Ecosystem Biogeochemistry
GEOG 354-4 Introduction to Geographic Information Systems
GEOG 419-4 Mass Transfer in the Biosphere

Electives
Additional electives are required to meet the total graduation requirement of 120 credit hours, including at least 44 at the upper division level.

Suggested Groupings of Optional Courses

1. *Biology Focus*
   BISC 304-3
   BISC 312-3
   ENPL 445-4
   GEOG 316-4

2. *Aqueous Chemistry Focus*
   BISC 414-3
   ENPL 410-4
   ENPL 411-4
   GEOG 311-4
   GEOG 316-4
   GEOG 419-4

3. *Atmospheric Focus*
   CHEM 372-3
   ENPL 410-4
   ENPL 415-4
   GEOG 214-3
   GEOG 419-4

4. *Toxic Materials Focus*
   BISC 312-3
   ENPL 412-3
   ENPL 414-4
   ENPL 445-4

HONORS ENVIRONMENTAL SCIENCE- ENVIRONMETRICS AREA OF EMPHASIS
To qualify for an Honors Degree in Environmental Science through this option, the student must also complete STAT 450-3. To complete the required 48 semester hours of upper division courses in a specific subject, the student will normally choose further courses listed above as options in Years 3 and 4. Other courses may be substituted subject to the approval of a faculty advisor.

POLLUTANT TRANSPORT
Lower Division requirements

Year 1
BISC 101-4 General Biology
CHEM 102-3 General Chemistry I

CHEM 103-3 General Chemistry II
CHEM 115-2 General Chemistry Laboratory I
CHEM 118-2 General Chemistry Laboratory II
ENPL 100-3 Global Change
MATH 151-3 Calculus I (or MATH 154-3 or 157-3)
MATH 152-3 Calculus II (or MATH 155-3 or 158-3)
PHYS 120-3 Modern Physics and Mechanics (or PHYS 101-3)
PHYS 121-3 Optics, Electricity and Magnetism (or PHYS 102-3)

Year 2
BISC 102-4 General Biology
CHEM 150-3 Organic Chemistry I
CMPT 102-3 Introduction to FORTRAN for Science Students (or CMPT 103-3)
ENPL 200-3 Environmental Dynamics
GEOG 111-3 Physical Geography
MATH 232-3 Elementary Linear Algebra
MATH 251-3 Calculus III (requires a grade of at least B in MATH 158 if used as the prerequisite)
MATH 252-3 Vector Calculus
PHYS 211-3 Intermediate Mechanics
STAT 270-3 Introduction to Probability and Statistics

Upper Division Requirements

Year 3
CHEM 218-3 Introduction to Analytical Chemistry
CHEM 250-3 Organic Chemistry II
CHEM 261-3 Physical Chemistry I
MACM 316-3 Numerical Analysis I
MATH 310-3 Intro. to Ordinary Differential Equations
PHYS 346-3 Energy and the Environment
STAT 330-3 Linear Models in Applied Statistics I

Year 4
CHEM 371-3 Chemistry of the Aqueous Environment
CHEM 372-3 Chemistry of the Atmospheric Environment
EVSC 401-1 Environmental Science Seminar
MATH 416-3 Numerical Analysis II
STAT 403-3 Intermediate Sampling and Experimental Design

And, in Years 3 and 4
At least 17 credit hours from the following list:
BISC 312-3 Environmental Toxicology
BISC 414-3 Limnology
CHEM 316-3 Introductory Instrumental Analysis
CHEM 317-2 Analytical Environmental Chemistry
ENPL 412-4 Environmental Modeling

ENPL 445-4 Environmental Risk Assessment and Management of Hazardous Substances
GEOG 214-3 Climatology I
GEOG 311-4 Hydrology
GEOG 314-4 Climatology II (requires GEOG 214-3)
GEOG 316-4 Ecosystem Biogeochemistry
GEOG 317-4 Soil Geography
GEOG 354-4 Introduction to Geographic Information Systems
GEOG 414-4 Climatology III
GEOG 419-4 Mass Transfer in the Biosphere
MATH 314-3 Boundary Value Problems
MATH 462-3 Fluid Dynamics
NUSC 341-3 Introduction to Radiochemistry

Electives:
Additional electives are required to meet the total graduation requirement of 120 credit hours, including at least 44 at the upper division level.

Suggested Groupings of Optional Courses

1. *Aqueous Biology Focus*
   BISC 312-3
   BISC 414-3
   ENPL 412-4
   GEOG 311-4
   GEOG 316-4
   GEOG 419-4

2. *Aqueous Chemistry Focus*
   BISC 414-3
   CHEM 316-4
   CHEM 317-2
   ENPL 412-4
   GEOG 311-4
   GEOG 316-4
   NUSC 341-3

3. *Atmospheric Focus*
   BISC 312-3
   ENPL 412-4
   GEOG 214-3
   GEOG 314-4
   GEOG 414-4
   GEOG 419-4

4. *Model Building Focus*
   BISC 414-3
   ENPL 412-4
   GEOG 214-3
   GEOG 311-4
   GEOG 354-4
   GEOG 419-4
   MATH 314-3
   MATH 462-3

Pollutant Transport
HONORS ENVIRONMENTAL SCIENCE - ~~ENVIRONMETRICS AREA OF EMPHASIS~~

To qualify for an Honors Degree in Environmental Science through this option, the student must also complete MATH 314-3 and 462-3. To complete the required 48 semester hours of upper division courses in a specific subject, the student will normally choose further courses listed above as options in Years 3 and 4. Other courses may be substituted subject to the approval of a faculty advisor.

<u>QUANTITATIVE TECHNIQUES FOR RESOURCE MANAGEMENT AREA OF EMPHASIS</u>

Lower Division requirements

Year 1

BISC 101-4 General Biology
BISC 102-4 General Biology
CHEM 102-3 General Chemistry I
CHEM 103-3 General Chemistry II
ECON 103-3 Principles of Microeconomics
ENPL 100-3 Global Change
MATH 154-3 Calculus I for the Biological Sciences (or MATH 151-3 or 157-3)
MATH 155-3 Calculus II for the Biological Sciences (or MATH 152-3 or 158-3)
PHYS 101-3 General Physics I (or PHYS 120-3)

Year 2

CMPT 102-3 Introduction to FORTRAN for Science Students (or CMPT 103-3)
ECON 105-3 Principles of Macroeconomics
GEOG 111-3 Physical Geography
BISC 204-3 Introduction to Ecology
ECON 260-3 Environmental Economics
ENPL 200-3 Environmental Dynamics
MATH 232-3 Elementary Linear Algebra
MATH 251-3 Calculus III (requires a grade of at least B in MATH 158 if used as the prerequisite)
PHYS 102-3 General Physics II (or PHYS 121-3)
STAT 270-3 Introduction to Probability and Statistics

Upper Division Requirements

Year 3

BISC 304-3 Animal Ecology
MACM 316-3 Numerical Analysis I
MATH 308-3 Linear Programming
MATH 310-3 Introduction to Ordinary Differential Equations
PHYS 346-3 Energy and the Environment
STAT 330-3 Linear Models in Applied Statistics I
STAT 350-3 Linear Models in Applied Statistics II

Year 4

BISC 407-3 Population Dynamics
EVSC 401-1 Environmental Science Seminar
MATH 309-3 Continuous Optimization
STAT 402-3 Generalized Linear and Nonlinear Modeling
STAT 410-3 Statistical Analysis of Sample Surveys
STAT 430-3 Statistical Design and Analysis of Experiments

And, in Years 3 and 4

At least 4 of:

BISC 305-3 Animal Physiology
BISC 400-3 Evolution
ECON 261-3 Resources and the Economy of British Columbia
ENPL 346-3 Impact Assessment
ENPL 412-4 Environmental Modeling
ENPL 413-4 Fisheries Management
ENPL 443-3 Decision Making in Resource and Environmental Management
ENPL 445-4 Environmental Risk Assessment and Management of Hazardous Substances
ENPL 471-4 Forest Ecosystem Management
GEOG 354-4 Introduction to Geographic Information Systems

Electives:

Additional electives are required to meet the total graduation requirement of 120 credit hours, including at least 44 at the upper division level.

Suggested Groupings of Optional Courses

1. *Fisheries Focus*
   BISC 305-3
   BISC 400-3
   ENPL 412-4
   ENPL 413-4
   GEOG 354-4

2. *Economic Focus*
   ECON 261-3
   ENPL 346-3
   ENPL 443-3
   ENPL 445-4
   GEOG 354-4

3. *Forestry Focus*
   ECON 261-3
   ENPL 346-3
   ENPL 443-3
   ENPL 471-4
   GEOG 354-4

HONORS ENVIRONMENTAL SCIENCE - QUANTITATIVE TECHNIQUES FOR RESOURCE MANAGEMENT AREA OF EMPHASIS

To complete the required 48 semester hours of upper division courses in a specific subject, the student will normally choose further courses listed above as options in Years 3 and 4. Other courses may be substituted subject to the approval of a faculty advisor.

New Courses to Contribute to the Interdisciplinary Approach

ENPL 100-3 Global Change A course providing a social and institutional emphasis to global concerns.

ENPL 200-3 Environmental Dynamics Introduction to geophysical, physiological and ecological concepts related to pollution.

ENPL 346-3 Impact Assessment
ENPL 412-4 Environmental Modeling
ENPL 413-4 Fisheries Management
ENPL 443-3 Decision Making in Resource and Environmental Management
ENPL 445-4 Environmental Risk Assessment and Management of Hazardous Substances
ENPL 471-4 Forest Ecosystem Management

All the ENPL courses are being developed by the School for Resource and Environmental Management for their undergraduate program. These courses at the 300/400 level will complement the Environmental Science Program in the Faculty of Science but are not an integral part of the Program.

EVSC 401-1 Environmental Science Seminar An evening program with guest speakers. Practicing environmental scientists will be invited to give their perspectives on current environmental issues and practices. *It is anticipated that this course will come forward for approval when required in the program.*

STAT 403-3 Intermediate Sampling and Experimental Design An introduction to survey design including spatial sampling and sampling of animal populations; experimental designs involving more than two factors; software for high-resolution graphics. (3-0-1) *Prerequisite: STAT 302.* [Mathematics major and honors students may not use this course to satisfy the required number of semester hours for upper division Mathematics. However, they may include the course to satisfy the total number of required hours of upper division credit.] *This course has already been approved by Senate.*

Committee Members: Tony Farrell, Biological Sciences (Chair)
Leah Bendell-Young, Biological Sciences
Steve Holdcroft, Chemistry
Rick Routledge, Mathematics and Statistics
Jeff Dahn, Physics

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information School: **Resource and Environmental Management**

Abbreviation Code: ENPL New Course No: 100 Credit Hours: 3 Vector: 2-1-0

Title of Course: **Global Change**

Calendar Description of Course: **Humanity's role in changing the face of the earth: 1) Changes in population and society: technological change; institutions, social organization, and cultural values; patterns of production and consumption; urbanization; changing attitudes and emphases. 2) Transformation of the global environment: land--forests; soils; sediment transfer; water--terrestrial water systems; coastal zone; oceans; atmosphere; biota--terrestrial fauna, marine biota, flora; Understanding transformations.**

Nature of Course: **Lecture, tutorial**

Prerequisites (or special instructions): None
What course(s), if any, is being dropped from the calendar if this course is approved:

2. Scheduling
How frequently will the course be offered? **Fall, Spring**
Semester in which the course will first be offered? 1995-3
Which of your present faculty would be available to make the proposed offering possible? **Chad Day. Sessional funding as necessary will be provided by the Faculty of Science.**

3. Objectives of the Course (rationale) **This is the introductory course to explore the range of impacts which humans have had on Earth and the institutions currently in place to regulate the rate of change in future.**

4. Budgetary and Space Requirements (for information only)
What additional resources will be required in the following areas:
Faculty:
Staff:
Library:
Audio Visual: **slide, overhead, and video projectors**
Space: **lecture and tutorial rooms**
Equipment: **None**

5. Approval

Date: 20 December '94	Dec 20/94	Dec 19/94
Department Chair	Dean	Chair, SCUS

14.

SCHOOL OF RESOURCE AND ENVIRONMENTAL MANAGEMENT

Bachelor of Applied Sciences in Environmental Planning
and Management (ENPL)

ENPL 100-3

Global Change

This course provides a basic understanding of macro level changes that are occurring within the biosphere. Based on the premise that rapid growth of human populations and technology are the major determinants of the rate of environmental change, the course will examine the effectiveness of current institutions and social organizations in managing such , cultural values, and evolving attitudes. Then the impact of these forces will be examined in terms of their impact on the global biophysical environment. In the final section, we will explore the adequacy of current paradigms of human-nature theory, social relations, and cultural-human ecology in providing the necessary constructs to move society closer to a sustainable future.

Grading Distribution:

Mid Term	25%	Paper	25%
Tutorials	25%	Final Examination	25%

Lecture Topics

A. The Great Transformation

B. Changes in Population and Society

1. Population
2. Technological change
3. Urbanization
4 Institutions, social organizations, and cultural values
5. Changing attitudes and emphases

C. Transformations of the Global Environment

1`. Land and atmosphere
2. Forests, flora, and fauna

3. Soils and terrestrial water

4. Coastal zone

D. Understanding Transformations

1. The inadequacy of Human-Nature Theory and the View of Mass Consumption

2. Social Relations: Production, Reproduction, and Gender in Environmental Transformation

3. Cultural-Human Ecology: Adaptation and Change in Historical Perspective

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information School: **School of Resource and Enviornmental Management**

Abbreviation Code: **ENPL** New Course No: 200 Credit Hours: 3 Vector: 2 - 1 - 0

Title of Course: **Environmental Dynamics**

Calendar description of course:
This course introduces students to the multidisciplinary nature of environmental studies, science, and management based on a holistic systems-oriented view of environmental problems. The most important environmental problems in the world are reviewed from a multidisciplinary approach. The course introduces students to the natural dynamics of the environment and complements ENPL 100, which addresses the "human" aspects of environmental problems. ENPL 100 is recommended.

Nature of Course: **Lecture, tutorial**

Prerequisites (or special instructions):
What course(s), if any, is being dropped from the calendar if this course is approved: **None**

2. Scheduling
How frequently will the course be offered? **Fall, spring**
Semester in which the course will first be offered? **1996-3**
Which of your present faculty would be available to make the proposed offering possible? **A.P. Farrell and L. Bendell-Young.**

3. Objectives of the Course (rationale) **This course will illustrate that multidisciplinary intelligence from the arts, science and applied sciences is necessary to resolve dynamic environmental problems.**

4. Budgetary and Space Requirements (for information only)
What additional resources will be required in the following areas:
Faculty:
Staff:
Library:
Audio Visual: **Adequate**
Space: **Lecture and tutorial rooms**
Equipment: **None**

5. Approval
Date: 20 December '94 Dec 20/94 Dec 19/94

Department Chair Dean Chair, SCUS

SCHOOL OF RESOURCE AND ENVIRONMENTAL MANAGEMENT

Bachelor of Applied Sciences in Environmental Planning and Management (ENPL)

ENPL 200-3

Environmental Dynamics

This courses introduces students to the multidisciplinary nature of environmental studies, science, and management based on a holistic, systems-oriented view of environmental problems. The most important environmental problems in the world are reviewed. ENPL 200 illustrates that a multidisciplinary approach is required in order to understand and address environmental problems. The courses introduces students to natural dynamics of the environment and complements ENPL 100, which addresses "human" aspects of environmental problems. ENPL 100 and ENPL 200 provide the rationale for the multidisciplinary programs in which students who persue environmental interests are involved.

Grading Distribution:

Mid Term	25%	Paper	25%
Tutorials	25%	Final Examination	25%

<u>Lecture Topics</u>

A. The sustainable environment

1. What is "sustainable" and "sustainable development"

2. How to achieve "sustainable development"
   Discuss cases of sustainable and non sustainable environmental practices
   Focus on human-environment relationship

B. The role of science in understanding and solving of environmental problems

1. What is science
2. The scientific method
   - hypothesis testing and statistical power
   - controlled experiments
   - quantitative and qualitative methods
   - theory
   - principles and natural laws
3. Science, Technology and Management
4. Application of Science for Management of the Environment

5.Multidisciplinary science and system understanding

C. The environment and its components

1. Components of the environment and their definitions
   - biosphere
   - communities and populations
   - species
   - organ systems and organs
   - macromolecules
   - elements
   - energy
   - biomes and ecosystem
   - human populations
   - organisms
   - cells and cell organelles
   - inorganic and organic molecules
   - atoms

2. Hierarchy and interdependence among environmental components
- illustrate that changes at the microscopic level such as molecular have an effect at the macroscopic level and visa versa. Relevant examples include eutrophication, acid rain, pollution and deforestation.
- focus on interrelationships and interdependency of environmental components including biotic and abiotic factors

3. Subdisciplines of the natural sciences that address the various levels of organization in environmental sciences.
   - geography
   - limnology
   - ecology and behaviour
   - ecotoxicology
   - environmental toxicology
   - toxicology
   - physics
   - physiology
   - evolutionary dynamics
   - environmental chemistry
   - biochemistry
   - geology
   - organic and inorganic Chemistry

Illustrate the combination of sciences required to addressing environmental problems. Explain the necessity of a multidisciplinary approach.

Discuss the role of supporting sciences :
- mathematics
- environmental modelling
- management science

D. Dynamics how the environment works

1. Matter and Energy: The Biosphere II Project case studies
   - Laws of thermodynamics
   - Forms of energy and energy conversion
   - Photosynthesis and oxidation
   - Consumers and producers

- Carbon cycle
- Energy flow in ecosystems
- Food chain
- Loss of mass in the food-chain

2. Nutrient cycling: Eutrophication in the Great Lakes case studies
   - Nitrogen cycle
   - Phosphorous cycle
   - Relationship between nitrogen, phosphorous and carbon cycles.
   - Human impacts on patterns of nutrient flow

3. The water cycle. California and Everglades case studies
   - the water cycle
   - human dependence and impacts on the water cycle
     - irrigation
     - salination,
     - saltwater intrusion
     - diversion
     - desertification and erosion
     - water use and management

4. Soil and sediment dynamics: Farming in the hills of Nepal and clear-cut logging in BC case studies
   - soil and sediment composition
   - sediment dynamics in rivers, lakes and oceans
   - soil and plants :
     - nutrient holding capacity
     - weathering
     - water holding
     - soil aeration
   - erosion and desertification
   - deforestation
   - irrigation
   - preventing erosion using contour farming, no-till systems and, perennial crops
   - rehabilitation

5. Pollutant cycling: DDT in the food-chain and Beluga whales in the St Lawrence River case studies.

   - transport and transformation
   - persistence and cycling
   - dilution and concentration
   - bioaccumulation in the food-chain
   - toxicity (additive and synergistic effects)

- pollution control
- clean-up and management of toxic waste
- remediation

E. Natural resources

- what are natural resources
- renewable and nonrenewable resources
- conservation and protection
- reducing, reusing, and recycling
- composting

F. Towards Sustainability: Pests and pest control case studies

- Development of chemical pesticides
- Problems associated with pesticide use
- Protection of human and environmental health
- Methods of natural and biological control
- Integrated pest management