APPENDIX D: PH.D. COURSES (UPDATED JULY 2020)

Appendix D.1 Mathematics Courses

Students must complete one Mathematics Fundamentals course from the list below and one Mathematics Specialization course from the list below for the Ph.D. degree. No other Notre Dame courses will be accepted. Mathematics courses taken at another University as part of an awarded M.S. degree and transferred to Notre Dame may fulfill the mathematics elective requirement.

Mathematics Fundamentals
(*one course from list below*)

Department of Aerospace and Mechanical Engineering
AME 60611 Mathematical Methods I

Department of Mathematics
MATH 60210 Basic Algebra I
MATH 60330 Basic Geometry And Topology
MATH 60350 Basic Real Analysis I
MATH 60370 Basic Complex Analysis I

Mathematics Specialization
(*one course from list below or any additional course from the Mathematics Fundamentals list*)

Department of Aerospace and Mechanical Engineering
AME 60611 Mathematical Methods II
AME 60617 Bayesian Data Assimilation and Parameter-State Estimation in Scientific Computing
AME 60624 Continuum Mechanics
AME 60714 Advanced Numerical Methods
AME 70779 Applied Probability and Statistical Computing Methods for Scientists and Engineers

Department of Mathematics
MATH 60610 Basic Discrete Mathematics
MATH 60620 Optimization
MATH 60650 Basic Partial Differential Equations I
MATH 60670 Differential Geometry I
MATH 60850 Probability

Department of Applied and Computational Mathematics and Statistics
ACMS 60395 Numerical Linear Algebra
ACMS 60630 Nonlinear Dynamical Systems
ACMS 60650 Applied Partial Diff Equations
ACMS 60786 Applied Linear Models
ACMS 60790 Numerical Analysis II
ACMS 60850 Applied Probability
ACMS 60852 Advanced Biostatistical Methods
ACMS 60885 Applied Bayesian Statistics

Department of Civil & Environmental Engineering & Earth Sciences
CE 60123 Probabilistic Methods for Engineers and Scientists

Appendix D.2 Techniques Courses

The following courses are accepted to meet the techniques course requirement for the Ph.D. degree. No other Notre Dame courses will be accepted. Techniques courses taken at another University as part of an awarded M.S. degree and transferred to Notre Dame may fulfill the techniques course requirement with approval by the DGS.

Department of Aerospace and Mechanical Engineering

AME 60541	Finite Element Methods
AME 60614	Numerical Methods
AME 60613	Finite Elements in Engineering
AME 60617	Bayesian Data Assimilation and Parameter-State Estimation in Scientific Computing
AME 60631	Experimental Methods in Fluids
AME 60644	Finite Elements in Structural Mechanics
AME 60714	Advanced Numerical Methods
AME 60735	Advanced Data Analysis Techniques

Department of Computer Science and Engineering

CSE 60113	Numerical Methods and Computation

Department of Mathematics

MATH 60620	Optimization
MATH 60690	Numerical Analysis I
MATH 60790	Numerical Analysis II
MATH 60850	Probability
MATH 60860	Stochastic Modeling
MATH 60920	Probabilistic Aspects of Linear Control and Optimization

Department of Applied and Computational Mathematics and Statistics

ACMS 50051	Numerical PDE Techniques for Scientists and Engineers
ACMS 60395	Numerical Linear Algebra
ACMS 60590	Finite Elements in Engineering
ACMS 60690	Numerical Analysis I
ACMS 60790	Numerical Analysis II
ACMS 60852	Statistical Methods in the Biological and Health Sciences
ACMS 60885	Bayesian Statistics

Department of Civil & Environmental Engineering & Earth Sciences

CE 60123	Probabilistic Methods for Engineers and Scientists
CE 60130	Finite Elements in Engineering
CE 60140	Applied/Computational Probability for Engineers

Department of Electrical Engineering

EE 60563	Probability and Random Processes
EE 60573	Detection and Estimation
EE 80603	Transmission Electron Microscopy

Department of Chemical and Biomolecular Engineering

CBE 60727	Ambient Methods of Surface Characterization

Appendix D.3 Pillar and Core Courses

All non-mathematics graduate courses in AME are organized along five research pillars as outlined below. Courses with an asterisk (*) are considered core courses. Students much complete at least three core courses in a single pillar plus any additional restrictions as listed for that pillar.

Fluid Mechanics and Aerodynamics

*AME 60635	Intermediate Fluid Mechanics
*AME 70731	Viscous Flow Theory
*AME 90935	Turbulence (to be numbered as 70000 after "Viscous Flow Theory")
AME 60630	Intermediate Compressible Flows
AME 60632	Physical Gas Dynamics
AME 60638	Turbine Engine Components
AME 60639	Advanced Aerodynamics
AME 60731	Surface Flow Measurement
AME 77103	Geometric & Physical Optics
AME 77104	Aeroacoustics: Theory & Comp
AME 90936	Computational Fluid Mechanics
AME 90937	Hydrodynamic Stability

Bioengineering

AME 40470	Numerical Methods for Bioengineering (to be renumbered as 60000)
*AME 50571	Biomaterials (to be renumbered as 60000)
*AME 50572	Biomechanics (to be renumbered as 60000)
*AME 60548	Biofabrication
*AME 60671	Orthopaedic Biomechanics
*AME 60672	Cell Mechanics
*AME 60673	Kinematics of Human Motion
*AME 60677	Biomimetic Tissue Engineering
*AME 60678	Biomedical Imaging Modalities
*AME 60679	Nanoparticles in Biomedicine
*AME 60691	Ultrasound Imaging and Signal Processing
*AME 60770	Stem Cell Engineering

Robotics and Dynamics

*AME50551	Introduction to Robotics (to be renumbered as 60000)
*AME50562	Intermediate Controls (to be renumbered as 60000)
*AME 50650	Applied Nonlinear Analysis and Controls (to be renumbered as 60000)
*AME 60623	Analytical Dynamics
*AME 60627	Computational Mechanism Design
*EE 60550	Linear Systems
*EE 60551	Mathematical Programming
AME 60619	Fractional Calculus for Engineers
AME 60654	Advanced Kinematics

Computational Engineering

*AME 60541	Finite Element Methods
*AME 60614	Numerical Methods
*AME 60714	Advanced Numerical Methods
*AME 60741	Computational Nonlinear Solid Mechanics
*AME 70779	Statistical Computing Methods for Scientists & Engineers
*AME 90936	Computational Fluid Mechanics
*ACMS 60212	Advanced Scientific Computing
*ACMS 60690	Numerical Analysis I
*ACMS 60790	Numerical Analysis II
*ACMS 60395	Numerical Linear Algebra
*ACMS 60650	Applied Partial Differential Equations
*CE 60140	Applied/Computational Probability for Engineers

Materials & Thermal Science and Manufacturing **(1 of the 3 required core courses must be an AME course)**

*AME 60624	Continuum Mechanics
*AME 60634	Intermediate Heat Transfer
*AME 60641	Advanced Mechanics of Solids
*AME 60642	Manufacturing Systems

*AME 60643	Additive Manufacturing
*AME 60645	Adv. Mech. Behavior of Materials
*AME 60646	Failure of Materials
*AME 60677	Biomimetic Tissue Engineering
*AME 60679	Nanoparticles in Biomedicine
*AME 60733	Solar Energy: Photovoltaic Systems
*AME 60637	Ionization & Ion Transport (to be renumbered as 70000)
*AME 70791	Molecular Level Modeling for Engineering Applications
*CBE 60547	Modern Methods in Computational Molecular Thermodynamics and Kinetics
*CBE 60561	Structure of Solids
*CBE 60577	Nanoscience and Technology
*CBE 60642	Molecular Thermodynamics
*CBE 60727	Ambient Methods of Surface Characterization
*CHEM 60435	Electrochemistry and Electrochemical Engineering
*CHEM 60610	Organometallic Chemistry
*CHEM 60618	Chemical Crystallography
*CHEM 60641	Statistical Mechanics I
*CHEM 60642	Statistical Mechanics II
*CHEM 60649	Quantum Mechanics
*EE 60548	Electromagnetic Theory
*EE 60556	Fundamentals of Semiconductor Physics
*EE 60566	Solid State Devices
*EE 60647	Alternative Energy Devices and Materials
*EE 60657	Optoelectronic Devices
*EE 60672	Vacuum and SEM Technology
*EE 67055	Introduction to Biophotonics and Biomedical Optics
*EE 80603	Transmission Electron Microscopy
*EE 87039	Quantum Optics and Nanophotonics