

# **Mechanical Engineering Graduate Student Handbook**

**Academic Year 2022-2023**



**MECHANICAL  
ENGINEERING**

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## ***Special Considerations for 2022-2023: COVID-19***

The University continues to monitor state and national recommendations and mandates, and to establish appropriate University policies accordingly. Policies are likely to evolve through the academic year. Students are encouraged to monitor regularly the information that is posted by the University at <https://virusinfo.psu.edu/> and by the Graduate School at <https://gradschool.psu.edu/covid19/>, and to contact the Graduate Programs Office in case of questions. Please be advised that to be eligible for an assistantship support package, you must comply with all applicable University policies and expectations. Graduate assistants who fail to comply with policies and expectations risk revocation of their assistantship packages.

# **Section I – General Information**

## **I.1 GRADUATE PROGRAMS OFFICE**

The Graduate Programs Office for Mechanical Engineering (ME) is located in 127 Reber Building. The office is supervised by the Associate Department Head for Graduate Programs (Dr. Dan Haworth), the Graduate Program Coordinator (Chris Cooper), and the Administrative Support Assistant (**position currently open**). The office is open during normal business hours on Mondays through Fridays; any changes in hours will be posted on the office door. Students can call the office at 814-865-1345, or email us at [grad@me.psu.edu](mailto:grad@me.psu.edu), and we will respond as quickly as possible.

General functions of the Graduate Programs Office include:

- 1) Assist students with administrative questions, documents and submitting theses and dissertations;
- 2) Prepare material for consideration and action by the department graduate faculty or Associate Department Head for Graduate Programs;
- 3) Recruit the highest quality graduate students;
- 4) Review applications for admission to graduate study; and
- 5) Administer the Ph.D. Qualifying Examination.

The Graduate Programs Office is guided and assisted in these duties by several faculty committees. Committee members are appointed by the Department Head, Professor Mary Frecker.

## **I.2 ID CARDS**

Every resident Penn State graduate student will need a Penn State id+ card. Information about how to get your card can be found at <https://idcard.psu.edu/getting-your-id-card>. You will need to present appropriate forms of identification to get your id+ card, and there is no charge for your first card.

## **I.3 PSU EMAIL**

Every Penn State graduate student will need a Penn State access account and email address. The Graduate Programs Office uses email to notify students of various announcements, events, etc. All graduate students are expected to use their Penn State email account for all correspondence regarding academics. If you choose to use an account other than the one provided by the University, you are responsible for all information contained in your Penn State account. Please see the Information Technology (IT) website for more information, at <https://it.psu.edu/>.

## **I.4 MAIL HANDLING**

The faculty and staff mailroom is located in Room 235 on the second floor of Reber Building. First-class mail and inter-office mail for faculty and staff are sent from, or picked up in, the mailroom. The default mailing address for graduate students is 127 Reber Building.

Do not use a department mailing address to receive personal items. The department is not responsible for loss or theft of any personal mail delivered for you to a department address. If you receive a package, you will be notified to come pick it up.

## **I.5 PARKING**

Every employee or student must have a parking permit to park on campus. Individuals enrolled in classes at Penn State are classified as students, and can obtain student parking permits through the Parking Office. Please refer to policies and online registration procedures at <http://www.transportation.psu.edu/>.

Parking registration must be completed online, and all permits are sold on a first-come, first-served basis.

## **I.6 OFFICES, KEYS, TELEPHONES, SUPPLIES, AND COPIES**

*OFFICES* - Students on teaching assistantships will be provided access to space so that they can carry out their responsibilities as teaching assistants. Students on research assistantships will be provided desk space by their research adviser. The TA room is located in 127 Hammond Building.

*KEYS* - Keys are individually numbered and assigned to each person. If you terminate your graduate studies or graduate, keys must be returned to the ME Business Office in 132 Reber Building. Access to Reber Building is gained by the use of the PSU student ID card.

*PURCHASE OF EQUIPMENT AND SUPPLY ITEMS* - Listed below is a brief overview. We stress that you ask before ordering anything.

School supplies and books are personal expenses, and may not be charged to any departmental budget, teaching or research. Teaching assistants in need of supplies from the supply closet should stop by 127 Reber Building for assistance. Research assistants should see their faculty adviser for advice on how to obtain office supplies, if needed; the supply closet does not stock items for use by research assistants. For ordering laboratory supplies, equipment items, etc., there are several different procedures, depending on the type of item, vendor, and price range. Before placing any order, check with your supervising faculty member or the appropriate staff assistant. If you order something on your own with the intent of eventually charging a university budget and violate University policy, you may be personally liable for the purchase price. Take time to review the procedures with someone who knows the system before you order, and you will avoid complications.

*COPY MACHINES* – Copy machines are in various locations in Reber Building and in other buildings occupied by ME faculty and graduate students. Your graduate research adviser can provide authorization to access these copiers. If you are using these services for "non-personal" University-related work, ask your faculty supervisor about how to pay for them before you have the work done.

## **I.7 TRAVEL REIMBURSEMENT**

A student who participates in a conference or workshop may be reimbursed for travel expenses, if the student's adviser wishes to do so. The appropriate staff assistant or the Graduate Programs Office can provide you with the necessary reimbursement paperwork. If you make travel arrangements on your own with the intent of eventually charging a

university budget and violate University policy, you may be personally liable for travel costs. Take time to review the procedures with someone who knows the system before you travel, and you will avoid complications.

## **I.8 COMPUTER AND IT RESOURCES**

ME students have access to various computer resources. IT support is available at [support@me.psu.edu](mailto:support@me.psu.edu). All department laptops that are provided to use for TA duties should not be used for personal needs.

ME IT Contact: Christopher Hirsh, IT Consultant, 119 Reber Building; Phone: 814-865-8267



## Section II – Administrative Policies and Procedures

### II.1 REPORTING POLICIES, PROCEDURES AND RESOURCES

All members of the Penn State community are expected to remain mindful of their individual commitment to Penn State's core values of [Integrity, Respect, Responsibility, Discovery, Excellence and Community](#) by helping to keep the University a safe and ethical institution. In addition, as members of this community, everyone should be responsible stewards of University funds, whether generated from state, federal, student, or other sources. The University does not condone wrongful conduct by any member of the Penn State community, no matter what position they may hold. Penn State University encourages the reporting of misconduct: ***If you see something, say something.*** If you report misconduct, be assured that the University will protect you from retaliation. See [AD67](#) or contact the [Office of Ethics & Compliance](#) for more information. The following resources are available for faculty, staff, students, and others.

#### TO MAKE A REPORT

A summary of types of misconduct and how to report is available at <http://reporting.psu.edu>.

If at any point you are unsure where to report a non-emergency, you may contact the Office of Ethics and Compliance Hotline 24/7 at 800-560-1637 or <http://hotline.psu.edu>.

#### **Crime or Emergency Situation**

- Contact the campus police at 814-863-1111.
- In an emergency, dial **911**.

#### **Alcohol and Drugs**

Penn State has established a [Responsible Action Protocol](#) in response to the University Park Undergraduate Association's campaign for a medical amnesty policy. Effective January 2018, the Responsible Action Protocol was updated and now reflects the following:

- A student who acts responsibly by notifying the appropriate authorities (e.g., calling 911, alerting a resident assistant, contacting police) AND meets one or more of the following criteria typically will not face University conduct action for his or her own use or possession of alcohol or drugs. However, the student will be required to attend an approved alcohol or drug education program, such as BASICS or the Marijuana Intervention Program (MIP); the fee will be waived. When the student's behavior involves other Code of Conduct violations (e.g., vandalism, assault, furnishing to minors) the additional behavior may be subject to conduct action. If a student exhibits a pattern of problematic behavior with alcohol or drugs, that student may be subject to conduct action.
- The criteria which invoke the Protocol are:
  - A student seeks medical assistance *for themselves* when experiencing an alcohol or drug overdose or related problems
  - A student seeks medical assistance *for a peer* suffering from an alcohol or drug overdose or related problems
  - A student suffering from an alcohol or drug overdose or related problems, *for whom another student seeks assistance* will also not be subject to conduct action for alcohol violations.

### **Suspected Ethical or Policy Violations**

This includes fraud, theft, conflict of interest, abusive or intimidating behavior, retaliation, athletics integrity or NCAA compliance.

- Report employee misconduct to your supervisor or [HR Strategic Partner](#).
- Report student misconduct to the [Office of Student Conduct](#) or call 814-863-0342.
- Use the Penn State Hotline at 800-560-1637 or <http://hotline.psu.edu>. Both are anonymous and are available 24/7.

### **Child Abuse, Including Child Sexual Abuse**

- Contact the Pennsylvania Child Welfare Services "ChildLine" at 800-932-0313 or <https://www.compass.state.pa.us/cwis>.
- If the child is in immediate danger, dial **911** first.
- You must also email [AD72@psu.edu](mailto:AD72@psu.edu) communicating that a report has been made. For more information on AD72 (Reporting Suspected Child Abuse), see <https://guru.psu.edu/policies/AD72.html>.
- Further details can be found in the "Building a Safe Penn State: Reporting Child Abuse" training available on the Learning Resource Network at <http://lrn.psu.edu>.

### **Behavioral Threat**

- Contact the Behavioral Threat Management Team at 814-863-BTMT (2868) or <http://btmt.psu.edu/>.

### **Bias, Discrimination, or Harassment**

- To report behavior *by an employee*, contact the Affirmative Action Office at 814-863-0471.
- Visit the Report Bias website at <http://equity.psu.edu/reportbias> (for student reporting only)
- Acts of intolerance by students may be reported to the [Office of Student Conduct](#) at 814-863-0342.

### **Sexual Harassment and Other Forms of Sexual Misconduct\***

To make a report to the University

- Contact the University's Title IX Coordinator at 814-867-0099, or [titleix@psu.edu](mailto:titleix@psu.edu).
- To file an online report, visit the Office of Sexual Misconduct Prevention and Response's website at <http://titleix.psu.edu/filing-a-report/>.
- To file an anonymous report, the Penn State Hotline is available 24/7 at 800-560-1637 or <http://hotline.psu.edu>. Both are anonymous, and are available 24/7.

\*Additional information and resources available in relation to incidents of sexual harassment and/or misconduct (including a campus-specific list of victim support services and confidential reporting options) can be found at <http://titleix.psu.edu/>.

To file a discrimination or harassment complaint outside of the University

- Call the Office for Civil Rights (Philadelphia Office) at 215-656-8541 or email [OCR.Philadelphia@ed.gov](mailto:OCR.Philadelphia@ed.gov).
- Call the Equal Employment Opportunity Commission (Philadelphia District Office) at 800-669-4000.
- Call the Pennsylvania Human Relations Commission (Harrisburg Regional Office) at 717-787-9780.

## Student Misconduct

- Contact the Office of Student Conduct at 814-863-0342 or <http://studentaffairs.psu.edu/conduct>, or report online at [https://pennstate.qualtrics.com/jfe/form/SV\\_8qYxyWYciWERPGL](https://pennstate.qualtrics.com/jfe/form/SV_8qYxyWYciWERPGL).
- Hazing by any student organization or individual is against Penn State's code of conduct, and also is a violation of Pennsylvania law. To report instances of hazing within any student organization or group, including fraternities and sororities, contact the Office of Student Conduct (<http://studentaffairs.psu.edu/conduct> or 814-863-0342), or the Penn State Hotline at 800-560-1637 or <http://hotline.psu.edu>.

## Research-Related Concerns

- Any research-related concerns should be directed to the Office for Research Protections at 814-865-1775 or [orp@psu.edu](mailto:orp@psu.edu).
- Research misconduct concerns should be directed to 814-865-1775 or [researchconcerns@psu.edu](mailto:researchconcerns@psu.edu).

## Some Key Penn State Policies

- AD88 – Code of Responsible Conduct: <https://policy.psu.edu/policies/AD88>
- HR91 – Conflict of Interest: <https://guru.psu.edu/policies/OHR/hr91.html>
- RP02 – Addressing Allegations of Research Misconduct: <https://guru.psu.edu/policies/RP02.html>
- RP06 – Disclosure and Management of Significant Financial Interests: <https://guru.psu.edu/policies/RP06.html>
- AD74 - Compliance with Clery Act: <https://policy.psu.edu/policies/ad74>
- AD77 - Engaging in Outside Professional Activities (Conflict of Commitment): <http://guru.psu.edu/policies/AD77.html>
- AD85 - Sexual Harassment: <https://guru.psu.edu/policies/AD85.html>
- AD86 – Acceptance of Gifts and Entertainment: <https://guru.psu.edu/policies/AD86.html>
- AD91 - Discrimination and Harassment and Related Inappropriate Conduct: <https://guru.psu.edu/policies/AD91.html>

## Where to Start

If it is not clear where to turn for assistance, any of the following offices will guide you to someone who can help:

- Office of Human Resources, Labor and Employee Relations at 814-865-1473 or <http://ohr.psu.edu/employee-relations/>
- Office of University Ethics and Compliance at 814-867-5088 or <http://www.universityethics.psu.edu/>
- Office of Affirmative Action at 814-863-0471 or <https://affirmativeaction.psu.edu/>
- Office of Sexual Misconduct Prevention and Response at 814-867-0099 or <https://titleix.psu.edu/>
- Office of Student Conduct at 814-863-0342 or <http://studentaffairs.psu.edu/conduct>
- Office of Internal Audit at 814-865-9596 or <http://www.internalaudit.psu.edu/>
- Clery Act Compliance Manager at 814-863-1273 or <http://www.police.psu.edu/clery/>
- Your campus, college, or unit's Human Resources Strategic Partner. Contact information is available at <https://hr.psu.edu/content/hr-strategic-partner-and-consultant-directory>.

## II.2 OTHER RESOURCES FOR GRADUATE STUDENTS

### Counseling and Psychological Services (CAPS)

CAPS can help students resolve personal concerns that may interfere with their academic progress, social development, and satisfaction at Penn State. Some of the more common concerns include difficulty with friends, roommates, or family members; depression and anxiety; sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. See <http://studentaffairs.psu.edu/counseling/>.

### The Graduate & Professional Student Association (GPSA)

The GPSA, <http://gpsa.psu.edu/>, is the representative body for all graduate students. The GPSA addresses issues of concern to graduate students, and elects members to sit on shared-governance bodies of the University. The GPSA also organizes social events for graduate students. Members and officers of the GPSA can help graduate students become more involved (academically or socially) in University life. The GPSA office has information on most services available at Penn State. If students need help navigating campus, various offices around campus and finding other organizations, the GPSA can help.

## II.3 HEALTH SERVICES AND HEALTH INSURANCE

The University Health Service is located in the Student Health Center, which is adjacent to the Eisenhower Parking Deck and the Bank of America Career Services Building, off Bigler Road. Its facilities are available to all students, including graduate students at all levels of training. See <https://studentaffairs.psu.edu/health>.

Health insurance is mandatory for all graduate students, and students with a teaching assistantship or a research assistantship appointment are automatically enrolled. As a graduate assistant or graduate fellow, you are eligible to receive subsidies for the medical, dental and vision plans for you and any eligible dependents. Students enrolled in the University health insurance plan have their premiums automatically deducted from their paychecks.

Deadlines and policies can be found at <https://studentaffairs.psu.edu/health>, or contact University Health Services directly at 814-862-0774 if you have any questions regarding Penn State student health insurance.

## II.4 SELECTING AND ENROLLING IN CLASSES, AND PAYING TUITION BILLS

### LionPATH

LionPATH (<https://lionpathsupport.psu.edu/>) is Penn State's student information system. It provides students with access to their academic, registration, and financial records. Students can enroll for classes, view/accept their financial aid awards, and view their tuition bills using LionPATH.

#### First Login to LionPATH

The first time that a student logs in to LionPATH, they must sign the Consent to Do Business Electronically agreement in order to use the system. While not technically a part of enrollment, this screen will prevent all other actions until students have clicked the box to indicate their agreement. If students do not agree, they will have to conduct LionPATH business outside of the system.

### Each Semester in LionPATH

Students will not be eligible to enroll in classes for each semester until they have completed the Pre-Registration Activity Guide, which includes verification of emergency contact information and the Financial Responsibility Agreement (FRA). The FRA is a promise to take financial responsibility for payment of the student account. A Financial Responsibility hold will remain on a student's account until they have completed the Activity Guide. If not yet completed, the Activity Guide can be found in the student's To Do List within the LionPATH Student Center. For more information on how to complete the Pre-Registration Activity Guide, see <http://lionpathsupport.psu.edu/student-help/>.

### Course Registration in LionPATH

All students must register for classes prior to the late registration period for each semester, which can be found at <http://www.registrar.psu.edu/academic-calendars/>. If you do not register before that date, you will be assessed a late-add fee and a late-registration fee. If you are on a half-time graduate assistantship (the usual case for most ME graduate students), you must register for 9-12 credits per semester. International students must be registered full-time, or for nine credits, to maintain their visa status. Further information for international students is given in Section II.6 below.

### Course Selection for New Students

Courses for the first semester will be selected after consultation with the ME Associate Department Head for Graduate Programs, unless a permanent adviser has already been selected. A typical course load for a first-semester student is three 3-credit courses, plus the ME Colloquium (ME 590, 1 credit). For lists of suggested courses in specific areas of interest, see Section III.11 below.

### Course Selection for Continuing Students

Courses will be selected after consultation with your academic adviser. For Ph.D. students, the courses will be in accord with the program approved by your doctoral committee.

### **Full-Time Academic Status**

Full-time academic status is satisfied by taking an appropriate course load. Most loan-granting agencies and other organizations will consider a nine-credit course load to be full-time status, fulfilling their registration requirements. The U.S. Immigration and Customs Enforcement (ICE) requires that all international students on student visas must maintain full-time academic status during the fall and spring semesters. Exceptions to this rule are possible under certain conditions. Students should contact the University Office of Global Programs for further information. For ICE purposes, a course load of nine credits is considered full-time during the fall and spring semesters. During the summer, graduate students generally do not need to register, unless they are taking their Ph.D. Comprehensive Examination or Final Oral Examination during the summer. Any graduate student registered for ME 601 (Note: Student must have passed the Ph.D. Comprehensive Exam in the prior semester to be eligible to enroll in ME 601) is considered to have full-time academic status. For full details, see the Graduate Bulletin website at <https://bulletins.psu.edu/graduate>.

## **Tuition Bills**

After enrolling in classes, all students will receive a tuition bill that can be viewed in LionPATH. Students who are on an assistantship should monitor their bill closely and inform the ME Graduate Programs Office if they are assessed a late fee. A delay can exist between the timing of the Bursar's bill due dates and when tuition payments for students on assistantships are processed.

## **II.5 EXPECTATIONS AND RESPONSIBILITIES OF GRADUATE STUDENTS**

### **Academic Adviser**

Each graduate student must have an academic adviser, who is chosen in agreement between the student and the faculty member. For Master's Degree students, the faculty member who supervises the student's thesis (or paper) will be the academic adviser. For doctoral students, the research adviser will be the academic adviser. The Associate Department Head for Graduate Programs will initially act as the temporary adviser for incoming graduate students.

Master's Degree students with academic advisers who are not members of the ME Graduate Faculty are required to have a co-adviser who is a member of the ME Graduate Faculty. Contact the Graduate Programs Office if you are in doubt about the graduate faculty status of a faculty member.

It is imperative that students identify an academic adviser as early as possible in their program of study; preferably by the end of their first semester. It is the student's responsibility to reach out to faculty about the availability of research assistantships and research topics of mutual interest. For students who are not self-funded, it is important to understand whether or not the faculty adviser will be able to fund them as a research assistant before a commitment is made.

A list of faculty members in Mechanical Engineering can be found at the ME website: <https://www.me.psu.edu/department/faculty-staff-list.aspx>. The ME faculty directory contains information on each ME faculty member, including an overview of the faculty member's expertise or research interest areas, publications, current and past research projects, affiliations, education, honors/awards, etc. The directory is a useful resource for graduate students seeking a research adviser. Alternatively, students can search by research area at <https://www.me.psu.edu/research/labs.aspx>.

### **Graduate Assistants**

Most ME graduate students are appointed as graduate assistants. Graduate assistants are assigned tasks in teaching, research, or other activities that are educationally significant. The privileges and benefits and the obligations and responsibilities of graduate assistants are as follows:

#### Privileges and Benefits

- Eligible for financial assistance, including tuition and a stipend.
- Eligible for services at the Student Health Center.
- Eligible to use Penn State Career Services: <https://studentaffairs.psu.edu/career/>.
- Eligible to participate in the programs of GPSA.
- Eligible to join student organizations, except those whose constitutions limit membership to undergraduate students.

### Obligations and Responsibilities

- Maintain satisfactory scholarship.
- Make satisfactory progress in the degree program, that is acceptable to the Department and the Graduate School.
- Assume responsibility for knowing the regulations and pertinent procedures of the Graduate School and the Graduate Bulletin (<https://bulletins.psu.edu/graduate/programs/>).
- Forego other employment while a graduate assistant, as required by the Graduate School.
- Meet standards of conduct outlined by the Division of Student Affairs – Office of Student Conduct – Code of Conduct for Penn State students. See the following website for details: <https://studentaffairs.psu.edu/conduct>.
- Register for the appropriate number of courses/credits per semester.
- Meet the Department's standards of behavior in the performance of assigned duties.
- Exercise the privileges and obligations of academic freedom.

Assistantships are contracts to provide services to the Department in research (a research assistantship) or in teaching (a teaching assistantship), for which a stipend plus tuition coverage is received. Each student's specific duties will be assigned by the faculty member to whom they have been appointed. A half-time assistantship allows a student to schedule 9-12 credits per semester, receive a stipend plus grant-in-aid of resident education tuition and certain other benefits, and perform tasks that, on the average, occupy approximately 20 hours per week.

Lack of satisfactory progress or performance of duties can result in termination of the assistantship contract at any time. Graduate students who are appointed for fall/spring assistantships or for fellowships are eligible for the Summer Tuition Assistance Program (STAP). This program allows students who are required to be registered during summer session (e.g., to take their Ph.D. Comprehensive Exam or Final Oral Exam) to have the tuition paid by the Graduate School. Detailed information about eligibility and the application procedure for STAP is sent to all ME graduate students late in the Spring semester.

### **Research Assistants (RAs)**

RAs usually are students who are supported by a faculty member through externally funded research projects. Continuation of a RA is subject to the availability of funding, and on making satisfactory progress and the quality of the work performed. Research duties often coincide with the student's graduate research that they perform to meet their degree requirements.

### **Teaching Assistants (TAs)**

Graduate students are eligible to apply for available teaching assistantships. A call for TA applications is sent out before each fall and spring semester. You are required to fill out the TA application for each semester you want to be considered for a TA.

### **Additional Summer Funding**

ME typically does not fund TAs during the summer. Students continuing their research or other activities during the summer should pursue research funding through their adviser, internships off campus, or other employment opportunities. Students who are required to

register for courses during the summer session may apply for tuition assistance (STAP). To be eligible for STAP, you must have been a TA or RA during the previous Fall AND Spring semesters. For international students to qualify, they must receive a satisfactory score on the AEOCPT test, which is administered by the Department of Applied Linguistics.

## II.6 INTERNATIONAL STUDENTS

Penn State policies and procedures for international students are subject to change, to maintain compliance with United States law. All international studies are strongly encouraged to check regularly for information and updates at <https://global.psu.edu/category/international-students>. Some current (at the time of this writing) general information for international graduate students is provided in the following.

In order for international students with student VISAs to maintain their visa status through Penn State, they must meet several obligations which are listed in detail on the Office of Global Programs website at <https://global.psu.edu/category/international-students>. Regardless of whether or not an international student is receiving a graduate assistantship, they must maintain full-time academic status. Nine credits in each of the fall and spring semesters (excluding courses taken for audit) is the minimum required to fulfill Department of Homeland Security (DHS) visa requirements for full-time enrollment. A Ph.D. candidate who has successfully completed the Comprehensive Examination and is registered for ME 601 is also considered to be a full-time student. As noted earlier, graduate students generally do not need to register during the summer, unless they are taking their Ph.D. Comprehensive Examination or Final Oral Examination during the summer.

Exceptions to full-time study must be approved by the faculty adviser and department in advance by completing the Reduced Course Load eForm in iStart. All exceptions granted by the International Student Adviser must be reported to DHS within 21 days, as well as the return to full-time status. Exceptions to full-time study due to academic difficulties are limited to one semester during the entire program of study; documented medical illnesses are limited to one year during the program of study. Failure to enroll for full-time study will be reported in the Student and Exchange Visitor Information System (SEVIS) as a violation, and the student's SEVIS record may be terminated for "unauthorized drop below full course level."

DHS requires that international students proceed in a timely fashion toward completion of their degrees, as established by the academic department and (usually) stated on their initial immigration document. Failure to maintain normal progress toward completion of the degree during this period will jeopardize the student's ability to continue academic study, adjust status, or seek future employment in the United States. Because of this, students should not be enrolled less than full-time during fall or spring semester without approval of the Directorate of International Student and Scholar Advising (ISSA). DHS requires ISSA to report violations of status, including failure to maintain full-time enrollment.

In an effort to make required immigration processes for international students more efficient, less expensive, and more secure for all parties, the University Office of Global Programs (UOGP) has transferred all processes to a paperless system called iStart. For any questions regarding visas, academic status, work permits, etc., students should contact UOGP at <https://global.psu.edu>.



### **Employment Requirements/Options for International Students**

As noted earlier, all international students must be enrolled full-time. International students generally may work up to 20 hours per week during the fall and spring semesters, and up to 40 hours per week on campus during the summer.

Curricular practical training (CPT), employment which is an integral part of an established curriculum, is available to F-1 students who have been lawfully enrolled on a full-time basis for one academic year. Students in English-language programs are ineligible for practical training. To be considered CPT, the work must not only be related to the major field of study but must also be an integral or important part of the student's studies.

Students who have been in F-1 status for at least one academic year are eligible for optional practical training (OPT), which is temporary employment in their field of study for purposes of gaining practical experience.

For further information pertaining to employment of International Students, please refer to the UOGP website at <https://global.psu.edu/>.

### **American English Oral Communicative Proficiency Test (AEOCPT)**

All international students who have been offered teaching assistantships that involve interaction with undergraduate students are required to have passed the AEOCPT. This test is administered before the semester begins by the Department of Applied Linguistics. See <https://aplng.la.psu.edu/programs/about-the-aeocpt>. You will be notified via email when your test has been scheduled prior to the start of the semester. Please note that these tests usually take place 1-2 weeks prior to the beginning of semester.

## **Section III –Academic Policies and Procedures**

### **III.1 GRADUATE BULLETIN**

The Graduate Bulletin (<https://bulletins.psu.edu/graduate/>) contains University-level policies established by the Graduate School regarding academic procedures, registration requirements, conduct, resolution of problems and procedures for termination, M.S. degree and Ph.D. degree requirements, as well as other procedures, regulations and requirements related to graduate study.

### **III.2 UNSATISFACTORY SCHOLARSHIP**

A graduate student who fails to maintain satisfactory scholarship or to make acceptable progress in a degree program may be dropped from the University. One or more failing grades, or a cumulative grade-point average below 3.00 for any semester or session or combination of semesters and/or sessions, may be considered as evidence of failure to maintain satisfactory scholarship. Action may be initiated by the department or committee in charge of the graduate major or by the chair of the student's committee. See <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-800/gcac-803-procedures-termination-unsatisfactory-scholarship/> for further information.

### **III.3 DEADLINES**

It is the responsibility of the student, working with their adviser and committee, to ensure that all relevant deadlines established by the Graduate School are met: see <https://gradschool.psu.edu/completing-your-degree/important-deadlines/>. Extensions should not be expected and are granted by the Graduate School only under exceptional circumstances.

### **III.4 MINORS**

Many ME students take graduate-level minors in other programs, or in specific areas such as the Computational Science Graduate Minor (<https://bulletins.psu.edu/graduate/programs/minors/computational-science-graduate-minor>). It is the student's responsibility to make sure that all requirements are met. Ph.D. students must inform the Graduate School of their intent to take a graduate-level minor before taking their Comprehensive Exam. Minors must be requested in conjunction with the establishment of Ph.D. committee, or prior to the semester of graduation for M.S. students. The Graduate School may decline late requests, as the intent is that a minor should be an integral part of the student's graduate program, not an afterthought.

### **III.5 CONCURRENT DEGREES**

Students who wish to pursue a concurrent degree must be officially admitted to the concurrent degree program prior to substantial completion of the home degree. See <http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-209-concurrent-degrees/> for the complete policy. You should contact the ME Graduate Programs Office if interested in pursuing a Concurrent Degree.

### III.6 GRADING SYSTEM

Grades are assigned to students on the basis of the instructor's judgment of the student's scholastic achievement, using the grading systems that can be found at <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-400/gcac-401-grading-system/>. A minimum grade-point average of 3.00 for work done at the University is required to remain in good academic standing, and for graduation.

### III.7 COURSE LOAD

Course load requirements have been discussed in previous sections. If in doubt, contact the Graduate Programs Office before scheduling courses, especially for the summer.

M.S. students are not required to register for course work or research once the minimum course requirements have been met, although international students may need to continue to register for courses to maintain their visa status. After passing the Comprehensive Exam, all Ph.D. students must maintain "continuous registration," which requires them to register for ME 601 (Ph.D. Thesis Preparation) for the fall and spring semesters. If Ph.D. students plan to take their Comprehensive Exam or their Final Oral Exam during the summer session, they must be registered during that summer. Also, Ph.D. students must spend at least two semesters over some 12-month period during the interval between completion of the Qualifying Exam and completion of the Ph.D. program as a registered full-time student; see <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-601-residency-requirement-research-doctorate>.

### III.8 ADDING AND DROPPING COURSES

If you are considering adding or dropping a course, there are several factors to consider:

- Is there still time to drop or add a course?
- Will dropping a course affect my progress towards my degree?
- Will a change in my course schedule have financial implications?
- If an international student, will a change in my course schedule have an impact on my visa status? Recall that international graduate students must maintain full-time registration to maintain their visa status during the fall and spring semesters.

Penn State maintains three periods relating to course drops in each semester: the pre-semester period, the regular add/drop period, and the late-drop period:

1. The pre-semester period begins on the first day of scheduling and ends the day before the semester starts. While exceptional circumstances may necessitate the need to process schedule changes after classes begin, students are encouraged to finalize all schedule changes prior to the first day of classes for the semester.
2. The regular drop/add period begins the day that your courses start, and is when dropping a course can be done without incurring a drop/add fee. The length of the period is six days from the beginning of the semester during fall/spring for full-semester courses, and is a calculated proportional length for other courses. See <https://www.registrar.psu.edu/academic-calendars/>. No signatures are required during this period.
3. A student can drop a course with certain restrictions and requirements after the regular drop/add period. The late-drop period starts the day after the regular drop period, and ends on the late-drop deadline for the semester. During this period:
  - No signatures are required;
  - A fee is imposed for each transaction; and

- Courses are recorded on the student's transcript as "LD."

Changing your overall number of credits after classes begin can have financial implications. Before making any registration changes, consult with your academic adviser.

- If you drop below full-time status, that can impact the tuition, fees, student aid, and refunds applied to your bursar account. Additionally, during the late-drop period, the University assesses a processing fee for any course that is dropped or added. Any tuition adjustment is determined by the effective date of the drop, and is made according to Penn State's Tuition Adjustment Schedule (<https://www.bursar.psu.edu/tuition-adjustment-policy>). If a full-time graduate student drops a course but remains at full-time status, the tuition rate does not change.
- You should also investigate whether or not you would meet the "Satisfactory Academic Progress" standards for federal financial aid programs when considering a course drop. Details about satisfactory academic progress is available at <https://studentaid.psu.edu/>.
- During the pre-semester period, you can add and drop courses as many times as needed to create a suitable schedule, without unfavorable financial implications. Please be mindful to check your tuition bill for updates if you make changes to your schedule (especially if adding credits) after you have paid your tuition bill.

### III.9 AUDITING COURSES

Requests to take a course for audit must be made to the program that offers the course, and requires permission from the instructor. Courses taken formally as audit are not included in the maximum number of credits required for assistantships or for satisfying visa requirements for international students. The request to audit a course must be done by the fourth day of classes within the regular drop/add period. Adding of an audited course after the regular drop/add period is not permitted. Courses cannot be changed to an audit after the semester has begun.

### III.10 TRANSFER OF CREDITS

#### Transfer of Credit from an External Institution

1. A maximum of six credits of high-quality graduate work done at a regionally accredited institution or recognized degree-granting institution may be applied toward the requirements for a Master's Degree. However, credits earned to complete a previous degree, whether at Penn State or elsewhere, may not be applied to a Master's or Doctoral degree at Penn State. Credit transfers are not allowed for the Ph.D. degree.
2. Approval to apply any transferred credits toward a degree program must be granted by the program head or graduate officer, and by the Graduate School.
3. Transfer credits must meet the following criteria:
  - Must have been earned at a regionally accredited institution or a recognized degree-granting institution in the United States;
  - Must be of "A" or "B" grade value ("B-" grades are not acceptable; pass-fail grades are not transferable unless substantiated by the former institution as having at least "B" quality);
  - Must appear on an official graduate transcript; and
  - Must be earned within five years prior to the date of registration to a degree program at Penn State.

Application forms for transfer of credit can be found at <https://gradschool.psu.edu/current-students/>.

### **Transfer of Nondegree Graduate Credits**

Approval to apply nondegree graduate credits toward a degree program must be granted by the program head or graduate officer, and by the Graduate School. A maximum of 15 credits earned at Penn State as a nondegree student may be applied to a degree program.

- The credits must have been earned within five years preceding entry into the degree program. Requests to transfer graduate work taken more than five years prior to admission into a graduate degree program must be accompanied by a letter justifying the validity of the course work.
- Only 400, 500 and 800-level graduate courses may be transferred.
- Only A, B, and C grades may be transferred.

Forms for transfer of credit may be obtained from the graduate programs office.

### **III.11 SUGGESTED CORE COURSES**

Students are expected to select courses and to write a thesis or paper in one or more general subfields within Mechanical Engineering, which may include:

#### Thermal Sciences

Heat Transfer  
Combustion  
Fluid Mechanics

#### Mechanical Sciences

Systems and Controls  
Dynamics, Vibrations and Noise Control  
Solid Mechanics and Mechanical Design

The following listings of suggested courses in each of six general areas are provided for guidance. Your adviser and/or committee may suggest alternative or additional courses. Most of the courses listed below are offered on a regular basis. New experimental courses may be offered from time to time; these will be numbered as ME497x for upper-level undergraduate courses, or as ME597x for graduate courses. The on-line schedule of courses for each semester will show which courses are being offered that semester.

FIELD	CORE COURSES	RELATED COURSES
Heat Transfer	ME 512, 513, 514, 521, 523	ME 411, 504, 515, 520, 522, 527, 530
Combustion	ME 521, 530, 532, 535, 537	ME 400, 404, 430, 431, 432, 504, 512, 513, 514, 520, 522, 523, 527, 533; AERSP 412
Fluids	ME 512, 513, 520, 521, 522, 523; AERSP 423	ME 405, 420, 514, 515, 524, 526, 527, 530, 532
Systems and Controls	ME 550, 554, 555	ME 455, 558, 559
Dynamics, Vibrations and Noise Control	ME 571, 572, 573, 580, 581	ME 452, 470, 471; ACS 510; E MCH 525
Solid Mechanics and Mechanical Design	ME 560, ME 563, ME 564, 565; E MCH 507, 560, ME 560	ME 460, 461, 462, 463, 480, 481, 546, 572; CE 541, 548; E MCH 506, 509, 531, 532, 540, 546

### III.12 COLLOQUIUM REQUIREMENT (ME 590)

All ME graduate students must successfully complete two credits of Mechanical Engineering Colloquium (ME 590). This must be done in the first two semesters in the program. For M.S. students, these two credits are not counted towards the 30-credit total required for completion of the M.S. degree.

### III.13 RESEARCH COURSES: ME 596, 600 (610), and 601 (611)

Graduate students registering for these courses must first consult with their adviser (or the instructor if different from adviser) to ensure that they are registering for the appropriate course and section. Failure to select the correct course may result in the student having to pay retroactive drop/add fees, and possibly additional course-credit fees. The ME Graduate Programs Office staff can assist graduate students in registering for the appropriate research course and section.

ME 596 - INDIVIDUAL STUDIES "Paper Research" - Creative projects, including non-thesis research, that are supervised on an individual basis and which fall outside the scope of formal courses. **ME 596 cannot be used for M.S. Option A (thesis option) or for Ph.D. thesis research. ME 596 is appropriate for the M.S. Paper Option (Option B) or for M.S. Option C (Ph.D. Research Proposal);** see Section IV.1 below. Three credits of ME 596, supervised by the student's adviser, can be counted toward the 30-credit total when following M.S. Option B or M.S. Option C.

ME 600 (or ME 610 for off campus) - THESIS RESEARCH - **This course should be used to register for research credits for M.S. Option A (thesis option) or for Ph.D. thesis research.** A minimum of six credits of ME 600/610 is required for M.S. Option A. There is no limit on the maximum total number of credits of ME 600/610 that a student can take. However, there is a maximum number of credits for which a student can receive a quality letter grade (A, B, etc.): a maximum of six credits for M.S. Option A, a maximum of 12 credits for the Ph.D., and a maximum of 18 credits for a Ph.D. student who does a M.S. thesis on the way to their Ph.D. A student must receive a non-letter grade (R, etc.) for any additional credits of ME 600/610. The R grade can be assigned for satisfactory completion of

research for any credits beyond the maximum. See <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-400/gcac-401-grading-system/>.

ME 601 (or ME 611 for part time) - Ph.D. THESIS PREPARATION – **This course is limited to Ph.D. students who have passed their Comprehensive Examination.** Ph.D. students are eligible to enroll in ME 601/611 in the semester following the successful completion of their Comprehensive Exam, and after they have met the two-semester Ph.D. residency requirement (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-601-residency-requirement-research-doctorate>). Ph.D. students can register for one additional course either for credit or audit (up to three credits) when they are registered for ME 601/611. Students who are eligible must contact the ME Graduate Programs Office staff to enroll in ME 601/611. Note that ME 601/611 cannot be used to meet the residency requirement.

### III.14 SCHOLARSHIP AND RESEARCH INTEGRITY (SARI) REQUIREMENT

The SARI program is an opportunity to engage graduate students broadly in a dialog surrounding issues pertinent to research ethics (<https://www.research.psu.edu/training/sari>). All Penn State graduate students are required to meet the SARI requirements before graduating. ME students must complete this requirement in the first year of their graduate program. SARI has two parts:

- SARI RCR (Responsible Conduct of Research) – to be completed during a student's first year
- CITI (Collaborative Institutional Training Initiative) – to be completed during a student's first semester

#### SARI RCR Overview

Every student must complete five hours of discussion-based SARI RCR education during their first year. SARI RCR hours can be earned through various workshops and/or seminars that are available through the College and from other sources. CITI online training does not count toward the five hours of SARI RCR.

#### CITI On-line Training

All ME graduate students are required to complete the on-line CITI training program for engineering within their first semester. Completion of the CITI program will result in a certificate of completion. Failure to comply will preclude certification for graduation by the Department. To complete this training:

1. Go to <https://citi.psu.edu/>.
2. Select "Log in to CITI" under University Park.
3. Enter your PSU credentials. (If this does not work, go to <https://www.citiprogram.org/> instead, and create a username and password to access the CITI online training.)
4. Select the course called "Responsible Conduct of Research (RCR) – Basic."
5. Remember to email the certificate to [grad@me.psu.edu](mailto:grad@me.psu.edu) after successfully completing the course.

## Section IV – Degree Programs

The Department of Mechanical Engineering offers two graduate degree programs for resident students: a Master of Science (M.S.) program, and a Doctor of Philosophy (Ph.D.) program. Both are research-based programs. The M.S. program is also available online, through Penn State World Campus (<https://www.worldcampus.psu.edu>).

### IV.1 MASTER OF SCIENCE (M.S.) DEGREE PROGRAM

The objective of the M.S. degree program is to gain advanced knowledge for research, analysis, and design in Mechanical Engineering.

#### M.S. Degree Requirements

Principal coursework and other requirements are as follows.

1. A minimum of 30 eligible course credits, of which 20 must be earned at University Park. The required course credits must be completed with a grade point average of 3.00 or higher. Further specifications follow.
2. A minimum of 18 of the 30 credits must be at the 500- and 600-level. See additional specific requirements for Options A, B and C below.
3. A minimum of 12 of the 30 credits must be 400- and 500-level course credits in Mechanical Engineering. ME 410, 440, 450, 454, and any other required courses in Penn State's ME undergraduate curriculum cannot be included in these 12 credits. If in doubt, contact the Graduate Programs Office before enrolling in a ME 400-level course. ME 596 and ME 600 cannot be counted toward fulfilling this requirement.
4. A minimum of three of the 30 credits must be eligible mathematics credits. These credits must be taken from the following group of courses: E MCH 524A, E MCH 524B, ME 512, ME 544, ME 550, and all 400- and 500-level "MATH" designated courses (MATH 4XX, MATH 5XX) except MATH 419, 427, 428, 435, 451, 455, 456, 461, 470, 471, 475, 475W, 482 and 484. Courses with a specific focus on numerical analysis cannot be used to meet the mathematics requirement.
5. M.S. paper or thesis presentation. All M.S. students must present the results of their thesis or paper at a meeting consisting (at a minimum) of their adviser and the thesis or paper reviewer (who must be a member of the ME graduate faculty). This requirement may be waived if the student makes a presentation related to their thesis or paper at a national or international scientific conference.
6. Preparatory course(s) required for teaching assistants (such as ENGR 888), remedial courses, and any courses required in Penn State's ME undergraduate program cannot be counted toward meeting the 30-course-credit requirement. Nontechnical courses may be accepted on a limited basis. The student should check with their adviser or the ME Graduate Programs Office, if in doubt. See the M.S. Transcript Audit section below.



7. ME Colloquium. All students must successfully complete two credits of ME 590, preferably in their first two semesters in the program. These two credits do not count toward meeting the 30-course-credit requirement.
8. SARI/CITI. All students must complete the SARI/CITI requirements in their first two semesters of the program.

### **Three M.S. Degree Options**

There are three options for the M.S. degree, which are outlined in the following. Each M.S. student must choose one of these three options, in consultation with their adviser.

#### OPTION A – M.S. THESIS

Six credits of ME 600 and/or ME 610 are required (see Section III.13 above), and the student submits a thesis following the procedures specified by the Graduate School. These six credits of ME 600/610 count toward meeting requirements 1 and 2 above, but not toward meeting requirement 3. Any additional 600/610 credits cannot be counted toward meeting degree course-credit requirements. This option therefore requires at least 24 additional course credits, of which a minimum of 12 credits must be at the 500 level, and a minimum of 12 credits must be eligible 400- or 500-level Mechanical Engineering courses. ME 596 does not count towards meeting the requirements for the thesis option.

#### OPTION B – M.S. PAPER

Three credits of ME 596 are required (see Section III.13 above), and the student submits a paper following the guidelines provided below (see M.S. Paper Guide). These three credits of ME 596 count toward meeting the 30-course-credit requirement. This option therefore requires at least 27 additional course credits, of which a minimum of 15 credits must be at the 500 level, and a minimum of 12 credits must be eligible 400- or 500-level Mechanical Engineering courses. ME 600 does not count towards meeting the requirements for the paper option.

#### OPTION C – Ph.D. RESEARCH PROPOSAL

Ph.D. candidates must submit a dissertation research proposal, demonstrating scholarship and the ability to plan a major research activity, to their doctoral committee for approval. In Option C, the research proposal replaces the M.S. paper in Option B above. Other requirements are:

1. Successful completion of the Ph.D. Qualifying Examination;
2. Completion of the Option B (not Option A) course requirements; in particular, three credits of ME 596 are required;
3. Notifying the ME Graduate Programs office of the intent to exercise this option *prior to scheduling the Ph.D. Comprehensive Exam.*
4. Acceptance of the research proposal by the student's doctoral committee: i.e., successfully passing the Ph.D. Comprehensive Exam.

### **M.S. Transcript Audit**

The form on the following page is used by the ME Graduate Programs Office to check that M.S. degree requirements have been met prior to approval for graduation. Candidates can use this as a checklist over the course of their degree program to make sure that they are on track to meet the degree requirements.

## M.S. Transcript Audit

Degree Option (select one): Option A, Option B, or Option C

1. Minimum of 30 eligible course credits
  - ME 590 does not count
  - SYSEN courses require approval. Other non-ME courses may require approval. Check with adviser and/or the ME Graduate Programs Office, if in doubt.
  - Option A: 6 credits of ME 600 are required, plus 12 additional 500-level credits; ME 596 does not count
  - Options B or Option C: 3 credits of ME 596 are required, plus 15 additional 500-level credits; ME 600 does not count
  - List of courses meeting this requirement:
2. Minimum of 18 credits in 500- and 600-level courses
  - ME 590 does not count
  - Option A: 6 credits of ME 600 are required, plus 12 additional 500-level credits; ME 596 does not count
  - Options B or Option C: 3 credits of ME 596 are required, plus 15 additional 500-level credits; ME 600 does not count
  - List of courses meeting this requirement (a subset of the courses listed under 1 above):
3. Minimum of 12 credits in 400- or 500-level ME courses
  - ME 590 does not count
  - See restrictions in the ME Graduate Student Handbook
  - List of courses meeting this requirement (a subset of the courses listed under 1 above):
4. Minimum of 3 credits of eligible math courses
  - See restrictions in the ME Graduate Student Handbook
  - Course meeting this requirement (one of the courses listed under 1 above):
5. Two credits of ME 590
  - Semesters taken:
6. Other courses taken that don't count toward meeting degree requirements
  - List of other courses (courses not listed under 1 above):
7. SARI
  - Requirement met:
8. GPA (minimum 3.0)
  - Candidate's GPA:
9. Thesis (Option A) or paper (Options B or C)
  - Written document and oral presentation signed off by adviser, reader, and grad programs office

## **Additional Information and Guidelines for M.S. Students**

### M.S. Thesis Guide (Option A)

The Graduate School provides a Thesis Guide, which provides templates and formatting instructions that should be used for M.S. theses. These can be found on the Penn State Graduate School site at <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/>.

### M.S. Paper Guide (Option B)

To ensure that M.S. papers meet accepted professional quality standards, the following guidelines have been established by the ME Graduate Faculty. Compliance will be monitored and enforced by the paper adviser, the paper reader and the Associate Department Head for Graduate Programs.

In content, length and structure, the paper is expected to be one that would be acceptable for publication in a peer-reviewed professional journal, or for presentation at a peer-reviewed national or international conference. Examples of papers that would not meet this standard would be a technical report to a sponsor, a presentation at a local or regional conference, or a presentation at a conference where selection is not based on a full-paper peer-review process.

In the case of a multiple-author paper, the degree candidate must be the first author, and the paper must be primarily the work of the degree candidate. If there are coauthors other than the degree candidate and their faculty adviser, then a brief summary of the contributions of each coauthor and an estimate of each coauthor's percentage of effort must be included.

If the paper has already been published and/or presented or has been accepted for publication and/or presentation, then the actual journal- or conference-formatted paper or manuscript should be submitted. Documentation must be provided to show that the paper has been published and/or presented or has been accepted for publication and/or presentation. The role of the reader in this case is primarily to confirm that the target journal or conference meets the criteria outlined above, and that the documentation is in order.

If the paper has been submitted for publication or presentation, but has not yet been accepted, then the actual journal- or conference-formatted manuscript should be submitted. Documentation must be provided to show that the manuscript is under consideration for publication and/or presentation. If reviewer comments are available, those should be provided. In addition to confirming that the journal or conference is appropriate, the reader in this case will effectively have the role of a peer reviewer, and will judge whether the manuscript is, in principle, suitable for publication in the target journal or presentation at the target conference.

If the paper has not yet been submitted for publication and/or presentation, but will be in the near future, then the requirements in the previous paragraph still apply, with the exception of the requirement to provide documentation that the paper is under consideration.

Finally, if the paper is not one that has been or will be submitted for publication or presentation, then an appropriate target journal or conference must be selected by the student and paper adviser, and the paper must be prepared as if it were going to be

submitted to that journal or conference. An appropriate template to use in this case would be the one that is available for ASME technical papers, for example:

<https://www.asme.org/publications-submissions/proceedings/conference-publications>. In this case, the paper reader must judge whether or not the paper would be acceptable, in principle, for publication in the target journal or presentation at the target conference. This option will place a greater burden on the reader, as they will not have the advantage of knowing that external peer reviewers are also reading and evaluating the paper.

#### Selection of a Faculty Reviewer (Reader)

A second ME graduate faculty member (in addition to the adviser) must be designated to serve as the faculty reviewer (or reader) for each M.S. thesis or paper. The reader usually is chosen by the student in consultation with their adviser and/or the Associate Department Head for Graduate Programs. The reader should be appointed in a timely manner to ensure that there is sufficient time to review the student's work.

#### Oral Presentation

All M.S. students must present the results of their thesis or paper at a meeting consisting (at a minimum) of their adviser and the thesis or paper reviewer. As noted earlier, this requirement may be waived if the student makes a presentation related to their thesis or paper at a national or international scientific conference.

#### Student Responsibilities

A typed draft of the thesis/paper must receive three approval signatures in the order indicated on the M.S. Thesis/Paper Approval Form: 1) the thesis/paper adviser; 2) the thesis/paper reader, and 3) the Associate Department Head for Graduate Programs. The completed approval form must be given to the Graduate Programs Office staff to be recorded and filed.

#### Reader Responsibilities

After reading the student's draft manuscript, the reader should prepare written comments to communicate with the thesis/paper adviser concerning any changes that they believe are essential. Minor corrections or editorial changes can be noted without discussion. If the reader wishes to discuss the material with the candidate, it is recommended that be done in the presence of the adviser.

#### Adviser Responsibilities

If there are questions or problems concerning the reader's comments, the thesis/paper adviser should arrange for a discussion with the reader. When the adviser and the reader have reached agreement, the adviser should direct the candidate to make any necessary changes. Minor editorial changes in pencil are acceptable, but major text changes should be retyped before the reader signs the approval form.

#### Deadlines

Key deadlines for each semester can be found on the Graduate School's website: <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/thesis-dissertation-performance-and-oral-presentation-deadlines-calendar/>. The Graduate School's deadlines apply primarily to candidates following the thesis option (Option A). Students who are following the paper option (Option B) should contact the ME Graduate Programs Office for deadlines. The ME Graduate Programs

Office will send specific instructions regarding graduation at the beginning of each semester.

If a student submits their thesis to the Graduate School after the dates above, but before the semester ends, they will graduate at the next scheduled graduation and will not be required to register for the subsequent semester. Upon request, the Graduate School will provide an official letter of certification indicating that the student has completed all the requirements for the degree. Allow two weeks for such a request to be processed.

## **IV.2 WORLD CAMPUS M.S. PROGRAM**

The World Campus Master's of Science in Mechanical Engineering (MSME) degree program is equivalent to the residential Master's Degree program. The programmatic requirements are the same as in Section IV.1 above. Some additional information that is specific to World Campus students follows.

All incoming World Campus MSME students must enroll in the section of ME 590 that is taught by the Director of the Online MSME program in their first term in the program. In this class, students will outline a plan of study and become familiar with the process for research for World Campus students.

All World Campus MSME students should check their Penn State email regularly. All important information from the ME Graduate Programs office, the Graduate School, course instructors, and the Director of the Online MSME program will be sent to that address. If a student is not enrolled in any classes, and their profile is discontinued, they may not be receiving important notifications from University sources. In that case, they should reach out to the Director of the Online MSME program.

All World Campus students must do independent research, complete a final written deliverable, and pass a culminating presentation under the advisement of their research adviser and a second faculty member. Most World Campus MSME students will follow M.S. Option B (paper option), but Option A (thesis option) is also available to them, as it is for resident students.

The typical timelines for research and research adviser matching for WC MSME students will be addressed in the World Campus section of ME 590 in the first semester of the MSME Program, that is taught by the Director of the Online MSME program.

## **IV.3 DOCTOR OF PHILOSOPHY (PH.D) DEGREE PROGRAM**

### **Course Requirements**

There are no specific course credit requirements for the Ph.D. degree, beyond the two-credit Colloquium Requirement (Section III.12 above). Course requirements are established by the adviser and doctoral Committee.

### **PH.D. Qualifying Examination**

A student who has been admitted to the Graduate School and has been accepted by the department or committee in charge of a major program in which the doctorate is

offered may begin working toward a doctoral degree. However, the student has no official status as a doctoral student, and no assurance of acceptance as a doctoral candidate, until the Qualifying Examination has been passed. Graduate School policy and requirements for the Qualifying Examination are given in GCAC-604: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-604-qualifying-exam/>.

### Purpose

The purpose of the Qualifying Examination is to assess a student's potential to excel in their Ph.D. studies and to conduct research at the highest level in their chosen field of study. Preparing for this examination is expected to help students strengthen their knowledge of fundamentals across the Mechanical Engineering discipline.

### Eligibility and Timing

Full requirements are given in GCAC-604. Key points regarding eligibility and timing are as follows:

- You must be enrolled in the ME Ph.D. program, and be in good academic standing.
- You must have completed at least 18 credits in courses eligible to be counted toward your graduate degree. This can include graduate courses taken prior to joining Penn State.
- You must take the exam with three semesters (excluding summers) of entry into the ME doctoral program. Some exceptions apply.
- It is in your best interest to have a faculty adviser in place before taking the exam. Historically, students who have been working with a faculty adviser have been more successful in passing the exam. If you do not have adviser, the Associate Department Head for Graduate Programs will serve in that role for this purpose.
- You are strongly encouraged to take the Qualifying Examination at the earliest possible time that is consistent with Graduate School policy, after discussion with your faculty adviser. Normally that will be in your third semester of study, excluding summers.

The ME Ph.D Qualifying Examination is administered two times each academic year, once each in the fall and spring semesters. Dates for the Qualifying Examination will be announced by the Graduate Programs Office by email to all graduate students.

### Format and Evaluation

The format of the examination and the process by which pass/fail decisions are made are detailed in the Appendix.

### **Doctoral Committee**

Immediately after passing the Qualifying Examination, a student must form his or her doctoral committee. Graduate School policy is that the committee must be formed no later than one year after successful completion of the Qualifying Examination.

Committee membership composition is specified in Graduate School policy GCAC-602: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-602-phd-committee-formation/>. Committee members are selected by the academic

adviser in consultation with the student, and consistent with GCAC-602. The adviser will recommend the members to the Associate Department Head for Graduate Programs, who in turn will notify the Graduate School. Once a committee is established, any requests to alter the committee membership must be made in writing to the Graduate Programs Office. All members currently on the committee and any member(s) to be added must be copied on the request.

Once the student's doctoral committee has been formed, the remainder of the student's program is under the control of the committee. The ME Graduate Program Office will continue to maintain records and monitor progress. The function and organization of the doctoral committee are enumerated in Graduate School policy GCAC-603: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-603-phd-committee-responsibilities/>. Students are encouraged to familiarize themselves with this policy, so that they can work effectively with their committee.

Each student's committee is encouraged to meet as a body at least once a year to review the status of the student's research and program of study. Graduate School policy requires that a written report on each Ph.D. candidate's progress be submitted annually to the program's Graduate Programs office. If there is a substantial change in the student's program of study or research objective, the committee should meet. A written record of this meeting describing these changes must be sent to the Department for inclusion in the student's official records.

### **Residency Requirement**

Over some twelve-month period during the interval between admission to the Ph.D. program (successful completion of the Ph.D. Qualifying Exam) and completion of the Ph.D. program, the candidate must spend at least two semesters (summer sessions are not included) as a registered full-time student engaged in academic work at the University Park campus. Note that ME 601 cannot be used to meet the full-time residency requirement. See <http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-601-residency-requirement-research-doctorate>.

### **Continuous Registration Requirement**

A candidate for the Ph.D. degree is required to register continuously for each fall and spring semester from the time the Comprehensive Examination is passed and the two-semester residence requirement is met until the dissertation is accepted by the doctoral committee and the final oral examination is passed. See <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-500/gcac-515-registration-course-work-completed/>.

### **Comprehensive Examination**

The purpose of the Comprehensive Examination is to demonstrate that candidates are qualified to successfully complete the research phase of their program. This requires that students have substantially completed the program of courses approved by their committee with a minimum grade point average of 3.00, and have satisfied the English proficiency requirement (which is assessed as part of the Qualifying Exam). The relevant Graduate School policy is GCAC-606: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-606-comprehensive-examination-research-doctorate/>.

The Graduate School requires that all members of the committee be present at the scheduled exam time.

The Comprehensive Exam should cover the specific areas of Mechanical Engineering, designated by the student's doctoral committee, which relate to the student's program and any minor field(s) of study (if elected or required). The Comprehensive Exam will consist of an oral examination administered by the student's Doctoral Committee, which includes two parts:

Part 1: Presentation of a proposal related to dissertation research. The main purpose of this part will be to demonstrate the candidate's technical communications skills and their competency of the subject matter closely related to the thesis topic.

Part 2: Structured oral examination. The main purpose of this part will be to demonstrate the candidate's in-depth knowledge in related areas of research.

The Comprehensive Examination also requires a written proposal related to the candidate's planned dissertation research. The written research proposal should include:

- a) Statement of the research problem;
- b) Literature review;
- c) Preliminary results, if available;
- d) Work plan describing methods of analysis and/or experimentation;
- e) Most significant results expected from the research and their impact on the current state of the art in the main area of the research; and
- f) Time schedule to degree completion.

A written exam may also be given, at the discretion of the Committee. A student must receive a favorable vote of at least two-thirds of the members of the Committee to pass the Comprehensive Exam.

The Comprehensive Exam is scheduled by the Graduate School upon request from the Associate Department Head for Graduate Programs, following notification from the chair of the doctoral committee. The student must be registered during the semester of the exam. It is the responsibility of the Ph.D. committee chair to complete all procedures and see that all requirements are met. It is the responsibility of the Ph.D. student to be certain that the committee chair performs these duties in a timely and accurate manner. The Graduate School requires at least two weeks' notice to process exam requests.

### **Dissertation Review**

Graduate School policy governing dissertations can be found in GCAC-607: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-607-dissertation-research-doctorate/>.

The Ph.D. dissertation will be reviewed by each member of the student's doctoral committee. Prior to submission to each committee member, the thesis draft should have been read and approved by the thesis adviser. Each member of the committee



should have a minimum of two weeks before the scheduled exam date to carefully read the thesis draft.

### **Final Oral Examination (Dissertation Defense)**

The purpose of this examination is for students to defend their Ph.D. dissertation. The relevant Graduate School policy is GCAC-608: <https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-608-final-oral-examination-research-doctorate/>. Some of the key rules include the following:

1. Requests for scheduling the oral examination should be made in writing by the student's committee chair to the Associate Department Head for Graduate Programs. The Graduate Program Office will then request the exam to be scheduled through the Graduate School. The Graduate School requires at least two weeks' notice for examinations to be scheduled.
2. When a period of more than six years has elapsed between passing of the Comprehensive Examination and the completion of the student's program, the student is required to pass a second Comprehensive Examination before the Final Oral Examination can be scheduled.
3. The Final Oral Examination may not be scheduled until at least three months have elapsed after the Comprehensive Examination was passed.
4. The Final Oral Examination will be administered by the student's entire doctoral committee and will be a defense of the student's dissertation. The final oral exam will be publicized, and members of the academic community are encouraged to attend. The student must receive a favorable vote of at least two-thirds of the members of their doctoral committee to pass the exam.

### **Timing and Deadlines**

Key deadlines for each semester can be found on the Graduate School's website: <https://gradschool.psu.edu/completing-your-degree/thesis-and-dissertation-information/thesis-dissertation-performance-and-oral-presentation-deadlines-calendar/>. The ME Graduate Programs Office will send specific instructions regarding graduation at the beginning of each semester.

If a student submits their dissertation to the Graduate School after the dates above, but before the semester ends, they will graduate at the next scheduled graduation and will not be required to register for the subsequent semester. Upon request, the Graduate School will provide an official letter of certification indicating that the student has completed all the requirements for the degree. Allow two weeks for such a request to be processed.

## **IV.4 FINAL STEPS**

### **Graduate Student Check-Out Sheet**

Before leaving the Department, every student is required to complete a check-out sheet with appropriate signatures and a "Transfer/Separation" form. Students should contact the ME Graduate Programs Office to obtain the paperwork.

**Exit Interview**

Every graduate student must schedule an exit interview with the Associate Department Head for Graduate Programs. Schedule your interview well in advance of your leaving the University, and complete the required paperwork (available from the Graduate Programs Office) prior to your interview.

## **Appendix: ME Ph.D. Qualifying Examination**

Detailed information about the exam and the decision process is provided in the following. The exam is developed and administered by the members of the ME Graduate Faculty, working closely with the Graduate Programs Office. It is structured around the review and critical assessment of a research paper from the literature that is related to the student's thesis research, and consists of two parts: a written exam and an oral exam. Throughout the exam, the student is required to demonstrate a high level of proficiency in the use of the English language, including reading, writing, and speaking.

The exam is administered twice each academic year, once each in the fall and spring semesters. Exam dates will be announced by the Graduate Programs Office by email to all graduate students. The oral and written exams normally will be given on the same day following a two-week preparation period, as detailed in the following.

### **Exam Signup and Paper Selection**

Approximately three months before the beginning of each fall and spring semester, the Graduate Programs Office will put out a call to ME graduate students to solicit registrations for the next round of exams. Students must comply with Graduate School requirements regarding eligibility to take the exams: [GCAC-604 Qualifying Examination - Research Doctorate \(psu.edu\)](https://www.psu.edu/graduate-school/requirements/eligibility). During the months leading up to the exams, students are strongly advised to work with their faculty advisers to practice critically reading literature, answering technical questions about scholarly literature verbally and in writing, and preparing effective technical presentations, in accordance with the format of the exam.

To register, students must work with their faculty advisers to prepare and submit a brief description of their academic background and research interests/expertise, along with other information that will be used to determine appropriate exam topic areas and papers. The Associate Department Head for Graduate Programs will serve in the adviser's role for students who do not yet have a faculty adviser. The exam areas and faculty examining committees may vary from semester to semester, depending on the research topics of the students taking the exams. Recent areas have included: Combustion; Design, Dynamic & Controls; Fluids; Manufacturing & Materials; and Solid Mechanics & Biomechanics. In cases where it is warranted (e.g., a student whose research area is highly specialized and/or unusual for ME), a special ad hoc examination committee may be formed for a student.

The faculty topic area exam committees are responsible for selecting papers that are reasonable in content and scope for early-career graduate students. The technical topics of focus will be outlined in a "guidance for students" paragraph that will be provided along with each paper. This paragraph is intended to guide students in preparing for the exam. The committees expect candidates to possess knowledge and understanding of Mechanical Engineering principles, to be able to recall them quickly, and to synthesize them accurately. An important aspect is to assess the way in which

the candidate can justify and critique the literature and foundational knowledge within published journal articles.

No less than two weeks before the exam date, the following information will be made available to students who have registered to take exams. See the example exam at the end of this Appendix for more specific information on what this will look like:

- A set of general questions to consider in preparing for the written exam.
- A written exam scoring rubric, minus paper-specific questions.
- An oral exam scoring rubric, minus paper-specific questions.
- A list of available papers, organized by topic area. There may be more than one paper per topic area.
- For each paper, brief “guidance for students” on what they should consider in preparing for the exam on that paper.

Each student should work with their faculty adviser to select one paper on which to be examined. Students can select any of the available papers, even one that is not in the topic area that they originally had in mind. Students must notify the Graduate Programs Office of their paper selection at least two weeks prior to the exam date, in accordance with the timeline that is provided each semester by the Graduate Programs Office.

Students will then have two weeks in which to prepare for their exam. During that period, students are not to discuss the exam with their faculty advisers. Students should study the motivation, methods, results, conclusions, and impact of the paper. They are also advised to read additional literature and texts to learn any unfamiliar content, derive any equations, and explain any material present in the assigned paper. Students should be prepared to answer questions about the mechanical engineering principles on which the paper is grounded. They should also use this time to prepare and practice their 10-minute oral presentation (see the Oral exam section below).

### **Exam Format**

Each student will take a written exam and an oral exam on their selected paper. Both exams normally will be given on the same day. English-language proficiency will be assessed as part of both exams.

**Written exam:** Written exams will be two hours in duration. Students will bring their own laptops to type their answers, or they can request a department-provided laptop in advance of the exam date if they do not have one. Students will have access to their selected paper, to written notes that they have taken in preparation for the exam, and to other information that will be specified at the start of the two-week preparation period. They will have access to the internet during the exam to access scholarly literature as needed, but should be aware that plagiarism in any form will not be tolerated and will result in University-level sanctions that may include expulsion from the University.

In the written exam, students will be instructed to complete a series of written prompts to demonstrate understanding of the article, technical proficiency, and mastery of

written English. The depth, quality, and accuracy of the answers to the questions will be used to assess technical mastery, and the quality of writing will be used to assess written communication skills.

The exam will be scored using a standardized rubric, which will be provided to students (minus the paper-specific questions) at the start of the two-week preparation period. The score will be reported as a single number out of 50 available points.

**Oral exam:** Oral exams will be 30 minutes in duration. Two faculty examiners will conduct each oral exam. The student's faculty adviser may observe oral exams, but may not ask or answer questions during exams. Students will give a 10-minute presentation on their paper, followed by 20 minutes of questions by the faculty examiners. Students will bring their own laptops to make their presentations, or will be provided with a laptop if they do not have one upon prior arrangement with the Graduate Programs Office.

10-minute presentation Students should prepare a 10±1 minute PowerPoint presentation, reviewing the underlying theory/theories, research objectives/hypotheses, findings, and overarching impact of the paper. Specifically, students should explain relevant theoretical underpinnings of the work, novel methodologies or techniques introduced, and significant findings leveraging visual evidence (graphics from the work, external sources, or original) to explain their perspectives of the work to an audience of faculty members. Students are expected to explicitly cover the following topics:

- Theoretical Background: Succinctly demonstrate an understanding of the underlying theories that support and motivate the work.
- Research Objectives/Methodology: Articulate a clear understanding of the overarching objectives of the work. Describe if/how the methods proposed are appropriate given the research objectives.
- Findings: Clearly summarize the key findings of the work.
- Impact: Contextualize the impact of the work in the field leveraging literature to support your arguments.

Students will be cut off at precisely 11 minutes. Failure to review all topics or complete the presentation will result in a lower score. It is imperative that students practice the presentation aloud and in the room in which they will be presenting beforehand to ensure they can cover the requisite topics in the timeframe allowed and to avoid any technical difficulties. Students should come prepared with their laptops fully charged and with all cables and connectors needed to make their presentations.

20-minute questions-and-answer The faculty examiners will ask foundational questions about the core ME topics that are covered in the paper. They may also ask questions based on the student's presentation. Students will be expected to demonstrate a thorough understanding of the paper and underlying theories through well-reasoned responses.

The exam will be scored using a standardized rubric, which will be provided to students (minus the paper-specific questions) at the start of the two-week preparation period. The score will be reported as a single number out of 50 available points.

### **Student Evaluation**

Scores on the written and oral exams will be added to give a single total score out of 100 points for each student. The outcome is then determined as follows.

- A score of  $\geq 70$  is a passing score.
- A score between 60 and 70 is a conditional pass. In this case, an appropriate remediation plan must be developed by the student and their faculty adviser and submitted to the Graduate Programs Office for approval. Appropriate remediation could include taking an additional course, developing instructional materials, etc.
- A score of  $< 60$  is a failing score. A student who fails the exam on the first attempt may take the exam a second time. The student must pass on the second attempt to remain in the ME Ph.D. program.

### **Resources for Students**

Students are advised to study foundational ME material and to take relevant coursework before taking the Ph.D. Qualifying Examination. They should also work with their faculty advisers to practice accessing and citing literature (in general), synthesizing literature, and discussing technical papers.

Students should be aware that plagiarism or academic dishonesty of any kind will not be tolerated. Plagiarism includes directly using the words of another person or work, or even slightly changing words without attribution. Because the job is to interpret the literature, students should not be directly quoting from the article such that borrowed text would appear in quotations; direct quotes are rarely used in engineering academic writing. It is not acceptable to just slightly change the authors' words—this still counts as plagiarism. Similarly, while students may look up other related literature during the exam, they must accurately cite the literature they are referencing. It is advisable that students look up appropriate citation styles and formatting and familiarize themselves with avoiding plagiarism before the exam.

**For guidance on expectations with respect to plagiarism**, see the following resources:

[https://owl.purdue.edu/owl/avoiding\\_plagiarism/index.html](https://owl.purdue.edu/owl/avoiding_plagiarism/index.html)

[https://owl.purdue.edu/owl/avoiding\\_plagiarism/plagiarism\\_faq.html](https://owl.purdue.edu/owl/avoiding_plagiarism/plagiarism_faq.html)

Instances of plagiarism will be reported using the College of Engineering Academic Integrity procedures (<https://www.engr.psu.edu/faculty-staff/academic-integrity.aspx>). International students should note that U.S. expectations for documentation and plagiarism may be more rigid than in other countries.

**For guidance on English-language grammar and usage**, see the following resources:

<https://www.englishgrammar101.com/>

<http://www.englishpage.com/minitutorials/>  
<http://www.talkenglish.com/grammar/grammar.aspx>  
<http://ctl.yale.edu/writing/resources-multilingual-writers/downloadable-english-grammar-tutorials>  
<http://www.talkenglish.com/grammar/articles.aspx>, (specifically with articles)  
[http://ctl.yale.edu/sites/default/files/files/Articles\\_and\\_Common\\_Nouns\\_1.pdf](http://ctl.yale.edu/sites/default/files/files/Articles_and_Common_Nouns_1.pdf)  
(specifically with articles)

**For guidance on engineering writing and literature reviews**, see the following resources:

- [Berdanier, C.G.P. and Lenart, J. \(2020\). So, You Have to Write a Literature Review. Wiley/IEEE. Available through PSU Libraries as an E-Book: <https://catalog.libraries.psu.edu/catalog/32175880>](#)
- Alley, M. (2018). The Craft of Scientific Writing (4th ed.). Springer. Available through PSU Libraries as an E-Book: <https://ebookcentral.proquest.com/lib/pensu/detail.action?docID=5327233>

**For guidance on engineering presentations**, see the following resources:

Alley, M. (2013). The Craft of Scientific Presentations (2<sup>nd</sup> ed.) Springer. Available through the PSU Libraries as an E-Book:  
<https://link-springer-com.ezaccess.libraries.psu.edu/book/10.1007%2F978-1-4419-8279-7#>

## An Example Exam

An example of an exam in the subject area of Fluid Mechanics follows. To choose which paper on which they will be examined, students will be provided with the paper itself, the corresponding Guidance for Students, the general Written Exam Questions (minus paper-specific questions), a sample Written Exam Scoring Rubric (minus paper-specific questions), and a sample Oral Exam Scoring Rubric (minus paper-specific questions).

### Paper

W.F. Phillips, D.O. Snyder (2000) Modern adaptation of Prandtl's classic lifting-line theory, *Journal of Aircraft*, 37:662-670. <https://doi.org/10.2514/2.2649> Full pdf available at [Modern Adaptation of Prandtl's Classic Lifting-Line Theory \(illinois.edu\)](#)

### Guidance for Students (provided to students along with the paper)

In preparation for the exam, students should familiarize themselves with the concepts of vorticity and circulation, the Biot-Savart law, the Kutta-Joukowski theorem and the Kutta condition, lifting-line theory, and aerodynamics-specific terms such as “camber,” “sweep,” “dihedral,” and “induced drag.”

### Some Additional Comments on What to Expect and How to Prepare

Students would be expected to understand and articulate the basic fluid mechanics principles on which the paper is based (potential flow theory, basic inviscid vortex kinematics, calculation of forces on immersed bodies from velocity fields, application of superposition principle, . . .) and the general logical development from a classic 2D analytic lifting-line theory (based on the Biot-Savart law) to a more general analytical/numerical approach for 3D bodies. Some of the vocabulary might be unfamiliar to some of our students, depending on their backgrounds, but they should be able to familiarize themselves with key terms during the preparation period.

### Written Exam Questions

Students would be provided with the following to prepare for the exam, minus the yellow-highlighted material.

1. Topic-specific or paper-specific questions (to guide the student in the right direction)

#### Example questions for this paper:

Provide a short synopsis of the Kutta-Joukowski theorem and the Kutta condition, and how those are invoked in this paper.



Provide a short synopsis of classic 2D lifting-line theory, including key assumptions/simplifications and limitations, and how that is used in this paper.

Explain the meanings of the following terms, in the context of aerodynamics: "camber," "sweep," "dihedral," and "induced drag."

Derive Eq. 1 in the paper, given the basic form of the Biot-Savart law (or at least, set up the derivation).

Under what conditions is superposition of flow solutions justified?

## 2. Critical assessment

- a. What do the authors identify as the main contributions of this paper?
- b. Do you agree with this contribution(s) in the context of the field? Explain and situate your response within existing literature.
- c. How well connected are the literature review and hypotheses/research questions?
- d. Does the literature review form a sound technical basis for the proposed hypotheses or research questions? Explain your answer.
- e. Comment on the appropriateness of the methods/approach.

## 3. Fundamental analysis

- a. Describe the relationships between the main concepts and fundamental ME principles.
- b. Identify assumptions made in the paper, and describe the practical implications of these assumptions for the work.
- c. Identify what aspects of the problem have not been addressed.

## 4. Extension

- a. Describe how the approach could be applied to other problems or emergent research questions.
- b. How have other researchers leveraged the findings from this work?

## Written Exam Scoring Rubric

This is a sample rubric that is intended as an example of the actual rubric that might be used to score a written exam. The actual rubric may be somewhat modified from this example, but will generally follow the same structure and will be in alignment with the exam prompts that are provided to students at the beginning of the two-week exam preparation period. The yellow-highlighted material in the rubric is intended to provide examples that examiners might use in scoring a written fluid mechanics qualifying exam based on the paper specified above. Those parts would *not* be provided to the students ahead of time.

Criteria	10 points	6 points	2 points	Score
<b>Engagement with and Mastery of Technical Material (Paper-specific prompts)</b>	<p>Discusses relevant technical information in terms of methods and findings. Discussion demonstrates understanding of the technical foundations governing the topics, methods, and findings described in the paper. Writer uses examples from the paper to demonstrate mastery without parroting back text from the paper superficially.</p> <p>[Essay demonstrates a clear understanding of the underlying foundation of inviscid vortex kinematics, how that builds to the classical 2D lifting-line theory, and how that is then developed into a general 3D method, including key assumptions and/or simplifications. The essay demonstrates an appreciation of the significance of the resulting relatively simple numerical approach that</p>	<p>Essay discusses some of the main technical information pertaining to the methods and results as per the paper-specific questions. Emphasis of student answers may be slightly misguided, or may demonstrate small misconceptions in relationships to technical material within the paper.</p> <p>[Essay demonstrates some understanding of the underlying foundation, and how that is developed into a general 3D method, but misses key steps in the logical development or key assumptions that are needed. The significance of the resulting approach is not discussed.]</p>	<p>Essay identifies few of the main issues with respect to technical methods and findings presented in the paper, often relying on superficial phrasings that do not reflect a mastery of the material. Answers may reflect deep conceptual misunderstandings.</p> <p>[Essay includes no indication that the writer understands the underlying fluid mechanics principles, how they are applied in the paper, or the significance of the resulting method.]</p>	

	does not require full 3D CFD to compute lift and drag forces on general 3D bodies.]			
<b>Connects Material in Paper to Engineering Fundamentals</b>	Paper adequately describes the relationships between the main paper and ME foundations, accurately identifying assumptions and practical implications of the assumptions of the paper. Paper discusses aspects of the problem that have not been addressed, and other limitations perhaps not identified by the paper. Discussion of these elements is thorough and is not limited to only what the journal article describes, demonstrating deep understanding of the topic area. Discussion of underlying theory is accurate without mistakes.	Written essays identify some relationships between the paper and ME foundations, or engages only superficially with the connections described. Paper may list assumptions or limitations, but does not engage thoroughly with what these assumptions/limitations mean for application. In general, the connection between the topics in the paper to foundational ME concepts is superficial. Discussion of theory may demonstrate small misconceptions.	Written essays identify few connections to ME foundations. Relationships with technical foundations are loose. If present, engagement with assumptions and limitations is incomplete, loose, and superficial. There are deep misconceptions with respect to disciplinary foundations and theory.	
<b>Critical Assessment</b>	Written answers to prompts accurately demonstrate student's understanding of the contribution of the paper to the discipline, situating the response within related literature. Essays thoroughly explain how the literature review forms a sound justification to set up the rationale and motivation for the work. Paper references and appropriately cites outside literature as necessary, demonstrating the ability to make connections in literature. Essays accurately describe	Written answers may not fully demonstrate through mastery of the contribution of the paper to the discipline. Essays may cite a few articles, but engage superficially with related literature, without highlighting the most meaningful connections. Essay does not accurately explain how the literature review forms a sound justification to set up the rationale and motivation for the work. Essays summarize methods employed and appropriateness of methods but engage superficially	Answers to essay questions demonstrate little understanding of the contribution of the paper to the discipline. Little, if any, literature is cited, and connections are not made with literature, or the connections are unclear and not meaningful. The essay does not accurately explain how the literature review forms a rational and justification for the work. The essays vaguely	

	the methods employed and the appropriateness of these methods for the work employed.	without demonstrating understanding.	summarize methods without demonstrating understanding or discussing why they are appropriate.	
<b>Extension</b>	Paper accurately and creatively identifies opportunities for future work extending past those described in the paper, demonstrating the ability to link literature with related fields. Student identified impact of the paper by accurately identifying and describing how other researchers have leveraged the findings from the work.	Paper identified opportunities for future work but may not engage fully with how the results from the paper were leveraged in the discipline. Engagement with these connections may be more superficial or have small misunderstandings in how findings impacted disciplinary community.	Paper vaguely identifies opportunities for future work, but does not expand on opportunities past those presented in the paper. Essays do not address how the findings impacted future studies or the discipline.	
<b>Criteria</b>	<b>5 points</b>	<b>3 points</b>	<b>1 point</b>	
<b>Clarity and Fluidity</b>	Use of transition words and topic sentences enhance fluidity/smoothness of the paper. Ideas are clear and easy to understand. Paragraphs flow logically through a linear thought progression, and have clear topic/umbrella sentences to guide the reader. Sentences are clear and of varying length to aid in fluidity, and vary in structure. Writing is not excessively wordy and use of passive voice is deliberate and not distracting. Word choice is deliberate and clear.	Writer usually uses transition words or topic sentences to guide readers. Few ideas are unclear or do not progress in a logical way. Some sentences do not flow together, and writing may exhibit reliance on "writing zeros" and passive voice. Some sentences have redundancies and may not exhibit variance of sentence structure. Word choice may be confusing at times.	Few transitions at all. Readers may struggle to interpret the relationship between points of paper. Sentences are choppy and difficult to understand. Sentence structure exhibits little variety, leading to reader fatigue. Overall sentence length is too long or too short. Exhibit an abundance of "writing zeros" and/or excessive passive voice. Word choice may be often confusing.	
<b>Mechanics (Spelling, typos,</b>	Few mechanical errors, not distracting to readers	Several punctuation, spelling, verb agreement, and grammar errors; may be distracting but not	Distracting amounts of errors in grammar, spelling, punctuation and verb agreement, makes it	

punctuation, and grammar)		prohibitive to the reading of the document. May include several verb agreement violations.	difficult for the reader to focus on the content of the paper.	
<b>Add last columns for total score (Total available points = 50).</b>				

Oral Exam Scoring Rubric

This is a sample rubric that is intended as an example of the actual rubric that might be used to score an oral exam. The actual rubric may be somewhat modified from this example, but will generally follow the same structure and will be in alignment with the exam prompts that are provided to students at the beginning of the two-week exam preparation period. The **yellow-highlighted** material in the rubric is intended to provide examples that examiners might use in scoring an oral fluid mechanics qualifying exam based on the paper specified above. Those parts would *not* be provided to the students ahead of time.

NAME				
Criteria	10 points	6 points	2 points	Score
<b>Organization and Efficacy of the Presentation</b>	Should review all the elements of the paper sequentially and logically. Strong transitional phrases used to move along the presentation.  Illustrations accurately depict main findings of the paper or clearly summarize key points. Appropriate figures and help audiences easier to understand the material. All illustrations are professional, readable from anywhere in the room, properly	Reviews the major elements of the paper, but there are missing links between topics leading to a lack of flow. Organization is present but within the slides, transitions are often weak or tenuous.  Most illustrations are relevant, but some have minor inaccuracies, indicating a small misunderstanding of the work. All the illustrations shown are useful and easy to see, but there is some evidence of "sloppiness":	Large logical gaps make it difficult for the audience to follow along. The flow is illogical and does not aid in the audience's understanding of the paper.  Illustrations are not at all related to the paper, or incorrectly depict aspects of the paper, indicating a larger misunderstanding of the work. Illustrations are difficult to read	

	labeled, and aligned well. Continuity between the illustrations on all slides.	Illustrations may be missing some axis labels or titles, etc.	or understand such that they fail to highlight the point the speaker is trying to make. Illustrations may have distracting flaws, misalignments, or errors that distract the audience.	
<b>Clarity of Technical Material and Connections to Fundamentals</b>	Addresses all parts of relevant research. Communication is clear and concise. Technical content of the study is thorough and does not leave any unaddressed gaps. Explains the necessary terms and equations in an unambiguous way and connects to fundamentals of the field.	Addresses most parts of the relevant research. The technical content may not always emphasize all of the highlights or necessary conclusions that can be drawn. Speaker makes effort to explain the terms and equations but it is not clear or understandable. While larger connections with fundamentals are made some underlying minor logical errors or misconceptions are evident.	The content leaves room for varying and opinionated conclusions among audience. Speaker fails to explain the terms and equations, leading to a presentation that may be choppy or not understandable. Clear misunderstandings of the paper are evident. Unable to clearly connect the work with the fundamentals of the field.	
<b>Question 1</b> <b>[Explain how the lift and drag forces around an immersed body in a steady flow could be computed, knowing the velocity field over a bounding surface that encloses the body. Discuss the relationship between that approach and the approach that is</b>	Provides logical evidence-based rationale to support answers to oral question. Leverages theory and findings from paper to support their argument.  [Student correctly develops a classical control-volume analysis, and makes appropriate assumptions/simplifications. Similarities and differences with the approach developed in the paper are clearly stated, especially with	Provides some evidence to justify rationale and support answers, but some minor gaps in argument exists. Small technical misconceptions apparent, but demonstrates sound understanding of work overall.  [Student correctly develops a classical control-volume approach with minimal prompting, but is unable to relate that to the approach that is developed in this paper without significant prompting.]	Does not support argument or answer with evidence or theory. Answers are incoherent and difficult to follow, and misconceptions about underlying theory are evident.  [Student is not able to develop a classical control-volume approach, even with significant prompting.]	

<p>developed in this paper.]</p>	<p>respect to assumptions/simplifications. Little, if any, prompting is necessary.]</p>			
<p><b>Question 2</b> [State the Biot-Savart law, and the conditions under which it applies. Starting from Biot-Savart law, derive Eq. 1 of the paper for the configuration shown in Fig. 2 of the paper. (Note: It might not be realistic for a student to complete the derivation in the time allowed, but they should be able to set it up and get started.)]</p>	<p>Provides logical evidence-based rationale to support answers to oral question. Leverages theory and findings from paper to support their argument. [Student correctly states the Biot-Savart law and the assumptions/simplifications required for it to apply. Student is able to explain the reasoning and set up the derivation of Eq. 1 correctly. Little, if any, prompting is necessary.]</p>	<p>Provides some evidence to justify rationale and support answers, but some minor gaps in argument exists. Small technical misconceptions apparent, but demonstrates sound understanding of work overall. [Student correctly states the Biot-Savart law, but does not demonstrate that they understand the assumptions/simplifications that apply. Student is not able to explain or set up the derivation of Eq. 1, without significant prompting.]</p>	<p>Does not support argument or answer with evidence or theory. Answers are incoherent and difficult to follow, and misconceptions about underlying theory are evident. [Student is not able to state the Biot-Savart law, or to set up the derivation of Eq. 1, even with significant prompting.]</p>	
<p><b>English Proficiency</b></p>	<p>Understood all questions without difficulty and formed appropriate responses to questions. Words are enunciated, sentences are easy to understand, and flow between ideas is natural. Clearly communicated and pronounced key terms and major points of the during the</p>	<p>Struggled to understand some of the questions posed. Some words were incorrectly pronounced, but did not detract in any major way from overall understanding or clarity of the speaker. Some portions of the presentation or responses to questions were challenging to understand, but major talking points were clearly understood.</p>	<p>Did not understand questions posed by faculty and questions were repeated multiple times for understanding. Challenging to understand the speaker.</p>	

	presentation and the question and answer period.			
<b>Add last columns for total score (Total available points = 50).</b>				