

Department Specific Scholarship Standards  
Department of Mechanical Engineering  
Effective December 22, 2015

Preamble: These guidelines are meant to specify for reviewers and tenure-stream members of the Mechanical Engineering Department how the Department assesses the scholarship of candidates for tenure and promotion to the ranks of Associate Professor and Professor. The document includes disciplinary and sub-disciplinary measures of quality, including specific forms of evidence. Works in progress are assessed to evaluate Assistant Professors' petitions for tenure. Petitions for promotion to Full Professor will be based on completed scholarship of appropriate stature and impact.

The Santa Clara University Faculty Handbook (3.4.2) states  
"Because the nature of teaching, scholarship or artistic creativity, and service differs in some respects among academic disciplines, the faculty of the college, schools, and division develop, adopt, and publish their respective clarifications of the three criteria. Candidates for tenure or promotion are referred to these publications, as amended from time to time, for a detailed explanation of the standards and procedures by which they will be evaluated."

In accord with the Faculty Handbook, discipline-specific standards for tenure and promotion have been developed by departments or disciplinary areas to clarify the criteria and guidelines for promotion and tenure review for both candidates and evaluators. These standards should inform and guide, but not dictate, the professional review of a candidate's portfolio. As noted in the Handbook, the standards may be revised from time to time to reflect changes and refinements within the discipline.

## DISCIPLINE

Engineering falls between science and technology. Where science can be interested in fundamentals truths in an abstract sense, engineering uses science and mathematics to advance knowledge to promote human welfare; and technology is the dissemination of these engineered solutions.

Mechanical Engineering is a very broad field that includes areas as diverse as thermodynamics, fluid mechanics, heat transfer, material properties, solid mechanics, structural analysis, dynamics and control, and machine and system design. Mechanical engineering has existed since antiquity, and is supported by a professional society, ASME, founded in 1880. The American Society of Engineering Education surveys academic institutions in the U.S. and, in 2012, mechanical engineering was the largest of the engineering disciplines with 221 departments granting 20,369 B.S., 6227 M.S., and 1323 Ph.D. degrees with a total of 4496 tenure stream faculty.<sup>i</sup> In 2015, Santa Clara was ranked

| 12<sup>th</sup> in Engineering for schools that primarily offer bachelor's or master's degrees, -and 109<sup>th</sup> nationally in mechanical engineering graduate programs<sup>ii</sup>. With its breadth, mechanical engineering work can also be disseminated through related areas and societies, for example, AIAA, TMS, IEEE, MRS, SIAM, SAE, APS, and AIP.

Academia's role in engineering is to provide new threads of understanding through scholarship, train future engineers through teaching and mentorship in research, and, as professional stewards, through service to the profession, their institutions, and dissemination of engineering throughout society. Scholarship, as such, is the development on new fundamental understanding, techniques, and theories. It is subdivided into basic research, applied research, and product development. Basic research is the creation of new understanding. Applied research is the demonstration of the knowledge in new applications. Product development and other innovative endeavors are also common among engineers but are not the central role of academia. Faculty may also be active in engineering related consulting, which is a demonstration of competence but due to separate compensation should not be a substitute for the role of scholarship on the part of a professor.

## FORMS OF EVIDENCE

Mechanical Engineers in academia are active in

Basic Research: discovery of physical principles (experimental), development of mathematical methods and/or the generation of new classes of results (numerical), and elucidation of the connection between the real world and human understanding (theory)

Applied Research: Use of engineering knowledge in a specific application; development of a tool or device based on existing knowledge, and demonstration of a result in a new context.

Engineering research generally follows lines or threads, wherein each poster, workshop, conference paper and journal paper constitute individual components. A thread of research will have multiple documents, where each document outlines an individual step with successful research typically culminating in one or more journal publications. Books are valued as scholarship only if they are original monographs, and should not be confused with edited collections and monographs. One strong line of research could be sufficient for promotion and tenure. Accomplishment in multiple lines is considered superior. If the research thread stems from the candidate's Ph.D. dissertation work, then the independence and significance of the research must be demonstrated through new developments following the original work.

Forms of evidence, in order of importance, are journal papers, conference papers, monographs (rare), standards, theses, workshops, and posters. A simple indication of the value of the different forms of evidence is shown in their appearance as citations in other works. In Mechanical Engineering, citations are primarily to journal papers (80% or more). Less frequently, citations are given to conference papers, monographs, textbooks, theses, and professional standards.

Journal papers are valued most highly due to the rigorous review process and commonplace use for reference.

Primary journals: Journals most commonly referred to in the field and subfield, including but not limited to ASME, IEEE, and AIAA journals; and commercial presses such as Elsevier. These journals should be well established (longevity) and have a thorough review process.

Secondary journals: More specialized journals in a subfield, less rigorous review process.

Tertiary journals: New journals, broad journals and magazines (with the exception of Science and Nature, and select magazines in sub disciplines)

Journals can be assessed through their Impact Factor ( $>1.0$ ), citation Half-Life ( $> 10$  years), and review processes (lower acceptance rate and a greater number of reviewers). It should be noted that a journal Impact Factor relates to the number of times papers in that journal are referenced by others in the field in one following year and is not always an ordered indication of journal quality. The external referees generally comment on the quality of the journals in which the candidate publishes.

Conference papers:

Significant conferences: Conferences that have a review process similar to a journal with review of a full paper and revision. Long standing conferences and conferences with a lower acceptance rate. Conferences that are the primary meeting for a subfield. Some conferences will select papers for publication in the journal of the sponsoring society.

Secondary conferences: Conferences that only require review of extended abstracts.

Tertiary conferences, meetings and workshops: Conferences select papers based only on the topic of the abstract.

Monographs: A faculty member may write a book which encapsulates his/her work in an area. These works should be original and are cited if valued. This type of scholarship is infrequent in mechanical engineering.

Standards: In mechanical engineering several organizations issue standards, e.g., ASME and ASTM. A standard is an important contribution to the field, however these activities fall under service to professional societies; rarely do academics pursue this avenue of scholarship.

Patents are an additional form of evidence of creative activity by engineers. Patents show the research potential of a faculty member. Patents are often used as a metric in industry, where publication of journal and conference papers is less encouraged.

Theses: Since engineering involves the mentorship of students, there may be pieces of evidence in terms of student theses. Typically, but not always, this work will also appear in journal papers and conference papers.

Posters: Posters are primarily intended to communicate and promote the activity of a research group. As such they are often a first step toward the creation of refereed conference and journal publications.

Student posters, papers, proposals, and presentations are also welcome but are not a substitute for the above scholarship. Some papers that detail innovative approaches to engineering education may be considered very good scholarship.

Since mechanical engineering is a broad field, it is not appropriate to provide a full list of journals and conferences in this document. The external reviewers should comment on the standard venues in the subfield. Typically the external reviewers will be from research based institutions and will be able to judge the appropriateness of the candidate's work.

Quantity is not the sole evaluation criterion. Breadth and consistency of work is appreciated. In addition, significant work should also be recognized. Overall measures should be the number of journal papers within the candidate's field, the number of conference papers, and the number of additional pieces of evidence as identified above. Over the three academic years from 2010-2011 through 2012-13, tenure stream faculty scholarship activity on a per person basis has consisted of approximately 0.81 journal papers, 1.43 conference papers, and 1.43 other pieces of evidence. Historic averages (back to 2004) have been 1.1 journal papers, 2.25 conference papers, and 1.50 other pieces. The difference in the averages was due to the number of research active faculty. Productivity is generally measured by impact, through the visibility and appreciation of the work. The most common measure is the citation index (CI), which counts how many times a paper is cited. Typically, important works will be cited numerous times. The CI measure is often reduced to the h-index and i10-index which attempt to generate a single number to capture the breadth and depth of the work. Still, the CI is not an ideal measure since it often takes time to build citations from recent work, and the number of citations will depend on the activity or popularity of a field.

Development of a candidate's work will also depend on time. Since the research work is almost always tied to the development of students, it is typical for work to lag to allow time for the students to develop. In addition, if the work is experimental, then research work may take a couple of years before it is publishable. Therefore, evaluating an experimentalist for tenure should consider that publishable work will not generally appear until three to five years after the establishment of a new experimental laboratory.

## NOTES AND PROCEDURES

Engineering programs are often categorized into *research* institutions, *e.g.*, MIT and Caltech, and *teaching* institutions, *e.g.*, Rose Holman and California State Universities such as SJSU and the Cal. Poly schools. The significant differences between these types of institutions are the teaching loads of the faculty, and the research expenditures. Santa Clara University falls somewhere between these two categories. Santa Clara is classified as a Master's/L institution in the Carnegie classifications, producing less than 20 Ph.D.'s per year<sup>iii</sup>. Mechanical Engineering, along with Electrical and Computer Engineering, have doctoral programs. Successful faculty at SCU should show achievement in both teaching and research, but evaluations should be cognizant of the fact that expected research activity should fall within the realm of the available faculty time for research and the available resources for support. The teaching load at heavy research institutions can be as low as two classes per year, and funding for start-up packages at

these institutions can be significant.

A critical element in the evaluation of scholarship is the feedback provided by an external panel of peers within the candidate's discipline/sub-discipline. These peers are best-positioned to evaluate a candidate's record in terms of rigor, originality, influence, and independence. Specifically, these reviewers, a) are aware of applicable norms and performance standards, particularly regarding publication venues and the value of non-publication contributions, b) can directly evaluate the scholarly work apart from the statistics for the publication venue, and c) can assess the candidate's scholarly record regarding his/her overall contribution to a discipline. External reviewers should be from research institutions or other recognized experts in the field. In reviewing scholarship, it should be clear that the teaching load at SCU is six classes per year for each faculty member.

Engineering as a discipline is very collaborative for two reasons: engineering often uses procedures and equipment developed over time by others; and the discipline often undertakes problems that are so complex that they are tackled best through collaborative efforts rather than by individuals. Mechanical Engineering requires a substantial level of education and preparation to make useful contributions. Mechanical Engineering scholarship also involves the development of students. As such, almost all research involves mentorship of students. As a result, it is typical to have multiple authors (typically three to five) on engineering publications, often with a student author first. It should be acknowledge that in many cases the faculty member is the primary impetus for the research work and often contributes the greater part of the intellectual merit.

External funding is often a critical part of engineering research and may be necessary to acquire equipment, and to support students and staff. At SCU, faculty are strongly encouraged to seek external funding commensurate with their needs to accomplish their research, however there is not, at this time, any explicit or implied requirement for a certain level of support to be generated by a faculty member.

## UPDATES & REVISIONS

The revision date of this document is 12/22/15; this is the first version of the document approved by the Department and accepted by the School. This document will be reviewed and updated on a five-year cycle, and may be updated at other times as needed and approved by the Department.

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<sup>i</sup> 2013 American Society of Engineering Education, Profiles in Engineering and Engineering Technology Education (this does not include Engineering Technology programs which are less numerous).

<sup>ii</sup> U.S. News and World Report.

<sup>iii</sup> See [classifications.carnegiefoundation.org](http://classifications.carnegiefoundation.org).