GUIDE TO GRADUATE STUDY AND DEGREE PROGRAMS

IN

MECHANICAL ENGINEERING

DEPARTMENT OF MECHANICAL & INDUSTRIAL ENGINEERING
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA 70803
(225) 578-5828

This handbook is for the graduate students and faculty of the MECHANICAL ENGINEERING Program. Policy changes may occur at any time. Students are responsible for checking with the MIE Graduate office and/or Graduate Advisor for updates. Mechanical Engineering Program Policies have been worked out by the graduate studies committee and approved by the Mechanical Engineering Graduate Faculty of the Department.

Revised in February 2023

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Links to forms required by LSU's Graduate School and the ME Graduate Program should be retrieved from Graduate School and/or the MIE Department website.

General Description

The Department of Mechanical & Industrial Engineering (MIE) is one of seven engineering departments at LSU. In the Mechanical Engineering (ME) program of the MIE department, there are currently 26 full-time faculty members. Graduate student enrollment, including both mechanical engineering and engineering science students supervised by the ME faculty, is about 60, nearly two-thirds of whom are in the Ph.D. program.

Mechanical Engineering faculty members span general areas of expertise ranging from the traditional ones such as mechanical systems (design & control), materials science & engineering, and thermal-fluid science and combustion, to more novel ones such as micro/nano-systems (design and fabrication) and molecular-level engineering. The ME faculty is primarily involved in research related to Energy, Materials & Manufacturing, Aerospace and Bio-Technology applications. Research is funded through grants from federal agencies (NSF, NASA, DoD, DoE, NIH etc.), state government (Louisiana Board of Regents), national laboratories, and various industries. The graduate faculty works closely with graduate students in research projects that cover both traditional and nontraditional areas. Graduate students are engaged in experimental, numerical, and modeling studies and can select their coursework from mechanical engineering and other departments, in consultation with their advisory committees. Students have access to excellent laboratory facilities and equipment, as well as to extensive computer systems, both in the department and on the LSU campus. Mechanical engineering graduates are prepared for employment in industry, universities, state and federal government, and the private sector.

In the ME Program, most graduate students are financially supported through research assistantships, teaching assistantships, or fellowships. Research areas are broadly organized as mechanical systems, thermal sciences, and materials science and engineering. Individual faculty supervising graduate research specialize in a range of topics including robotics, controls, biomechanics, tribology, fluid dynamics, combustion, microsystems, materials science, advanced manufacturing, and others.

Student organizations within the department include the ME Graduate Student Association (ME-GSA), Chapters of the American Society of Mechanical Engineers (ASME), American Institute of Aeronautics and Astronautics (AIAA), Society of Automotive Engineers (SAE), The Materials Society (TMS) - American Society for Metals (ASM), and National Association of Corrosion Engineers (NACE). In addition, some mechanical engineering students belong to the college chapters of the Society of Black Engineers (SBE) and Society of Women Engineers (SWE).

ME Graduate Faculty

By Appointment Rank

Full Professors

Devireddy, Ram
Gonthier, Keith
Guo, Shengmin
Khonsari, Michael
Li, Guoqiang
Meng, Wen Jin
Moldovan, Dorel
Nikitopoulos, Dimitris
Park, Sunggook
de Queiroz, Marcio
Wahab, M.
Wang, Wanjun
Wong, Harris

Associate Professors

Gartia, Manas
Schoegl, Ingmar
Wang, Ying

Assistant Professors

Barbalata, Corina
Gilbert, Hunter B.
Marvel, Christopher
Menon, Shyam
Owoyele, Ope
Palardy, Genevieve
Upadhyay, Kshitiz

Instructors

Becnel, Andrew
Pettrey, Katherine
Walker, Eamonn

Professors Emeriti

Acharya, Sumanta
Arnas, A. Ozer
Courter, Robert W.
Daniel, Lawrence R. "Dan"
Murphy, Michael
Sabbaghian, Mehdi
Sinclair, G. B.
Waggenspack, Warren
Yannitell, Daniel W

Past Faculty Contributors

Charalampopoulos, Tryfon T.
Raman, Aravamudhan
Ram, Yitshak

By Topical Group

Mechanical Systems

Barbalata, Corina
Gartia, Manas
Gilbert, Hunter B.
Khonsari, Michael†
Li, Guoqiang
Murphy, Michael
Palardy, Genevieve
Park, Sunggook‡
de Queiroz, Marcio
Upadhyay, Kshitiz
Wahab, Muhammad*
Wang, Wanjun

Thermal Fluids

Devireddy, Ram
Gartia, Manas
Gonthier, Keith
Guo, Shengmin
Khonsari, Michael
Menon, Shyam
Nikitopoulos, Dimitris
Owoyele, Ope
Schoegl, Ingmar
Wong, Harris†

Materials Science and Engineering

Devireddy, Ram†
Gartia, Manas
Gonthier, Keith†
Guo, Shengmin†
Marvel, Christopher
Meng, Wen Jin
Moldovan, Dorel
Li, Guoqiang*
Park, Sunggook
Wahab, Muhammad*
Wang, Ying
Wong, Harris†

* Core member of Mechanical Systems Group
† Core member of Thermal-Fluid Science Group
‡ Core member of Materials Science and Engineering Group

More details on research topics of individual faculty members can be found at the MIE website. Each faculty member is assigned a separate section for the research courses ME 8000 and ME 9000.

Advanced Degrees in Mechanical Engineering

Graduate Degree Programs

The Mechanical Engineering (ME) program offers degree programs leading to:

- Master of Science
- Doctor of Philosophy

In addition, the department participates in the college's Interdisciplinary Engineering Science degree programs and the university's Mechanical Engineering Minor (see Section "Other Programs").

Admissions Standards

To pursue an advanced degree in Mechanical Engineering, an applicant must hold a B.S. degree from an engineering department accredited by the Accreditation Board of Engineering and Technology (ABET), or the equivalent. Special programs can be developed if the degree is from another discipline. The graduate faculty of the department must approve these special programs. As a potential graduate student of Mechanical Engineering, you must meet the minimum requirements for admission to LSU's Graduate School before being considered for admission into the Mechanical Engineering graduate program. The admission requirements of the department are in addition to those of the Graduate School and are generally more restrictive. Typically, a minimum undergraduate and/or Masters grade-point average of 3.0 ("A" = 4.0, "B"=3.0) and competitive GRE scores are required. Applications with a Quantitative Reasoning GRE score below the 80th percentile will not be considered unless petitioned by an ME faculty member. For foreign applicants a minimum TOEFL score of 213 (computer-based), 550 (paper-based), 79-80 (internet based – IB) or minimum 6.5 (IELTS) would be expected. As deciding on admissions and assistantships as well as taking care of visa formalities take considerable time, potential students are advised to apply sufficiently early, say six to nine months in advance of the semester in which they wish to enroll.

Full Time Graduate Student Status

A full-time graduate student at the MS or Ph.D. level is required to take at least nine (9) credit hours of approved course work and one (1) hour of ME 7901 seminar course during fall/spring semesters. The ME 7901 seminar course is required for registration every semester (excluding summer terms) for full-time graduate students. A part time graduate student at the M.S. or Ph.D. level is required to take the ME 7901 seminar course for one semester only and attend for that semester during his or her degree program.

International students are required to be full-time and conform to these regulations to take adequate preparatory courses to demonstrate proficiency in written and spoken English before being allowed to teach. This is expected of all foreign students within the first year.

Probationary Status

Full-time students with ***probationary status upon admission*** must complete a minimum of nine (9) credit hours of technical graduate-level courses with at least a 3.00 average. Students will remain on probation until nine hours of technical graduate-level courses have been completed with at least a 3.00 average. Failure to attain this average may result in being dropped from the program. Part-time students entering on probation and registering for fewer than nine hours may be dropped from the Graduate School if their semester and/or graduate GPA is less than 3.00 during any semester they are registered. Students admitted on probation may not be appointed to assistantships or fellowships until they attain good academic standing. (See PS-21 for additional information)

If probationary status is acquired at the end of any semester, the student becomes ineligible for any assistantship while on probation. A graduate student placed on academic probation by the Graduate School for failing to make satisfactory progress may not be appointed or reappointed to a graduate assistantship unless the student's cumulative/semester GPA is at least 3.00. Details and additional information regarding

eligibility for a graduate assistantship may be found in PS-21, and on the Graduate School on-line Catalog @ https://catalog.lsu.edu/index.php

M.S. Degree (Thesis Option)

To receive an M.S. degree from the ME program, you **must** satisfy the M.S. degree requirements, as specified in the current ***General Catalog.*** The additional departmental requirements listed here provide background in the fundamentals of mechanical engineering, while allowing you the flexibility to specialize in thermal systems, mechanical systems, materials science, and engineering or micro-systems.

1. Major Professor and Graduate Advisory Committee

Upon entering the program, you need to identify a major professor from the area in which you intend to specialize. Once you do this, you will meet with the professor and finalize this arrangement with an official binding agreement. In consultation with your major professor, your program advisory committee is named. The major professor and the members of your Graduate Program Committee constitute your Advisory Committee. While joining the graduate program, you and the graduate advisor or your major professor will devise an initial plan of study that constitutes the intended courses that you will take for the M.S. degree, which must be approved by your Graduate Advisory Committee. For the remainder of your degree program, you will follow this plan. Your plan of study can be altered at any time only upon approval of your Advisory Committee; you will need to resubmit a "Plan of Study" form for any changes made to your course work.

The Advisory Committee must have a minimum of three faculty members, including two from the ME program of the MIE Department. One member can be from another department. The Advisory Committee must be composed of members of the Graduate Faculty, including at least one full member of the graduate faculty from the ME program of the MIE Department.

2. Course Work

(24 hours minimum of lecture courses plus 6 hours of thesis research)

Course offerings are listed in the LSU Catalog. A petition to waive any of the requirements in this section requires approval of the graduate faculty through your Advisory Committee and the Graduate Studies Committee (GSC). Equivalency of courses offered as substitutes or transfers will be determined by the last faculty member to teach the required course.

Transfer of Courses

Students who have taken graduate-level courses from a previous university and want to transfer the courses to Mechanical Engineering Degree at LSU need to complete the required transfer form through the Graduate School. Information on transferring courses is in the Graduate School Catalog on the Graduate School's website.

M.S. Course Requirements – Thesis Option

- Declare a primary specialization in one of the following areas:
  Thermal Sciences, Mechanical Systems, or Materials Science and Engineering
- Take a minimum of three core courses within your primary area of specialization
- Take one core course from one of the other two ME specialization areas outside your primary area
- Take a minimum of five ME courses
- Take a minimum of twelve (12) credit hours of course work at the 7000 level (4 courses)
- Register for ME 7901 (ME Graduate Seminar): required to register and attend every semester (excluding summers).

  Please Note: The seminar attendance requirement for part-time students will be for one semester only. The seminar course (ME 7901) attendance requirement is waived for any student, after the date when

he/she has successfully defended his/her thesis, or while he/she is participating in an out-of-state internship or out-of-state student exchange program under approval of his/her major professor. If this condition is met for an entire semester, the registration requirement is waived.

- Take a minimum of six hours of ME 8000
- Your major professor and advisory committee must approve all course selections.
- You are required to present your research results at a departmental forum before graduation, usually during your final semester in residence. This is done in the departmental, annual Graduate Student Research Conference (GSRC), prior to graduation.
- The list of approved core courses follows:

Thermal Sciences

ME 4353	Advanced Engineering Thermodynamics
ME 7313	Advanced Fluid Dynamics I
ME 7323	Advanced Fluid Dynamics II
ME 7333	Hydrodynamic Stability
ME 7343	Computation of Fluid Flow & Heat Transfer
ME 7433	Heat Transfer I
ME 7443	Heat Transfer II

Mechanical Systems

ME 4273	Stress Analysis in ME
ME 4143	Vibrations
ME 7153	Advanced Vibrations
ME 7163	Advanced Dynamics
ME 7273	Advanced Stress Analysis in ME
ME 7633	Advanced Engineering System Dynamics
ME 7673	Advanced Mechanical Systems Control

Materials Science and Engineering

ME 4723	Advanced Methods of Material Characterization
ME 4733	Deformation and Fracture of Engineering Materials
ME 7723	Electron Beam Characterization of Materials (TEM course)
ME 7743	Defects, Diffusion, & Transformation in Solids*
ME 7753	Thermodynamics of Solid Materials *

For the Materials Minor, we have:

ME 4723	Advanced Methods of Materials Characterization
ME 4743	Kinetics of Materials
ME 4733	Deformation and Fracture of Engineering Materials

* Required for all Materials Majors

Take one course from the following list of basic Math courses:

MATH 4038	Mathematical Methods in Engineering
MATH 4340	Partial Differential Equations
MATH 4036	Complex Variables
ME 7533	Numerical Methods in Applied Mechanics

3. Thesis and Final Examination

The master's thesis should demonstrate your capacity for research, originality of thought, and facility in organizing materials. An open, announced, oral presentation of the thesis and a "defense" examination is required after completion of writing of the thesis. The exam part is to be administered by the student's advisory committee in a closed session for privacy purposes.

- A request for the final examination must be submitted to The Graduate School with the graduate advisor's approval at least three weeks prior to the proposed examination date or by the current semester deadline, if the student is a candidate for a degree (see the Graduate School calendar for all pertinent dates on the Graduate School web-site).
- The examining committee must have copies of the thesis at least two weeks prior to the final examination. The thesis must have been scrutinized and approved by your major professor prior to submission to the committee members.
- The result of this examination will be filed with the Graduate School by the major professor through the graduate administrative coordinator as soon as possible, provided all degree and departmental requirements have been met.

Other Requirements - Check with the Graduate Administrative Coordinator and Graduate School regarding other requirements regarding electronic submission of thesis, payment of fees, etc. Also, leave your future contact address with the Graduate Administrative Coordinator. Keep in touch with your home department and Alma Mater, and inform us of your professional affiliation and growth in your career.

M.S. Degree (Non-thesis Option)

The non-thesis option is considered to result in a terminal degree in a technical field. It is appropriate for practicing and/or employed engineers who wish to acquire advanced background and knowledge in chosen subject areas without having the need to pursue rigorous research. The degree can be earned with a part-time (non-thesis) program of study. It is generally not available to International students under student visa (F1) category.

You must declare your intent to join the M.S. non-thesis option before beginning your program of study. If you are in the non-thesis option, you will not be eligible for any financial aid from the university. If you are currently in the thesis option and have received financial support from the department, you will not be permitted to switch to the non-thesis option.

1. Course Work Requirements (Non-thesis Option)

- A minimum of six courses must be taken from the list of mechanical engineering core courses given earlier under the thesis option. At least one course must be taken from each of the three areas of specialization: thermal sciences, mechanical systems, and materials.
- One course in mathematics from the courses listed earlier is required.
- Additional four courses, approved by the advisory committee, to achieve depth and breadth in one or more areas are required. Some of these courses may be from other departments.
- You must complete a three credit-hour project under ME 7903 and present a report approved by your major professor and advisory committee. This report is used in your final exam (defense presentation) as a document to portray your ability to do in-depth analysis of a Mechanical Engineering topic.
- You must have at least 18 hours at the 7000 level courses.
- You must attain a grade of "B" or above in order for a course to qualify toward the degree requirements.
- Register for ME 7901 (ME Graduate Seminar); required to register and attend every semester (excluding summers).

  Please Note: The seminar attendance requirement for part-time students will be for one semester only. The seminar course (ME 7901) attendance requirement is waived for any student, after the date when he/she has successfully defended his/her thesis, or while he/she is participating in an out-of-state internship or out-of-state student exchange program under approval of his/her major professor. If this condition is met for an entire semester, the registration requirement is waived.

2. Transfer to Thesis Option

Transfer from non-thesis to the thesis option may be done at any time. However, all of the requirements of the thesis degree program must be met. This includes the appointment of a new advisory committee and possibly a new major professor, the formulation of a new plan of study, and the identification of a research area from which a thesis can be produced. Courses taken in the non-thesis program may be applied to the thesis program only at the discretion of the new advisory committee.

Other Requirements - Check with the Graduate Administrative Coordinator and Graduate School regarding other requirements regarding the electronic submission of thesis, payment of fees, etc. Also, leave your future contact address with the Graduate Administrative Coordinator. Keep in touch with your home department and Alma Mater, and inform us of your professional affiliation and growth in your career.

Doctoral (Ph.D.) Degree

For the Ph.D. degree, you must satisfy the general requirements as specified in the Graduate Catalog, which can be found on the Graduate School Web-Site, as well as the departmental requirements listed below. All decisions regarding your program of study must be made in consultation with your major professor, your Graduate Advisory Committee, and the Graduate Studies Committee of the department.

1. Major Professor and Graduate Advisory Committee

The Graduate School has specifically defined requirements regarding the full advisory committee. The ME program of the MIE Department will follow these regulations:

- Consists initially of three members of the graduate faculty; **all three committee members must be members of the graduate faculty.**
- Major Professor, who acts as chair or co-chair, must be from the ME program of the MIE department.
- If either an adjunct or a non-tenure track faculty member is the major professor, a full-time tenured or tenure-track graduate faculty member from the ME program of the MIE department must co-chair the committee.
- At least one-half of the graduate faculty on doctoral committees must be full-time tenured or tenure-track faculty at LSU. A minimum of two of those faculty members must be from the student's major department at LSU and at least one of whom must be a full member of the LSU graduate faculty.
- Remaining members may be from the major department or may be from outside the department if pertinent to the student's area of concentration, with the proviso that at least one of the remaining members must be a full member of the graduate faculty.
- Any declared outside minors require representation, either among the first 3 members of the committee or by additional appointments to the committee.
- In addition, the Dean of the Graduate School appoints a member or members of the graduate faculty to serve on the doctoral general and final examination committees (aka dean's representative).
- Refer to the ***Graduate School Catalog on the Graduate School's Website for more detailed Information: https://catalog.lsu.edu/index.php***

2. Course Work

Course offerings are listed in the Graduate School Catalog. A petition to waive any of the requirements in this section requires approval of the graduate faculty through your Advisory Committee and the Graduate Studies Committee (GSC). Equivalency of courses offered as substitutes or transfers will be determined by the last faculty member to teach the required course.

Direct Admission to Ph.D. from B.S.

If you are deemed eligible by the GSC to enter the Ph.D. program directly from a B.S. degree, you will be required to take a minimum of 36 hours of course work (not S/U graded coursework) and 18 hours of dissertation research (ME 9000). The entire course work must be approved by the major professor and advisory committee, as evidenced by the attestation of the departmental plan of study form. The form is recommended to be submitted to the department by the end of the first semester for M.S. degree holders and before the end of the first year for the B.S. graduate.

- Declare a primary specialization in one of the following areas:
  Thermal Sciences, Mechanical Systems, or Materials Science and Engineering
- Take a minimum of 12 credit hours of core courses in thermal sciences, mechanical systems, or materials science and engineering

- Take 3 credit hours of a Math course
- Take 21 credit hours of technical elective courses (selected by student/major professor/advisory committee)
- Take a minimum of eighteen (18) credit hours of course work at the 7000 level (6 courses)
- Register for ME 7901 (ME Graduate Seminar): required to register and attend every semester (excluding summers).

  Please Note: The seminar attendance requirement for part-time students will be for one semester only. The seminar course (ME 7901) attendance requirement is waived for any student, after the date when he/she has successfully defended his/her thesis, or while he/she is participating in an out-of-state internship or out-of-state student exchange program under approval of his/her major professor. If this condition is met for an entire semester, the registration requirement is waived.
- **Core courses for PhD students are the same as required for M.S. Degree students**
- Take a minimum of eighteen (18) hours of ME 9000
- You are required to present your research results at a departmental forum before graduation, usually during your final semester in residence. This is done in the departmental, annual Graduate Student Conference (GSC), prior to graduation.

Admission to Ph.D. from M.S.

If the student has earned a recognizable M.S. degree with at least 24 hours of graduate-level courses, **he/she may be allowed to transfer up to 18 hours of course work credit** upon approval by the major professor and the student's advisory committee, which will count on the requirement of a minimum of 36 hours of course work. You will require a minimum core requirement of 12 credit hours thermal sciences, mechanical systems, or materials science and engineering, along with 6 credit hours of technical electives (related to the student's research area and approved by the advisory committee), and 18 hours of dissertation research (ME 9000) for the Ph.D. degree. Among the 12 credit hours of core course work, a minimum of 9 credit hours should be taken from 7XXX level courses. Course work must be approved by the major professor and the student's advisory committee, as evidenced by the certification of the departmental plan of study form and the Doctoral Degree Audit and Request for General Examination, which is submitted no later than three (3) weeks to the Graduate School in advance from the actual date of the general exam (you would put all your course work on this form). **Please Note:** Independent/Specialty Topics courses (ME 7903) will NOT count towards the 18 hour course requirement for Ph.D. students with obtained Master's Degrees.

For transfer of courses from a previous university, you need to complete the required transfer form that can be found on the MIE website.

Minor Requirements for PhD in ME (optional for Ph.D. students)

Minor: If a student chooses to, he/she can complete a minor in an area either within the ME department or outside in another appropriate department, relevant to the program. Students with a major in mechanical systems or thermal fluids may choose materials science and engineering within ME as their minor emphasis area, and vice versa. Alternatively, the minor area could be centered on a program offered in another department at LSU.

For an internal minor, 9 credit hours of graduate level course work in the area is required, of which a minimum of three (3) credit hours must be in 7XXX level courses. The selection of courses relevant to the minor emphasis program is left to the student and the minor professor. An overall average of 3.00 or better is required in the courses of the minor area.

Grade Point Average

- No grade of 'D' will count towards your Ph.D.

- Minimum GPA of at least a 3.0 every semester unless you are receiving a scholarship or fellowship in which a higher GPA average will be required (for example, EDA Fellows should maintain a minimum of a **3.5 average**)

3. Ph.D. Qualifying/Comprehensive Examinations

Qualifying examinations are administered by the department through the Mechanical Engineering Coordinators for Materials, Mechanical Systems, Thermal Fluids, and Math. Passing in a minimum of three areas including Mathematics is required to qualify.

The areas for examination will be selected in conjunction with your major professor. At least one of the exams will be required in your major field. If you change your major professor after you have successfully completed the qualifying examinations, you may be required to retake some or all of the examinations at the discretion of the new major professor.

If you fail in any given qualifying exam, you will be given one more opportunity to pass the subject the next time when an exam is offered in that subject. Two consecutive failures will lead to your termination from the ME Ph.D. program. You will, however, be able to continue if you receive a conditional pass provided you fulfill the stipulated conditions mentioned below.

You will not be able to select another subject without the permission from your advisory committee and ME graduate studies committee. If the advisory committee approves the substitution, it will be considered equivalent to the second attempt on that subject and failure in that subject will lead to your termination from the ME Ph.D. program.

Upon the exam results being made available to students, students have one week (i.e., seven calendar days) to submit a written request for their examination to be regraded. The written request should include appropriate reasons for regrading. Email these written requests to gradmie@lsu.edu.

Qualifying Exam Guidelines

The following graduate faculty-approved policies and procedures apply:

I. Type of Examination

Written, or oral, or optionally written and oral examinations should be scheduled in area group and advisory committee approved fields. The examinations are given in the following fields:

Thermal Science	**Mechanical Systems**	**Materials**
i) Fluid Mechanics	i) Statics/Strength/Failure	i) Materials Science
ii) Thermal Science	ii) Dynamics/Control/Vibrations	ii) Materials Engineering

Mathematics (required for ALL Ph.D. students)

Students should **select two examinations out of the first three groups** after consulting with their major professors and advisory committee members. Note that at least one examination in the major area is required. Some groups would require both the examinations to be selected in the major area. In addition, the **examination in Mathematics is compulsory for all students.**

II. Qualifying Exam Requirements

The following requirements apply to all written qualifying exams (exceptions are noted below).

Average score ≥ 70% → Pass

60% ≤ average score < 70% → Conditional Pass

Should a student receive "Conditional Pass" on the first attempt of an examination, student must choose only one of two options, either (a) take up to 2 courses to correct his/her deficiency and earn a grade B (3.0) or better in each course, or (b) retake the examination the next time it is offered. A result of "Conditional Pass" on the second attempt of an examination OR a grade of "B-" or lower on any course

recommended in the "Conditional Pass" is considered a result of "Failure" and the student shall be dismissed from the Mechanical Engineering Ph.D. Program. A student who chooses to retake the exam the next time it is offered, the first attempt will be counted as a fail.

Average score < 60% → Fail

With the exception of the Math exam, which has separate criteria, the student must retake the exam the next time it is offered and pass it. If the student fails the exam in the second attempt, he/she will be terminated from the Ph.D. program.

50% ≤ Average score < 70% Conditional Pass (Math Exam)

For an average score between 60% and 70%, the same rules as stated above apply, i.e. the student must take up to 2 courses to correct his/her deficiency and earn a grade B or better in each course. For a score between 50% and 60%, the same rules as stated above apply except that the student must take 3 courses to correct his/her deficiency, and earn a grade B or better in each course. In either case, the courses will be selected by the Math committee, and will not count toward the Ph.D. degree coursework requirement.

Average score < 50% Fail (Math Exam)

The student must retake the exam the next time it is offered and pass it. If the student fails the exam in the second attempt, he/she will be terminated from the Ph.D. program.

III. Scheduling of Examinations

The qualifying examinations in all subjects are given once a year, around the start of the fall semester. The deadline to complete registration for the PhD Qualifying Exams is May 15th, which is when study guides are provided. A potential PhD candidate must schedule qualifying examinations according to the following rules:

1. Students must complete at least one attempt in each of the applicable subjects before the beginning of their fourth semester of enrollment as a graduate student at LSU.
2. If a student has not attempted all exam subjects according to time limits stated above, any missed exam counts as a failed first attempt. Students will have to unconditionally pass on their second attempt to continue in the ME PhD program.

IV. Conduct of the Examinations

The area group coordinators are responsible for administering the examinations. Each group generates the examination questions through due solicitation process. For the sake of convenience, each examination is handled by one designated examiner who seeks the questions from the faculty concerned, selects the ones for the test in consultation with the group members and sets up the question paper in the examination area.

The selected questions appearing in the examination must have solutions prepared at the time of inclusion of the questions in the paper. The examination papers with the solutions and other data as specified above are given to the Graduate Administrative Coordinator for processing.

The examiner or any other designated member proctors the examination at the time when it is administered. Students are advised not to write their names on the answer sheets. They sign in and are identified on a master list against the number of the examination paper given to them. This list is turned over to the graduate administrative coordinator at the end of the examination. The examiner and/or any others designated by the group shall grade the examination papers.

At least two members of the graduate faculty will be involved in grading. It is the responsibility of the examiner designate and the group leader to ascertain the final average score of the examinees, get the final results approved by the entire group and turn in the results to the Graduate Program Coordinator for due processing.

The Graduate Administrative Coordinator will inform the examinees of the results.

4. General Examination

Upon completion of essentially all course work (not before the last semester of course work), your graduate advisory committee will administer the general examinations (including the minor fields). **PhD candidates are required to take their general exam within 15 months after they completely satisfy the requirements for the qualifying exam.** The nature and extent of these examinations will be at the sole discretion of the advisory committee. In addition to possible oral examinations, presentation and successful defense of a plan of research is required.

- A request for the general examination must be submitted to The Graduate School by the student's department chair at least three weeks prior to the proposed examination date.
- Submit your major professor approved research proposal to the advisory committee administering the general examination at least two weeks before the examination.

Continuous Registration Requirement - Doctoral candidates must maintain continuous registration for a minimum of three semester hours of credit each regular semester (excluding summer) from the completion of the general examination to the end of the semester in which an approved dissertation is submitted to the Graduate School.

5. Research Seminar

Before graduation, you must present a seminar, discussing the major results of your research. This should occur at the Graduate Student Research Conference scheduled annually.

Earning a passing grade in the ME Graduate Seminar Series, ME 7901, is also required. Full-time graduate students are required to register for ME 7901 (Graduate Seminar) and attend every semester. Part-time students are required to register and attend the seminar (ME 7901) course for one semester. You are not allowed to have more than two excused absences and one unexcused absence in any semester in the seminar course in order to pass. Keep track of other departmental seminar and presentation requirements.

Please Note: The seminar attendance requirement for part-time students will be for one semester only. The seminar course (ME 7901) attendance requirement is waived for any student, after the date when he/she has successfully defended his/her thesis, or while he/she is participating in an out-of-state internship or out of state student exchange program under approval of his/her major professor. If this condition is met for an entire semester, the registration requirement is waived.

6. Dissertation and Final Examination

The dissertation must demonstrate a mastery of research techniques, ability to do original and independent research, and skill in formulating conclusions that in some way enlarge upon or modify accepted ideas.

An open, announced, oral presentation of the dissertation and a "defense" examination is required after completion of writing of the dissertation. The exam part is to be administered by the student's advisory committee in a closed session for privacy purposes.

- A request for the final examination must be submitted to The Graduate School by the student's department chair at least three weeks prior to the proposed examination date or by the current semester deadline, if the student is a candidate for a degree (see the academic calendar for all pertinent dates).
- The examining committee, including the dean's representative, must have copies of the dissertation at least two weeks prior to the final examination. The dissertation must have been scrutinized and approved by your major professor prior to submission to the committee members.
- The result of this examination will be filed with the Graduate School by the major professor through the graduate administrative coordinator as soon as possible, provided all degree and departmental requirements have been met.

Other Requirements - Check with the Graduate Administrative Coordinator and the Graduate School regarding other requirements regarding electronic submission of dissertation, payment of fees, etc. Also, leave your future contact address with the graduate administrative coordinator. Keep in touch with your home department and Alma Mater, and inform us of your professional affiliation and growth in your career.

Other Programs

Interdisciplinary Programs

The College of Engineering offers programs leading to two interdisciplinary graduate degrees:

- Master of Science in Engineering Science
- Doctor of Philosophy in Engineering Science

These programs provide a mechanism for one to pursue advanced study in interdisciplinary fields, not covered by the graduate programs administered by individual departments of the college, such as Materials Science, Environmental Science, etc. The Associate Dean for Research and Graduate Activities of the College of Engineering administers these programs by keeping records of all students enrolled in interdisciplinary studies and by acting as coordinator for admissions decisions and as Program chairman of record on all documentation.

To participate in any of these programs, contact the Associate Dean for Research and Graduate Activities of the College of Engineering, as well as appropriate faculty within the ME program of the MIE Department. In general, these individuals, along with your advisory committee determine admission requirements, program of study, and examinations.

Mechanical Engineering as Minor

If you are a Ph.D. candidate in another doctoral program and wish to select mechanical engineering as a minor area; the requirements are:

- Take at least nine credit hours of courses acceptable for graduate credit in ME and approved by your advisory committee
- Take at least three hours of 7000-level ME courses (ME 7903-Independent Study may not be applicable as the only one in the 7xxx category; one of the major core courses or any other approved general 7xxx level ME course would be applicable)
- Obtain a "C" or better and achieve an overall average of 3.0 or better in these courses
- Have an ME faculty member on your Ph.D. advisory committee who may administer written and/or oral examinations as part of the general and final examinations

Appendix: Graduate Courses Offered

(Note) The course information described here may be changed at any time without notice. For the most updated information, students are required to consult the Graduate catalog. (https://catalog.lsu.edu/index.php)

4143 Mechanical Vibrations (3) ***Prereq.: CE 3400, MATH 2070, ME 3143, and 4133; or equivalent.*** Basic principles of oscillating mechanical systems; single and multiple degrees of freedom; dynamic balancing; applications to mechanical systems; continuous systems vibrations.

4163 Intermediate Dynamics (3) F ***Prereq.: MATH 2070 and ME 3133***. Rotating reference frames, rigid body kinetics in three dimensions, central force motion, variable mass problems, and Lagrange's equations.

4183 Theory and Design of Mechanical Control Systems (3) ***Prereq.: MATH 2090, ME 3143 and credit or registration in ME 3603.*** Basic principles, concepts, characteristics and performance of linear feedback control systems; stability of linear systems; frequency response methods; compensator design in the frequency domain.

4213 Welding Engineering I (3) ***Prereq.: ME 2723 or ME 2733, ME 3633, grade of "C" or better in ENGL 1001.*** Fundamentals of welding and joining; introduction to nondestructive evaluation; basics of welding technology and welded structures; GMAW and GTAW; shielded metal arc welding processes.

4223 Welding Engineering II (3) ***Prereq.: ME 2723 or ME 2733; ME 3633; ME 4213 or consent of instructor; grade of "C" or better in ENGL 1001.*** Fundamentals and intermediate level welding and joining; intermediate nondestructive evaluation emphasizing phased-array-ultrasonics; design calculations of welded structures; advanced welding processes.

4273 Stress Analysis in Mechanical Engineering (3) ***Prereq.: CE 3400.*** Finite element solutions of 1D and 2D elasticity problems with emphasis on computing accurate stresses using commercial finite element software for a variety of physical configurations and load states.

4293 Introduction to Microsystem Fabrication and Design (3) ***Prereq.:*** **ME 3752.** Microfabrication techniques; design issues for fabrication systems containing microelectric and micromechanical elements.

4353 Advanced Engineering Thermodynamics (3) ***S Prereq.: ME 2334 or equivalent***. Postulational treatment of laws of thermodynamics; equilibrium and maximum entropy postulates; development of formal relationships; principles and application to general systems.

4383 Thermal System Design (3) ***Prereq.: ECON 2030, ME 2334, and ME 4433.*** Principles and practices concerning the design and optimization of thermal systems.

4443 Introduction to Combustion (3) ***Prereq.: ME 4433.*** Basic principles of combustion and their application in solving engineering problems.

4563 Mathematical Methods in Engineering (3) See MATH 4038.

4573 Interactive Computer Graphics (3) ***Prereq.: Experience in math and computer programming. Also offered as CSC 4356,*** Analytical treatment of graphics using the digital computer; graphical display and input devices; computer graphics systems and standards; two–and three–dimensional transformations; geometric modeling; interactive techniques; basic data structures; realism in 3-D graphics; future trends.

4583 Applied Computer Graphics (3) ***Also offered as CSC 4357. Prereq.:*** **CSC 4356 or** ***ME 4573 or equivalent.*** Application of computer graphics techniques to solve specific problems in engineering design, scientific visualization, and digital media.

4633 Internal Combustion Engines (3) ***S Prereq.: ME 2334 or 3333 or equivalent.*** Classification of internal combustion engines, gas turbines, cycles with different components, spark-ignition gasoline engines, detonation, carburetion, compression-ignition engines, combustion and diesel knock, fuel atomization and atomizers, combustion chambers, two- and four-stroke cycle engines, and supercharging.

4643 Thermal Environmental Engineering (3) ***F Prereq.: ME 2334 and credit or registration in ME 4433; or equivalent.*** Design of thermal environment for humans, animals, processes, and inanimate objects; the means of control.

4663 Power Plant Engineering (3) F ***Prereq.: ME 2334 and 4433; or equivalent.*** Power plants for industrial and central-station use; emphasis on cycles, design, capabilities, and economics of the plant as a whole; components used in various types of plants.

4673 Introduction to Modern Control Theory (3) ***S Prereq.: ME 4183 or equivalent.*** State space modeling, controllability, observability and stability, pole placement, optimal control laws via minimum principle and dynamic programming.

4683 Sensors and Actuators (3) ***V Prereq.: EE 3950, ME 3143.*** Basic knowledge and operational principles of various transduction (sensing and actuation) methods, especially electromechanical sensors and actuators; actual designing, building and testing transducers.

4723 Advanced Materials Analysis (3) ***F Prereq.: ME 2733, 3701 or equivalent. 1 hr. Lecture; 6 hrs. Lab.*** Concepts and operation of modern analytical instruments using photon or electron beams and X-rays; macroscopic and microscopic examination of materials coupled with separate and combined testing of mechanical, tribological, and corrosion properties.

4733 Deformation and Fracture of Engineering Materials (3) ***F Prereq.: CE 3400 and ME 2733 or equivalent.*** Effect of temperature, strain rate, corrosion, and microstructure on stress-strain behavior and fracture of engineering materials, including metals, ceramics, and plastics.

4743 Kinetics in Materials Processes (3) ***S Prereq.: ME 2334, ME 2733 or equivalent.*** Applications of the principles of diffusion, phase transformation, and thermodynamics to describe the kinetics of microstructural evolution in engineering materials

4763 Fundamentals of Corrosion Science and Engineering (3) ***F Prereq.: ME 2733 or equivalent, and any first course in thermodynamics.*** Corrosion principles; polarization, passivation, inhibition, and other phenomena; principal methods used in corrosion prevention

4783 Composite Materials: Manufacturing, Properties, and Design (3) ***Prereq.: ME 2733 and CE 3400 or equivalent.*** Constituent materials, micro- and macromechanics, mechanical behavior, fracture, manufacturing and design of components made of composite materials, including polymer, ceramic, and metal matrix materials.

4813 Interdisciplinary Fluid Dynamics: Physical Concepts (3) ***Also offered as HNRS 4813. Prereq.: Diff. Equations and Introductory Physics.*** An introduction to fluid dynamics from a multi-disciplinary perspective, emphasizing theoretical, mathematical and physical concepts of fluid flows and their application to a range of physical scales and disciplines.

4823 Interdisciplinary Fluid Dynamics: Computational Methods (3) ***Also offered as HNRS 4823. Prereq.: Diff. Equations, Linear Algebra and Computer Programming.*** Numerical solution strategies for differential equations relevant to fluid flow and transport processes. Finite-difference, finite-volume and finite-element methods. Parallel computations.

4843 Gas Dynamics (3) F ***Prereq.: MATH 2070 and ME 2334; or equivalent.*** Derivation and review of basic equations of compressible fluid flow; reduction of the general problem to 1-D flow; 1-D flow in nozzles with and without friction; 1-D flow with heat addition; normal shock wave, Prandtl-Myer turn, and oblique shock waves.

4853 Turbomachinery (3) ***Prereq: ME 2334, 3834, and 4433.*** Preliminary design of axial- and radial-flow pumps, compressors, and turbines; determination of optimum flow angles and dimensions, blade design, blade selection, and performance prediction.

4913 Aerodynamics (3) ***Prereq.: ME 2334, ME 3834, or graduate standing.*** Fundamental principles and concepts of aerodynamics; inviscid incompressible and compressible flow; and viscous flow phenomena.

4923 Jet and Rocket Propulsion (3) ***Prereq.: ME 2334 and ME 3834.*** Propulsive systems; aerothermochemistry; air-breathing propulsion; rocket propulsion.

4933 Advanced Topics in Mechanical Engineering, (3) ***May be taken for a max. of 6 hrs. of credit when topics vary. Two sections may be taken concurrently.***

4943 Special Problems in Aerospace Engineering (3) ***Prereq.: Senior standing in mechanical engineering or related discipline. May be taken for a max. of 12 sem. hrs. of credit when topics vary.*** Aerodynamic problems of special interest in the analysis and design of water, land, air, and space transportation systems.

4953 Nuclear Reactor Engineering Design (3) ***Prereq.: PHYS 2101 and PHYS 2102 or equivalent and credit or registration in ME 4433.*** Characteristics of radioactive materials, neutron interactions, the fission process; static criticality, time-dependent behavior of cores and design of nuclear power reactors.

4963 Nuclear Reactor Systems Engineering (3) ***Prereq.: ME 4953 or equivalent.*** Engineering aspects of reactor systems; nuclear fuel cycles, isotope separation, mechanical and thermal design, selection of materials and environmental impact of nuclear facilities.

4973 Space Systems (3) ***Prereq.: ME 3133 and credit or registration in ME 4143.*** Design of spacecraft for orbital operations, space exploration, and human spaceflight; includes mission requirements; astrodynamics; atmospheric entry; top-level design of power; propulsion; altitude determination and control; communications; thermal management; life support; reliability; cost and scheduling; political, commercial, and national security aspects of spaceflight.

7163 Advanced Dynamics (3) ***Prereq.: a first course in engineering dynamics, and a course in differential equations.*** Rotating reference frames, rigid body kinetics in three dimensions, central force motion, orbital mechanics, variable mass problems, and Lagrange's equations.

7153 Advanced Vibrations (3) ***Prereq.: ME 4143 or equivalent.*** Modeling and response of continuous vibratory systems; inverse problems in vibration; active vibration control; dynamic absorption; wave propagation and reflection; numerical methods for continuous systems.

7273 Advanced Stress Analysis in Mechanical Engineering (3) *Prereq.: ME 4273.* The nature and limitations of the underlying theory in stress analysis. Computation of verified stresses for properly posed problems using finite element analysis.

7313 Advanced Fluid Dynamics I (3) ***Prereq.: credit or registration in MATH 4038 or equivalent.*** Cartesian tensors; kinematics of fluid motion; mass and momentum conservation equations for Newtonian fluids; vorticity dynamics; irrotational incompressible flow; dynamic similarity and scaling analysis; laminar flow; compressible flow.

7323 Advanced Fluid Dynamics II (3) ***Prereq.: ME 7313 or equivalent.*** General conservation laws and Navier-Stokes equations; incompressible laminar boundary theory; regular and singular perturbation methods; gravity waves; stability of laminar flows; transition and turbulent boundary layers; dynamics and statistical description of turbulence; compressible boundary layer flow.

7333 Hydrodynamic Stability (3) ***Prereq.: ME 7323 or equivalent.*** Linear stability analysis; weakly nonlinear stability analysis; chaos.

7343 Computation of Fluid Flow and Heat Transfer (3) ***Prereq.: ME 3834, ME 4433 or equivalent.*** Finite-difference methods for solving equations of fluid motions and energy; computer program use to solve complex problems involving fluid flow; heat transfer and chemical reaction; mathematical models for turbulence; radiation and combustion; their computing implications; application of prediction procedures for practical situations.

7433 Advanced Heat Transfer I (3) ***F Prereq.: MATH 4038 or equivalent.*** Steady and transient heat conduction.

7443 Advanced Heat Transfer II (3) ***F Prereq.: ME 7843 or equivalent.*** Convection heat transfer.

7533 Numerical Methods in Applied Mechanics (3) ***V Prereq.: ME 4533 or equivalent.*** Computer methods used to solve engine problems; advanced numerical methods.

7633 Advanced Engineering System Dynamics (3*) Prereq.: ME 4183 or equivalent.* Dynamic system modeling; bond graphs; state-determined systems; simulation; controllability/observability.

7643 Advanced System Modeling (3*) Prereq.: ME 7633 or equivalent* Mathematical models and dynamic behaviors of engineering systems in multi-energy domains; bond-graph modeling methods, simulations using contemporary software.

7673 Advanced Mechanical Systems Control (3) F ***Prereq.: ME 4183 or equivalent.*** Analysis and design of distributed parameter feedback control systems; observability, controllability, and stability of distributed parameter systems; state estimation and optimal control of distributed systems; parameter identification and adaptive control techniques.

7743 Defects, Diffusion, and Transformation in Solids (3) ***F Prereq.: ME 2733 or equivalent.***. Defects and atomistic mechanisms, dislocation theory, quantitative description of diffusion process and phase transformations in materials.

7753 Thermodynamics of Solid Materials (3*) Prereq.: ME 2733 and any first level course in Thermodynamics.* Review of first and second laws of thermodynamics; material property relationaships; chemical equilibrium in reactions; solid solutions and phase diagram enunciations; reaction kinetics and non-equilibrium therodynamics.

7901 Seminar (1*) Graduate students are required to attend this course every semester; only 1 sem. hr. of credit in this course allowed toward degree. Pass-fail grading*

7903 Independent Study in Mechanical Engineering (3) ***May be taken for a max. of 6 hrs. of credit.*** Directed independent study for graduate students

7933 Mechanical Engineering Problems (3) Advanced problems of special interest in mechanical engineering being developed and offered by faculty

7953 Advanced Topics in Mechanical Engineering (3) ***May be taken for a max. of 6 hrs. of credit when topics vary, with consent of department.*** Mechanical engineering treatment of various areas of interest

8000 Thesis Research (1-12 hrs. per semester) "S" / "U" grading; 6 hrs counted toward M.S. (ME) degree

9000 Dissertation Research (1-12 hrs. per semester) "S" / "U" grading; 12 hrs counted toward Ph.D. (ME) degree

Note: Each faculty member is assigned a separate section for the research courses ME 8000 and ME 9000. Section numbers could change each semester. **Always double check that you are enrolled in the correct section for your Major Professor.**