Ph.D. in Mathematical Sciences

Degree Requirements

Applied Mathematics Track (NJIT)

Students choosing the applied mathematics track must fulfill the requirements for the doctor of philosophy as specified in this catalog. Specific courses of study are planned in consultation with a faculty advisor and are subject to approval. In general, students are encouraged to take courses both in mathematics and in areas of application.

Seminar: In addition to the minimum degree credits required, all doctoral students must enroll each semester in MATH 791 Graduate Seminar.

Courses: A typical schedule of courses for the first four semesters in Applied Mathematics consists of the following:

Semester I		**Term Credits**
MATH 599	Teaching in Mathematics	3
MATH 613	Advanced Applied Mathematics I: Modeling [1]	3
MATH 631	Linear Algebra [2]	3
MATH 645	Analysis I [3]	3
MATH 651	Methods of Applied Mathematics I [1]	3
	Term Credits	**15**
Semester II		
MATH 614	Numerical Methods I [2]	3
MATH 656	Complex Variables I [3]	3
MATH 689	Advanced Applied Mathematics II: Ordinary Differential Equations	3
MATH 745	Analysis II [3]	3
	Term Credits	**12**
Semester III		
MATH 671	Asymptotic Methods I	3
MATH 676	Advanced Ordinary Differential Equations	3
MATH 690	Advanced Applied Mathematics III: Partial Differential Equations	3
MATH 712	Numerical Methods II	3
	Term Credits	**12**
Semester IV		
MATH 707	Advanced Applied Mathematics IV: Special Topics (Advanced Applied Mathematics IV)	3
MATH 713	Advanced Scientific Computing: Multi-Dimensional Finite-Difference Schemes and Spectral Methods	3
MATH 756	Complex Variables II	3
Course from Natural Sciences or Engineering relevant to student's interests.		3
	Term Credits	**12**
	Total Credits	**51**

1 Helps to prepare for applied mathematics preliminary examination.

2 Helps to prepare for linear algebra-numerical methods preliminary examination.

3 Helps to prepare for analysis preliminary examination.

In addition to these courses, there are advanced courses in:

Mathematical Fluid Dynamics I and Mathematical Fluid Dynamics II		
MATH 715	Mathematical Fluid Dynamics I	3
MATH 716	Mathematical Fluid Dynamics II	3
Mathematical Biology		
MATH 637	Foundations of Mathematical Biology	3
MATH 672	Biomathematics I: Biological Waves and Oscillations	3
MATH 673	Biomathematics II: Pattern Formation in Biological Systems	3
Wave Propagation		

MATH 722	Wave Propagation	3
Asymptotic Methods II		
MATH 771	Asymptotic Methods II	3
Mathematical Modeling II		
MATH 639	Mathematical Modeling II	3
Partial Differential Equations		
MATH 675	Partial Differential Equations	3
Inverse Problems and Global Optimization		
MATH 717	Inverse Problems and Global Optimization	3

Also, there are special topics courses in:

- computational electromagnetics
- computational fluid dynamics
- computational neuroscience
- financial mathematics
- integral equations
- materials science
- microwave processing of materials
- courses in probability and statistics

Qualifying Examination

The qualifying examination for the applied mathematics track consists of a preliminary examination in three parts and an oral examination. The three components of the preliminary examination are: Applied Mathematics, Analysis, and Linear Algebra-Numerical Methods. Students must achieve a grade of A in each component to pass the preliminary examination and proceed to the oral examination. Components may be passed at different times. However, a student may attempt each component at most twice and must pass all three components before taking the oral examination. The qualifying examination must be passed by the end of the second year in the program. Typically, two opportunities to take each component are provided each year: Applied Mathematics (January and May), Analysis and Linear Algebra-Numerical Methods (May and August). The oral examination is usually offered in January and May.

Topics for the oral examination are:

1. Applied Mathematics, based on the courses MATH 689 Advanced Applied Mathematics II: Ordinary Differential Equations and MATH 690 Advanced Applied Mathematics III: Partial Differential Equations
2. choice of two out of the following three:
   a. Ordinary Differential Equations, based on MATH 676 Advanced Ordinary Differential Equations
   b. Asymptotic Methods, based on MATH 671 Asymptotic Methods I
   c. Numerical Methods, based on MATH 614 Numerical Methods I and MATH 712 Numerical Methods II

It should be noted that taking the above courses is not mandatory but students are strongly encouraged to take them before attempting the qualifying examinations. The scope of the qualifying examinations is not limited to the specific list of topics covered in these courses, but these topics are indicative of the overall scope of the examinations.

Dissertation Committee

The dissertation committee is an important resource for the doctoral student in the conduct of research for their dissertation. According to the regulations specified in this catalog, doctoral students are required to have a dissertation advisor selected, a dissertation committee formed, and research proposal approved within one year of passage of the qualifying examination.

Dissertation Proposal

Doctoral students must prepare a research proposal for approval by their dissertation committee. The student must offer an oral defense of this proposal before the dissertation committee and obtain its approval within one year of passing the qualifying examination. The committee determines if the proposal has an appropriate objective, if there is a reasonable plan to reach that objective, and if the student possesses the knowledge and skills needed to carry out the plan. The dissertation proposal can only be approved by unanimous consent of the committee members.

Dissertation Defense

A public oral defense of the dissertation before the dissertation committee is required. All members of the committee must be present for the defense. Success of the defense is determined by a majority vote of the dissertation committee.

Applied Probability and Statistics Track (NJIT)

Students choosing the applied probability and statistics track must fulfill the requirements for the doctor of philosophy as specified in this catalog. Specific courses of study are planned in consultation with a faculty graduate advisor and are subject to approval. In general, students are encouraged to take courses both in mathematics and in areas of application.

Seminar: In addition to the minimum degree credits required, all doctoral students must enroll each semester in MATH 791 Graduate Seminar

Courses: A typical schedule of courses for the first four semesters in Applied Probability and Statistics consists of the following:

Semester I		**Term Credits**
MATH 599	Teaching in Mathematics	3
MATH 631	Linear Algebra	3
MATH 644	Regression Analysis Methods [1]	3
MATH 645	Analysis I [2]	3
MATH 662	Probability Distributions [1]	3
	Term Credits	**15**
Semester II		
MATH 665	Statistical Inference [2]	3
MATH 699	Design and Analysis of Experiments [3]	3
MATH 745	Analysis II [2]	3
MATH 768	Probability Theory [3]	3
	Term Credits	**12**
Semester III		
MATH 659	Survival Analysis	3
MATH 691	Stochastic Processes with Applications	3
MATH 707	Advanced Applied Mathematics IV: Special Topics	3
Course in statistics/mathematics/engineering/computing sciences relevant to student's interest		3
	Term Credits	**12**
Semester IV		
MATH 664	Methods for Statistical Consulting	3
MATH 698	Sampling Theory	3
Two Courses in statistics/mathematics/engineering/computer science relevant to student's interest		6
	Term Credits	**12**
	Total Credits	**51**

1. Helps to prepare for probability distributions and regression analysis methods preliminary examination.
2. Helps to prepare for real analysis and statistical inference preliminary examination.
3. Helps to prepare for probability theory and design and analysis of experiments preliminary examination.

In addition to these courses, there are advanced courses in:

Time Series Analysis		
MATH 646	Time Series Analysis	3
Clinical Trials Design and Analysis		
MATH 654	Clinical Trials Design and Analysis	3
Statistical Reliability Theory and Applications		
MATH 761	Statistical Reliability Theory and Applications	3
Large Sample Theory and Inference		
MATH 786	Large Sample Theory and Inference	3
Non-Parametric Statistics		
MATH 787	Non-Parametric Statistics	3

Qualifying Examination

The qualifying examination for the applied probability and statistics track consists of a preliminary examination in three parts and an oral examination. The three components of the preliminary examination are: Probability Distributions and Regression Analysis Methods, Real Analysis and Statistical

Inference, Probability Theory and Design and Analysis of Experiments. Students must achieve a grade of A in each component to pass the preliminary examination and proceed to the oral examination. Components may be passed at different times. However, a student may attempt each component at most twice and must pass all three components before taking the oral examination. The qualifying examination must be passed by the end of the second year in the program. Typically, two opportunities to take each component are provided each year: Probability Distributions and Regression Analysis Methods (January and May), Real Analysis and Statistical Inference and Probability Theory and Design and Analysis of Experiments (May and August). The oral examination is usually offered in January and May.

Topics for the oral examination are:

1. Stochastic Processes, based on MATH 691 Stochastic Processes with Applications
2. Survival Analysis, based on MATH 659 Survival Analysis
3. Generalized Linear Models, based on MATH 707 Advanced Applied Mathematics IV: Special Topics.

It should be noted that taking the above courses is not mandatory but students are strongly encouraged to take them before attempting the qualifying examinations. The scope of the qualifying examinations is not limited to the specific list of topics covered in these courses, but these topics are indicative of the overall scope of the examinations.

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Dissertation Defense

A public oral defense of the dissertation before the dissertation committee is required. All members of the committee must be present for the defense. Success of the defense is determined by a majority vote of the dissertation committee.

Pure Mathematics Track (Rutgers-Newark)

Students interested in the Pure Mathematics track should contact the Department of Mathematics and Computer Science at Rutgers-Newark.