4-13-1978

Proposal for a Ph. D. in Applied Mathematical Sciences

University of Rhode Island Faculty Senate

Serial Number #77-78--26

UNIVERSITY OF RHODE ISLAND
Kingston, Rhode Island

FACULTY SENATE
BILL

Adopted by the Faculty Senate

TO: President Frank Newman

FROM: Chairman of the Faculty Senate

1. The attached BILL, titled Proposal for a Ph. D. In Applied Mathematical Sciences, is forwarded for your consideration.

2. The original and two copies for your use are included.

3. This BILL was adopted by vote of the Faculty Senate on April 13, 1978 (date).

4. After considering this bill, will you please indicate your approval or disapproval. Return the original or forward it to the Board of Regents, completing the appropriate endorsement below.

5. In accordance with Section 8, paragraph 2 of the Senate's By-Laws, this bill will become effective on May 4, 1978 (date), three weeks after Senate approval, unless: (1) specific dates for implementation are written into the bill; (2) you return it disapproved; (3) you forward it to the Board of Regents for their approval; or (4) the University Faculty petitions for a referendum. If the bill is forwarded to the Board of Regents, it will not become effective until approved by the Board.

Copy

April 14, 1978
(date)

Robert M. Gutchen
Chairman of the Faculty Senate

ENDORSEMENT

TO: Chairman of the Faculty Senate

FROM: President of the University

Approved by Bd. of Regents 6/12/80

1. Returned.

2. Approved_____. Disapproved_____.

3. (If approved) In my opinion, transmittal to the Board of Regents is not/is necessary.

(date)

President

(OVER)

Form revised 6/77

ALTERNATE ENDORSEMENT 1.

TO: Chairman of the Board of Regents

FROM: The University President

1. Forwarded.

2. Approved.

_____ _____

(date) President

ENDORSEMENT 2.

TO: Chairman of the Faculty Senate

FROM: Chairman of the Board of Regents, via the University President.

1. Forwarded.

_____ _____

(date)

_____

(Office)

ENDORSEMENT 3.

TO: Chairman of the Faculty Senate

FROM: The University President

1. Forwarded from the Chairman of the Board of Regents.

_____ _____

(date) President

Original received and forwarded to the Secretary of the Senate and Registrar for filing in the Archives of the University.

_____ _____

(date)

Chairman of the Faculty Senate

UNIVERSITY OF RHODE ISLAND

College of Arts and Sciences

Ser. A No. 2 Curriculum Committee November 3, 1977

Curriculum Committee Members

R. Trivelli
J. Kulberg
R. Nelson
R. Leathers
A. Nunes
J. Peterson
G. Silvestri
W. Surver, Chairman

The Departments of Computer Science and Experimental Statistics, Industrial Engineering, Management Science, and Mathematics propose an Interdisciplinary Ph.D. Program with areas of specialization in:

a.) Applied Mathematics
b.) Computer Science
c.) Operations Research
d.) Statistics
e.) Applied Probability

A. Rationale:

There are many highly qualified faculty actively pursuing research in the applied mathematical sciences in various URI departments. At the same time, the demand continues, both regionally and nationally, for Ph.D. training in these areas. This proposal is an attempt to bring together the existing research interests in some applied mathematical sciences at URI in order to offer a high quality Ph.D. program in this area without the attendant costs that a new Ph.D. program would ordinarily entail. We already have all the necessary faculty resources and facilities to support this program. Most of the support for full-time students would be derived from research grants or contracts. It is anticipated that many of the students who would enroll in this program would be part-time students who are employed full-time within the State of Rhode Island and are interested in advancing their educational background. The Department of Computer Science and Experimental Statistics is now in its seventh year of an active program with the Naval Underwater Systems Center to provide on-site URI courses (principally advanced courses in computer sciences) for their personnel. This program is administered through the Extension Division and includes faculty from Harvard, M.I.T., and Brown.

Currently, fifteen NUSC employees are enrolled part-time in this program as candidates for the M.S. degree.

Among the sponsoring departments, only Mathematics offers the Ph.D. degree. The mathematics program, however, does not possess sufficient flexibility to accommodate faculty and student interests in the applied areas covered by this proposal. Furthermore, it is not intended that the proposed program be restricted to the sponsoring departments. It is intended that the program be broadly based, involving as major professors faculty in many URI departments who work in areas (a) through (e) above. This program would be unique to the state universities within New England. Although both the University of Connecticut and the University of Massachusetts offer the Ph.D. in some of the specializations (computer science at the University of Connecticut and the University of Massachusetts, operations research at the University of Massachusetts, statistics at the University of Connecticut), none of them provide the interdisciplinary environment and training inherent in the proposed program.

B. Description of Program:

A student with a B.S. degree can pursue the Ph.D. directly in the program; however, the program has been designed principally for students who have an M.S. degree. A student entering the program with an M.S. degree in a related area may be granted up to 30 credits toward the Ph.D. in applied mathematical sciences. Each student would be expected to satisfy all of the following requirements (no single course can by used to satisfy two course requirements):

1. The student must complete 54 credits of course work beyond the B.S. degree in addition to 18 credits for his doctoral dissertation. Courses which are normally required in the URI undergraduate program corresponding to the student's B.S. program may not be applied toward the 54 credits of course work.

2. MTH 437 and MTH 438, Advanced Calculus I and II, are required.

3. The student will be required to complete two of the following mathematics courses.

   MTH 462, Functions of a Complex Variable
   MTH 513, Linear Algebra
   MTH 515, Algebra I
   MTH 535, Measure Theory and Integration
   MTH 545, Ordinary Differential Equations I
   MTH 561, Advanced Applied Mathematics
   MTH 641, Partial Differential Equations I

4. The student will be required to select two (2) areas of core courses and complete three (3) courses in each area. Special problems and topics courses in MTH, CSC, EST, and IDE can be used to satisfy this requirement if approved by the student's doctoral committee. The areas of core courses and courses included in each area are given below.

   a.) Applied Mathematics

   MTH 545, Ordinary Differential Equations I
   MTH 546, Ordinary Differential Equations II
   MTH 561, Advanced Applied Mathematics
   MTH 641, Partial Differential Equations I
   MTH 642, Partial Differential Equations II

   b.) Basic Analysis

   MTH 535, Measure Theory and Integration
   MTH 536, Measure Theory and Integration
   MTH 562, Complex Function Theory
   MTH 629, Functional Analysis I
   MTH 630, Functional Analysis II

   c.) Numerical Analysis

   MTH 471, Introduction to Numerical Analysis I
   MTH 472, Introduction to Numerical Analysis II
   MTH 572, Numerical Analysis
   CSC 500, Scientific Applications of Digital Computers I
   CSC 551, Scientific Applications of Digital Computers II

   d.) Computer Science

   CSC 411, Computer Organization and Programming
   CSC 412, Programming Systems
   CSC 413, Data Structures
   CSC 500, Scientific Applications of Digital Computers I
   CSC 502, Theory of Algorithmic Languages and Compilers
   CSC 505, Design of Digital Circuits
   CSC 512, Advanced Programming Systems
   CSC 515, Theory of Computation
   CSC 525, Simulation
   CSC 535, Information Organization and Retrieval
   CSC 551, Scientific Applications of Digital Computers II
   CSC 581, Intelligence in Machines and Humans
   CSC 582, Robotics

   e.) Operations Research

   IDE 432, Operations Research I
   IDE 433, Operations Research II
   IDE 500, Network Application in Industrial Engineering

IDE 540, Production Control and Inventory Systems
IDE 555, Engineering Applications of Mathematical Programming I
IDE 556, Engineering Applications of Mathematical Programming II
IDE 565, Theory of Scheduling
IDE 570, Operations Research Modeling in Health Care
IDE 657, Geometric and Dynamic Programming
IDE 660, Methods of Optimization

f.) Statistics

EST 409, Statistical Methods in Research I
EST 412, Statistical Methods in Research II
EST 413, Data Analysis
EST 500, Nonparametric Statistical Methods
EST 511, Linear Statistical Models
EST 520, Fundamentals of Sampling and Applications
EST 532, Experimental Design
EST 541, Multivariate Statistical Methods
EST 550, Ecological Statistics
EST 577, Econometrics II
EST 584, Pattern Recognition
EST 610, Factor Analysis
IDE 513, Statistical Quality Control
IDE 525, Simulation
IDE 533, Advanced Statistic Methods for Research and Industry
IDE 535, Industrial Reliability Engineering
IDE 634, Design and Analysis of Industrial Experiments
IDE 635, Response Surfaces and Evolutionary Operations
MTH 452, Mathematical Statistics
MTH 551, Mathematical Statistics

g.) Applied Probability

MTH 451, Introducation to Probability and Statistics
MTH 456, Probability
MTH 550, Probability and Stochastic Processes
IDE 535, Industrial Reliability Engineering
IDE 550, Advanced Topics in Probabilistic Operations Research I
IDE 551, Advanced Topics in Probabilistic Operations Research II
IDE 610, Topics in Applied Queuing Theory

5. All normal examination policies of the Graduate School will apply to the proposed program.

a.) Students admitted without an M.S. degree will be expected to take an oral qualifying examination, usually after 24-30 credits have been completed. Students entering the program with an M.S. degree may be required to take the qualifying examination if so notified on their letter of admission. The qualifying examination committee will consist of the student's major profession and two other faculty appointed by the Coordinating Committee. Unanimous agreement of the examining committee is required for the student to pass. The content of this examination will be discussed with the student by his major professor during his first semester of study.

b.) A comprehensive examination will be administered near the completion of each student's course work. On this examination, the student will be held responsible for at least ten (10) courses, including the 12 required mathematics credits in (b) and (c) above and the required 18 credits from (d) above. The oral examination committee will include at least one member from the Mathematics Department. Unanimous approval by this committee is required for passing.

c.) Language requirement. Reading proficiency in one foreign language will be required. The student's major professor will approve the selection of a suitable language and will administer an examination testing reading proficiency in the student's area of specialization.

C. Administration:

A coordinating committee composed of six (6) members of the doctoral applied mathematical sciences faculty (see below) will have primary responsibility for administering this program. The membership of this committee will consist of:

1. A representative from each of the sponsoring departments appointed by the department chairperson (or the department chairperson should he or she elect to represent the department).

2. Two representatives selected by the Dean of the Graduate School from a list, submitted by the sponsoring departments, of names of faculty outside the sponsoring departments. These appointments made by the graduate dean will be for a two-year period. Normally the appointments will be for staggered terms, with one person appointed each year. A member may be reappointed for successive terms.

3. The coordinating committee will annually elect one of its members as chairperson. This chairperson shall fulfill the responsibilities delegated to a department chairperson in the graduate student manual.

4. The coordinating committee shall:

a.) Publicize the program.

b.) Process applications from prospective students when forwarded from the Graduate school, and recommend admission or rejection.

c.) Make any necessary recommendations or decisions concerning non-departmental financial support for graduate students.

d.) Assign to each incoming graduate student a temporary advisor in an area close to the student's interest.

e.) Ensure that a doctoral committee is formed for each student within the first 60 days of his/her initial semester. At least two members of the committee, including the major professor, shall be members of the doctoral applied mathematical sciences faculty. Furthermore, at least one appropriate faculty member from either the CSC and EST Department of the Mathematics Department must be on each doctoral committee.

f.) Appoint an examination committee for each student taking a qualifying examination.

g.) Make any recommendations, after appropriate consultations, concerning retention or dismissal of a graduate student.

h.) Maintain summary records of students currently and previously enrolled.

i.) Make any modifications of the program which it deems appropriate.

5. All decisions of the coordinating committee shall be by majority vote, except that any modification of requirements or procedures or areas of specialization of the program shall also require unanimous approval of the representatives of all sponsoring departments.

D. The Doctoral Applied Mathematical Sciences Faculty:

It is intended that this faculty be composed of all those URI graduate faculty who are actively pursuing research or scholarly activity in the applied mathematical sciences and are both qualified and interested in directing Ph.D. students in the areas of specialization (a) through (e) above. Those faculty from the sponsoring departments whose names are appended would form the initial nucleus for this body. Other URI faculty with an interest in participating would request appointment from the graduate dean to the doctoral faculty of this program. The coordinating committee would assist the dean in evaluating the qualifications of the applicant relative to this program. The dean would then make the appointments.

1. Department of Computer Science and Experimental Statistics

Leonard J. Bass, Assoc. Prof. of Computer Science
Edward J. Carney, Prof. of Computer Science and Statistics
Frank M. Carrano, Assoc. Prof. of Computer Science
R. Choudary Hanumara, Assoc. Prof. of Statistics
William J. Hemmerle, Prof. of Computer Science and Statistics
Edward Lamagna, Asst. Prof. of Computer Science
William D. Lawing, Assoc. Prof. of Industrial Engineering and Statistics
Peter F. Merenda, Prof. of Psychology and Statistics
Lewis T. Smith, Prof. of Animal Science and Statistics

2. Department of Industrial Engineering

Charles James, Prof.
William D. Lawing, Assoc. Prof. of Industrial Engineering and Statistics
David Shao, Assoc. Prof.

3. Department of Management Science

Dennis W. McLeavey, Assoc. Prof.
Richard Mohena, Assoc. Prof.
Warren Rogers, Prof.
Arun Sanghvi, Asst. Prof.

4. Department of Mathematics

Rodney Driver, Prof.
Norman Finizio, Assoc. Prof.
Gerasimos Ladas, Prof.
Howard Levine, Assoc. Prof.
James Lewis, Assoc. Prof.
Pan-Tai Liu, Assoc. Prof.
Lewis Pakula, Asst. Prof.
John Papadakis, Assoc. Prof.
Emilio Roxin, Prof.
Oved Shisha, Prof.
Robert Sine, Assoc. Prof.
E. R. Suryanarayan, Prof.
Ghasi Verma, Assoc. Prof.
David Wood, Asst. Adjunct Prof.

12/2/77

PROPOSED PH.D. PROGRAM IN THE APPLIED MATHEMATICAL SCIENCES

DATA PACK

A. The qualifications of each participating faculty member whose name is listed on pages 6 and 7 of the Arts and Sciences Curriculum Committee Report (A&SCCR) are attached.

B. It is roughly estimated that within 5 years' time there will be about 25 students enrolled in this program. Most of these students are likely to be distributed among the sponsoring departments--perhaps 6 in each. Different departments will assimilate these students in different ways. The Mathematics Department feels that it can easily handle more Ph.D. students if outside funds are obtained to support them. The mix of graduate students within Computer Science and Experimental Statistics would probably change, with research assistantships being awarded to Ph.D. students rather than M.S. students. The same practice is expected to be followed by the Industrial Engineering Department. All of the departments feel that they would have an easier time obtaining research grants and contracts were this program available.

C. Courses on the 400, 500 and 600 levels which are now available for fulfilling degree requirements are listed on pages 2 - 4 of the A&SCCR. These are all existing courses within the departments of Computer Science and Experimental Statistics, Industrial Engineering and Mathematics (some of the courses are also cross-listed with other departments). Existing courses in other URI departments consistent with program objectives may be included in the student's program of studies. Instructors would be those faculty who normally teach these courses as listed in the URI Graduate Bulletin. No new courses are to be introduced other than AMS699, Doctoral Dissertation Research.

D. The current physical research facilities are adequate to support this program. The principal facility necessary to the program is the Academic Computer Center. The URI Academic Computer Center has an Itel AS/5 computer (equivalent to IBM System/370 Model 158) with 3072K of high speed storage, disk storage units, magnetic tape, card, and printer input/output devices and an off-line plotter. The system's hardware and software accommodate both remote batch and interactive terminal usage as well as normal batch processing. An intermediate-speed remote batch terminal is installed within the Graduate School of Oceanography at the Narragansett Bay Campus. The Department of Electrical Engineering has two PDP-9 computers with a graphics display console and a Data General Eclipse linked to the Computer Center's system. Various typewriter and graphics display terminals for interactive use or remote job entry are located on the campus in most of the science and engineering departments as well as the College of Business Administration, the College of Pharmacy, the Graduate School of Oceanography and the Computer Center. The staff of the Academic Computer Center develop and maintain programming systems and application programs, conduct short courses and workshops and provide programming assistance for the University community. The academic staff hold joint appointments with the Department of Computer Science and Experimental Statistics.

E. Listings of the available library resources in applied mathematics, computer science, operations research, statistics and applied probability have been appended. This library holding is considered sufficient by the sponsoring departments for this program.*

F. No additional resources or additional state funding is required to offer this program. No requests have been made or are expected to be made by any of the sponsoring departments for additional staff, graduate students or physical facilities from state funds to support this program.

*No additional library resources would be required provided that current subscriptions are maintained.

G. We sincerely hope that other URI graduate faculty who are not members of the sponsoring departments but who are actively pursuing research in the applied mathematical sciences will become involved in this program; however, it is not necessary for other departments to commit resources to this program in order for it to be viable.

H. Sample programs are attached for each of the 5 specializations. All of these sample programs satisfy the course work requirements for the proposed Ph.D. in the Applied Mathematical Sciences (items 1 - 4 on pages 2 & 3 of the A&SCCR).

I. This program would be unique to the state universities within New England (see page 2 of A&SCCR).

J. See page 1 of A&SCCR and section entitled "Rationale".

K. This program has now been approved by the Colleges of Arts and Sciences, Engineering and Business Administration.

SAMPLE PROGRAM OF STUDY

SPECIALIZATION: APPLIED MATHEMATICS

(This program assumes that the student has had MTH 437-438, Advanced calculus, and MTH 462, Complex variables, as well as MTH 451, Intro. Probability and Statistics, as an undergraduate.)

	Courses	Credit hours
MTH 513	Linear Algebra	3
MTH 535	Measure Theory and Integration I	3
MTH 536	Measure Theory and Integration II	3
MTH 545	Ordinary Differential Equations I	3
MTH 546	Ordinary Differential Equations II	3
MTH 561	Advanced Applied Mathematics	3
MTH 629	Functional Analysis I	3
MTH 630	Functional Analysis II	3
MTH 456	Probability	3
MTH 550	Probability and stochastic processes	3
CSC 411	Computer Organization and Programm.	3
CSC 500	Scientific Appl. of Digital Comp.I	3
CSC 551	Scientific Appl. of Digital Comp.II	3
IDE 432	Operations Research I	3
IDE 433	Operations Research II	3
IDE 500	Network Appl. in Industrial Eng.	3
IDE 555	Eng. Appl. of Mathemat. Programming I	3
IDE 556	Eng. Appl. of Mathemat. Programming II	3
	Total	54
AMS 699	PhD. Thesis Research	18
		72

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SAMPLE PROGRAM OF STUDY---SPECIALIZATION IN COMPUTER SCIENCE

(Assumes that student has the equivalent of MTH437, MTH438, Advanced Calculus I and II, MTH451, Introduction to Probability and Statistics, and CSC411, Computer Organization and Programming, as an undergraduate)

Courses	Credit Hours	
CSC412, Statistical Methods in Research II	3	
CSC413, Data Analysis	3	
CSC500, Scientific Applications of Digital Comp. I	3	
CSC502, Theory of Algorithmic Languages & Compilers	3	
CSC512, Advanced Programming Systems	3	
CSC525, Simulation	3	
CSC515, Theory of Computation	3	
CSC551, Scientific Applications of Digital Comp.II	3	
CSC599, Master's Thesis Research	6	
		30 (MS in CSC)
MTH513, Linear Algebra	3	
MTH545, Ordinary Differential Equations	3	
MTH456, Probability	3	
MTH550, Probability and Stochastic Processes	3	
IDE565, Theory of Scheduling	3	
IDE610, Topics in Applied Queuing Theory	3	
CSC535, Information Organization and Retrieval	3	
CSC591, Problems in CSC (Queuing Models of Computer Systems)	3	
		54
AMS699, Ph.D. Thesis Research		18
		72

SAMPLE PROGRAM OF STUDY, SPECIALIZATION IN OPERATIONS RESEARCH

Courses	Credits	
IDE 433, Operations Research II	3	
IDE 513, Statistical Quality Control	3	
IDE 533, Advanced Statistical Methods for Research & Industry	3	
IDE 540, Production Control and Inventory Systems	3	
IDE 555, Engineering Applications of Mathematical Programming	3	
IDE 565, Theory of Scheduling	3	
IDE-CSC 525, Simulation	3	
ACC 510, Financial Accounting	3	
ECN 576, Econometrics I	3	
IDE 599, Masters Thesis Research	6	
	33	(MSIE)
MTH 437, 438, Advanced Calculus I, II	6	
MTH 535, Measure Theory and Integration	3	
MTH 462, Functions of A Complex Variable	3	
IDE 657, Geometric and Dynamic Programming	3	
IDE 660, Methods of Optimization	3	
IDE 556, Engineering Applications of Mathematical Programming	3	
EST 511, Linear Statistical Models	3	
EST 541, Multivariate Statistical Models	3	
IDE 634, Design and Analysis of Industrial Experiments	3	
IDE 635, Response Surfaces and Evolutionary Operations	3	
	33	66
AMS 699, PhD Thesis Research		18
		84

12/1/77

SAMPLE PROGRAM OF STUDY--SPECIALIZATION IN STATISTICS

(Assumes that student has the equivalent of MTH437, MTH438, Advanced Calculus I and II, and MTH451, Introduction to Probability and Statistics, as an undergraduate)

Courses	Credit Hours	
EST409, Statistical Methods in Research I	3	
EST412, Statistical Methods in Research II	3	
EST413, Data Analysis	3	
MTH452, Mathematical Statistics	3	
EST511, Linear Statistical Models	3	
EST520, Fundamentals of Sampling and Applications	3	
EST541, Multivariate Statistical Methods	3	
CSC500, Scientific Applications of Digital Computers I	3	
EST599, Master's Thesis Research	6	
		30 (MS in EST)
EST500, Nonparametric Statistical Methods	3	
EST532, Experimental Design	3	
EST591, Problems in EST (Statistical Computations)	3	
MTH513, Linear Algebra	3	
MTH535, Measure Theory and Integration	3	
MTH551, Mathematical Statistics	3	
CSC525, Simulation	3	
CSC551, Scientific Applications of Digital ComputersII	3	
		24
AMS699, Ph.D. Thesis Research		18
		72

SAMPLE PROGRAM OF STUDY, SPECIALIZATION IN APPLIED PROBABILITY.

Courses	Credits	
IDE 433, Operations Research II	3	
IDE 500, Network Applications in Industrial Engineering	3	
IDE-CSC 525, Simulation	3	
IDE 540, Production Control and Inventory Systems	3	
IDE 550, Advanced Topics in Probabilistic Operations Research I	3	
IDE 555, Engineering Applications of Mathematical Programming I	3	
IDE 556, Engineering Applications of Mathematical Programming II	3	
IDE 570, Operations Research Modeling in Health Care	3	
IDE 599, Masters Thesis Research	6	
	30	(MSIE)
MTH 437, 438, Completed as an Undergraduate Student		
MTH 535, Measure Theory and Integration	3	
MTH 513, Linear Algebra	3	
IDE 551, Advanced Topics in Probabilistic Operations Research II	3	
IDE 610, Topics in Applied Queueing Theory	3	
IDE 535, Industrial Reliability Engineering	3	
MTH 545, Ordinary Differential Equations I	3	
MTH 641, Partial Differential Equations I	3	
MTH 561, Advanced Applied Mathematics	3	
	24	54
AMS 699, PhD Thesis Research		18
		72