Assessment of the graduate field of Theoretical and Applied Mechanics

Overview
The graduate field of Theoretical and Applied Mechanics (TAM) provides a foundation in engineering science and applied mathematics that prepares students to carry out analytical or experimental research and to develop models to solve a wide variety of engineering problems. Faculty are particularly strong and active in dynamical systems, networks, composites, adhesion, granular flow, fracture, planetary dynamics, robotics, biomechanics and bio-mathematics, locomotion and insect flight.

The field offers three degrees:

1. Ph.D.
2. Master of Science
3. Master of Engineering

The field typically has more than 30 active Ph. D. degree candidates.

Ph.D. Degree
The Ph.D. programs provide advanced levels of training suitable for students pursuing careers in research and development, academics, or advanced engineering analysis. A candidate for a doctoral degree is expected to demonstrate mastery of knowledge in the chosen discipline and to synthesize and create new knowledge, making an original and substantial contribution to the discipline in a timely fashion. Doctoral degree candidates must take the field’s qualifying examination in addition to the examinations required by the Graduate School. Teaching experience for one semester, normally satisfied by a teaching assistantship, is required of all Ph.D. students.

Learning Outcomes
The following proficiencies are expected from students receiving a Ph.D. in TAM. A student receiving a Ph.D. should:

1. Make an original and substantial contribution to the discipline
   a. Think originally and independently to develop new concepts and methodologies
   b. Identify new research opportunities within one’s field
2. Demonstrate advanced research skills
   a. Synthesize existing knowledge, identifying and accessing appropriate resources and other sources of relevant information and critically analyzing and evaluating one’s own findings and those of others
   b. Master the application of existing research methodologies, techniques, and technical skills
3. Demonstrate commitment to advancing the values of scholarship
a. Keep abreast of current advances within one’s field and related areas  
b. Show commitment to personal professional development through engagement in professional societies, publication, and other knowledge-transfer modes  
c. Show commitment to creating an environment that supports learning—through teaching, collaborative inquiry, mentoring, or demonstration

4. Demonstrate professional skills  
a. Advance ethical standards in the discipline  
b. Communicate in a style appropriate to the discipline  
c. Listen, give, and receive feedback effectively

**Assessment**

The ability of Ph.D. students to meet the above stated proficiencies is measured using the following metrics and evidence:

1. **Ph.D. Dissertation**, as accessed by the student’s Ph. D. committee (addresses proficiencies 1,2,3).
2. **Thesis Defense (B exam)** and presentations, as assessed by student’s special committee and documented in a form which must be approved by the Director of graduate studies (DGS) (addresses proficiencies 1,2,4)  
3. **Admission to Candidacy (A exam)** and presentations, as assessed by the student’s Ph. D committee and documented in a form which must be approved by the DGS (addresses proficiencies 2,4)  
4. **Qualifying Exam**, as assessed by the entire field faculty of TAM. The qualifying exam is given to all incoming students with a Bachelor’s degree at the end of their first year at Cornell and after the fall semester for students entering with a master’s degree. The exam consists of three disciplines: Applied Mathematics, Dynamics and Solid and Continuum Mechanics. The performance of each student in these three disciplines will be discussed by all TAM field members on the same day of the exam. For each student, the field will provide recommendation to strengthen any weaknesses. These recommendations will be enforced by the DGS (addresses proficiencies 2).
5. **Publication of Scholarly articles**, as tracked by the students and the field during the annual review which is conducted by the entire TAM field after the Q exam, measures the ability of students to make an original and substantial contribution to the discipline (addresses proficiencies 3, 4)  
6. **Participation and presentation at professional meetings**, as tracked by the students and the field during the annual review, develops the student’s ability to make presentations, give and receive feedback (addresses proficiencies 3, 4)  
7. **TA Evaluations**, as tracked by the field, measures the student’s commitment to teaching (addresses proficiencies 2)  
8. **Average Time to degree**, as tracked by the graduate school, measures the number of semesters from matriculation to graduation (addresses proficiencies 1,2,3)  
9. **Graduate field reviews**, as tracked by the field, measures students’ general progress towards completing the Ph.D. objectives in a timely manner and identifies any systematic obstacles to graduation. This review of all graduate students takes place after the completion of the Q exam. (addresses proficiencies 1,2,3)  
10. **Grade point average** in courses taken, as tracked by the registrar, measures the proficiency of technical skill acquired (addresses proficiencies 2)
11. **Residency units**, as tracked by the student advisors and the graduate school each semester, measures the satisfactory progress of each student towards completion of a degree (addresses proficiencies 1,2,3)

**Improvement**
The data listed above (reports, grades, and lists) are tracked by the field, registrar, and the graduate school (as listed) and compiled for each individual student. The loop is closed in the following ways:

- The chair of each student’s Ph. D. committee monitors each student’s overall progress towards completion of the Ph.D. objectives, and provides feedback to the student as needed
- The director of graduate studies monitors the overall status of the field and makes adjustment to policies and strategies, in consultation with field members
- The field meets in an annual meeting to discuss data and identify action items for improvement of student learning and of collection of data. This annual meeting takes place after the completion of the Q exam

**Master of Science Degree**
The Master of Science (M.S.) programs provide advanced levels of training suitable for students pursuing careers in research and development and advanced engineering analysis and design. The TAM field does not admit students into an M.S. program directly but may offer the degree under special circumstances.

**Learning Outcomes**
The following proficiencies are expected from students receiving a M.S. in TAM. A student receiving an M.S. should:

1. Possess advanced research skills
   a. Synthesize existing knowledge, identifying and accessing appropriate resources and other sources of relevant information and critically analyzing and evaluating one’s own findings and those of others
   b. Apply existing research methodologies, techniques, and technical skills to solve engineering problems
2. Demonstrate commitment to advancing the values of scholarship
   a. Keep abreast of current advances within one’s field and related areas
   b. Show commitment to personal professional development through engagement in professional societies and other knowledge-transfer modes
3. Demonstrate professional skills
   a. Adhere to ethical standards in the discipline
   b. Communicate in a style appropriate to the discipline
   c. Listen, give, and receive feedback effectively

**Assessment**
The ability of M.S. students to meet the above stated proficiencies is measured using the following metrics and evidence:
1. **Master's Thesis**, as assessed by the student’s special committee (addresses proficiencies 1,2,3)
2. **Master's Thesis Defense** and presentations, as assessed by the special committee (addresses proficiencies 1,2,4)
3. **Average Grade Point** in courses taken, as tracked by the registrar, measures the proficiency of technical skill acquired (addresses proficiencies 1,3)
4. **Average Time to degree**, as tracked by the graduate school, measures the number of semesters from matriculation to graduation (addresses proficiencies 1,2,3)

**Improvement**
The data listed above (reports, grades, and lists) are tracked by the field, registrar, and the graduate school (as listed) and compiled for each individual student. The loop is closed in the following ways:

- The chair of each student’s committee monitors each student’s overall progress towards completion of the MS objectives, and provides feedback to the student as necessary
- The director of graduate studies monitors the overall status of the field and makes adjustment to policies and strategies, in consultation with field members
- The field meets in an annual meeting to discuss data and identify action items for improvement of student learning and of collection of data. This annual meeting takes place after the completion of the Q exam

**Master of Engineering (M.Eng.) Degree**
The professional degree of Master of Engineering in Engineering Science provides a one-year course of study for those who want to develop a high level of competence in applied mathematics and engineering science and who plan to practice engineering in industry or professionally. The program has a thirty-credit curriculum and requires a research/engineering project.

**Learning Outcomes**
The following proficiencies are expected from students receiving a M.Eng. in TAM. A student receiving a M.Eng. should:

1. Learn advanced technical skills  
   a. Apply existing research methodologies, techniques, and technical skills to solve engineering problems
2. Demonstrate commitment to advancing the values of scholarship  
   a. Keep abreast of current advances within one’s field and related areas
3. Demonstrate professional skills  
   a. Adhere to ethical standards in the discipline  
   b. Communicate in a style appropriate to the discipline  
   c. Listen, give, and receive feedback effectively

**Assessment**
The ability of M.Eng. students to meet the above stated proficiencies is measured using the following metrics and evidence:
1. **Master’s Project report**, as assessed by the student’s advisor in a grade assigned to the student (addresses proficiencies 1,2,3)
2. **Average Grade Point** in courses taken, as tracked by the registrar, measures the technical skill proficiency (addresses proficiencies 1,2)
3. **Number of courses taken**, as tracked by the field, ensures that the students are taking advanced courses appropriate for this degree (addresses proficiencies 1,2,3)

**Improvement**

The data listed above (reports, grades, and lists) are tracked by the field members, field administrator, registrar, and the graduate school and compiled for each individual student and for the entire field. The loop is closed in the following ways:

- The advisor of each student’s committee monitors each student’s overall progress towards completion of the M.Eng. objectives, and provides feedback to the student as necessary
- The M.Eng. director, M.Eng. administrator, and the director of graduate studies monitor the overall status of the program and adjust policies and strategies, in consultation with field members
- The field meets in an annual meeting to discuss data and identify action items for improvement of student learning and of collection of data

**Resources**

1. Cornell Graduate School  Learning Proficiencies 011811
2. Barbara E. Walvoord, “So Our Assessment Plan is Done, Now What Do We Do?”
3. Arizona state ME Grad assessment:  
   http://assessment.arizona.edu/eng/Aerospace%20and%20Mechanical%20Engineering%20Grad