

# SIMON FRASER UNIVERSITY

S.74-157

## MEMORANDUM

To SENATE

From SENATE COMMITTEE ON UNDERGRADUATE STUDIES

Subject FACULTY OF SCIENCE -  
DEPARTMENT OF MATHEMATICS -  
PROPOSED CURRICULUM CHANGE

Date November 14, 1974

MOTION 1: "That Senate approve - and recommend approval to the Board, the new course proposals, as set forth in S.74-157 , for

MATH 310-3 - Introduction to Ordinary Differential Equations  
MATH 312-4 - Multidimensional Calculus  
MATH 320-4 - Theory of Convergence"

If 1 is approved

MOTION 2: "That effective September 1975 the following courses will be discontinued

MATH 352-2 (c.f. MATH 310-3)  
MATH 311-4 (c.f. MATH 312-4, 320-3)"

If 1 is approved

MOTION 3: "That Senate approve - and recommend approval to the Board - the new course proposal, as set forth in S.74-157 , for

MATH 420-4 - Linear Analysis  
with discontinuation of MATH 412-4 effective September 1975."

If 1 and 3 are approved .

MOTION 4: "That Senate approve, as set forth in S.74-157, the proposed changes in requirements and in prerequisites"

If 1 is approved

MOTION 5: "That Senate approve, as set forth in S.74-157 the proposed changes to Chemical Physics, Chemistry and Physics."

MOTION 6: "That Senate approve, as set forth in S.74-157 the change in Mathematics prerequisite for the Physics Core Program."

SIMON FRASER UNIVERSITY

MEMORANDUM

To SENATE

From SENATE COMMITTEE ON UNDERGRADUATE STUDIES

Subject Faculty of Science: Proposed Curriculum changes, Department of Mathematics.

Date November 14, 1974

At its meeting of 12th November, the Senate Committee on Undergraduate Studies considered the attached curriculum changes for the Department of Mathematics and allied programs. This proposal is now forwarded to Senate for its consideration, with the Committee's recommendation that it be approved.

*I. Mugridge*  
I. Mugridge

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SIMON FRASER UNIVERSITY

MEMORANDUM

Senate Committee on  
Undergraduate Studies  
Subject MATHEMATICS CURRICULUM CHANGES

From A.E. Curzon  
Acting Dean of Science  
Date November 7, 1974

The following motions were passed by the Faculty of Science at its meeting of October 31, 1974:

- 1) "That the new course proposals for MATH 310-3, 312-4, and 320-3 be approved." (See Appendix A)
- 2) "That the number and name of MATH 412-4 (Methods II) be changed to MATH 420-4 (Linear Analysis)." (See Appendix B)
- 3) "That the calendar changes outlined in [Appendix C] be approved."
- 4) "That modifications in the Chemical Physics, Chemistry, and Physics programs be approved, to incorporate the course changes outlined in [Appendix A]." (See Appendix D)
- 5) "That the prerequisite change for MATH 241-2, outlined in [Appendix E], be approved."

These motions are now submitted to SCUS for its approval.

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A. E. Curzon

Scus 74-56A

# SIMON FRASER UNIVERSITY

APPENDIX A

## MEMORANDUM

Dr. S. Aronoff

Dean of Science

Subject: MATHEMATICS 310-3, 312-4, and 320-3  
PROPOSED NEW COURSES

From: Dr. A. H. Lachlan, Chairman

Department of Mathematics

Date: August 23, 1974

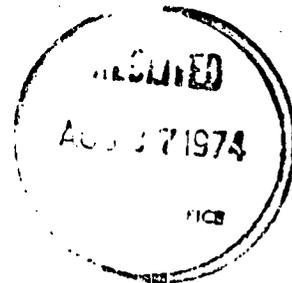
We propose to introduce three new courses, Mathematics 310-3, 312-4, and 320-3, and to change the name and number of another.

Mathematics 310-3 (Introduction to Ordinary Differential Equations) replaces Mathematics 352-2. The pace will be less hectic, and there will be time to discuss the Laplace transform and its use in solving differential equations. Otherwise, the course will be much like 352-2. It will be a required course in the Mathematics Honors Program, as was Mathematics 352-2. We plan to offer 310-3 quite frequently. There is no reason why a fourth level student who has completed Mathematics 253-4 cannot take this upper division course, and we would recommend that students planning to take Mathematics 310-3 do so as early as possible.

Mathematics 312-4 (Multidimensional Calculus) and 320-3 (Theory of Convergence) together replace Mathematics 311-4, a course which has been less than completely satisfactory for students and for faculty. Multidimensional Calculus and the Theory of Convergence traditionally appear in Advanced Calculus courses, and, except for that fact, have nothing to do with each other. Mathematics 311-4 tried to cover too much material (every bit of it quite essential material) in a four credit course. Mathematics 312-4 contains the multidimensional calculus portion of Mathematics 311-4. The four credit hours (rather than approximately 2½) allow proper treatment of the material, much of which was done in cursory fashion (or omitted completely) when it was part of Mathematics 311-4. Mathematics 320-3 contains material on convergence of sequences and series of numbers and of functions, and of improper integrals, from Mathematics 311-4. There is time for a discussion of convergence of Fourier Series, and additional time for applications. Both courses will be required in the Mathematics Honors Program. We would expect the Physics Department to replace their Mathematics 311-4 requirement with one for Mathematics 312-4; in addition we urge them to consider replacing their Mathematics 241-2 requirement for honors students with one for Mathematics 320-3. Although we only plan to offer 320-3 every other semester initially, if the course proves to be as popular as we hope, we may then increase its frequency of offering to twice a year. We are considering making it a prerequisite for Mathematics 421-4. Mathematics 312-4 and 320-3 could be taken by properly prepared fourth level students.

PLEASE READ  
AND INITIAL

DEAN	
ASST. DEAN	
ADMIN. ASST.	KA



We will be able to offer the courses as frequently as we have indicated because we will do several things to make time available for these important courses. First, if faculty do not handle the tutorials in MATH 310-3, then a sessional lecturer may be appointed to do so. Since there usually are several tutorial sections, we will come out ahead this way. Next, we'll be cutting back slightly on the frequency of offering of some of our applied courses - in particular, Mathematics 412-4, 414-4, and 422-4. We may cut back on our Real Analysis course, MATH 421-4, especially if we make MATH 320-3 a prerequisite for it. Though we dislike doing all this, the new courses are more fundamental than the ones being cut back, and we would rather do this than stick with the very unsatisfactory MATH 311-4. Finally, we have made certain cutbacks in our graduate course offerings for faculty teaching credit (some courses now get taught "for free") and we have come up with a few hours there. So if you just look at MATH 310-3 versus MATH 352-2, or MATH 312-4 and MATH 320-3 versus MATH 311-4, it would appear to be the case that we can't do it, but if you look at the whole programme you can see that we'll manage.

# SIMON FRASER UNIVERSITY

## MEMORANDUM

..... Dr. S. Aronoff .....

..... Dean of Science .....

Subject MATHEMATICS 310-3, 312-4, 320-3  
AND 420-4 PROPOSED NEW COURSES

From David Ryeburn, Chairman.....  
Undergraduate Studies Committee  
Department of Mathematics .....

Date. October 23, 1974

Here is a list of certain mathematics courses, the number of faculty teaching hours devoted to them for the two periods Fall 1973 - Summer 1975 and Fall 1975 - Summer 1977, and the number of times offered. It makes sense to look at two-year periods since many of these courses repeat on a six semester cycle instead of a three semester cycle.

1973 - 1975			1975 - 1977		
Course	Hours	Times Offered	Course	Hours	Times Offered
311-4	26	4	312-4	24	4
			320-3	20	5
352-2	24	5	310-3	22	4
412-4	15	3	420-4	10	2
414-4	15	3	414-4	10	2
421-4	20	4	421-4	15	3
422-4	16	3	422-4	20	4
433-4	5	1	433-4	0	0
TOTAL	<u>121</u>		TOTAL	<u>121</u>	

I was mistaken when I said in my October 17 memorandum that we were planning to cut back on 422-4 -- in fact we'll offer it more often. But we are going to cut back on 310-3 and 421-4, and have eliminated 433-4. It should be noted that to some extent what we are doing is offering more hours of applied mathematics and fewer hours of pure mathematics. Our graduate programme has been cut back from 36 hours per year to 24.

*David Ryeburn*

APPLIED MATHEMATICS UNDERGRADUATE COURSE OFFERINGS

July 31, 1974

YEAR I (1976-77)			YEAR II (1975-76)		
Fall	Spring	Summer	Fall	Spring	Summer
	104-3			104-3	
	161-3			161-3	
	308-3			308-3	
310-3		310-3	310-3	310-3	310-3
312-4		312-4	312-4	312-4	
316-3			316-3		
	320-3		320-3		320-3
361-3			361-3		
412-4				412-4	
	413-4				
	414-4		414-4		
				416-3	
	422-4		422-4		422-4
431-4		431-4		431-4	
466-4			466-4		
471-4*	468-4*	467-3*		469-4*	470-4*

\* The order of these courses can be rearranged provided 1) 468 should follow 361, and 2) 469 should follow 422.

TOTAL APPLIED HOURS 69

TOTAL APPLIED HOURS 67

Note: For comparison purposes these figures include those courses listed as "applied" on "Summary of Hours of Course Offerings" table. That is these totals do not include 104-3, 422-4 and 431-4.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

COURSE PROPOSAL FORM

Calendar Information

Department: Mathematics

Abbreviation Code: \_\_\_\_\_ Course Number: 310 Credit Hours: 3 Vector: 3-1-0

Title of Course: INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS

Calendar Description of Course: *First and higher order differential equations; linear differential equations; solution by power series; Laplace transform method; applications to physical, chemical, biological and social sciences.*

Nature of Course Lecture/Tutorial

Prerequisites (or special instructions): Math 253-4. Students who have obtained credit for MATH 352-2 cannot subsequently obtain credit for MATH 310-3.

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

MATH 352-2

2. Scheduling

How frequently will the course be offered? Twice a year.

Semester in which the course will first be offered? Fall 1975

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

All faculty members.

Objectives of the Course The purpose of this course is to provide the students, mathematics major or otherwise, the basic knowledge about ordinary differential equations. The emphasis here is on the techniques of solving ordinary differential equations and on the applications to various diversified fields.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty - Probably none.

Staff

Library

Audio Visual

Space

Equipment

} NONE

5. Approval

Date: 17/10/74 7/11/74

A. B. Lachin  
Department Chairman

A. E. Canyon  
Dean

\_\_\_\_\_  
Chairman, SCUS

INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS

1. First order equations: Equations solved by separation of variables, exact equations, integrating factor, homogeneous equations, higher order equations reducible to first order, applications of first order differential equations to geometry and to social, biological, physical and chemical science. (3 weeks)
2. Linear differential equations: Existence and uniqueness of solutions, linear independence and Wronskians, solution of homogeneous equations, particular solutions of nonhomogeneous equations, method of undetermined coefficients, method of variation of parameters, applications. (3 weeks)
3. Systems of linear differential equations: Matrix notation, solution of systems of linear differential equations, applications. (1 1/2 weeks)
4. Solutions in power series: Power series, solution of differential equations in power series, regular singular points, method of Frobenius, numerical solutions. (1 1/2 weeks)
5. Solution of differential equations by the Laplace transform; Fourier series: Laplace transform, some supporting theory, applying the transform. The Fourier series concept. Fourier transform, applications. (3 weeks)

Suggested Textbooks: (The Instructor should choose any one of the following)

1. Applied Differential Equations by M.R. Spiegel.
2. Ordinary Differential Equations, a first course by F. Brauer and A. Noble.
3. Introduction to Ordinary Differential Equations by A.L. Rabenstein.
4. Differential Equations with Applications and Historical Notes by G.F. Simmons.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

COURSE PROPOSAL FORM

Calendar Information

Department: Mathematics

Abbreviation Code: \_\_\_\_\_ Course Number: 312 Credit Hours: 4 Vector: 4-1-0

Title of Course: MULTIDIMENSIONAL CALCULUS

Calendar Description of Course:

*Functions of several variables; gradient, divergence and curl; extrema; multiple integrals; line and surface integrals; Stokes' theorem and divergence theorem; curvilinear coordinates; applications.*

Nature of Course: Lecture/Tutorial

Prerequisites (or special instructions): MATH 253-4. Students who have obtained credit for MATH 311-4 cannot subsequently obtain credit for MATH 312-4.

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

MATH 311-4

2. Scheduling

How frequently will the course be offered? Twice a year

Semester in which the course will first be offered? Fall 1975

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

Objectives of the Course

The object of this course is to provide a standard treatment of calculus of several variables.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	}	NONE
Staff		
Library		
Audio Visual		
Space		
Equipment		

5. Approval

Date: 17/10/74 7/11/74

G.H. Lachen  
Department Chairman

A.E. Canyon  
Dean

\_\_\_\_\_  
Chairman, SCUS

MATHEMATICS 312-4

MULTIDIMENSIONAL CALCULUS

1. Quick review of functions of several variables. (1 - 1 1/2 weeks)
2. Differential operator  $\nabla$ ; gradient, divergence and curl of vector valued functions; directional derivatives; geometrical applications (2 weeks).
3. Extrema of functions of several variables; extrema under constraints (Lagrange multipliers method); application of Lagrange multipliers method (1 1/2 weeks).
4. Multiple integrals, iterated integrals; change of variables in multiple integrals. (2 weeks)
5. Line and surface integrals; simply or multiply connected regions; independence of the path; Green's Theorem; the divergence theorem, Stokes' theorem, physical applications. (3 weeks)
6. Curvilinear coordinates; coordinate curves and coordinate surfaces; base vectors; orthogonal curvilinear coordinates; gradient, curl, Laplacian, etc. in orthogonal curvilinear coordinates. (2 weeks)  
(Notes to be prepared for students)

- TEXTS:
1. Advanced Calculus by Watson Fulks
  2. Advanced Calculus by D.V. Widder
  3. Advanced Calculus by A. Taylor and R. Mann

(The Instructor should choose any one of the above textbooks)

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

COURSE PROPOSAL FORM

Calendar Information

Department: Mathematics

Abbreviation Code: \_\_\_\_\_ Course Number: 320 Credit Hours: 3 Vector: 3-1-0

Title of Course: THEORY OF CONVERGENCE

Calendar Description of Course:

*Sequences and series of functions; uniform convergence; consequences of uniform convergence; improper integrals; additional applications of convergence.*

Nature of Course: Lecture/Tutorial

Prerequisites (or special instructions): MATH 253-4. Students who have obtained credit for MATH 311-4 cannot subsequently obtain credit for MATH 320-3.

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

MATH 311-4

2. Scheduling

How frequently will the course be offered? Initially each semester.

Semester in which the course will first be offered? Fall 1975

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

Objectives of the Course: This course is designed to acquaint the students with the important notion of uniform convergence. By discussing this concept in connection with sequences and series of functions and improper integrals one demonstrates its usefulness in various applications. At the same time, this treatment of uniform convergence will improve the students' ability in pursuing abstract mathematical thinking.

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: 17/10/74

7/11/74

C. H. Leachman  
Department Chairman

A. E. Connor  
Dean

\_\_\_\_\_  
Chairman, SCUS

THEORY OF CONVERGENCE

- I. Infinite Series 2 weeks
1. Convergence, absolute and conditional.
  2. Series with non-negative terms. Comparison tests.
  3. Series with non-negative terms. Ratio and root tests. Remainders.
  4. Series with variable signs.
  5. More delicate tests.
- II. Sequence and Series of Functions. Uniform Convergence. 2 1/2 weeks
1. Uniform convergence.
  2. Consequences of uniform convergence (Integration and differentiation).
  3. Abel's and Dirichlet's tests.
- III. The Taylor Series 2 weeks
1. Power series. Interval of convergence.
  2. Properties of power series.
  3. The Taylor and Maclaurin series.
  4. The arithmetic of power series.
- IV. Improper Integrals 3 1/2 weeks
1. Improper integrals. Conditional and absolute convergence.
  2. Improper integrals with non-negative integrands.
  3. The Cauchy principal value.
  4. Uniform convergence and some consequences.
- V. To be chosen from: 2 weeks to any one topic
- I: Integral Representations of Functions
- (a) Generalities
  - (b) Gamma and Beta functions
- II. Asymptotic series and integrals (Notes to be supplied to students)
- III. Fourier Series (Notes may be supplied to students from 'Advanced Calculus' by I.S. Sokolnikoff)
- (a) Criterion of Approximations
  - (b) Fourier coefficients
  - (c) Dirichlet conditions
  - (d) Orthogonal functions
  - (e) Expansion of functions
  - (f) Change of interval (if time permits)

- TEXTS:
1. Advanced Calculus by Watson Fulks
  2. Advanced Calculus by D.V. Widder
  3. Advanced Calculus by A.E. Taylor and R. Mann

(The Instructor should choose any one of the above texts)

COURSE PROPOSAL FORM

Calendar Information

Department: Mathematics

Abbreviation Code: Course Number: 420 Credit Hours: 4 Vector: 4-1-0

Title of Course: LINEAR ANALYSIS

Calendar Description of Course:

Fourier Series, harmonic analysis, eigenvalue problems in differential equations. Some special functions.

Nature of Course: Lecture/Tutorial

Prerequisites (or special instructions): MATH 232-3 and 253-4 and 310-3 (or 352-2). MATH 320-3 (or 311-4) is highly recommended. Students who have obtained credit for MATH 412-4 cannot subsequently obtain credit for MATH 420-4.

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

MATH 412-4. See attached for details.

2. Scheduling

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

Semester in which the course will first be offered? Spring 1976

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

Objectives of the Course: The objective of this course is to utilize the tools of Euclidean vector spaces and linearity with development of the theory of Fourier series, Sturm-Liouville theory and other aspects of differential equations. Special functions and the separation of variables technique are developed as a byproduct.

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: 17/10/74 7/11/74

Department Chairman, Dean, Chairman, SCUS

1. Calendar Information

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

MATH 412-4. NOTE: MATH 420-4 is in every respect except name and number identical with MATH 412-4, Methods II. The disappearance of MATH 311-4, Methods I, makes the continued existence of a course called Methods II unreasonable. The new number, 420, is reasonable since the course will then have a number appropriate to its location among our other analysis courses (320-3, 421-4, 422-4, and 423-4); the new name, unlike Methods II, is informative.

LINEAR ANALYSIS

This course serves two main purposes: First, it introduces the student to applications of linear algebra and second, it develops the concept and the techniques associated with the method of separation of variables in Partial Differential Equations. The primary tool is Fourier series and the course develops the underlying theory.

The following syllabus refers to the recommended text.

- Chapter 1 - Real Vector Spaces
- Chapter 2 - Linear Transformation and Matrices  
(Give a quick review here - about 5 hours)
- Chapter 7 - Euclidean Spaces - 3 hours (Omit 7-6, 7-7)
- Chapter 8 - Convergence in Euclidean Spaces - 3 hours  
(Omit 8-5 for later consideration in Chapter 10)
- Chapter 9 - Fourier Series - 2 - 3 hours
- Chapter 10 - Convergence of Fourier Series - 12 hours
- Chapter 11 - Orthogonal Series of Polynomials - 6-9 hours  
(Can treat Hermite, Laguerre polynomials less intensively than Legendre.)
- Chapter 12 - Boundary Value Problems for Ordinary Differential Equations - 6 - 7 hours  
(Omit 12-9, 12-10, 12-11)
- Chapter 13 - Boundary Value Problems for Partial Differential Equations - 2 - 5 hours  
Sections 13-4 and 13-6 plus some other material if time allows.
- Chapter 14 - Boundary Value Problems for Laplace Equations - 4 hours  
(Omit 14-7)
- Chapter 15 - Boundary Value Problems Involving Bessel Functions  
(Can be omitted or given some coverage as time allows.  
Difficult to cover without knowledge of 413.)

TEXT: AN INTRODUCTION TO LINEAR ANALYSIS - Kreider, Kuller, Ostberg & Perkins

RATIONALE:

The Department of Mathematics wishes to change the number and name of Mathematics 412-4 (Methods II) to Mathematics 420-4 (Linear Analysis), since with the disappearance of Mathematics 311-4 there will be no Methods I course. The numbering also makes it clear that it belongs to the analysis subset (320-3, 420-4, 421-4, 422-4, and 423-4) and the name is informative. The course is identical with the old Mathematics 412-4.

MATH 310-3 replaces 352-2, 312-4 and 320-3 replace 311-4, and 420-4 replaces 412-4, the following calendar changes will be necessary:

1. Page 272

Present requirement:

(iv) in the case of honors students - to obtain credit in the following upper division Mathematics courses:

MATH 311-4, 352-2, 421-4, 422-4 and at least one of 431-4 or 432-4." (Note that the existing requirement specifies 18 of the required 50 hours of upper division Mathematics work.)

New requirement:

(iv) in the case of honors students - to obtain credit in the following upper division Mathematics courses:

MATH 310-3, 312-4, 320-3, 421-4, 422-4, and at least one of 431-4 or 432-4. (Note that now 22 of the 50 hours would be specified.)

2. Certain prerequisites should be changed.

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310-4: Old prerequisites: MATH 352-2. MATH 311-4 is highly recommended.

New prerequisite: MATH 310-3 (or MATH 352-2), and 320-3 (or MATH 311-4).

414-4: Old prerequisite: MATH 352-2 and 311-4.

New prerequisite: MATH 310-3 (or MATH 352-2) and MATH 311-4 (or MATH 311-4). MATH 320-3 is highly recommended.

416-3: Old prerequisite: MATH 316-3 (or MATH 406-3), and MATH 352-2.

New prerequisite: MATH 310-3 (or MATH 352-2), and MATH 316-3 (or MATH 406-3).

421-4: Old prerequisite: MATH 241-2. MATH 311-4 is highly recommended.

New prerequisite: MATH 241-2. MATH 320-3 is highly recommended.

422-4: Old prerequisite: Either MATH 311-4, or both of MATH 253-4 and 241-2.

New prerequisite: MATH 253-4. MATH 320-3 is highly recommended.

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466-4: Old prerequisite: MATH 253-4. MATH 232-3 is highly recommended.

New prerequisite: MATH 253-4, and MATH 232-3 or permission of the Mathematics Department. MATH 312-4 (or MATH 311-4) is highly recommended.

Page 279 (Continued)

467-3: Old prerequisite: MATH 161-3 and 352-2. MATH 311-4 and 361-3 are highly recommended.

New prerequisite: MATH 161-3, MATH 310-3 (or MATH 352-2) and PHYS 203-2. MATH 361-3 is highly recommended.

468-4: Old prerequisite: MATH 311-4 and 361-3.

New prerequisite: MATH 312-4 (or Math 311-4) and MATH 361-3.

470-4 Old prerequisite: MATH 161-3 or PHYS 203-2. MATH 311-4 or PHYS 382-4 should precede or be taken concurrently.

New prerequisite: MATH 161-3 or PHYS. 203-2. MATH 310-3. Both MATH 312-4 (or MATH 311-4) and MATH 320-3 (or MATH 311-4), or else PHYS 382-4, should precede or be taken concurrently.

471-4: Old prerequisite: MATH 311-4 or PHYS 382-4.

New prerequisite: MATH 312-4 (or MATH 311-4), or PHYS 382-4.

## PREREQUISITE RATIONALE

MATH 422-4: Has been MATH 311-4, or else MATH 253-4 and MATH 241-2.  
To be MATH 253-4, with MATH 320-3 highly recommended.

The MATH 241-2 prerequisite was more of a mathematical maturity requirement than an absolute need for knowledge gained while studying the material of MATH 241-2. The MATH 253-4 course, as currently taught, will provide the minimum experience needed to allow MATH 422-4 to be taken with profit. There is no question that MATH 320-3 would provide material making the theoretical part of MATH 422-4 easier to understand, but Physics honours students, who will take MATH 422-4, should not be kept from doing so through lack of MATH 320-3. Physics honours students will have had MATH 241-2 anyway (and we hope this will be changed to MATH 320-3).

MATH 467-3: Has been MATH 161-3 and MATH 352-2, with MATH 311-4 and MATH 361-3 highly recommended.  
To be MATH 161-3, MATH 310-3, and PHYSICS 203-2, with MATH 361-3 highly recommended.

The added Physics 203-2 prerequisite will provide students with two mechanics courses (Physics 201-2 and Physics 203-2) which will help motivate the mathematics in this course. Neither MATH 312-4 nor MATH 320-3 is absolutely required for this course, so the MATH 311-4 recommendation should be dropped.

MATH 469-4: Has been MATH 361-3, and MATH 311-4 or PHYS 382-4 as corequisites.  
To be MATH 422-4.

This represents a slight shift in viewpoint. Fluid dynamics can be looked upon as applied complex analysis, and indeed one MATH 422-4 text we have used (Dewar & Redheffer's Complex Variables) shows how to interpret analytic functions in terms of fluid flow in a way attractive even to pure mathematicians. Our applied mathematicians feel that if the approach to the same material in MATH 469-4 is changed in this way, MATH 422-4 will give more appropriate preparation for the course.

MATH 470-4: Has been MATH 161-3 or PHYS 203-2, and MATH 311-4 or PHYS 382-4 as corequisites.  
To be MATH 161-3 or PHYS 203-2, and MATH 310-3, with MATH 312-4 and MATH 320-3 (or else PHYS 382-4) as corequisites.

The introduction of the differential equations prerequisite (MATH 310-3) will insure that students will have had some experience with ordinary differential equations before looking at the Euler-Lagrange equations.

CHEMICAL PHYSICS

Major Program - Current Mathematics requirements:

MATH 151-3, 152-3, 232-3, 253-4, 352-2

Proposed Change: Delete MATH 352-2 and add MATH 310-3.

Honors Program - Current Mathematics requirements:

MATH 151-3, 152-3, 232-3, 253-4, 311-4 (or 431-4), 352-2,  
412-4 (of PHYS 382-4)

Proposed Change: MATH 151-3, 152-3, 232-3, 253-4, 310-3  
312-4 (or 431-4), 420-4 (or PHYS 382-4).

CHEMISTRY

Chemistry Core Program (Major and Honors Programs)

Current Mathematics requirements: MATH 151-3, 152-3,  
253-4, 352-2

Proposed Change: Delete MATH 352-2 and add MATH 310-3.

Chemistry Minor Programs (General Chemistry and Physical  
and Nuclear Chemistry)

Current Mathematics requirements: MATH 151-3, 152-3,  
253-4, 352-2 recommended

Proposed Change: Replace MATH 352-2 with 310-3.

PHYSICS

Major Degree

Levels 3 and 4 - Present Mathematics requirements:

MATH 253-4, 352-2

Proposed Change: Delete MATH 352-2 and add MATH 310-3.

Levels 5, 6, 7, and 8 - Present Mathematics requirements:

MATH 311-4

Proposed Change: Delete MATH 311-4 and add MATH 312-4.

Honors Degree

Levels 3 and 4 - Present Mathematics requirements:

MATH 241-2, 253-4, 352-2

Proposed Change: Delete MATH 241-2, 352-2 and add MATH 310-3.

Levels 5, 6, 7, and 8 - Present Mathematics requirements:

MATH 311-4, 414-4, 422-4, one of 431-4, 432-4

Proposed Change: Delete present requirements and replace with: MATH 312-4, 320-3, 422-4 and one other MATH course numbered 412 or greater.

Subject: MATH 241-2 Prerequisite

Because the Physics Department has proposed that MATH 241-2 be dropped from the core program in Physics, the Department of Mathematics has proposed the following change in the prerequisite for that course:

Current prerequisite: MATH 142-2 and 152-3. For Physics students, MATH 253-4 may be substituted.

Proposed change: Delete, "For Physics students, MATH 253-4 may be substituted."