Mechanical Engineering, Ph.D.

Curriculum in Doctor of Philosophy – Mechanical Engineering

A candidate for the Ph.D. degree with a major in mechanical engineering must comply with the rules and regulations as outlined in the WVU Graduate Catalog and the specific requirements of the Statler College and the Department of Mechanical, Materials, and Aerospace Engineering (MMAE).

Program Requirements

The doctor of philosophy degree with a major in mechanical engineering is administered through the college's interdisciplinary Ph.D. program. The research work for the doctoral dissertation must show a high degree of originality on the part of the student and must constitute an original contribution to the art and science of mechanical engineering.

All Ph.D. degree candidates are required to perform research and follow a planned program of study. The student's research advisor, in conjunction with the student's Advising and Examining Committee (AEC) will be responsible for determining the plan of study appropriate to the student's needs. The underlying principle of the planned program is to provide the students with the necessary support to complete their degree and prepare them for their career.

The doctoral courses of study are selected to fit the particular interests and objectives of the student, with proper attention given to broadening related areas of study. The research work for the doctoral dissertation may entail a fundamental investigation into a specialized area or a broad and comprehensive study in a related subject.

All students pursuing a Ph.D. degree in the MMAE department are expected to engage in research and complete and successfully defend a Ph.D. dissertation. They should identify a subject for their Ph.D. dissertation, form a five-member advisory and examining committee, and file a plan of study by the end of their first semester of enrollment in the graduate program. At least one member of the graduate faculty from outside the department is required to serve on the advisory and examining committee.

PUBLICATION REQUIREMENT

Prior to scheduling the dissertation defense, Ph.D. students are required to provide written documentation that they have received formal proof of submission of either:

a.) At least one manuscript, generally co-authored with their research supervisor and about some portion of their PhD dissertation research, to an archival journal for publication, or

b.) At least one patent disclosure, also generally about some portion of their PhD dissertation research.

Curriculum Requirements (BS-PhD Pathway)

Code	Title	Hours
A minimum cumulative GPA of 3.0 is required in all courses.		
Course Requirements [+]		
Core Area Courses		9
Select nine (9) hours from one of the following core areas:		
Area A: Fluid Mechanics and Aerodynamics (FMA)		
MAE 532	Dynamics of Viscous Fluids	
MAE 624	Convection Heat Transfer	
MAE 636	Fundamentals of Turbulent Flow	
Area B: Thermal Sciences and Systems (TSS)		
MAE 521	Advanced Thermodynamics 1	
MAE 532	Dynamics of Viscous Fluids	
MAE 624	Convection Heat Transfer	
Area C: Dynamics and Controls (D&C)		
MAE 642	Intermediate Dynamics	
MAE 653	Advanced Vibrations	
MAE 660	Feedback Control in Mechanical Engineering	
Area D: Solid Mechanics and Design (SMD)		
MAE 543	Advanced Mechanics of Materials	
MAE 640	Continuum Mechanics	
MAE 642	Intermediate Dynamics	

MAE 653	Advanced Vibrations	
Area E: Materials Science (MS)		
MSEN 580	Crystallography and Crystals	
MSEN 583	Thermodynamics and Kinetics of Materials	
MSEN 649	Microscopy of Materials	
Mathematics Requirements		12
Select twelve (12) hours from the following (at least two (2) courses with MATH prefix or MAE 515):		
MATH 521	Numerical Analysis	
MATH 522	Numerical Solution of PDE	
MATH 541	Modern Algebra 1	
MATH 543	Linear Algebra	
MATH 545	Number Theory 1	
MATH 551	Real Variables 1	
MATH 555	Complex Variables 1	
MATH 560	Introduction to Dynamical Systems and Applications	
MATH 563	Mathematical Modeling	
MATH 564	Intermediate Differential Equations	
MATH 566	Intermediate Partial Differential Equations	
MATH 567	Advanced Calculus 1	
MATH 568	Advanced Calculus	
MATH 573	Graph Theory	
STAT 513	Design of Experiments	
STAT 545	Applied Regression Analysis	
STAT 561	Theory of Probability and Statistics 1	
STAT 562	Theory of Probability and Statistics 2	
MAE 515	Analytical Methods in Engineering	
MAE 623	Conduction Heat Transfer	
MAE 633	Computational Fluid Dynamics	
MAE 640	Continuum Mechanics	
MAE 645	Energy Methods in Applied Mechanics	
CHE 531	Mathematical Methods in Chemical Engineering	
EE 515	Linear Control Systems	
EE 517	Optimal Control	
IENG 518	Technology Forecasting	
IENG 553	Applied Linear Programming	
PHYS 611	Introduction to Mathematical Physics	
Additional Courses [++]		15
Select fifteen (15) hours from the following:		
Any BIOM, BMEG, CE, CHE, CHEM, CPE, CS, EE, IENG, IH&S, MAE, MATH, MINE, PNGE, PHYS, SAFM, SENG, EXPH 583, or STAT courses 500-795, as approved by the student's AEC		
Research		**24**
MAE 797	Research	
Milestones		
Plan of Study		
Qualifying Exam		
Candidacy Exam		
Publication Requirement		
Final Exam		
Dissertation		
Total Hours		60

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Students who do not hold a baccalaureate degree in mechanical engineering are required to take a set of undergraduate mechanical engineering courses above and beyond the minimum coursework requirements in order to overcome deficiencies in the area.

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No more than 6 hours of independent study can count. No courses below 500 level can count.

Curriculum Requirements (MS-PhD Pathway)

Code	Title	Hours
A minimum cumulative GPA of 3.0 is required in all courses.		
Course Requirements *		
Core Area Courses		**3**
Select one course in the relevant core area from the following:		
Area A: Fluid Mechanics and Aerodynamics (FMA)		
MAE 532	Dynamics of Viscous Fluids	
MAE 624	Convection Heat Transfer	
MAE 636	Fundamentals of Turbulent Flow	
Area B: Thermal Sciences and Systems (TSS)		
MAE 521	Advanced Thermodynamics 1	
MAE 532	Dynamics of Viscous Fluids	
MAE 624	Convection Heat Transfer	
Area C: Dynamics and Controls (D&C)		
MAE 642	Intermediate Dynamics	
MAE 653	Advanced Vibrations	
MAE 660	Feedback Control in Mechanical Engineering	
Area D: Solid Mechanics and Design (SMD)		
MAE 543	Advanced Mechanics of Materials	
MAE 640	Continuum Mechanics	
MAE 642	Intermediate Dynamics	
MAE 653	Advanced Vibrations	
Area E: Materials Science (MS)		
MSEN 580	Crystallography and Crystals	
MSEN 583	Thermodynamics and Kinetics of Materials	
MSEN 649	Microscopy of Materials	
Mathematics Requirements		**6**
Select two of the following (at least one course with MATH prefix or MAE 515):		
MATH 521	Numerical Analysis	
MATH 522	Numerical Solution of PDE	
MATH 541	Modern Algebra 1	
MATH 543	Linear Algebra	
MATH 545	Number Theory 1	
MATH 551	Real Variables 1	
MATH 555	Complex Variables 1	
MATH 560	Introduction to Dynamical Systems and Applications	
MATH 563	Mathematical Modeling	
MATH 564	Intermediate Differential Equations	
MATH 566	Intermediate Partial Differential Equations	
MATH 567	Advanced Calculus 1	
MATH 568	Advanced Calculus	
MATH 573	Graph Theory	
STAT 513	Design of Experiments	
STAT 545	Applied Regression Analysis	
STAT 561	Theory of Probability and Statistics 1	

STAT 562	Theory of Probability and Statistics 2	
MAE 515	Analytical Methods in Engineering	
MAE 623	Conduction Heat Transfer	
MAE 633	Computational Fluid Dynamics	
MAE 640	Continuum Mechanics	
MAE 645	Energy Methods in Applied Mechanics	
CHE 531	Mathematical Methods in Chemical Engineering	
EE 515	Linear Control Systems	
EE 517	Optimal Control	
IENG 518	Technology Forecasting	
IENG 553	Applied Linear Programming	
PHYS 611	Introduction to Mathematical Physics	
Research		**24**
MAE 797	Research	
Any BIOM, BMEG, CE, CHE, CHEM, CPE, CS, EE, IENG, IH&S, MAE, MATH, MINE, PNGE, PHYS, SAFM, SENG, EXPH 583, or STAT courses 500-795, as approved by the student's AEC.		9
Milestones		
Plan of Study		
Qualifying Exam		
Candidacy Exam (Dissertation research proposal defense)		
Publication Requirement		
Final Exam		
Dissertation		
Total Hours		42

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Students who do not hold a baccalaureate degree in mechanical engineering are required to take a set of undergraduate mechanical engineering courses above and beyond the minimum coursework requirements in order to overcome deficiencies in the area.

Examinations

QUALIFYING EXAM

All students must take and pass a written qualifying examination. Normally, the qualifying examination is given no later than one semester after completion of eighteen credit hours toward the doctoral degree. This examination is designed to assess the basic competency of students in the mechanical engineering field to determine whether or not they have sufficient knowledge to undertake independent research.

The Ph.D. qualifying examination is the method of assessing whether the student has attained sufficient knowledge of the discipline and supporting fields in order to undertake independent research or practice. Students are required to pass a qualifying examination administered by the department which tests for a minimum level of proficiency expected of all students in a given area. It is expected that students will take the qualifying exam during their first or second semester of enrollment in the Ph.D. program; however, it is required that full-time students pass the qualifying examination no later than the end of the third semester of enrollment in their Ph.D. program. Students admitted in the direct track from B.S. to Ph.D. degree option are expected to take the qualifying exam by the end of their fourth semester of enrollment in the MMAE graduate program.

CANDIDACY EXAMINATION

In order to be admitted to candidacy, the student must pass a candidacy exam, which is designed to evaluate the student’s overall ability to engage in high-level research.

As the student progresses, his or her advisory and examining committee is charged with evaluating the student’s competency in the specific area of study through the assessment of a dissertation proposal for the research to be completed and the evaluation of the student’s plan of study and associated coursework. After these requirements are completed, the student is formally admitted to candidacy for the Ph.D. degree. Only at this point can a student be called a doctoral candidate; admission to the graduate program for the purpose of pursuing the Ph.D. degree is not equivalent to becoming a Ph.D. candidate. Doctoral candidates are allowed no more than five years to complete the remaining degree requirements after admission to candidacy. An extension of time can be obtained only by repeating the qualifying and candidacy examinations and meeting any other requirements specified by the student’s advisory and examining committee.

A student who has successfully completed all coursework, passed the qualifying examination, and successfully defended the research proposal is defined as one who is a candidate for the Ph.D. degree.

FINAL EXAMINATION

At the completion of the dissertation research, candidates must prepare a dissertation and pass the final oral examination (defense) administered by their AEC.

In order to complete the Ph.D. requirements, a student must pass a final oral examination on the results embodied in the dissertation. This examination is open to the public and, in order to evaluate critically the student's competency, may include testing on material in related fields, as deemed necessary by the AEC. In addition, since the Ph.D. degree is primarily a research degree that embodies the results of an original research proposal and represents a significant contribution to scientific literature, the student must submit a manuscript on this research to the AEC.

JOURNAL PAPER PUBLICATION REQUIREMENT FOR ALL PHD STUDENTS:

Beginning with all PhD students admitted for the summer or fall of 2016 and thereafter, every Ph.D. student, prior to his/her dissertation defense, will be required to provide written documentation that they have received formal proof of submission of either:

a.) At least one manuscript, generally co-authored with their research supervisor and about some portion of their PhD dissertation research, to an archival journal for publication, or

b.) At least one patent disclosure, also generally about some portion of their PhD dissertation research.

This publication requirement will have to be satisfied prior to scheduling the defense of the Ph.D. Dissertation.

Major Learning Outcomes

MECHANICAL ENGINEERING

The MMAE Department is committed to deliver high quality education and research experience to all graduate students in order to enable them to achieve success in their careers, though the following Learning Goals:

- Expertise, depth and breadth in a chosen field of mechanical engineering.
- Capacity to engage in original research, advanced technological discovery and innovation in order to advance the frontiers of knowledge in the science of the mechanical engineering discipline.
- Capacity of effective high level communication in order to document, disseminate and transfer knowledge of the science of the mechanical engineering discipline in educational, research or applied workplace settings.
- Appreciation and understanding of the role of the science of mechanical engineering discipline in a global and societal context.