DOCTOR OF PHILOSOPHY WITH A MAJOR IN INDUSTRIAL ENGINEERING

All PhD programs must incorporate a standard set of Requirements for the Doctoral Degree.

Students in the Ph.D. with a major in Industrial Engineering program choose a single track from: General Industrial Engineering, Supply Chain Engineering, Statistics, Economic Decision Analysis, and System Informatics & Control.

Each track has specific course requirements. Students are expected to complete the course programs described below prior to candidacy, and many of the courses are recommended to be completed prior to the comprehensive examination. Students seeking to waive a program course requirement must receive permission from the Associate Chair for Graduate Studies. It is not our intent to have students repeat coursework that they may have already mastered during prior graduate degree programs, so please ask for appropriate waivers.

General Industrial Engineering

Code	Title	Credit Hours
Methodology Core (4 courses)		
Group 1 (at least 2 courses)		
ISYE 6661	Linear Optimization	3
ISYE 6662	Discrete Optimization	3
ISYE 6761	Stochastic Processes I	3
ISYE 6832	Simulation Theory and Methods	3
ISYE 6412	Theoretical Statistics	3
ISYE 6414	Statistical Modeling and Regression Analysis	3
ISYE 6416	Computational Statistics	3
ISYE 6740	Computational Data Analysis: Learning, Mining, and Computation	3
Group 2		
ECON 7012	Microeconomic Theory I	3
ECON 7013	Microeconomic Theory II	3
CSE 6140	Computational Science and Engineering Algorithms	3
CS 6550	Design and Analysis of Algorithms	3
ISYE 6402	Time Series Analysis	3
ISYE 6412	Theoretical Statistics	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6420	Introduction to Theory and Practice of Bayesian Statistics	3
ISYE 6663	Nonlinear Optimization	3
ISYE 6664	Stochastic Optimization	3
ISYE 6679	Computational Methods in Optimization	3
ISYE 6761	Stochastic Processes I	3
ISYE 7401	Advanced Statistical Modeling	3
ISYE 7405	Multivariate Data Analysis	3
ISYE 7406	Data Mining and Statistical Learning	3
ISYE 7661	Theory of Linear Inequalities	3
ISYE 7682	Convexity	3
ISYE 7683	Advanced Nonlinear Programming	3
ISYE 7686	Advanced Combinatorial Optimization	3
ISYE 7687	Advanced Integer Programming	3
ISYE 8813	Special Topics in Operations Research (Constraint Programming)	3
ISYE 8813	Special Topics in Operations Research (Game Theory)	3
Domain Core (at least 3 courses)		
HS 6000	Introduction to Healthcare Delivery	3
ISYE 6201	Manufacturing Systems	3
ISYE 6202	Warehousing Systems	3
ISYE 6203	Transportation and Supply Chain Systems	3
ISYE 6225	Advanced Engineering Economy	3
ISYE 6227	Introduction to Financial Engineering	3
ISYE 6230	Economic Decision Analysis	3
ISYE 6320	Public Impact Applications of Operations Research and Management Science	3
ISYE 6421	Biostatistics	3
ISYE 6673	Financial Optimization Models	3
ISYE 6785	The Practice of Quantitative and Computational Finance	3
ISYE 7201	Production and Service Systems Engineering	3
ISYE 7203	Logistics Systems Engineering	3
ISYE 7205	Inventory Theory	3
ISYE 8813	Special Topics in Operations Research (On Life Cycle Assessment)	3
Technical Elective (3 courses) [1,2]		

1 Decided in consultation with advisor.

2 Up to two technical electives may double-count toward satisfying the minor requirement

Comprehensive Exam

The General Industrial Engineering comprehensive exam has two parts:

1. Written exam: Students have to select any two courses from Group 1 methodology core of General Industrial Engineering track. They are required to solve one question each from these 2 topics. Both questions are to be solved in one three hour exam.
2. Research paper: The research paper must be submitted by the day of the exam. The paper must be:

- Written 100% by the student. (The student may mention the name of faculty/student collaborator.)
- No more than 10 pages (excluding references), font size 11, margin at least 1 inch.
- The first page should contain the title, the research collaborators, and a short abstract.
- The introduction should be a broadly accessible to a non-expert and contain exposition of the main goals, ideas and techniques, including motivation and a clear literature survey (The entire paper can be a literature survey paper).

Supply Chain Engineering

Code	Title	Credit Hours
Methodology Core (4 courses)		
Group 1 (at least 2 courses)		
ISYE 6661	Linear Optimization	3
ISYE 6662	Discrete Optimization	3
ISYE 6761	Stochastic Processes I	3
ISYE 6832	Simulation Theory and Methods	3
Group 2		
ISYE 6230	Economic Decision Analysis	3
ISYE 6412	Theoretical Statistics	3
ISYE 6414	Statistical Modeling and Regression Analysis	3
ISYE 6663	Nonlinear Optimization	3
ISYE 6664	Stochastic Optimization	3
ISYE 6740	Computational Data Analysis: Learning, Mining, and Computation	3
ISYE 7682	Convexity	3
ISYE 7683	Advanced Nonlinear Programming	3
ISYE 7686	Advanced Combinatorial Optimization	3
ISYE 7687	Advanced Integer Programming	3
ISYE 8813	Special Topics in Operations Research (Constraint Programming)	3
Domain Core (3 courses)		
Group 1 (at least 2 courses)		
ISYE 6202	Warehousing Systems	3
ISYE 7201	Production and Service Systems Engineering	3
ISYE 7203	Logistics Systems Engineering	3
ISYE 7205	Inventory Theory	3
Group 2		
ISYE 6201	Manufacturing Systems	3
ISYE 6203	Transportation and Supply Chain Systems	3
ISYE 6320	Public Impact Applications of Operations Research and Management Science	3
Computational Core (1 course) [1]		
ISYE 6679	Computational Methods in Optimization	3
CSE 6140	Computational Science and Engineering Algorithms	3
CS 6550	Design and Analysis of Algorithms	3
Technical Elective (2 courses) [2,3]		

1 Computational core may be chosen from the list above or can be other graduate-level courses related to the major area of study.
2 Decided in consultation with advisor.
3 Up to two technical electives may double-count toward satisfying the minor requirement

Comprehensive Exam

The Supply Chain Engineering comprehensive exam has two parts:

1. Written exam: Students have to select any two courses from Group 1 methodology core of Supply Chain Engineering track. They are required to solve one question each from these 2 topics. Both questions are to be solved in one three hour exam.
2. Research paper: The research paper must be submitted by the day of the exam. The paper must be:
   - Written 100% by the student. (The student may mention the name of faculty/student collaborator.)
   - No more than 10 pages (excluding references), font size 11, margin at least 1 inch.
   - The first page should contain the title, the research collaborators, and a short abstract.
   - The introduction should be a broadly accessible to a non-expert and contain exposition of the main goals, ideas and techniques, including motivation and a clear literature survey (The entire paper can be a literature survey paper).

Statistics

Code	Title	Credit Hours
Domain Core (4 courses)		
ISYE 6412	Theoretical Statistics	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6416	Computational Statistics	3
ISYE 7401	Advanced Statistical Modeling	3
Statistics Electives (4 courses)		
ISYE 6402	Time Series Analysis	3
ISYE 6404	Nonparametric Data Analysis	3
ISYE 6420	Introduction to Theory and Practice of Bayesian Statistics	3
ISYE 6421	Biostatistics	3
ISYE 6740	Computational Data Analysis: Learning, Mining, and Computation	3
ISYE 6781	Reliability Theory	3
ISYE 6783	Statistical Techniques of Financial Data Analysis	3
ISYE 6805	Reliability Engineering	3
ISYE 7400	Advanced Design of Experiments	3
ISYE 7405	Multivariate Data Analysis	3
ISYE 7406	Data Mining and Statistical Learning	3
Technical Electives (2 courses) [1,2]		
ISYE 6661	Linear Optimization	3
ISYE 6662	Discrete Optimization	3
ISYE 6663	Nonlinear Optimization	3
ISYE 6664	Stochastic Optimization	3
ISYE 6761	Stochastic Processes I	3
ISYE 6762	Stochastic Processes II	3
ISYE 6832	Simulation Theory and Methods	3
ISYE 6810	Systems Monitoring and Prognostics	3
ISYE 7204	Informatics in Production & Service Systems	3
MATH 6014	Graph Theory and Combinatorial Structures	3
MATH 6241	Probability I	3
MATH 6242	Probability II	3
MATH 6643	Numerical Linear Algebra	3
CS 6550	Design and Analysis of Algorithms	3
CS 7520	Approximation Algorithms	3
CS 7530	Randomized Algorithms	3

CS 7545	Theoretical Foundations of Machine Learning	3
ECE 6254	Statistical Machine Learning	3

All ten courses satisfying the above requirement in the Program of Study must be completed to obtain doctoral candidacy.

1 Other PhD-level Mathematics, Computer Science, or Machine Learning courses by permission of the Associate Chair for Graduate Studies
2 Two of the Technical Electives courses may double-count to the Minor if they are part of a cogent Minor approved by the Associate Chair for Graduate Studies

Comprehensive Exam
The comprehensive exam for the Statistics track is based on all four domain courses.

Economic Decision Analysis

Code	Title	Credit Hours
Operations Research Core (3 courses)		
ISYE 6661	Linear Optimization	3
ISYE 6662	Discrete Optimization	3
ISYE 6663	Nonlinear Optimization	3
ISYE 6761	Stochastic Processes I	3
Economic Decision Analysis Core (3 courses)		
ISYE 6225	Advanced Engineering Economy	3
ISYE 6230	Economic Decision Analysis	3
ISYE 8813	Special Topics in Operations Research (Game Theory)	3
ECON 7012	Microeconomic Theory I	3
ECON 7013	Microeconomic Theory II	3
Statistics Core (1 course)		
ISYE 6402	Time Series Analysis	3
ISYE 6421	Biostatistics	3
Breadth Elective (at least 1 course)		
ISYE 6227	Introduction to Financial Engineering	3
ISYE 6673	Financial Optimization Models	3
ISYE 6785	The Practice of Quantitative and Computational Finance	3
ISYE 7201	Production and Service Systems Engineering	3
ISYE 7203	Logistics Systems Engineering	3
HS 6000	Introduction to Healthcare Delivery	3
CS 7525	Algorithmic Game Theory and Economics	3
Technical Elective (2 courses) [1,2]		

1 Decided in consultation with advisor.
2 Up to two technical electives may double-count toward satisfying the minor requirement

Comprehensive Exam
The Economic Decision Analysis comprehensive exam has two parts:

1. Written exam: Students have to select any two courses from Group 1 methodology core of Economic Decision Analysis track. They are required to solve one question each from these 2 topics. Both questions are to be solved in one three hour exam.
2. Research paper: The research paper must be submitted by the day of the exam. The paper must be:
   - Written 100% by the student. (The student may mention the name of faculty/student collaborator.)
   - No more than 10 pages (excluding references), font size 11, margin at least 1 inch.
   - The first page should contain the title, the research collaborators, and a short abstract.
   - The introduction should be a broadly accessible to a non-expert and contain exposition of the main goals, ideas and techniques, including motivation and a clear literature survey (The entire paper can be a literature survey paper).

System Informatics and Control

Code	Title	Credit Hours
Domain Core (3 courses)		
ISYE 6384	Advanced Manufacturing	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6810	Systems Monitoring and Prognostics	3
ISYE 7201	Production and Service Systems Engineering	3
ISYE 7204	Informatics in Production & Service Systems	3
or ISYE 640	Statistical Methods for Manufacturing Design and Improvement	
ISYE 8803	Special Topics (High Dimensional Data Analytics)	3
ISYE 8803	Special Topics (Domain Aware Statistical Learning)	3
Methods Core (3 courses)		
ECE 6270	Convex Optimization: Theory, Algorithms, and Applications	3
ISYE 6384	Advanced Manufacturing	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6661	Linear Optimization	3
ISYE 6740	Computational Data Analysis: Learning, Mining, and Computation	3
ISYE 6761	Stochastic Processes I	3
ISYE 6810	Systems Monitoring and Prognostics	3
ISYE 7201	Production and Service Systems Engineering	3
ISYE 7204	Informatics in Production & Service Systems	3
ISYE 7406	Data Mining and Statistical Learning	3
ISYE 7750	Mathematical Foundations of Machine Learning	3
ISYE 8803	Special Topics (High Dimensional Data Analytics)	3
ISYE 8803	Special Topics (Domain Aware Statistical Learning)	3
Methods Breadth (4 or more courses)		
Select courses from two or more of the six focus areas:		
Machine Learning and AI		
CS 6476	Introduction to Computer Vision GR	3
CS 6601	Artificial Intelligence	3
CS 7450	Information Visualization	3
CS 7643	Deep Learning	3
CS 7650	Natural Language	3

CS 7751	Probabilistic Graphical Models in Machine Learning	3
or ISYE 7751	Probabilistic Graphical Models in Machine Learning	
or CSE 7751	Probabilistic Graphical Models in Machine Learning	
CS 8803	Special Topics (Machine Learning with Limited Supervision)	3
CS 8803	Special Topics (Statistical Machine Learning Models for Neural/Behavioral Data)	3
Stochastics and Simulation		
ISYE 6644	Simulation	3
ISYE 6832	Simulation Theory and Methods	3
ISYE 6656	Queuing Theory	3
ISYE 6762	Stochastic Processes II	3
Statistics		
ISYE 6402	Time Series Analysis	3
ISYE 6405	Statistical Methods for Manufacturing Design and Improvement	3
ISYE 6412	Theoretical Statistics	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6420	Introduction to Theory and Practice of Bayesian Statistics	3
ISYE 7401	Advanced Statistical Modeling	3
ISYE 7405	Multivariate Data Analysis	3
ECE 6555	Optimal Estimation	3
Computing and Algorithms		
ISYE 6679	Computational Methods in Optimization	3
ISYE 6416	Computational Statistics	3
CS 6550	Design and Analysis of Algorithms	3
Dynamics and Control		
ECE 6120		3
ECE 6550	Linear Systems and Controls	3
ECE 6551	Digital Control	3
ECE 6552	Nonlinear Systems and Control	3
ECE 6553	Optimal Control and Optimization	3
ECE 6554	Adaptive Control	3
ECE 6556		3
ECE 6559	Advanced Linear Systems	3
ME 6401	Linear Control Systems	3
ME 6402	Nonlinear Control Systems	3
ME 6403	Digital Control Systems	3
ME 6404	Advanced Control System Design and Implementation	3
ME 6443	Variational Methods in Engineering	3
Optimization		
ISYE 6662	Discrete Optimization	3
ISYE 6663	Nonlinear Optimization	3
ISYE 6664	Stochastic Optimization	3
Applications		
ISYE 6201	Manufacturing Systems	3
ISYE 6202	Warehousing Systems	3
ISYE 6203	Transportation and Supply Chain Systems	3
ECE 6557		3
ME 6222	Manufacturing Processes and Systems	3
ME 6223	Automated Manufacturing Process Planning	3
ME 6225	Metrology and Measurement Systems	3
ME 6754	Engineering Database Management Systems	3

Comprehensive Exam

The comprehensive exam for System Informatics and Control is based on all three domain courses.

Dissertation Research Proposal (for all tracks)

The first step toward completing a final dissertation is to receive formal approval of a dissertation research topic. This is accomplished via the Dissertation Research Proposal. Students must present their dissertation research proposal to the Thesis Advisory Committee no later than the end of Spring semester of the student's third full year in the program.

Each Ph.D. student must prepare a cogent, self-contained written research proposal that should describe the research to be addressed, demonstrate an understanding of existing work, describe intended research approaches, and present initial and anticipated results. The student must deliver this proposal, along with an oral presentation, to his/her committee. The content expected in the written research proposal should be discussed with the research advisor and committee members.

If judged to be satisfactory, the Thesis Advisory Committee members must sign the appropriate section of the Request for Admission to Ph.D. Candidacy form approving the thesis topic. Each member of the committee must also complete the Dissertation Proposal

Assessment Form, available on the ISyE website. The student should bring copies of all forms to the proposal presentation and is responsible for returning all forms to the Academic Programs Office. A student must present the thesis proposal at least one semester prior to the Final Doctoral Examination.

A student who fails to obtain approval of his/her thesis proposal must modify the existing proposal, and if required by the Thesis Advisory Committee, must defend the modified proposal in a subsequent oral presentation. If this second thesis proposal is not successful, the student will have not more than 6 months to identify a new research topic and if necessary a new research advisor, and to report this information to the Associate Chair for Graduate Studies. Failing to do so will prevent a student from continuing in the program.

Dissertation (for all tracks)

The primary requirement of a Ph.D. program is the completion of a dissertation, a written work documenting the research findings of a searching and authoritative investigation of a topic in the chosen primary field of study. The dissertation must either extend the boundaries of fundamental knowledge in a field or provide a new and better understanding or interpretation of facts already known. It should demonstrate that the candidate possesses powers of original thought, a talent for scholarship and research, and an ability to organize and present his/her findings.

Georgia Tech Graduate Studies maintains a website that discusses policies and requirements for Ph.D. dissertations at Georgia Tech.

Minor (for all tracks)

The minor will follow the standard Georgia Tech requirement: 6 hours outside the student's home unit with a letter grade of 'C' or higher. The courses for the minor should form a cohesive program of study that is

approved by the ACGS. Courses selected from the breadth requirements can be used to count toward the Minor.