AST Ph.D. Curriculum Guide Effective 2019-2020

Applied Science and Technology, Ph.D.

College of Science and Technology
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The mission of the Applied Science & Technology Ph.D. program is to prepare students for high-level science and technology careers in industry, research, and government. Graduates will be able to conceive, develop, and conduct original research that applies physical, mathematical, and technological methods to provide solutions to a broad range of emerging local, national, and global problems related to Atmospheric, Environmental and Energy Science; Applied Physics; Bioscience; Applied Chemistry; Data Science and Analytics; Applied Engineering Technology; Information Technology; Technology Management; and Geomatics.

Admission Requirements
- B.S. degree in a science, technology, engineering, math (STEM) or related discipline with a GPA≥3.5/4.0 or a M.S. degree in a science, technology, engineering, math (STEM) or related discipline with a GPA≥3.25/4.0 from a college or university recognized by a regional or general accrediting agency
- GRE verbal and quantitative scores, no minimum score requirement

Program Outcomes
- Communication Skills – Students completing the Applied Science & Technology Ph.D. program will exhibit effective oral communication skills in terms of customizing presentations to the audience, displaying information, and delivering the presentations.
- Critical Thinking Skills - Students completing the Applied Science & Technology Ph.D. program will effectively use quantitative and qualitative analytical problem-solving skills in terms of defining hypotheses/research questions, reviewing research literature, developing a research plan, identifying the broader impacts of research, and developing a research timetable.
- Disciplinary Expertise - Students completing the Applied Science & Technology Ph.D. program will demonstrate discipline-specific expertise in terms of the scientific method, applying technical knowledge to answer research questions, experimental plans and data analysis, analytical methods, and research ethics.
- Research/Creative Engagement - Students completing the Applied Science & Technology Ph.D. program will demonstrate ability to engage productively in the review and conduct of disciplinary research in terms of making conference presentations and publishing refereed journal publications.

Degree Requirements
Total credit hours: 66 (post B.S.), 42 (post M.S.)
- Core courses (9 credits): AST 830 (Foundations of Scientific Research), AST 831 (Math and Computational Modeling), MATH 721 (Multivariate Statistical Analysis)
- Seminar (6 credits post B.S., 3 credits post M.S.): Take AST 992 (Doctoral Seminar) six times in six semesters
- Dissertation (15 credits): AST 997 (Doctoral Dissertation)
- Pass qualifying exam, preliminary exam, and dissertation defense
- In consultation with advisor, take 18 credit hours (15 post M.S.) within one of the following concentrations:

- o Applied Chemistry
- o Applied Physics
- o Atmospheric, Environmental and Energy Science
- o Bioscience
- o Data Science and Analytics
- o Information Technology and Technology Management
- o General – no specified concentration
- In consultation with advisor, take 18 credit hours (post B.S.) of additional courses relevant to research area

Concentration Courses
For each program concentration, students will typically take courses that are included in the following lists with additional courses possible with approval of research adviser and program director:

Applied Chemistry

CHEM 611	Advanced Inorganic Chemistry
CHEM 621	Intermediate Organic Chemistry
CHEM 624	Qualitative Organic Chemistry
CHEM 631	Electroanalytical Chemistry
CHEM 641	Instrumentation of the Modern Sciences
CHEM 642	Techniques in X-ray Crystallography
CHEM 643	Introduction to Quantum Mechanics
CHEM 651	General Biochemistry
CHEM 652	General Biochemistry Lab
CHEM 673	Introduction to Computational Chemistry
CHEM 674	Computational Methods/Protein Modeling Drug Design
CHEM 716	Selected Topics in Inorganic Chemistry
CHEM 722	Advanced Organic Chemistry
CHEM 732	Advanced Analytical Chemistry
CHEM 743	Chemical Thermodynamics
AST 812	Environmental Chemistry
BMEN 711	Biomaterials and Biocompatibility
ECEN 701	Electronic Ceramics
NANO 701	Simulation Modeling Methods in Nanoscience and Nanoengineering
NANO 702	Fundamentals of Nanoengineering Physical Principles
NANO 703	Fundamentals of Nanoengineering Chemical and Biochemical Principles
NANO 704	Fundamentals of Nanomaterials
NANO 705	Nano Safety
NANO 711	Introduction to Nanoprocessing
NANO 721	Nanobioelectronics
NANO 731	Introduction to Nanomodeling and Applications
NANO 811	Polymeric Materials Engineering
NANO 812	Process Modeling in Composites
NANO 821	Advanced Nanosystems
NANO 851	Computational Nano Modeling Lab
NANO 852	Nanoelectronics Laboratory
NANO 853	Nano-Bio Electronics Lab
NANO 854	Nanomaterials Laboratory
NAN 601	Nanochemistry
CHEM 811	Physical Methods for Inorganic Chemistry

CHEM	812	Inorganic Chemical Kinetics and Mechanisms
CHEM	818	Introduction to Soft Matter
CHEM	823	Integrative Medicinal Chemistry
CHEM	827	Organic Structural Spectroscopy
CHEM	833	Biosensors and Bioanalytical Technologies
CHEM	841	Advanced Mass Spectrometry Instrumentation
CHEM	856	Protein Structure and Function
CHEM	885	Special Topics
NAN	615	Intro Spectroscopy Methods in Nanoscience
NAN	630	Advances in Nano-biosensors
NAN	705	Macromolecular and Supramolecular Chemistry Nanoscience
NAN	730	Nanoscale Reactions
NAN	771	Computational Quantum Nanochemistry

Applied Physics

PHYS	600	Classical Mechanics
PHYS	605	Mathematical Methods
PHYS	615	Fundamentals of Electromagnetic Theory
PHYS	620	Quantum Mechanics I
PHYS	630	Statistical Mechanics
PHYS	715	Advanced Electromagnetic Theory
PHYS	720	Quantum Mechanics II
PHYS	730	Optical Properties of Matter
PHYS	737	Physics of Solids
PHYS	738	Nuclear Physics
PHYS	745	Computational Physics
PHYS	746	Methods in Radiation Detection and Measurement
PHYS	843	Experimental Methods
PHYS	850	Quantitative Analysis in Biophysics
PHYS	885	Special Topics
NAN	603	Nanophysics

Atmospheric, Environmental and Energy Science

AST	812	Environmental Chemistry
AST	813	Sustainable Energy Systems
AST	814	Life Cycle Analysis
AST	821	Environmental Energy Econometrics I
AST	841	Biomaterials Characterization
AST	842	Biomass Thermal Conversion Processes
AST	843	Biomass Biological Conversion Processes
AST	844	Environmental and Policy Studies of Biomass Use
AST	850	Physical Meteorology
AST	851	Dynamic Meteorology
AST	852	Climatology
AST	853	Numerical Weather Prediction
AST	854	Advanced Synoptic Weather Analysis
AST	855	Principles of Air Quality
AST	856	Atmospheric Aerosols
AST	857	Advanced Remote Sensing
AST	858	Tropical Meteorology
AST	859	Advanced Mesoscale Analysis

AST	885	Special Topics
NANO	761	Introduction to Nano Energy
NANO	861	Advanced Nano Energy Systems
CM	704	Special Topics in Renewable Energy Technology
CM	679	Environmental Issues in Construction Management
EPT	687	Electrical Power Generation using Nuclear Technology

Bioscience

BIOL	615	Principles of Virology
BIOL	630	Molecular Genetics
BIOL	640	Introduction to Bioinformatics and Genomic Research
BIOL	651	Principles and Practice of Immunology
BIOL	700	Environmental Biology
BIOL	703	Experimental Methods Biology
BIOL	704	Cell and Molecular Biology
BIOL	720	Environmental Influences
BIOL	749	Recent Advances in Cell Biology
BIOL	762	Molecular Pathogenesis of Cancer
AST	843	Biomass Biological Conversion Processes
ANSC	771	Bioinformatics Genome Analysis
ANSC	782	Cellular Pathobiology
BMEN	713	Biotechnology Entrepreneurship
BIOL	830	Advanced Techniques in Integrative Biosciences
BIOL	831	Cellular and Molecular Biology of Disease
BIOL	832	Microbial Pathogenesis
BIOL	833	Recent Advances in Immunology
BIOL	834	General Physiology I
BIOL	835	General Physiology II
BIOL	855	Advances in Systems Biology
BIOL	885	Special Topics
STAT	824	Biostatistics Health Analytics
NAN	602	Nanobiology
NAN	620	Immunology Nanoscience
NAN	625	Molecular Biology in Nanosciences
NAN	626	Introduction to Stem Cell Biology and Ethics
NAN	745	Nanoimaging
NAN	750	Nanomedicine

Data Science and Analytics

MATH	612	Advanced Linear Algebra
MATH	623	Probability Theory and Applications
MATH	624	Theory and Methods of Statistics
MATH	665	Principles of Optimizations
MATH	675	Graph Theory
MATH	690	Scientific Programming for Mathematical Scientists
MATH	706	Categorical Data Analysis
STAT	707	Introduction to Data Science
STAT	708	Linear Models for Data Science
MATH	709	Disc and Combi Math for Data Sci
STAT	710	Statistical and Deep Learning
STAT	711	Stat Comp & Algorithm Analysis

MATH 712 Numerical Linear Algebra
STAT 719 Statistical Computing and Algorithm Design & Analysis
MATH 721 Multivariate Statistical Analysis
MATH 723 Advanced Topics Stochastic Modeling
MATH 733 Advanced Probability and Stochastic Processes
MATH 782 Statistical Data Analytics and Visualization
CST 764 Advanced Big Data Analytics
COMP 751 Data Analytics Tools and Techniques
COMP 765 Data Mining
STAT 808 Advanced Regression Methods for Data Science
STAT 823 Time Series Analysis Business Analytics
STAT 824 Biostatistics Health Analytics
MATH 885 Special Topics
NAN 605 Mathematical Methods

Information Technology and Technology Management

AET	710	Manufacturing Materials
AET	720	Industrial Economics
AET	721	Industrial Operational Management
AET	735	Manufacturing Organization and Management
AET	745	Managing New Product Development
AET	755	Production Management and Control
AET	760	Advanced CNC Machines
AET	770	Managing Total Quality Systems
AET	772	Strategic Concepts in Quality
AET	780	Reliability Testing and Analysis
MSTM	701	Strategic Management of Technology and Innovation
MSTM	702	Enterprise Resource Plan Systems
MSTM	703	Statistics and Probability in Technology Management
MSTM	704	Research Methods for Technology Management
MSTM	705	Advanced Applied Statistics and Probability
MSTM	779	Statistical Research in Technology Management
LAND	682	Sustainable Development and Construction
LAND	683	Planning and Development of Energy-Efficient Affordable Housing
LAND	705	Sustainable Planned Communication
LAND	781	Risk Management in Construction
CM	700	Ethical & Professional Issues in Construction Management
CM	705	Human Resource Development in Construction Management
CM	708	Construction Cost Estimating & Project Controls
CM	710	Advanced Construction Practices & Organization
CM	715	Productivity & Methods Improvement in Construction Management
CM	720	Construction Contracts Administration
CM	750	Research Methods in Construction
CM	764	Risk Management in Construction
CM	780	Emerging Trends in CM of International Projects
CM	785	Construction Economics
CM	786	Construction Trends & Analysis
CST	700	Project Management for IT Professionals
CST	702	Statistical Methods
CST	714	Reconfigurable Computing
CST	717	Health Informatics System Architecture

CST	725	Wide Area Networks
CST	729	Data Warehousing
CST	731	Knowledge Discovery Systems
CST	735	Telecom Management Issues
CST	745	Network Services for the Enterprise
CST	750	Computer System Security
CST	752	Advanced Computer Forensics
CST	755	Enterprise Management Systems
CST	760	Intermediate Enterprise Systems
CST	764	Advanced Big Data Analytics
CST	765	Advanced Enterprise System Operation
CST	770	Survey of Virtualization Technology
CST	885	Special Topics
TECH	708	Impacts of Technology
COMP	727	Secure Software Engineering
COMP	823	Secure Social Computing
CSE	703	Data Structure Software Principles & Programming
CSE	806	Computational System Theory
ECEN	885	Advanced Robotic Systems
INEN	833	Supply Chain System Engineering
INEN	861	Nano Micro and Bio Manufacturing
AET	810	Project Management Essentials
AET	820	Managing R&D Process
AET	830	Internet of Things Technology
AET	840	Industrial Fire Protection
AET	885	Special Topics

General

GEOM	612	Applied Geospatial Mthd Anal
GEOM	620	Advanced Computer Applications in Geomatics
GEOM	640	Applied Adjustment Computation
GEOM	650	Land Information Systems and Management
GEOM	660	Applied Geodetic Measurements
GEOM	670	Advanced Boundary Research
GEOM	710	Geospatial Techniques and Analysis
GEOM	720	Advanced Imaging
GEOM	831	Advanced Geospatial Analysis
GEOM	845	Methodologies of Applied Remote Sensing
GEOM	885	Special Topics

EHS	600	Environmental and Occupational Toxicology
EHS	613	Industrial Hygiene Ventilation
EHS	704	Environmental and Occupational Epidemiology
EHS	708	Environmental and Occupational Safety and Health Management
EHS	711	Current Issues in Environmental and Occupational Health
EHS	885	Special Topics
STAT	824	Biostatistics Health Analytics

Dissertation Research

A student may not register for dissertation credits before passing the Qualifying Examination. No more than 15 dissertation credits are counted toward the total credit hours requirement for the degree.

Qualifying Examination
The Qualifying Examination is given to assess the student's competence in a broad range of relevant subject areas. Only students with unconditional status and in good academic standing may take the Qualifying Examination. No student is permitted to take the Qualifying Examination more than twice. A student not recommended for re-examination or who fails the exam on a second attempt may be dismissed from the doctoral program.

Preliminary Oral Examination
The Preliminary Oral Examination is conducted by the student's dissertation committee and is a defense of the student's dissertation proposal. Passing this exam satisfies requirements for Ph.D. Candidacy. Failure on the examination may result in dismissal from the doctoral program. The student's Dissertation Committee may permit one re-examination. At least one full semester must elapse before the re-examination. Failure on the second attempt will result in dismissal from the doctoral program.

Admission to Candidacy
Student will be admitted to candidacy upon successful completion of the Qualifying Exam and the Preliminary Oral Exam.

Final Oral Examination
The Final Oral Examination is conducted by the student's dissertation committee. This examination is the final dissertation defense presentation that is scheduled after a dissertation is completed. The examination may be held no earlier than one semester (or four months) after admission to candidacy. Failure on the examination may result in dismissal from the doctoral program. The student's Dissertation Committee may permit one re-examination. At least one full semester must elapse before the re-examination. Failure on the second attempt will result in dismissal from the doctoral program.

Submission of Dissertation
Upon passing the Ph.D. Final Oral Examination, the Ph.D. student must have the dissertation approved by each member of the student's Dissertation Committee. The approved dissertation must be submitted to The Graduate College by the deadline given in the academic calendar and must conform to the Graduate College's guidelines for theses and dissertations.