S.75-70

SIMON FRASER UNIVERSITY

MEMORANDUM

To SENATE	From SENATE COMMITTEE ON UNDERGRADUATE STUDIES
Subject PROPOSED BIOPHYSICS PROGRAM	Date APRIL 7, 1975

MOTION: "That Senate approve, and recommend approval to the Board of Governors, the proposal for a Biophysics Program, as set forth in S.75-70, including:

i) Major Program
ii) Honors Program
iii) PHYS 433-3 - Biophysics Laboratory
iv) PHYS 482-3 - Physics of Biological Membranes and Membrane Models
v) PHYS 483-3 - Topics in Mathematical Biophysics."

If the above motion is approved,

MOTION: "That the normal two semester time lag requirement be waived in order that PHYS 433-3 and PHYS 482-3 may be first offered in the Fall semester 1975."

SIMON FRASER UNIVERSITY

MEMORANDUM

To SENATE

From SENATE COMMITTEE ON UNDERGRADUATE STUDIES

Subject PROPOSED BIOPHYSICS PROGRAM

Date 7th April, 1975

At its meeting of 25th March, the Senate Committee on Undergraduate Studies discussed the attached proposal for a Biophysics Program including:

i) Major Program
ii) Honors Program
iii) PHYS. 433-3: Biophysics Laboratory
iv) PHYS. 482-3: Physics of Biological Membranes and Membrane Models
iv) PHYS. 483-3: Topics in Mathematical Biophysics.

These proposals are now forwarded to Senate for its consideration, with the Committee's recommendation that they be approved.

During discussion of these proposals, it became clear that, although members of the Committee had no reservations about the validity of these proposals, there was some feeling that they appeared to be introducing a new program and new courses which would lead into areas of study for which the necessary provision had not been made and that therefore the proposal should be discussed by the Academic Planning Committee before submitting it to Senate. In view of the assurance of the representatives of the Science Faculty that this was not the case, that the programs were substantially a rearrangement of existing courses to enable students to undertake a major or honors program in a new area, and that the three courses proposed could be serviced from existing resources in the Physics Department, it was ruled that the proposal came within the competency of SCUS and could therefore proceed directly to Senate.

It should also be noted that the Committee recommends that the normal two-semester time lag requirement be waived in the cases of Physics 433-3 and Physics 482-3 to enable them to be offered in the Fall semester, 1975.

I. Mugridge

:ams

att.

SCUS 75-15

SIMON FRASER UNIVERSITY

MEMORANDUM

To: Senate Committee on Undergraduate Studies	From: S. Aronoff S. Aronoff Dean of Science
Subject: PROPOSED BIOPHYSICS PROGRAM	Date: March 5, 1975

At its meeting of February 27, 1975, the Faculty of Science passed the following motions:

"That the Faculty approve the proposal for a Biophysics Program for Majors and Honours, and that the proposal be forwarded to SCUS for consideration."

"That the Faculty approve new course proposal PHYS 433-3, 'Biophysics laboratory', and forward to SCUS for consideration."

"That the Faculty approve new course proposal PHYS 482-3, 'Physics of Biological Membranes and Membrane Models' and forward to SCUS for consideration."

"That the Faculty approve new course proposal PHYS 483-3, 'Topics in Mathematical Biophysics' and forward to Faculty for consideration."

The supporting documentation for this program and the proposed new courses is attached.

/pel
Encl.

BIOPHYSICS PROGRAM

A Major Program and an Honours Program in Biophysics are offered by the Departments of Physics and Biological Sciences in the Faculty of Science. Outlines of the programs are given below. For further details please contact the following faculty members.

ADVISORS

K. Colbow	Physics Room P8458 Local 3162
A. H. Burr	Biological Sciences Room 9233 Local 4803
R. Cushley	Chemistry Room 9045 Local 4230
T. Calvert	Kinesiology Room 420 Local 4253

BIOPHYSICS

(A) MAJOR PROGRAM

Levels 1 and 2[a]

BISC	202-3	Genetics	
or			
BISC	201-3	Cell Biology and Biochemistry	3
CHEM	104-3	General Chemistry I	
	105-3	General Chemistry II	
	115-2	General Chemistry Laboratory	8
MATH	151-3	Calculus I	
	152-3	Calculus II	
	232-3	Elementary Linear Algebra	9
PHYS	201-2[a]	Introductory Mechanics	
	202-2	Introductory Optics	4
ELECTIVES			6
			30

Levels 3 and 4

BISC	201-3	Cell Biology and Biochemistry	
or[b]	202-3	Genetics	3
CHEM	251-3	Organic Chemistry	
	256-2	Organic Chemistry Laboratory I	5
MATH	253-4	Calculus III	4
PHYS	203-2	Intermediate Mechanics	
	204-2[a]	Introductory Electricity and Magnetism	
	205-2	Intermediate Electricity and Magnetism	
	231-3	Introductory Physics Laboratory I	
PHYS	206-2	Introductory Thermal and Modern Physics	
or			
CHEM	261-3	Physical Chemistry I	11-12
ELECTIVES			6 - 7
			30

MAJOR PROGRAM (continued)

Levels 5, 6, 7, 8

CHEM	252-3	Organic Chemistry II	3
BICH	301-3	The Structure and Reactivity of Biomolecules	
or			
BISC	301-3	Biochemistry I	3
BICH	403-3	Physical Biochemistry	3
BISC	405-3	Cell Physiology	
BISC	481-3	Biophysics	6
MATH	310-3	Introduction to Ordinary Differential Equations	3
PHYS	331-3	Intermediate Laboratory I	
or			
PHYS	333-4	Introduction to Instrumentation in the Life Sciences	
PHYS	341-4(c)	Thermal and Statistical Physics	
PHYS	381-4	Modern Physics	
PHYS	482-3	Physics of Biological Membranes and Membrane Models	
PHYS	483-3	Topics in Mathematical Biophysics	
PHYS	433-3	Biophysics Laboratory	20-21
			38-39

Additional upper division courses must be taken to give a total of 44 upper division units. A set of courses can be chosen in such a manner that they provide emphasis in a specific area of interest. For example, three possible areas, with some appropriate courses, are given below. The student must however choose his program in consultation with a Faculty Advisor.

1) THEORETICAL AND PHYSICAL ASPECTS OF BIOPHYSICS

PHYS	351-4	Optics
PHYS	382-4	Mathematical Physics
PHYS	412-4	Quantum Mechanics
PHYS	421-4	Electricity and Magnetism
MATH	361-3	Mechanics of Deformable Media
MATH	312-4	Multidimensional Calculus
MATH	413-4	Ordinary Differential Equations

2) MOLECULAR AND CHEMICAL ASPECTS OF BIOPHYSICS

CHEM	361-3	Physical Chemistry II
CHEM	464-2	Physical Chemistry of Solutions

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MAJOR PROGRAM (continued)

2) MOLECULAR AND CHEMICAL ASPECTS OF BIOPHYSICS (Continued)

BICH	302-3	Metabolism
BICH	312-2	Metabolism Laboratory
BICH	311-2	Analytical Biochemistry Laboratory
BICH	411-2	Enzymology Laboratory
BICH	413-2	Physical Biochemistry Laboratory

3) BIOLOGICAL AND BIOMEDICAL ASPECTS OF BIOPHYSICS

BISC	302-3	Genetic Analysis
BISC	305-3	Animal Physiology
BISC	315-3	Plant Physiology
BISC	401-3	Biochemistry I
BISC	455-3	Endocrinology
BISC	438-3	Experimental Techniques II
BISC	402-3	Physiological Genetics
BISC	428-3	Experimental Techniques
KINS	405-3	Physiology of Motor Activity
KINS	442-3	Biomedical Systems
KINS	401-4	Mechanics of Human Movement

(B) HONOURS PROGRAM

Levels 1, 2, 3, 4

Identical to Major Program.

Levels 5, 6, 7, 8

CHEM	252-3	Organic Chemistry II	3
BICH	301-3	The Structure and Reactivity of Biomolecules	
or			
BISC	301-3	Biochemistry I	3
BICH	403-3	Physical Biochemistry	3
BICH	413-2	Physical Biochemistry Laboratory	2
BISC	302-3	Genetic Analysis	3
BISC	305-3	Animal Physiology	
or			
BISC	315-3	Plant Physiology	3
BISC	405-3	Cell Physiology	
BISC	481-3	Biophysics	6
MATH	310-3	Introduction to Ordinary Differential Equations	3
PHYS	331-3	Intermediate Laboratory I	
or			
PHYS	333-4	Introduction to Instrumentation in the Life Sciences	
PHYS	341-4 (c)	Thermal and Statistical Physics	
PHYS	381-4	Modern Physics	
PHYS	382-4	Mathematical Physics	
PHYS	482-3	Physics of Biological Membranes and Membrane Models	
PHYS	483-3	Topics in Mathematical Biophysics	
PHYS	433-3	Biophysics Laboratory	
PHYS	412-4	Quantum Mechanics	28-29 / 54-55

Additional courses must be chosen to give a total of 60 upper division credits. These courses should be selected to satisfy individual interests in a manner similar to that described under the Major Program. For example, student's interested in the following areas should select courses from the associated list.

1) THEORETICAL AND PHYSICAL ASPECTS OF BIOPHYSICS

PHYS	332-4	Intermediate Laboratory II
PHYS	351-4	Optics
PHYS	421-4	Electricity and Magnetism
PHYS	471-4	Nuclear Physics

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HONOURS PROGRAM (continued)

1) THEORETICAL AND PHYSICAL ASPECTS OF BIOPHYSICS (Continued)

MATH	312-4	Multidimensional Calculus
MATH	361-3	Mechanics of Deformable Media
MATH	431-4	Algebra I
MATH	413-4	Ordinary Differential Equations
MATH	414-4	Partial Differential Equations

2) MOLECULAR AND CHEMICAL ASPECTS OF BIOPHYSICS

CHEM	361-3	Physical Chemistry II
CHEM	464-3	Physical Chemistry of Solutions
BICH	302-3	Metabolism
BICH	312-2	Metabolism Laboratory
BICH	311-2	Analytical Biochemistry Laboratory
BICH	411-2	Enzymology Laboratory

3) BIOLOGICAL AND BIOMEDICAL ASPECTS OF BIOPHYSICS

BISC or (d)	305-3	Animal Physiology
BISC	315-3	Plant Physiology
BISC	401-3	Biochemistry II
BISC	438-3	Experimental Techniques II
BISC	455-3	Endocrinology
BISC	402-3	Physiological Genetics
BISC	428-3	Experimental Techniques
KINS	405-3	Physiology of Motor Activity
KINS	442-3	Biomedical Systems
KINS	401-4	Mechanics of Human Movement

NOTES:

(a) Students not having the necessary Grade XII high school prerequisites (Math 12, Phys 12, Chem 12 and BiSc 12) will be required to take additional first year courses to obtain entry into the Program. In this regard note that a grade B or better in PHYS 101 and 102 enables a student to proceed directly to PHYS 203-2 and PHYS 205-2. See the SFU calendar for further details.

(b) Whichever was not taken in Levels 1 and 2.

(c) Or CHEM 261-3 and CHEM 362-3.

(d) Whichever was not taken in the core program.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: PHYSICS

Abbreviation Code: PHYS Course Number: 433-3 Credit Hours: 3 Vector: 0-0-4

Title of Course: BIOPHYSICS LABORATORY

Calendar Description of Course: Advanced experimental techniques in physics and their application to biological systems.

Nature of Course Laboratory

Prerequisites (or special instructions): Either (a) PHYS 331-3 or
(b) PHYS 231-3 plus PHYS 333-4

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? Once 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? K. Colbow in collaboration with faculty members presently supervising laboratories in physics.

3. Objectives of the Course

To familiarize students with some important physical techniques useful in biological research and in the study of biological membrane model systems. A particular emphasis will be placed on the basic principles of the physical techniques involved. This course is required for the proposed Biophysics Program.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty One additional faculty member may be required

Staff None

Library None

Audio Visual None

Space None

Equipment None

5. Approval

Date: 17 FEB. 75 6/Mc/75

A. E. Cumyn
Department Chairman

S. Arnott
Dean

Chairman, SCUS

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

BIOPHYSICS LABORATORY 433-3

EXPERIMENTS WILL BE SELECTED FROM THE FOLLOWING LIST

1) LIPID MONOLAYERS AND MULTILAYERS

1) Drexhage (1970) Scientific American 222, 108
2) Bücher et.al. (1967) Molecular crystals 2, 199
3) Kuhn and Möbius (1971) Angew. Chemie intern. Edit. 10, 620.
4) Shah and Shulman (1967) T. Lipid Res. 8 (215, 227)

2) BLACK LIPID FILMS (CONDUCTIVITY MEASUREMENTS)

1) Laüger (1972) Science 178, 24
2) Hanai et al (1964) Proc. Roy. Soc. A. 42, 51
3) Müller et al. (1962) Nature 194, 979

3) LIPID VESICLES (LIGHT SCATTERING, PHASE TRANSITIONS)

1) Atwood and Saunders (1965) Biochem. Biophys. Acta 98, 344
2) Huang (1969) Biochem. 8, 344
3) Colbow (1973) Biochem. Biophys. Acta, 318, 4
4) Batzri and Korn (1973) Biochem. Biophys. Acta 298, 015

4) HELIUM-NEON GAS LASER

Geometrical & Physical Optics, Longhurst (Longmans) 1969

5) SPECTROMETERS AND PHOTOMULTIPLIER TUBES

"Photoelectric cells and Photomultiplier Tubes", J. Shorpe 1958 EMI Publications

6) GRATING AND PRISM SPECTROMETERS

"Optics", Klein (Wiley) 1970

7) FRAUNHOFER AND FRESNEL DIFFRACTION

"Optics" , Rossi (Addison Wesley) 1967

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8) ELECTRON DIFFRACTION AND MICROSCOPY

Hall, C.E., Introduction to Electron Microscopy, New York, McGraw Hill.

9) ULTRASONIC PROPAGATION AND LIGHT SCATTERING IN SOLIDS AND LIQUIDS

"Ultrasonic Absorption", A.B. Bhatia (Oxford) 1967.

10) ELECTRON SPIN RESONANCE

"Nuclear Magnetism Resonance" E.R. Andrews (Cambridge University Press) 1958)
Some "Helpful Reprints" for Spin Labelers from the Institut of Molecular Biology, University of Oregon

11) NUCLEAR MAGNETIC RESONANCE

Same as #10.

12) MÖSSBAUER EFFECT

"Experiments in Modern Physics", A. Melissinos (Academic Press) 1966

13) β-RAY SPECTROSCOPY

"Nuclear Physics" E. Fermi (University of Chicago Press) 1950

14. IONIZATION CHAMBER

"Experimental Nucleonics" Bleuler & Goldsmith (Holt, Rinehard and Winston) 1960

* Alta Lake Summer School "On the Physics of Biological Membranes"
(K. Colbow, editor) SFU 1975

* "Biological Membranes" (D. Chapman, editor) Vol. 1
Academic Press, London 1968

* "Biological Membranes" (D. Chapman and D.F.H. Wallach, editors)
Vol. 2 Academic Press, London 1973

* These general references discuss the application of NMR, ESR, infrared absorption, x-ray scattering, fluorescent probes, light scattering, calorimetry, etc. to a study of Biological Membranes and Membrane Model systems.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: PHYSICS

Abbreviation Code: PHYS Course Number: 482-3 Credit Hours: 3 Vector: 3-0-0

Title of Course: The Physics of Biological Membranes and Membrane Models

Calendar Description of Course: Structure, transport and phase transitions in membrane models and applications to membranes in biological systems.

Nature of Course Lectures

Prerequisites (or special instructions): PHYS 381-4 or CHEM 361-3; and either (a) PHYS 341-4 or (b) CHEM 261-3 plus CHEM 362-3

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, if demand exists.

Semester in which the course will first be offered? Fall 1975, if demand exists.

Which of your present faculty would be available to make the proposed offering possible? K. Colbow, B.L. Jones

3. Objectives of the Course

This course is designed as one of the required courses for the proposed Biophysics Program. The subject matter forms an important area of biophysics of considerable current interest. The course should acquaint the student with the role of structure and function in biophysics.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty One additional faculty member may be required

Staff None

Library None

Audio Visual None

Space None

Equipment None

5. Approval

Date: 17 FEB 75 6/Mr/75

A R Cooper — Department Chairman

S. Smith — Dean

Chairman, SCUS

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

PHYSICS 482-3 THE PHYSICS OF BIOLOGICAL MEMBRANES and MEMBRANE MODELS

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1. Introduction: The structures and functions of biological membranes (electron microscopy).

2. Lipids, water and amphipathic molecules.

3. Lipid monolayers (pressure-area diagrams, surface potential measurements, the effects of cholesterol and calcium).

4. Lipid multilayers (X-ray measurements and the polar group orientation, fluorescent probes and energy transfer).

5. Lipid vesicles (phase transitions by various physical techniques: light scattering, fluorescent probes ESR, NMR, dilatometry, calorimetry).

6. Black lipid films (conductivity and capacity measurements, transport of water, ions and non-electrolytes across membranes; facilitated diffusion by gramicidin, valinomycin and other antibiotics).

7. Diffusion, facilitated transport and active transport.

8. Phase transitions in biological systems.

9. Applications to membranes in biological systems.

Useful References:

D. Chapman (1968) "Biological Membranes: Physical Fact and Function", Col. 1, Academic Press, London.

D. Chapman and D.F.H. Wallach (1973): Biological Membranes, Vol. 2, Academic Press, London.

B. Katz (1966) Nerve, muscle and synapse, McGraw-Hill, Toronto.

R. Plonsey and D.G. Fleming (1969) "Bioelectric phenomena", McGraw-Hill, Toronto.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information — Department: PHYSICS

Abbreviation Code: PHYS Course Number: 483-3 Credit Hours: 3 Vector: 3-0-0

Title of Course: TOPICS IN MATHEMATICAL BIOPHYSICS

Calendar Description of Course: Mathematical and biophysical applications to biology. Molecular evolution, competition of species, biological flow systems, bioelectric phenomena, electrodiffusion across membrane, etc.

Nature of Course: Lectures

Prerequisites (or special instructions): MATH 310-3; and
either (a) PHYS 341-4 or
(b) CHEM 261-3 plus CHEM 362-3

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

2. Scheduling

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

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

Which of your present faculty would be available to make the proposed offering possible? K. Colbow, B.L. Jones

3. Objectives of the Course

This course is designed as one of the required courses for the proposed Biophysics Program. The topics are chosen to illustrate the application of thermodynamics and differential equations to biological systems.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty: One additional faculty member may be required

Staff: None

Library: None

Audio Visual: None

Space: None

Equipment: None

5. Approval

Date: 17 FEB 75	6/Mr/75	
A. E. Curzon	S. Aronoff	
Department Chairman	Dean	Chairman, SCUS

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

TYPICAL AREAS

1. Bioelectric phenomena:
Nerve and muscle, electrochemistry and electrodes, subthreshold membrane phenomena, membrane action potentials, electrocardiography.

Reference: Plonsey, R. and Fleming, D.G.
"Bioelectric phenomena"
McGraw-Hill, Toronto, 1969

2. Self-Organization of Molecular Systems and the Evolution of the Genetic Apparatus
(Chemical oscillators, competition of species, etc.)

References: H. Kuhn (1972) Angew. Chem. Internat. Edit 11, 798-824.

I. Prigogine, G. Nicolis and A. Babboyantz (1972), Physics Today (Dec.) 38-44.

E. Montroll, Notes - Special Lecture Series, Simon Fraser University, Fall 1969.

3. Hydrodynamics of Biological Systems
Hydrostatics, flow velocity, viscosity, turbulence, Poiseuille equation.

Reference: D.H. Bergel (1972) Cardiovascular Fluid Dynamics, Academic Press, London.

4. Physics of Macromolecules
Statistical physics of DNA, protein, etc., interaction forces, helix-coil transformations, denaturing processes, energy transfer mechanisms.

References: M.V. Volkenstein, "Molecules and Life", Plenum Press, New York, 1970.

D. Chapman and R.B. Leslie, "Molecular Biophysics", Oliver and Boyd, London, 1967.

U-75-3

SIMON FRASER UNIVERSITY

MEMORANDUM

To Dr. B.D. Pate, Chairman, Faculty of Science UGCC	From A.E. Curzon, Chairman, Department of Physics
Subject Proposed Biophysics Program	Date December 16, 1974.

The Department of Physics has approved the attached Biophysics Program proposal and it is being submitted for Faculty of Science approval. Copies of the proposed program have been mailed to Dr. J. Webster and the faculty advisers listed on the first page of the proposal for comments. Although no formal replies have been received, informal discussions with faculty from other departments have been very encouraging. We believe that this program will produce students with an excellent background that will enable them to pursue a wide variety of careers. We also feel that academically and economically this is the soundest way of initiating a biophysics program that will fill a void that presently exists in our Science curriculum. We are hoping for the co-operation and approval of the remainder of the Science faculty.

A. E. Curzon.

AEC/mgj

A.E. Curzon

SIMON FRASER UNIVERSITY

MEMORANDUM

To Office of the Dean. Faculty of Science	From Edward A. Weinstein Library - Sciences
Subject Proposed Biophysics Program: Library Impact (U-75-3)	Date February 6, 1975

The subject program, sponsored by the Department of Physics, entails three new courses, as follows:

1. Physics 481-3: Topics in mathematical biophysics
2. Physics 482-3: Physics of biological membranes and membrane models
3. Physics 433-3: Biophysics laboratory.

1. above is new to SFU in name only, for the actual topic is considered within ongoing collections policy scope under mathematical physics. No impact.

2. above has been a topic of specific research interest at SFU and consequent collections activity. No impact.

3. above, a laboratory course, is of no library consequence.

In sum: a substantial increase in graduate and faculty research must occur before a change in our present collections policy would be required in this area. The above undergraduate program utilizes existing courses almost totally.