
**UNIVERSITY OF RHODE ISLAND
INTERDISCIPLINARY Ph.D. PROGRAM
APPLIED MATHEMATICAL SCIENCES
WITH SPECIALIZATIONS IN:**

- a) Applied Mathematics
- b) Computer Science
- c) Operations Research
- d) Statistics

SPONSORING DEPARTMENTS:

Computer Science and Statistics, Industrial and Manufacturing Engineering, Management Science and Information Systems, and Mathematics.

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 closely 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 be 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 the 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. MTH435 and MTH436, Introduction to Mathematical Analysis I and II, are required.
3. The student will be required to complete two of the following courses:

- MTH462, Functions of a Complex Variable
- MTH513, Linear Algebra
- MTH515, Algebra I
- MTH535, Measure Theory and Integration
- MTH545, Ordinary Differential Equations I
- MTH547, Combinatorics and Graph Theory
- MTH548, Topics in Combinatorics
- MTH561, Advanced Applied Mathematics
- MTH641, Partial Differential Equations 1
- CSC542, Mathematical Analysis of Algorithms
- CSC544, Theory of Computation

One of these courses must be either MTH513 or MTH515.

4. The student will be required to select two (2) areas of core courses and complete at least three (3) courses in each area. Students choosing core areas different from those pursued in their master's program will be required to do additional course work. Special problems and topics courses in MTH, CSC, STA, and IME 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; asterisks indicate those courses that may not be offered in every academic year.

a. Applied Mathematics

- MTH545, Ordinary Differential Equations I
- * MTH546, Ordinary Differential Equations II
- * MTH547, Combinatorics and Graph Theory
- * MTH548, Topics in Combinatorics
- MTH561, Advanced Applied Mathematics
- MTH641, Partial Differential Equations I
- * MTH642, Partial Differential Equations II
- MCE666, Nonlinear Mechanics
- * CSC542, Mathematical Analysis of Algorithms

b. Basic Analysis

- MTH535, Measure Theory and Integration I
- MTH536, Measure Theory and Integration II
- MTH562, Complex Function Theory
- * MTH629, Functional Analysis I
- * MTH630, Functional Analysis II

c. Computational Mathematics

- MTH471, Introduction to Numerical Analysis I
- MTH472, Introduction to Numerical Analysis II
- * MTH572, Numerical Analysis
- * CSC550, Computer Algebra

d. Computer Science Fundamentals and Theory

- CSC501, Programming Languages Semantics
- * CSC511, Advanced Computer Organization
- * CSC512, Topics in Distributed Systems
- * CSC541, Design and Analysis of Algorithms II
- * CSC542, Mathematical Analysis of Algorithms
- * CSC544, Theory of Computation
- * CSC547, Combinatorics and Graph Theory
- * CSC548, Topics in Combinatorics
- * CSC550, Computer Algebra

e. Applied Computer Science

- * CSC502, Theory of Compilers
- * CSC505, Advanced Topics in Software Engineering
- * CSC509, Object-Oriented Software Design
- * CSC517, Design and Analysis of VLSI Systems
- * CSC519, Computer Networks
- * CSC525, Simulation
- * CSC536, Topics in Data Management Systems
- * CSC581, Special Topics in Artificial Intelligence
- * CSC583, Computer Vision

f. Operations Research

- IME432, Operations Research I
- IME433, Operations Research II
- IME500, Network Application in Industrial Engineering
- IME525, Simulation
- IME540, Production Control and Inventory Systems
- IME555, Engineering Applications of Mathematical Programming I
- * IME610, Topics in Applied Queueing Theory
- * IME660, Methods of Optimization
- MTH456, Introduction to Random Processes
- MTH550, Probability and Stochastic Processes

g. Statistics

- * STA413, Spatial Data Analysis
- STA500, Nonparametric Statistical Methods
- * STA501, Analysis of Variance and Variance Components
- * STA502, Applied Regression Analysis
- * STA520, Fundamentals of Sampling and Applications
- STA532, Experimental Design
- STA541, Multivariate Statistical Methods
- * STA542, Categorical Data Analysis Methods
- STA550, Ecological Statistics
- * STA576, Econometrics
- * STA584, Pattern Recognition
- * STA610, Factor Analysis
- * STA611, Linear Statistical Models
- IME513, Statistical Quality Assurance
- IME533, Advanced Statistical Methods for Research and Industry
- * IME634, Design and Analysis of Industrial Experiments

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- MTH451, Introduction to Probability and Statistics
MTH452, Mathematical Statistics
MTH551, Mathematical Statistics
5. Other courses must be selected in order to meet the 54 credit minimum. These courses should be selected in consultation with the student's Advisor or Major Professor and need not necessarily be from among those listed in Part 4.
 6. All normal examination policies of the Graduate School apply to this program.
 - a. Students admitted without an M.S. degree will be expected to take a 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 professor 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 credits in (2) and (3) above and the required 18 credits from (4) 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 arrange for the administration of an examination testing reading proficiency in the student's area of specialization.

**SAMPLE PROGRAM OF STUDY
SPECIALIZATION IN APPLIED MATHEMATICS**

(This program assumes that the student has had MTH437-438, Advanced Calculus, and MTH462, Complex Variables, as well as MTH451, Introductory Probability and Statistics, as an undergraduate.)

<u>Courses</u>	<u>Credit Hours</u>
MTH513, Linear Algebra	3
MTH535, Measure Theory and Integration I	3
MTH536, Measure Theory and Integration II	3
MTH545, Ordinary Differential Equations I	3
MTH546, Ordinary Differential Equations II	3
MTH547, Combinatorics and Graph Theory	3
MTH548, Topics in Combinatorics	3
MTH561, Advanced Applied Mathematics	3
MTH629, Functional Analysis I	3
MTH630, Functional Analysis II	3
MTH456, Probability	3
MTH550, Probability and Stochastic Processes	3
CSC542, Mathematical Analysis of Algorithms	4
IME432, Operations Research I	3
IME433, Operations Research II	3
IME500, Network Application in Industrial Engineering	3
IME555, Engineering Applications of Mathematical Programming I	3
IME556, Engineering Applications of Mathematical Programming II Replace that course	3
Total	55
AMS699, Ph.D. Thesis Research	18
	73

**SAMPLE PROGRAM OF STUDY
SPECIALIZATION IN COMPUTER SCIENCE**

(This program assumes that the student was an undergraduate computer science major and has taken the equivalent of MTH435, MTH436, Introduction to Mathematical Analysis I and II.)

<u>Courses</u>	<u>Credit Hours</u>
CSC406, Computer Graphics	4
CSC481, Artificial intelligence	4
CSC501, Programming Language Semantics	4
CSC511, Advanced Computer Organization	4
CSC512, Topics in Distributed Systems	4
CSC541, Design and Analysis of Algorithms II	4
CSC599, Master's Thesis Research	6
(M.S. in CSC)	30
MTH513, Linear Algebra	3
MTH547, Combinatorics and Graph Theory	3
MTH548, Topics in Combinatorics	3
CSC502, Theory of Compilers	4
CSC542, Mathematical Analysis of Algorithms	4
CSC544, Theory of Computation	4
CSC581, Special Topics in Artificial Intelligence	3
 Total	 54
AMS699, Ph.D. Thesis Research	18
	72

SAMPLE PROGRAM OF STUDY
SPECIALIZATION IN OPERATIONS RESEARCH

(This program assumes that the student has taken the equivalent of MTH435, MTH436, Introduction to Mathematical Analysis I and II.)

<u>Courses</u>	<u>Credit Hours</u>
IME433, Operations Research II	3
IME513, Statistical Quality Assurance	3
IME533, Advanced Statistical Methods for Research and Industry	3
IME540, Production Control and Inventory Systems	3
IME555, Engineering Applications of Mathematical Programming	3
IME565, Theory of Scheduling replace that course	3
IME/CSC525, Simulation	3
ACC610, Financial Accounting	3
ECN576, Econometrics	3
MTH535, Measure Theory and Integration	3
MTH462, Functions of a Complex Variable	3
IME555, Engineering Applications of Mathematical Programming Appears twice	3
IME660, Methods of Optimization	3
IME556, Engineering Applications of Mathematical Programming II replace that course	3
STA511, Linear Statistical Models	3
	3
STA541, Multivariate Statistical Models	3
IME634, Design and Analysis of Industrial Experiments	3
IME635, Response Surfaces and Evolutionary Operations	3
Total	54
AMS699, Ph.D. Thesis Research	18
	72

SAMPLE PROGRAM OF STUDY SPECIALIZATION IN STATISTICS

(This program assumes that the student has taken the equivalent of MTH435, MTH436, Introduction to Mathematical Analysis I and II, MTH451, Introduction to Probability and Statistics, and STA409, Statistical Methods in Research I, as an undergraduate.)

<u>Courses</u>	<u>Credit Hours</u>
STA412, Statistical Methods in Research II Replace by another course	3
STA413, Spatial Data Analysis	3
MTH452, Mathematical Statistics	3
STA500, Nonparametric Statistical Methods	3
STA501, Analysis of Variance and Variance Components	3
STA520, Fundamentals of Sampling and Applications	3
STA541, Multivariate Statistical Methods	3
CSC550, Computer Algebra	4
STA599, Master's Thesis Research	5
(M.S. in STA)	30
STA502, Applied Regression Analysis	3
STA591, Directed Study in Statistics (Statistical Computations)	3
STA611, Linear Statistical Models	3
MTH513, Linear Algebra	3
MTH535, Measure Theory and Integration	3
MTH551, Mathematical Statistics	3
CSC525, Simulation	3
IME634, Design and Analysis of Industrial Experiments	3
Total	54
AMS699, Ph.D. Thesis Research	18
	72