

SIMON FRASER UNIVERSITY

S.74-119

MEMORANDUM

To SENATE

From SENATE COMMITTEE ON UNDERGRADUATE STUDIES

Subject MATH 154-3 AND 155-3

Date SEPTEMBER 17, 1974

MOTION: "That Senate approve, as set forth in S.74-119,
the Revised Proposal for MATH 154-3 and 155-3."

SIMON FRASER UNIVERSITY

S.74-119

MEMORANDUM

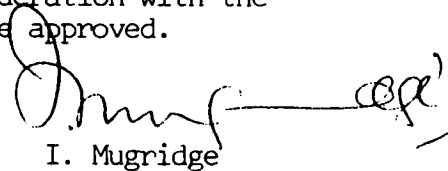
To..... SENATE

From.. Senate Committee on Undergraduate Studies

Subject..... Math. 154-3 and 155-3

Date... September 17, 1974

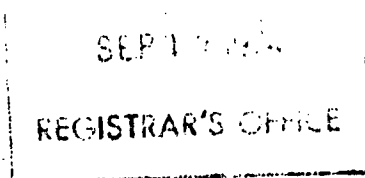
At its meeting of September 10, 1974 the Senate Committee on Undergraduate Studies considered the attached revised proposal for Math 154-3 and 155-3. It is now transmitted to Senate for its consideration with the Committee's recommendation that it be approved.



I. Mugridge

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SIMON FRASER UNIVERSITY

SCUS 74-35

MEMORANDUM

To Senate Committee on
Undergraduate Studies
Subject MATH 154-3 and 155-3

From S. Aronoff *S. Aronoff*
Dean of Science
Date August 7, 1974

Attached for the consideration of SCUS is the revised proposal for two new Mathematics courses, MATH 154-3 and 155-3. They have been reapproved by the Faculty Undergraduate Curriculum Committee and the Faculty of Science Executive Committee respectively.

lw

cc: A. Lachlan, Mathematics

SIMON FRASER UNIVERSITY

MEMORANDUM

Dr. S. Aronoff

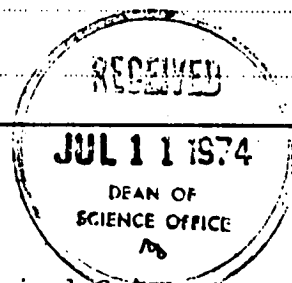
Dean of Science

Subject: NEW COURSE PROPOSALS - Math 154-3,
Math 155-3 and their associated
changes in prerequisites for
mathematic courses

From: Dr. A. H. Lachlan, Chairman

Mathematics Department

Date: July 10, 1974



1. Following discussions with the Department of Biological Sciences, this Department agreed to split the first year calculus courses into two sections. One section was for students in Biology, and the other for those in Chemistry, Mathematics and Physics. This has been done on an experimental basis for the past two years and is considered to be worthwhile. One positive result is the reduction of class size, in the case of Math 151-3 from 250-300 students to lectures with 100-150 students in each section. For the past year, a textbook different from the one used in the regular section of Math 151-3 has been adopted and as a result, there have been syllabus changes. This is one of the reasons we are making formal proposals for new course numbers. The other reasons are to ease administrative procedures with respect to pre-registration in these courses. Without separate course numbers, it is difficult for the Registrar's Office to ensure that students register in the appropriate lecture and tutorial sections. During the experimental period this has resulted in tutorial assignments for the split calculus courses being done departmentally. The new course numbers will mean that these courses can be treated like the others in the pre-registration procedure.

2. Assuming that Math 154-3, 155-3 are approved by Senate, the following changes and prerequisites for other mathematic courses should be made. We are hereby also seeking approval of these changes contingent upon the approval by Senate of Math 154-3, 155-3. In summary these changes are as follows:

Math 154-3 and 155-3 are to be equivalent to Math 151-3 and 152-3, respectively as prerequisites for other mathematic courses. A detailed list of necessary changes is attached.

3. Below, some of the objections raised in Senate, when these courses were first considered, are rebutted.

One objection to the new calculus sequence was that the proposed courses, Math 154-3 and Math 155-3, would give insufficient preparation for further mathematics courses. Math 151-3 and Math 154-3 are in fact interchangeable as prerequisites for other mathematics courses. The only possible difficulty concerning prerequisites arises with Math 155-3 in comparison with Math 152-3. These courses are interchangeable as prerequisites for all mathematics courses. However, in Math 155-3 more material is covered than in Math 152-3, but in less detail. Moreover, infinite series, covered in Math 152-3 is not covered in Math 155-3. Thus a student entering certain courses from Math 155-3 (e.g. Math 253-4, Math 371-3) would be well advised to study series on his own.

Another objection voiced in Senate was that the proposed calculus sequence for biologists would limit the flexibility of students to pick alternate programmes. Only a minimal amount of difficulty will arise if the student wishes to change from Biology to Chemistry, Physics, Mathematics, Bio-Chemistry or Kinesiology. Math 154-3 and Math 155-3, while they provide adequate background for these subjects do not provide optimal background for them. Thus Biology students who feel that there is any significant likelihood of their changing into any of the above mentioned fields or taking additional mathematics beyond first year calculus should take Math 151-3 and Math 152-3. We must emphasize that Biology students who take Math 154-3, Math 155-3 and who decide to take additional mathematics will certainly be able to do so.

Although the topic of infinite series has been omitted from the Math 154-3, Math 155-3 sequence, introductory treatments of ordinary differential equations and of functions of several variables have been included in Math 155-3. These topics do not appear in either Math 151-3 or Math 152-3. Thus the proposed sequence is not a "watered-down" version of Math 151-3, Math 152-3. The proposed sequence is obtained from the old one by the substitution of topics which biologists find more useful. In traditional calculus courses there is a great emphasis on examples in Physics and Geometry. In this sequence there will be far more examples from Biology. Finally, there is a stronger emphasis in Math 154-3, Math 155-3 on applications than in Math 151-3, Math 152-3.

It has been argued that all Science students should take the same first year calculus courses. But to include the topics and applications desirable for Biology students, as well as those needed by students in the other Sciences, in two 3 credit courses of only three semester hours credit each would necessitate a pace intolerable to students and faculty alike. Thus such courses usually short-change the Biology student.

Attached are copies of the Course Proposal Forms for Math 154-3, Math 155-3 together with copies of supporting letters from Dr. Geen, Biology Department, Dr. Pate, Chemistry Department, and Leigh Hunt Palmer, Physics Department.

A. M. Sachs

DETAILED LIST OF PREREQUISITE CHANGES

COURSES . CURRENT PREREQUISITES

- MATH 142-2 MATH 141-2 or 151-3. Students who have obtained credit for MATH 241-2 cannot subsequently receive credit for 142-2.
- MATH 150-3 B.C. High School Math 12 or MATH 100-3. Students who have obtained credit for MATH 151-3 cannot subsequently receive credit for 150-3.
- MATH 151-3 B.C. High School Math 12 or MATH 100-3. Students with other qualifications must consult an adviser in the Mathematics Department before they can be admitted to the course. Such students may be required to study additional work prior to or concurrent with MATH 151-3. Students who have obtained credit for MATH 150-3 cannot receive credit for 151-3.

PROPOSED PREREQUISITES

- MATH 141-2, 151-3 or 154-3 Students who have obtained credit for MATH 241-2 cannot subsequently receive credit for 142-2.
- B.C. High School Math 12 or MATH 100-3. Students who have obtained credit for MATH 151-3 or 154-3 cannot receive credit for 150-3.
- B.C. High School Math 12 or MATH 100-3. Students with other qualifications must consult an adviser in the Mathematics Department before they can be admitted to the course. Such students may be required to study additional work prior to or concurrent with MATH 151-3. Students who have obtained credit for MATH 150-3 or 154-3 cannot receive credit for 151-3.
- MATH 150-3 (with a grade of A or B), 151-3 or 154-3. Students who have obtained credit for MATH 155-3 cannot receive credit for 152-3.
- B.C. High School Math 12, or MATH 100-3. Students who have obtained credit for MATH 150-3 or 151-3 cannot receive credit for 154-3.
- MATH 150-3 (with a grade of A or B), 151-3 or 154-3. Students who have obtained credit for 152-3 cannot receive credit for 155-3.

DETAILED LIST OF PREREQUISITE CHANGES

COURSES	CURRENT PREREQUISITES	PROPOSED PREREQUISITES
MATH 161-3	MATH 151-3 must precede or be taken concurrently.	MATH 151-3 or 154-3 must precede or be taken concurrently.
MATH 190-3	Those students who have received credit for MATH 150-3 or 151-3 and those who are Mathematics majors or honors cannot take this course for credit.	Those students who have received credit for MATH 150-3, 151-3 or 154-3 and those who are Mathematics majors or honors cannot take this course for credit.
MATH 232-3	MATH 150-3 or 151-3.	MATH 150-3, 151-3 or 154-3.
MATH 241-2	MATH 142-2 and 152-3. For Physics students, MATH 253-4 may be substituted.	MATH 142-2, and 152-3 or 155-3. For Physics students, MATH 253-4 may be substituted.
MATH 253-4	MATH 152-3. Students who have obtained credit for MATH 251-3 cannot receive credit for 253-4.	MATH 152-3 or 155-3.
MATH 316-3	MATH 152-3 and 232-2 and knowledge of a programming language (e.g. MATH 106-3 or CMPT 102-2). Students who have obtained credit for MATH 406-3 cannot subsequently receive credit for MATH 316-3.	MATH 152-3 or 155-3, and 232-3 and knowledge of a programming language (e.g. MATH 106-3 or CMPT 102-2). Students who have obtained credit for MATH 406-3 cannot subsequently receive credit for MATH 316-3.
MATH 371-3	MATH 152-3.	MATH 152-3 or 155-3.

SENATE COMMITTEE ON UNDERGRADUATE STUDIESCOURSE PROPOSAL FORM1. Calendar InformationDepartment: MathematicsAbbreviation Code: _____ Course Number: 154 Credit Hours: 3 Vector: 3-1-0Title of Course: CALCULUS I FOR THE BIOLOGICAL SCIENCES

Calendar Description of Course:

The logarithmic, trigonometric and exponential functions. Limits and continuity. The derivative and techniques of differentiation. Maxima, minima, the mean value theorem. Applications for the Biological Sciences.

Nature of Course: Lecture/Tutorial.Prerequisites (or special instructions): Math 12 (B.C. Schools) or Mathematics 100-3.

Students with other qualifications must consult an advisor in the Mathematics Department before they can be admitted to the course. Students who have received credit for either Mathematics 150-3 or 151-3 cannot receive credit for Mathematics 154-3.

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

2. SchedulingHow frequently will the course be offered? Twice per year; Fall and Spring Semester.Semester in which the course will first be offered? Fall 1974Which of your present faculty would be available to make the proposed offering possible: All faculty members.

3. Objectives of the Course The objective of the course is to make the study of calculus more relevant to students in Biological Sciences. The difference between the topics discussed in Math 154-3 and those discussed in Math 151-3 is very small. The emphasis in Math 154-3 is placed on the application of techniques learned in calculus to problems in the Biological Sciences, wherever it is possible.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty	There will be no net increase in faculty teaching time required for this course.
Staff	For the past two years, the Department has offered separate sections of Math 151-3 in the Fall Semester. One section has been for Biology students; and the
Library	other for Chemistry, Mathematics and Physics students. This experiment has
Audio Visual	proved to be successful and as a result, the Department has rearranged its
Space	upper level course offerings so that it can afford to offer this course in
Equipment	Spring Semesters.
	None

5. ApprovalDate: 11-VII-74*A. M. Lachin*

Department Chairman

Dean

Chairman, SCUS

MATHEMATICS 154-3

Calculus for Biology Students

I. Real Number, Sets, Functions and Limits

- Section 1.0 Real Numbers, Order, Absolute Value
- 1.1 Sets, Set Notation, Operations with sets
 - 1.2 Functions (Polynomial Functions, Rational Functions)
 - 1.3 Addition, Multiplication, Division and Composition of Functions
 - 1.4 Limits
 - 1.5 Increments and Rate of Change
 - 1.6 Review of Trigonometry (3 lectures)
 - 1.7 Limits of Trigonometric Functions
 - 1.8 Limit as x tends to Infinity

II. The Derivatives

- Section 2.1 Slope and Equation of Straight Lines
- 2.2 Continuous Functions
 - 2.3 The Derivative of a Function (Geometric and Physical Interpretation, Rate of Growth)
 - 2.4 The Derivative of Polynomials
 - 2.5 The Derivative of Products and Quotients
 - 2.6 The Derivative of Composite Functions
 - 2.7 The Derivative of $\sin u$ and $\cos u$
 - 2.8 Derivatives of $\tan u$, $\cot u$, $\sec u$ and $\csc u$
 - 2.9 Higher order Derivatives
 - 2.10 Exponential and Logarithmic Functions (See Seeley's Approach)

III. More About Derivatives and Their Applications

- Section 3.1 Curve Analysis
- 3.2 Maxima - Minima
 - 3.3 Applications of Maximum - Minimum
 - 3.4 The Differential
 - 3.5 Implicit Differentiation and Applications
 - 3.6 Inverse Functions
 - 3.7 Derivatives of the Inverse Trigonometric Functions
 - 3.8 Geometric Interpretation of Rolle's Theorem and the Mean Value Theorem

TEXT: Calculus for Business, Biology and the Social Sciences
by Crowdis, Shelley and Wheeler

SENATE COMMITTEE ON UNDERGRADUATE STUDIESCOURSE PROPOSAL FORM1. Calendar InformationDepartment: MathematicsAbbreviation Code: _____ Course Number: 155 Credit Hours: 3 Vector: 3-1-0Title of Course: CALCULUS II FOR THE BIOLOGICAL SCIENCES

Calendar Description of Course:

The integral. Techniques of integration. Differential equations, partial differentiation. Applications to the Biological Sciences.

Nature of Course: Lecture/Tutorial

Prerequisites (or special instructions):

Mathematics 150-3 (with a grade of A or B) or Mathematics 151-3 or 154-3. Students who have received credit for Mathematics 152-3 cannot receive credit for this course.

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 in the Spring Semester.

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

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

3. Objectives of the Course

The objective of the course is to make the study of calculus more relevant to students in Biological Sciences. The syllabus has been prepared on the assumption that those students who take the course will probably not take further courses in Mathematics. For this reason a greater variety of topics are discussed in Math 155-3.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty There will be no net increase in faculty teaching time required for this course. For the past two years, the Department has offered separate sections of Math 152-3 in the Spring semesters, with one section being primarily for students in Biological Sciences.

Staff

Library

Audio Visual

Space

Equipment

} NONE

5. ApprovalDate: July 15, 1974S. M. Jackson

Department Chairman

Dean

Chairman, SCUS

MATHEMATICS 155-3

Calculus for Biology Students

IV. Introduction to the Integral

- Section 4.1 Area Bounded by a Curve
- 4.2 Sigma Notation
- 4.3 Properties of the Integral
- 4.4 The Indefinite Integral
- 4.5 Indefinite Integrals - Trigonometric Functions

V. Integration

- Section 5.1 The Fundamental Theorem of Calculus
- 5.2 The Natural Logarithm
- 5.3 The Exponential Function
- 5.4 Integration by Parts
- 5.5 Trigonometric Substitutions
- 5.7 Improper Integrals
- 5.8* Use of semi-log and log-log graph papers, curve fitting

VI. Applications of Integration

- Section 6.1 Areas
- 6.2 Probability
- 6.3 Families of Curves, Parameters, Moments
- 6.4 Normal Curve Areas, Areas with Tables
- 6.8† Natural Growth and Decay

VII. Functions of Several Variables

- Section 7.1 Functions of Several Variables
- 7.2 Three-Dimensional Coordinate Geometry
- 7.3 Partial Derivatives
- 7.4 Extrema for Functions of Two Variables -
Maximum and Minimum
- 7.5* Curve Fitting - Least Square Method

VIII* Introduction to Ordinary Differential Equations

- Section 8.1 Differential Equations
- 8.2 First Order Differential Equations
- 8.3† Natural Growth and Decay
- 8.4 Systems of First Order Linear Differential Equations -
Species Competition

IX* Matrices and Vectors

- Section 9.1 Matrix Notations
- 9.2 Matrix Algebra
- 9.3 Applications

* Materials which have to be supplemented by the instructor from sources other than the current textbook.

† This topic is covered twice.

TEXT: Calculus for Business, Biology and the Social Sciences
by Crowdis, Shelley and Wheeler

November 1973

SIMON FRASER UNIVERSITY

MEMORANDUM

Dr. A. H. Lachlan

Mathematics Department

Subject Proposed New Courses
Math 154-3 and Math 155-3

From Dr. G. H. Geen

Biological Sciences Department

Date June 14, 1974.

I am in complete agreement with the philosophy and content of the proposed new courses, Mathematics 154-3 and Math 155-3. I have always been satisfied that these two courses would be different from, but not inferior to Math 151-3 and 152-3. It has been a very common complaint for many years that the usual University calculus courses had limited relevance to the needs of Biology students. I would be the first to applaud your efforts to remedy this situation.

Some years ago the Mathematics Association of America developed a series of recommendations for the Undergraduate Mathematics Program for students in the Biological, Management and Social Sciences (EMSS). They recommended that Mathematics Departments offer courses designed to meet the needs of students in the biological, management and social sciences. This group recognized the problem in providing the varied training in mathematics in the limited time that biology students have available for mathematics during their undergraduate years. The Mathematical Association of America report went on to say:

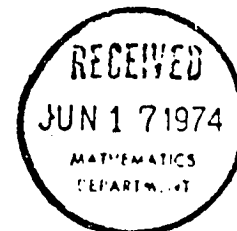
"It is, therefore, important to recognize that they need mathematics primarily as a language for scientific reasoning, and that they do not need as much training in detailed techniques as mathematics and physical science students. Nor is it reasonable to expend as much time on rigorous proofs for EMSS students as for mathematics majors. Also, more stress should be placed on applications which are of special interest in the biological and social sciences."

I believe this is a very reasonable position and one that is being tackled very well in the proposed new Mathematics courses aimed at the biology students.



Glen H. Geen,
Chairman.

GHG/ms



SIMON FRASER UNIVERSITY

MEMORANDUM

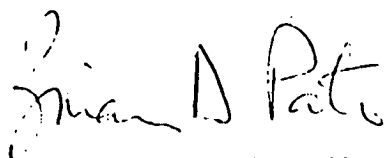
To	S. Aronoff, Dean of Science.	From	B. D. Pate Department of Chemistry.
Subject	<u>MATHEMATICS 154 and 155</u> PROPOSED COURSES	Date	June 4th, 1974.

This memorandum is intended to brief you on the Chemistry Department's position regarding these courses, in time for the next discussion at Senate.

You will recall that the Chemistry Department Undergraduate Studies Committee and the Department as a whole considered the course proposal originating from the Mathematics Department, and, at both levels, supported the proposal. The Undergraduate Studies Committee has now reconsidered the proposal, and as a result I comment the following:

(a) The normal Mathematics requirements of the Chemistry undergraduate program are specified to begin with Mathematics 151 and Mathematics 152.

(b) If a student instead takes the proposed Mathematics 154 and Mathematics 155, and subsequently decides to transfer into the Chemistry undergraduate program, we are satisfied that the transferability from these mathematics courses to subsequent Mathematics courses required for the Chemistry program is adequate. The content of Mathematics 154 and Mathematics 155 is also judged adequate for the preparation of students transferring into the Chemistry program under these circumstances.



Brian D. Pate, Chairman,
Undergraduate Studies Committee,
Department of Chemistry.

bdp:smh

c.c.: D. Ryeburn, Mathematics Department

SIMON FRASER UNIVERSITY

MEMORANDUM

To Dr. S. Aronoff

From Leigh Hunt Palmer

Dean Science

Department of Physics

Subject Math 154-3 and 155-3

Date 22 May 1974.

I am the faculty member principally involved in the counselling of students in the Physics Major and Physics Honors programs. I am also Chairman of the Physics Department Undergraduate Studies Committee and also the Physics representative on the Science Faculty Undergraduate Studies Committee. I have examined the proposal of the Mathematics Department for two new calculus courses, MATH 154-3 and 155-3, intended principally for Biological Sciences students, and I have discussed this proposal with Dr. Ryeburn in the Mathematics Department. I judge that any student who is otherwise well-qualified to change from a Biological Sciences program to one in Physics will not be precluded from doing so by having taken the 154-3, 155-3 calculus sequence. He should easily be able to go on with no lost time or extra courses.

Leigh Hunt Palmer.

LHP/ly'

c.c. Dr. Ryeburn