Professors have a variety of professional concerns, from obtaining tenure to professional growth, which directly or indirectly affects their teaching. Matters of faculty development for a successful and enjoyable career confront them with responsibilities of professional ethics and the necessity that they be ethical professionals. After first considering how faculty members actually spend their time, the sections that follow will deal with these matters in turn.

In this chapter we are reporting the situation as we see it, not as we wish it would be. We believe that both education and research are important, but education and the welfare of students should be the primary activity and focus of the university. What we see at most research universities is the reverse.

17.1. SUMMARY AND OBJECTIVES

After reading this chapter, you should be able to:
- Explain tenure and the usual procedures for promotion and tenure at universities.
- Discuss the environment for engineering faculty and ways to improve it.
- Discuss methods for developing faculty and prepare a personal development plan.
- Outline the AAUP ethical standards and determine if the AAUP guidelines are satisfied.
- Determine the applicability of Hougen’s principles in one’s own engineering discipline.

17.2. FACULTY TIME

How many hours per week do faculty work? Bowen and Schuster (1986) and Fairweather (1996) report that studies typically find that professors work 55 to 62 hours per week during the academic year and slightly less during student vacation periods. Beaufait and Harris (1989) state the norm for new faculty is about 55 hours per week. A 2010 survey at the University of Michigan found the mean hours per week of respondents was 58.4, which was an increase
from the 57.2 recorded in 1996 (Wright, 2011). How do faculty split their time between teaching, research and committee work? Table 17-1 shows the results from the 2007-08 Higher Education Research Institute at UCLA survey.

Table 17-1 shows that on average female professors spend less time on research and scholarly writing than do males. Although the median number of hours/week is in the same range, female professors spend more hours per week than male professors in scheduled teaching, in preparing to teach and grading, and in committee work and meetings. Both female and male professors spend less time doing research than they do in teaching activities. The University of Michigan study (Wright, 2011) reported all ranks spent 46% of their time teaching and meeting with students versus 29% on scholarship and research. Assistant professors spent more time per week and higher percentages of their time in both teaching and scholarship than other ranks. To some extent assistant professors were protected from university service, which allowed them to spend less time on service. Menges (1999) found that new faculty spend more time on teaching than do more experienced faculty. At research universities new faculty spent approximately 35% of their time on research and 35% on teaching. At other institutions two-thirds or more of new faculty time was spent teaching. Service commitments started very low but had increased significantly to 10 to 15% of faculty time by the third year. At many research universities new faculty are assigned one course a semester. Based on Boice’s (2000) data on time spent by new faculty, the time spent on this assignment is typically:

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>1–4%</th>
<th>5–8%</th>
<th>9–12%</th>
<th>13–16%</th>
<th>17%+</th>
<th>Median h/wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled teaching, Female</td>
<td>0.7</td>
<td>11.8</td>
<td>30.1</td>
<td>35.4</td>
<td>13.6</td>
<td>8.5%</td>
<td>9–12</td>
</tr>
<tr>
<td>Scheduled teaching, Male</td>
<td>0.6</td>
<td>14.5</td>
<td>32.0</td>
<td>35.0</td>
<td>11.1</td>
<td>6.8</td>
<td>9–12</td>
</tr>
<tr>
<td>Preparing to teach &amp; grading, Female</td>
<td>0.3</td>
<td>7.9</td>
<td>21.9</td>
<td>23.4</td>
<td>16.0</td>
<td>30.5</td>
<td>9–12</td>
</tr>
<tr>
<td>Preparing to teach &amp; grading, Male</td>
<td>0.3</td>
<td>11.9</td>
<td>25.1</td>
<td>25.3</td>
<td>15.6</td>
<td>21.8</td>
<td>9–12</td>
</tr>
<tr>
<td>Research &amp; scholarly writing, Female</td>
<td>19.1</td>
<td>36.9</td>
<td>19.1</td>
<td>11.1</td>
<td>5.1</td>
<td>8.7</td>
<td>1–4</td>
</tr>
<tr>
<td>Research &amp; scholarly writing, Male</td>
<td>13.2</td>
<td>29.3</td>
<td>20.8</td>
<td>13.5</td>
<td>7.5</td>
<td>15.6</td>
<td>5–8</td>
</tr>
<tr>
<td>Committee work &amp; meetings, Female</td>
<td>4.1</td>
<td>55.2</td>
<td>28.2</td>
<td>8.3</td>
<td>2.6</td>
<td>1.7</td>
<td>1–4</td>
</tr>
<tr>
<td>Committee work &amp; meetings, Male</td>
<td>5.7</td>
<td>58.5</td>
<td>25.4</td>
<td>7.0</td>
<td>2.1</td>
<td>1.3</td>
<td>1–4</td>
</tr>
</tbody>
</table>
• 3 h/wk in class plus 20 minutes/day interacting with students before and after class (total = at least 4 h/wk)
• 9–15 h/wk preparing for class, plus another 1–2 h/wk grading. (total = at least 10 h/wk and sometimes 20 h/wk)
• 3–6 h/wk for office hours, and more if have an open door policy
• Total = 16 to 30+ h/wk

New faculty who have already learned how to teach will be at the low end of this estimate.

17.3. PROMOTION AND TENURE

We will first consider the pros and cons of tenure and then discuss promotion procedures along with the widely perceived criteria for promotion. Finally, we'll consider appropriate actions for untenured professors desiring to be promoted.

17.3.1. Tenure

Tenure is close to a lifetime guarantee of a job as long as the university continues to teach the subject and as long as the professor is not found guilty of any heinous crime. Tenure was invented to protect a faculty member’s right to say things in her or his area of competence (Segal, 1974). This right is now called “academic freedom.” Prior to the development and widespread adoption of tenure it was not unusual for a professor to be “summarily dismissed” for saying something that the president or board of trustees of the institution disliked. Clearly, the American Association of University Professors (AAUP) was reacting to abuses when its 1915 Declaration of Principles was adopted. Amended in 1940, this declaration advocates:

1. Bestowing tenure on all associate and full professors.
2. A probationary period with a maximum length of seven years.
3. Explanation of the grounds for dismissal.
4. Written notification and a hearing before a faculty committee prior to dismissal.

Most universities use the AAUP guidelines as the basis for their individual variations of tenure. Tenure has proven to be the best protection for academic freedom. There are numerous instances of abuses by institutions, but sanctions established by the AAUP are embarrassing to the institution and do force most institutions to use due process for tenured professors, a protection not enjoyed by the untenured. Approximately 85% of faculty works at an institution with a tenure system (Higher Education Research Institute, 2009). However, adjunct (aka contingent or temporary) faculty status has effectively removed many professors from the tenure system (O’Meara et al., 2008). Adjunct professors often scrape by on part-time earnings and essentially have no protection from being laid off. Fortunately, engineering continues to hire tenure track professors for most positions.

For some professors the granting of tenure serves to unleash a latent creative ability that can lead to major scholarly advances. The newly tenured professor may feel free to try risky research or to attack the scholarly establishment. Although this flowering does not always occur, the possibility that it might occur is a strong argument in tenure’s favor. One additional advantage is that tenure forces the institution to make a carefully considered decision at a defined point in time. Otherwise, many institutions, like many individuals, would
procrastinate and not make hard decisions. When the department chair needs to fill out the teaching roster, it would be quite easy to keep someone barely adequate in place.

Like any structure invented in response to abuses, tenure can be abused. First, the process of granting tenure often does not follow the AAUP ideal of faculty control. Even if administrators do not vote or have a limited vote, their presence on committees certainly has an effect on tenure decisions. Of course, the AAUP is an advocacy group, and their ideal may not be in the best interests of all universities.

Perhaps the major charge against tenure is that it inbreeds mediocrity (Segal, 1974). Once mediocre professors become promoted they may promote other mediocre professors and the quality of the entire faculty erodes. As faculty quality slides downhill, the truly excellent professors may decamp. The danger in the tenure decision is that it is at best a guess at a fairly early stage about what a professor will do for the next thirty or so years. If too fine a cut is made, some excellent people may be let go, and they may well bloom elsewhere. If the cut is too easy, mediocre or lazy individuals may be retained.

Tenure often places untenured professors under enormous pressure, while tenured professors are under almost no pressure. This pressure on assistant professors pushes them to do research that is rapidly publishable but not necessarily important. The untenured professor is told to focus and not become a broadly educated scholar. Changing one’s research area from one’s PhD subject is highly discouraged even if the now older and wiser professor can see more productive research areas. The push for tenure can also severely limit the time an untenured professor spends on improving teaching.

The pressures of tenure also skew the institution’s resources. Assistant professors are often given light or nonexistent teaching loads and committee assignments. This is done to let them devote time to research. In the best circumstances this strategy works well, although in the worst circumstances the assistant professor leaves before ever having produced anything. In addition, this procedure may reduce the teaching load below the critical mass necessary for the assistant professor to learn how to become an effective, efficient teacher.

Finally, the very idea of academic freedom can be abused. Academic freedom is meant to protect professors in their areas of competence. There are those who wander outside their areas of competence and still expect to be protected by academic freedom. Occasionally professors teach material totally unrelated to their discipline and argue that it is their academic freedom to do so. Since our colleagues in areas such as biology, climate studies, philosophy, political science, and religion really need the protection of tenure, we are in favor of retaining tenure.

17.3.2. Structure of the Promotion Process

Promotion and tenure systems differ significantly from institution to institution, but the general pattern is similar. We will describe a representative pattern. Untenured professors should determine both the written and the unwritten rules for tenure at their university.

In engineering most new academics are hired as assistant professors on the tenure track. Being on the tenure track means the assistant professor can become tenured, but it also means that if not promoted to associate professor within a specified time frame (usually seven years) the assistant professor loses his or her position. At most institutions, promotion and the granting of tenure occur at the same time. A few institutions promote first and grant tenure later as
a separate decision. The next step after associate professor is promotion to professor (aka full professor). There is no set time frame for this promotion. Many schools have instituted named chairs and distinguished professor positions for full professors with outstanding credentials.

Formerly, the promotion process started in the fall. Since many institutions currently ask for letters from eminent researchers, the process often starts in the spring to give time to solicit and obtain letters. The promotion document is prepared by the candidate’s department, usually with considerable input from the candidate. The departmental promotion and tenure committee, consisting of the full and sometimes the associate professors in the department, receives a copy of the document. At the spring meeting the committee decides if the candidate should be very strongly considered for promotion. If yes, then letters are requested. In the fall the candidate is fully discussed at the primary committee meeting and the letters are carefully analyzed for hidden meanings. After considerable discussion, a vote, usually by secret ballot, is taken. To have an open and free discussion the committee meetings are totally confidential. Support from the candidate’s department and chair is necessary, but not sufficient, for promotion.

If the candidate is successful at the departmental level, the nomination including the letters of recommendation is sent to the next level, which is often the college (such as the college of engineering) level. The department head or a representative makes a presentation to this committee, and another vote is taken. If successful, the nomination is sent to the university level where yet another committee discusses and votes on it. Finally, the nomination is sent to the board of trustees for approval. The board has the legal right to vote no, but fortunately most boards are wise enough to leave promotion decisions to the faculty. By now, it is spring and candidates who are naturally nervous are reduced to quivering jelly.

The details of exactly when this all occurs, who votes, how many votes are required to pass, and so forth vary greatly. Often the only way to find out is to ask.

### 17.3.3. Criteria for Promotion and Tenure

The criteria for promotion also vary. Although often not written down, time in grade is usually included. Many schools adhere to the AAUP guidelines with promotion being considered during the sixth year so that unsuccessful candidates can be given the seventh year to find another position. Many schools have an unwritten but firm minimum number of years (four or five) required before the candidate will be considered. Since schools have both written and unwritten criteria, an untenured professor is advised to develop a relationship with a mentor (Boice, 2000). The written criteria at most schools include research, teaching, and service. These requirements should certainly be read carefully since they contain some useful information and some nuggets of truth. At research universities the actual criterion for promotion to associate professor and for receiving tenure was previously

\[
\text{RESEARCH / RESEARCH / RESEARCH}
\]

this was usually translated into

\[
\text{PUBLISH / PUBLISH / PUBLISH}
\]

(Lee et al., 1997; Sisson, 1982; Boyer, 1990). Reporting on a 1989 Carnegie Foundation survey of faculty, Boyer (1990) found that 83% of faculty at research universities agreed with the
statement “In my department it is difficult for a person to achieve tenure if he or she does not publish.” This number was up from 44% in 1969 and is probably higher now. Among engineering professors 63% strongly agreed with this statement (see Table 17-2). There is an apparent disconnect between promotion and tenure requirements that are heavily based on research while faculty spend considerably more time on teaching related activities than on research (Table 17-1).

Recently, some evidence (Duderstadt and Womack, 2003) has appeared that many schools have revised the unwritten promotion criterion for engineering professors to

PUBLISH / MONEY / ADEQUATE TEACHING

Or more often to

MONEY / PUBLISH / ADEQUATE TEACHING

The addition of two requirements corresponds to a general tightening of the tenure requirements at most universities. The importance of bringing in money is shown in Q3 in Table 17-2. The argument for the need for sponsored research is that professors cannot continue to do excellent research without support, and the peer review process measures quality. Some institutional self-interest may also enter the picture.

The importance of teaching is shown in Q4 in Table 17-2. The results in Q4 probably understate the importance of teaching since the requirement for adequate teaching seems to operate as a minimum condition that must be surpassed but then is not considered further. More recent changes in engineering faculty rewards in the United States were explored by Lattuca et al. (2006). Approximately one-half of the respondents reported that over the past decade there were no changes, approximately one-third reported an increased emphasis on “teaching in faculty hiring, promotion, tenure, and salary and merit decisions,” and approximately one-fourth reported a decrease in emphasis on teaching. Interestingly, senior faculty reported more emphasis on teaching in promotion and tenure decisions, whereas untenured faculty thought the emphasis had decreased. This difference in perceptions is important because perceptions of the faculty reward systems influence faculty behavior. Since bad teachers continually cause the department, and particularly the chair, a great deal of grief, the requirement for adequate teaching is clearly in the best interests of the department. Obviously, one can argue with the values that only adequate teaching is necessary; our purpose here is to report what is, not what could or should be.

An untenured professor needs to know the details of what counts for how much in the various areas. This search will lead into many subjective areas (Watson, 1991; Wankat, 2002). For instance, not all publications are equal. Ideally, the quality of all publications would be determined by careful scrutiny, but this is a difficult subjective judgment. Boyer (1995) gives guidance on judging the quality of scholarship, but most engineering departments use journals and the opinions of outside experts as a substitute for directly measuring quality. For technical papers, refereed articles in a major (widely available, included in the Science Citation Index, and with a high impact factor [“average number of citations received per paper published in that journal during the two preceding years,” http://en.wikipedia.org/wiki/Impact_factor]) journal are more important than refereed articles in a minor journal, which are more important than refereed notes, which are more important than articles in refereed proceedings (computer sci-
ence is an exception—some conference proceedings are very selective and very prestigious), which are more important than non-refereed articles. Nontechnical articles are less important than any of the above. Thus, the journal is used as a substitute for a direct measure of quality. Since there may be little difference in the time and energy required for publishing in prestigious journals, assistant professors are often advised to publish in these journals.

"Citation counts are one of the better indicators of the visibility and value of research" (Centra, 1993, p. 139). However, citation counts need to be normalized with respect to how active a field is and what the norms for citing are. In addition, self-citations probably should be removed. Unfortunately, many promotion and tenure committees look at the h-index without considering other factors. [To determine an h-index, first list the person’s publications in order of the number of times they are cited with publication #1 having the most citations. Then count down until the number of publications counted equals the number of citations of the current paper. This is the h-index. Example A: Professor A has 40 papers and a total of 600 citations. The top paper (#1) has 150 citations, paper #10 has 14 citations, papers #11 and #12 have 11 citations and paper # 40 has 0 citations. Prof. A has an h-index of 11 (see problem 3 in Homework for another example).] Presentations at conferences and universities also count, but in a different way. Since most schools require recommendation letters from professors in the candidate’s area to evaluate the candidate’s research, assistant professors need to become acquainted with researchers in their area. It is easier for the professor to

<table>
<thead>
<tr>
<th>Responses to statement #1:</th>
<th>Strongly agree</th>
<th>Agree with reservation</th>
<th>Neutral</th>
<th>Disagree with reservation</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Institution</td>
<td>83</td>
<td>12</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Engineering</td>
<td>63</td>
<td>18</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Responses to Q2 to Q4:</th>
<th>Very Important</th>
<th>Fairly Important</th>
<th>Fairly Unimportant</th>
<th>Very Unimportant</th>
<th>No Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2. How important is the number of publications for granting tenure in your department?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>56</td>
<td>39</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Engineering</td>
<td>43</td>
<td>40</td>
<td>10</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Q3. How important are research grants received by the scholar for granting tenure in your department?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>40</td>
<td>36</td>
<td>16</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Engineering</td>
<td>49</td>
<td>28</td>
<td>17</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Q4. How important are student evaluations of courses taught for granting tenure in your department?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>10</td>
<td>41</td>
<td>30</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Engineering</td>
<td>17</td>
<td>38</td>
<td>31</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>
remember the candidate’s research and to write a favorable letter if the professor knows the candidate. Excellent presentations, informal discussions at meetings, and networking help one to develop these personal connections. Networking does not replace the need to conduct good research, but networking (e.g., Misner, 2009) has become an important skill for faculty.

Who the candidate writes publications with is also scrutinized. Papers from the candidate’s thesis are expected and count positively only if they are of exceptional quality or quantity. Since the thesis papers are expected but really do not count, it is important to finish them as soon as possible. This is one advantage of having a postdoctoral appointment. Under no circumstance should an assistant professor start a job before he or she has completed the requirements for a PhD. Once these papers have been completed, the candidate needs to sever the umbilical cord to the adviser. This is particularly important for professors who stay at the school where they earned their PhD. Besides papers from the thesis, the candidate should have a mix of papers written by her- or himself, with colleagues and with students. If all papers are written with colleagues, members of the promotion committees will wonder if the candidate is independent, and if all papers are solos, the question will be whether the candidate can work with others.

Support for research is necessary to continue doing quality research and to support graduate students. As is the case with publications, not all research support is counted equally. At many research universities grants from certain government agencies such as NSF, NIH, and NASA are more valued than other grants. External support is always more highly valued than internal university support. The most weight is given to grants with the candidate as the principal investigator (PI). Grants for which the candidate is a co-principal investigator or investigator also count but not as much. At undergraduate institutions research with undergraduates requires significantly less money, but external grants are always appreciated.

In the past, most research universities did not expect that assistant professors would have graduated PhD’s within the six-year probationary period. Unfortunately, this expectation appears to have changed and in addition to having graduate students who are conducting research and writing papers with their advisor, assistant professors at many research universities are expected to have graduated at least one PhD. However, because of the six-year time constraint, assistant professors should not expect the research of their students to be sufficient for promotion and tenure.

Does engineering education research count? Most of the items used to analyze technical research are also in place for engineering education research. These include the availability of research grants, journals and conference proceedings with a reasonably well established pecking order, and a market for PhDs and postdocs who have done engineering education research. The National Science Foundation has grants for engineering education research and development. These grants are quite competitive and count toward promotion, but at many schools they count less than grants for technical research. Occasional education papers are often considered to be a “hobby” and may count very little. Depending on the institution, a serious effort at engineering education research may or may not be considered equal to technical research. A big part of the problem is that many senior professors have no idea how difficult it is to publish research in the top-ranked engineering education journal—Journal of Engineering Education. Publishing a review article is also a challenge but is not nearly as difficult as publishing a research paper. Professors interested in focusing on engineering education research need
to determine in advance how promotion committees will look at this research. Surprisingly, many undergraduate institutions do not appear to value engineering education research.

A UK survey by Alpay and Verschoor (2014) found that STEM faculty believed that achievements with the most impact were novel technical research, technical research publications and reputation as a technical researcher, while those with the least impact were funding teaching activities and teaching publications. They observed a general desire of faculty to reduce teaching loads. When asked if technical research enhanced undergraduate teaching, 70.9% of the respondents agreed with 23.5% choosing occasionally, 35.4% choosing often, and 18.0% choosing to a great extent. When asked if undergraduate education enhanced technical research, 45.0% of the respondents agreed with 25.7% choosing occasionally, 13.5% choosing often, and 5.8% choosing to a great extent. Clearly, in the UK STEM faculty believe technical research is more important than teaching.

A final comment: Many full professors at research universities want to see a big, long-term research plan. What will the candidate be doing five and ten years from now? Develop a research plan to help guide your activities and to help impress the full professors.

Teaching counts, but not enough at most research universities. Of course, at institutions focused on teaching, teaching counts a lot. Since no one benefits from bad teaching, most departments want proof that teaching is at least adequate. Although the lack of a large number of student complaints may be sufficient proof, it is better to obtain positive proof by regularly obtaining student evaluations of the class. Unfortunately, at most research universities excellent teaching helps only in borderline cases. For example, if the promotion case looks to be a little early on the basis of research alone, excellent teaching may make the difference. Excellent teaching can be proven with teaching evaluations and teaching awards. In Chapter 16 we noted that teaching evaluations need to be used with care in promotion decisions. A uniform procedure for administration should be followed for distributing and collecting the forms. Items which ask for overall ratings should be used since they correlate more highly with student learning. Adjustments should be made for factors such as elective versus required courses, class size, time of day, or unpopularity of classes (such as laboratory courses). Finally, since different personalities do better in different types of courses, ratings should be collected for a variety of courses.

For promotion to associate professor and for receiving tenure, service has very little clout at most universities, although at four-year and community colleges service can be an important factor. Even at research universities one cannot totally ignore service, since failure to do one’s share of committee work and other types of departmental service will be a negative factor. However, once a reasonable share has been done, more will not help. Professional society activities are also expected, but moderation is again the key. However, chairing sessions at national meetings is an excellent way to network with faculty in your interest areas. The fairly common practice of giving women and underrepresented minorities more committee and advising assignments is unfair if these activities do not count for promotion (Alexander-Snow and Johnson, 1999).

Ouellett (2010) notes that there has been a general broadening of the role of faculty, and rewards including promotion can now occur for activities in teaching and service. However, at least in engineering at research universities, these rewards usually occur after the professor has tenure. Once a professor has tenure, teaching and service do count at many
institutions. Lee et al. (1997) were surprised by their survey result that faculty believed that service is rewarded more than teaching but less than research. Earlier, Sisson (1982) obtained the same result. Our observation based on anecdotal evidence, which is less reliable than surveys, is that service counts more for promotion to full professor than to associate professor, but we believe it is still third. However, service is probably more important than teaching for salary increases. A professor who does much of the departmental service is very much appreciated by the Head, and often the Head will reward this person with above average salary increases.

A final unwritten area is general conduct and personality. Promotion is not a case where “nice guys finish last.” All things being equal, it is easier to promote a personable individual and easier not to promote a nasty person than vice versa. A talented nasty person will be promoted, but a mediocre nasty person probably will not. If you act in a collegial fashion, do your share willingly, get things done on time, and have a generally positive outlook on life, then you will benefit if your promotion is not clear-cut. Part of the tenure process involves the decision that the candidate fits in with the institution (Watson, 1991). This paragraph may seem unfair, but in industry the ability to get along and work with a team is more highly prized than in academia.

If all of this sounds to you like promotion and tenure committees nit-pick and search for any possible reason to doubt that the assistant professor should be promoted, then you have the right idea. However, despite all the nit-picking, the committees often make the right decision. We think that all the nit-picking occurs because committee members either want to impress other committee members or they want to justify voting no—a difficult decision for many professors.

Universities do change and the criteria for promotion and tenure change. Over the last 20 years publishing and research support have remained most important, but research universities have been able to redefine scholarship to some extent so that a broader range of activities is rewarded. This follows the main conclusion of the Carnegie report (Boyer, 1990). There has been a clear swing toward increasing the importance of teaching although the increase in weight given to teaching in promotion decisions was modest. As with the weather, it is often easier to talk about rewarding good teaching than to actually do anything about it. Some of the unhappiest people we know are professors who were hired to do one thing (teaching) and then had the university change and ask them to do something else (research). Professors need to watch the trends at their university.

### 17.3.4. Actions for Untenured Professors

Many professors want to argue with the values their university uses to set priorities for promotion and tenure. However, professors, particularly assistant professors, ignore the established reward system at their peril. Research universities do not punish professors for excellent teaching and for spending time with students. What universities punish professors for (by denying tenure or promotion) is not doing what the university asked for (research and money). To survive with your moral esteem intact, determine how to do both what you want and what the university wants. Previously (roughly before about the year 2000), there was enough time to do a good job on both teaching and research even if the new assistant profes-
sor needed on the job training to learn to write proposals, mentor graduate students, and teach. At many research universities, expectations have increased so much that assistant professors need to start with as much preparation and experience in academic duties as possible. The actions that PhD students and postdocs who aspire to faculty positions should do are discussed in Appendix A immediately after this chapter.

What can you do as an untenured professor to increase the odds that you will be promoted and receive tenure? First, retain your sense of humor. It will help keep stress under control. Gray and Prow (2008) provide useful advice for new faculty along with a dose of humor. For example, hint #1: “Gray’s Theorem of N + 2. The number of papers required for tenure is N + 2, where N is the number you published. Corollary: Gray’s Theorem is independent of N.” In a serious vein, they recommend serious networking with scholars in your discipline.

Find a teaching mentor (Felder, 1993; Felder et al., 2011; Williams et al., 2014) and a research mentor. The research mentor will probably be in your department, but the teaching mentor does not have to be in your department or even your college. If there is a formal mentoring program in your department or college, tap into it as soon as possible. New faculty who join volunteer formal mentoring programs are promoted faster than those who do not join (Wasburn and LaLopa, 2003). If you did not have a course on teaching as a graduate student, attend a teaching workshop that lasts at least three days—the ASEE National Effective Teaching Institute (NETI) is particularly effective (Felder et al., 2011). Proposal writing workshops are also very useful.

Find out as clearly as possible what the target is, especially since the requirements for promotion and tenure are a vaguely defined moving target. Thus, the opinions of several professors in addition to your mentors are important. Once the target has been identified, develop a plan (see Chapter 2) that focuses first on activities and priorities and then on appropriate schedules and to-do lists. List those things which count for promotion at your school and list those that you want to do. Plan to combine teaching and research by teaching classes in your research specialty. Unfortunately, women tend to be given fewer of these assignments (Creamer, 1998). Discuss with your chair the teaching assignments for the next several years and see if you can get commitments to teach an elective course and to teach courses several times in a row to reduce your preparation time.

Develop a tentative schedule for doing and publishing technical research (if you want educational research to count as research for P&T obtain a signed agreement from your dean). This schedule needs to include plans for writing proposals, visiting funding agencies, training new graduate students, doing research, going to meetings, networking, writing papers, and so forth. Discuss the plan with your research mentor. Since plans like these are usually overly optimistic, plan to get more done than will be needed to secure your promotion. Then if some of the plans are delayed, you will still have done enough.

Your plans should be developed for the entire probationary period at a sustainable pace. If you can do some research that will come to fruition quickly and some that will take more time to mature, you will have a steady stream of papers coming out. Since this is typically a six-year period, you need to include time to relax. Even if family and other obligations would allow you to work more, work at most six days per week except in rare emergencies. Schedule an extra day to relax by flying to meetings on a Saturday. Schedule a week of vacation every year. In the long run these breaks will increase your efficiency, and you will get more done.
Keep a running record of things that you do to ensure that all pertinent information is included in the curriculum vita. This is important in order to avoid selling yourself short in the promotion and tenure document. For instance, if you give three or four seminars every year at different universities, at the end of five years you will have accumulated between fifteen and twenty visits. If these are not written down, it is very easy to forget one or more of them. Keep a running curriculum vitae in a computer file. Get into the habit of recording things right after you have done them.

The world does not end when tenure is denied. Most engineers who are denied tenure go into industry (Watson, 1991). Their salary and job satisfaction are often higher than in academia. If teaching was a positive part of the academic experience, there are many part-time teaching opportunities available. Other faculty find another institution is a much better fit for their priorities.

17.4. FACULTY ENVIRONMENT

We will first discuss the faculty environment and explore the reason for the mixed messages from faculty: there may be widespread grumbling in the professorial ranks (Beaufait and Harris, 1989; Boyer, 1990; Duderstadt and Womack, 2003; Mooney, 1991), yet in many ways professors like their jobs (Boyer, 1990; Mooney, 1991). After considering the complaints, we will discuss what can be done to improve the environment for college professors. This discussion is continued in Section 17.5 on faculty development. Obviously, more money would help but is probably not forthcoming. In 2014, states in the US are slowly starving their state institutions while becoming more involved (some would say meddling) in the academics. Thus, the focus will be on what can be done with no or modest amounts of money.

Perhaps the best sources of information on the attitudes of faculty are the extensive faculty surveys done by the Carnegie Foundation for the Advancement of Teaching (Boyer, 1990) and by the Higher Education Research Institute at the University of California at Los Angeles. The signs of dissatisfaction were widespread in 1989 when the Carnegie study was conducted (Table 17-3). From the responses to question Q1 in Table 17-3, one can see that in 1989 the interests of engineering professors were split 50-50 between teaching and research, although teaching had more professors strongly interested in it. There was an obvious difference between professors’ interests and the perceived requirements for tenure that are reported in Table 17-2. Assistant professors are usually hired from major research universities where they were socialized that research is the “supreme value” (Schwem, 1993, p.5). Since assistant then associate professors are promoted based on their research ability, most members of promotion and tenure committees are successful researchers. Thus, the percentage of engineering professors more interested in teaching has probably decreased since 1989 (Wankat, 2013).

Unfortunately, the data pools for Boyer (1990) and the Higher Education Research Institute (2003, 2006) are different for Q1, but some comparisons can be made. The 2001–02 and 2004–05 public university data is probably closest to Boyer’s all four year institution data. Comparing these sets of data, there appears to be a modest swing towards research.

Another source of dissatisfaction in 1989 was the perception that publication pressures reduce teaching quality (see Q2 in Table 17-3). More than half of the professors at research institutions and more than half of the engineering professors agreed with this statement. The
Table 17-3. Faculty Satisfaction

<table>
<thead>
<tr>
<th>Answers Q1: Do your interests lie primarily in research or teaching?</th>
<th>Research</th>
<th>Lean to research</th>
<th>Lean to teaching</th>
<th>Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 4 yr. Institutions</td>
<td>9</td>
<td>33</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Research Institution</td>
<td>18</td>
<td>48</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>Engineering</td>
<td>7</td>
<td>43</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Public Univ. 01–02(^a)</td>
<td>8.6</td>
<td>40.5</td>
<td>34.5</td>
<td>16.4</td>
</tr>
<tr>
<td>Public Univ. 04–05(^b)</td>
<td>7.9</td>
<td>40.8</td>
<td>33.4</td>
<td>17.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Responses to statements Q2 to Q8:</th>
<th>Strongly agree</th>
<th>Agree with reservation</th>
<th>Neutral</th>
<th>Disagree with reservation</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2. The pressure to publish reduces the quality of teaching at my university.</td>
<td>Research Institution</td>
<td>24</td>
<td>29</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>Engineering</td>
<td>24</td>
<td>29</td>
<td>13</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>Q3. During the past two or three years, financial support for work in my discipline has become harder to obtain.</td>
<td>Research Institution</td>
<td>38</td>
<td>25</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>Engineering</td>
<td>29</td>
<td>23</td>
<td>34</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Q4. I hardly ever get to give a piece of work the attention it deserves.</td>
<td>Research Institution</td>
<td>13</td>
<td>33</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Engineering</td>
<td>22</td>
<td>29</td>
<td>15</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>Q5. My job is the source of considerable personal strain.</td>
<td>Research Institution</td>
<td>15</td>
<td>32</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Engineering</td>
<td>16</td>
<td>33</td>
<td>18</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Q6. If I had it to do over again, I would not become a college teacher.</td>
<td>Research Institution</td>
<td>6</td>
<td>7</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td>Engineering</td>
<td>8</td>
<td>5</td>
<td>11</td>
<td>21</td>
<td>54</td>
</tr>
<tr>
<td>Q7. I feel trapped in a profession with limited opportunity for advancement.</td>
<td>Research Institution</td>
<td>5</td>
<td>9</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Engineering</td>
<td>6</td>
<td>10</td>
<td>13</td>
<td>16</td>
<td>56</td>
</tr>
<tr>
<td>Q8. This is a poor time for any young person to begin an academic career.</td>
<td>Research Institution</td>
<td>7</td>
<td>15</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>Engineering</td>
<td>11</td>
<td>17</td>
<td>15</td>
<td>32</td>
<td>25</td>
</tr>
</tbody>
</table>

Data from Boyer (1990), except where indicated otherwise: \(^a\)Higher Education Research Institute (2003), \(^b\)Higher Education Research Institute (2006); Answers are in percents
interaction of teaching and research will be discussed in more detail later. There was also substantial agreement that it had become more difficult to obtain financial support (Q3, Table 17-3), and the situation appears to have become worse. For example, the percentage of NSF engineering education proposals funded in 2011 was approximately 12% for the Research Initiation Grants in Engineering Education (RIGEE) program, 19% for the Research/Educational Enhancement (REE) program, and 10–12% for the Transforming Undergraduate Education in Science (TUES) program (Wankat, 2013). In 2014, anecdotal evidence is that financial support for research is even more difficult to obtain than in the past. Professors also reported that they had difficulty putting sufficient time into any project (Q4, Table 17-3). These sources of dissatisfaction add up to considerable strain on faculty (Q5, Table 17-3). Approximately half of faculty members report considerable strain. Duderstadt and Womack (2003) believed that all of these pressures had gotten worse. The Higher Education Research Institute survey (Mooney, 1991) reported that the following were major sources of stress:

1. Time pressures (reported by 83.5% of professors surveyed).
2. Lack of personal time (79.8%).
3. Teaching load (65%).
4. Managing household responsibilities (63.7%).
5. Committee work (57.5%).
6. Colleagues (54.2%).
7. Students (50.4%).
8. Research or publishing demands (50.4%).
9. Faculty meetings (49.6%).

The youngest faculty members reported considerably more strain than any other age group (Boyer, 1990). Clearly, there is a price to pay for trying to earn promotion and tenure. This is strongly supported by anecdotal evidence. Lee et al. (1997) point out that the discrepancy between what faculty thinks the university promotion and reward system should be and the faculty perceptions of the promotion and reward system will result in faculty dissatisfaction. Duderstadt and Womack (2003) believe that the major cause of faculty stress is rapid change in the roles of faculties and universities.

Table 17-3. (Cont.).

<table>
<thead>
<tr>
<th>Responses to statements Q9 to Q11:</th>
<th>Very important</th>
<th>Fairly important</th>
<th>Fairly unimportant</th>
<th>Not at all important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q9. Please indicate the degree to which your academic discipline is important to you.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>77</td>
<td>21</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Engineering</td>
<td>75</td>
<td>23</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Q10. Please indicate the degree to which your department is important to you.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>48</td>
<td>39</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Engineering</td>
<td>52</td>
<td>42</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Q11. Please indicate the degree to which your college or university is important to you.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Institution</td>
<td>30</td>
<td>50</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Engineering</td>
<td>41</td>
<td>43</td>
<td>16</td>
<td>1</td>
</tr>
</tbody>
</table>
Several questions in Table 17-3 show that in some ways college professors are satisfied with their jobs. Q6 shows that most professors would become college professors again despite everything they now know. In addition, Q7 shows that most professors do not feel trapped, and Q8 shows that most thought that 1989 was a good time to start an academic career. Clearly, there was something satisfying about being a professor when it is compared to the alternatives. Q9 to Q11 show that the academic discipline, department, and university were all important to professors but that their academic discipline had the highest level of allegiance.

Extensive national data for 2007–08 on faculty were reported by De Angelo et al. (2009). The overall satisfaction of faculty with their career is shown in Table 17-4. This data shows three trends that will continue in other data sets.

1. Male professors are more satisfied than female professors.
2. Full professors are most satisfied.
3. Associate professors are not more satisfied than assistant professors

Data collected in 2010 on the climate for male and female professors at Rochester Institute of Technology (RIT) is summarized in Table 17-5 (Marchetti et al., 2012). For both genders satisfaction with work/life balance was most strongly correlated with overall satisfaction. Males were more satisfied than females (p < 0.05). The mean score for work/life balance was significantly less for women (p < 0.0001), and the mean score for departmental climate was significantly less for women (p < 0.01). Composite score for value and influence was significantly less for African American, Latin American and Native American faculty (p < 0.05). Gender differences in satisfaction appeared to increase at the higher ranks, but were generally not significant because of small sample sizes.
What do these tables of data mean? There appear to be some major satisfactions to being a college professor. But there are some demotivating factors at work, some of which have increased in recent years. These factors include pressure on faculty, red tape, too many administrative responsibilities, too many courses to teach, inadequate staff support, lack of modern equipment, excessive workload, lack of influence, tenure requirements, lack of collegiality, a poor administration, gender and racial inequalities, and the low value placed on teaching (Beaufait and Harris, 1989; Boyer, 1990; Duderstadt and Womack, 2003; Marchetti et al., 2012; Mason et al., 2013). Interestingly, salary and fringe benefits are no longer the major problems they once were.

Gender and racial inequalities and bias, that are invisible to white males, are all too obvious to women and racial and ethnic minorities (Creamer, 1998; Marchetti et al., 2012; Mason et al., 2013; Trautner et al., 2002). For example, members of these groups are often asked to do additional duties that will not count in their promotion decisions, such as serve on committees, advise student groups, and present at recruiting fairs. They may be denied opportunities that will count in promotion, such as teaching upper division or graduate courses. The “white male way of acting” is often considered to be the norm. “Women’s emotions and the manner in which they interact with others may be different from men. However, they do not differ in their intellectual abilities. Women are often accused of ‘being too sensitive’ or of ‘taking things too personally’” (Trautner et al., 2002, p. 48). Women may be isolated, lack mentors, and, if they do research with a male professor, it is often assumed that the male professor is the lead in the research. Both women and underrepresented minorities complain about not being acknowledged as professors by students, other professors, staff and the police.

In their book Do Babies Matter? Gender and Family in the Ivory Tower, Mason et al. (2013) collect an overwhelming mass of data that illustrates the difficulties women face in academic careers. In 2000, women earned 49% of the PhDs awarded to US citizens in the US and currently women earn 51%. The median age of new male PhD recipients is 32 and of women is 33. Despite a number of years of equality in numbers of PhD degrees, many more men are hired as assistant professors than women. In engineering only 22% of PhD recipients are women. Earning a PhD in engineering tends to take less time than in humanities, but by time the almost mandatory post-doc has been completed new assistant professors in engineering are in their mid-30s. Waiting to start a family until after tenure becomes biologically risky for women. On the other hand, “Women who had children within five years of receiving their PhD were much less likely than men with early babies to acquire tenured professorships” (Mason et al., 2013, p. 3). And only one-third of the women who accept a tenure-track position before they have a baby ever become a mother. Women, whether they have children or not, receive tenure at a lower rate than men. Women with tenure are more likely to be single and more likely to be divorced than men with tenure. Women who earn tenure take longer than men to be promoted to full professor.

Retention of women and underrepresented minorities can be increased with a number of steps (Mason et al., 2013; Trautner et al., 2002). Workshops on gender and race/ethnicity can be remarkably effective at helping people become sensitive to these issues if they are strongly supported and attended by the upper administration. Faculty and staff need to realize that attendance is expected. A modest allocation from the dean’s office can help support groups significantly. Family and child-bearing friendly policies that are enforced are necessary for everyone
including post-docs and graduate students. Part-time positions with tenure that are convertible to full-time positions would provide needed flexibility for dealing with family responsibilities. Department heads need to make it clear that sexist or racist banter or “jokes” are unacceptable.

Collegiality is a caring about one’s colleagues. It involves both informal and formal sharing of the load required for an excellent department. It involves cooperation instead of competition. In a collegial atmosphere everyone is glad when one professor wins an award since the whole department has won. Working and playing together leads to collegiality. In a collegial atmosphere everyone works within the system and tries to change things without being disruptive. Like good will, collegiality is a fragile resource easily lost and difficult to regain. Unfortunately, the competitive atmosphere of research universities causes collegiality to suffer (Astin, 1985). Malicious gossip, vendettas, paranoia and false accusations, temper tantrums, pettiness, and bickering all lead to a poisonous atmosphere. Many professors are lonely and interact with their colleagues only in the halls and in faculty meetings (Altman, 2004). One way to start to regain collegiality is to reinstitute Friday afternoon social hour with other faculty and graduate students. Another start is the development of ad hoc faculty groups to learn about new developments in mathematics, science, engineering, or education. Since young faculty members in particular complain about a lack of collegiality (Altman, 2004; Boice, 2000), an organized luncheon series to discuss teaching methods can be very helpful.

Boyer (1990) strongly urges universities to find new ways to define scholarship and to develop new methods for the evaluation of teaching. Universities that have followed these recommendations have probably reduced some of the demotivating stress and eased the strain, particularly on untenured faculty.

As noted in Q2 in Table 17-3, there is widespread belief that research can decrease the quality of a professor’s teaching. At the same time there is widespread belief among administrators and researchers that research improves a professor’s teaching. Neither belief is supported by the data on teaching evaluations. From reviews of the literature Feldman (1987), Prince et al. (2007), and Svinicki and McKeachie (2014) state that studies show little correlation between effective research and effective teaching. For practical purposes the correlation coefficient is zero. Ratz’s (1975) study found no effect of research on teaching ratings of engineering professors. On the other hand, Kuriger (1978) found that the teaching ratings of engineering professors who did no research were considerably lower than those of professors who did research. The ratings of professors doing a moderate amount of research were slightly better than those of faculty with a large amount of research. If only elective courses were considered, then teachers doing a large amount of research did slightly better than those doing a moderate amount. Bresler’s (1968) study of scientists and engineers at Tufts University agreed with Kuriger’s study, except that Bresler found that professors who did extensive research received higher ratings in all courses. Since professors doing a lot of research often have significant clout in their departments, they may teach more than their share of elective courses. As noted in Chapter 16, students in elective courses give higher teacher ratings.

The disagreement between studies is an indication that the relationship between teaching and research on the level of the individual professor is complex. Murray et al. (1990) found that few teachers are either good or poor in all courses. Professors who are ambitious, competent, hardworking, and confident tend to receive high student ratings in methodology courses which are very work-oriented. These same personality traits are highly correlated
with research productivity. Thus, for this one type of course one might expect a correlation between student ratings and research. However, correlation does not imply causation. In addition, the link between engineering research and the teaching of undergraduates is rather weak (Prince et al., 2007). Ideally, research or other scholarly activity reinforces teaching and both the teaching and the research improve. In engineering this is most likely to happen in elective courses since the professor has more freedom to discuss research. The advantages of doing research include developing faculty who are vital and enthusiastic, and the faculty in some sense remain learners themselves. However, there are other methods such as writing review papers that are probably just as effective if not more so (Centra, 1993).

Duderstadt and Womack (2003) imply that the pressure to do research, obtain funding, and publish has become worse, and that research interferes more with teaching than it did when the previously listed studies were done. The widespread belief that research interferes with teaching probably also comes from observation that on the university level research does weaken teaching (Astin, 1993). Research harms teaching if fewer faculty are teaching, the students are neglected, curriculum development is neglected, promotion depends only on research, university expenditures have shifted from instruction to research, or the uncertainty of being on “soft” money lowers faculty morale (Duderstadt and Womack, 2003). Fairweather (1999) estimated that faculty at research universities spend about 40% of their time teaching while at other institutions the percentage can be up to 67%. He found that it is difficult for professors to be above average in both teaching and research. However, universities routinely require a balance of research and teaching for each individual faculty member.

Enrollment and the supply of PhDs interested in becoming professors are cyclical. In 1992 an expected shortage of engineering teachers was a major concern. In 2014 the economy is still recovering from a recession, jobs in industry remain tight, and the supply of well qualified candidates to become engineering professors is greater than the demand.

A more diverse faculty would better match the more diverse pool of students. One could increase the pool by increasing the number of women and underrepresented minority BS engineers and by increasing the percentage of women and underrepresented minorities that go on to graduate school. This requires action from grade school through high school up to the undergraduate years. We can encourage more students to go to graduate school by stopping the current “burnout process,” explaining the advantages of graduate school, increasing the stipend, providing teaching (Newton and Scholz, 1987) and research opportunities to undergraduates, pointing out the long-term economic return of graduate school (Kauffman, 1985), developing one-day workshops for undergraduates on graduate education (Blackmond, 1986), and selling students early on the joys of being a professor (Landis, 1989).

Another solution is to increase the percentage of underrepresented minority and women PhD engineers who become professors. Since salaries are competitive, other aspects of a professor’s job need to be made more appealing. Innovative plans to lessen the sting of the probationary period for tenure may help. Careful analysis of the loads on different professors and efforts to give credit for additional activities asked of women and underrepresented minorities would help even the playing field. Innovative maternity and paternity leaves and plans to handle “the two-career problem” could attract well-qualified engineers into teaching. Candidates’ choices of schools are heavily influenced by the reputation of the school (Matier, 1991). Other important factors over which the department has more direct control are teach-
ing and research loads, teaching assignments, research opportunities, congeniality of associates, and rapport with departmental leaders.

Schools could also change the definition of “qualified.” Aren’t engineers with many years of industrial design experience qualified—probably more qualified—to teach design, laboratory, and possibly other courses than professors with no industrial experience? Some innovative institutions have developed Professor of Practice positions that allow them to hire experienced engineers at the right level without typical tenure and publication concerns. Could more use be made of “loan” engineers or engineers from industry on sabbatical? Our experience is that professors of practice and engineers on loan are usually very interested in students and teaching.

17.5. FACULTY DEVELOPMENT

Faculty development is needed because most graduate schools have not prepared PhD graduates for most of the duties they will perform as faculty members (Altman, 2004; Boice 2000; Brent et al., 2006; Reis, 1997; Wankat, 2002). Since the real quality of a university is not the facilities but the faculty and staff, universities need to make a long-term commitment to faculty development or they will risk having older, tenured faculty members who are both obsolete and burned out. It is essential that engineering faculty remain current with technological advances and industrial practice. One argument in favor of having engineering faculty do research is that research keeps them current. This is true, but often only in the professor’s narrow specialty. Only very large departments can afford the luxury of having professors teach only in their special area. Most professors teach some courses that are not their specialty, but if they do not make an effort to stay current, the course will soon become somewhat stale. For teaching undergraduate courses, other methods for staying current, such as writing a textbook, consulting, writing review papers, and attending workshops, may be more effective than research.

Another reason for faculty development is that professors need to continually update their knowledge and skills as their roles change during their careers (O’Meara et al., 2008). The first three years are spent learning how to teach and starting on research. During this period new professors usually receive less help and mentoring than they want (Boice, 2000). For the second two or three years, assistant professors are very concerned about tenure and may explore alternatives should tenure be denied. Associate professors enjoy the recent promotion and tenure and become more involved in their institution. However, they may go through a “sophomore slump” since they are no longer receiving the attention and help that assistant professors receive. Full professors often go through a transition period or midlife crisis (Levinson and Levinson, 1996; Levinson et al., 1978). They may feel less enthusiasm for teaching and research and may suffer declines in student ratings and research productivity. In general terms, these professors must choose between stagnation and diversification. As retirement nears, the professor may start to withdraw gradually, possibly become more “mellow,” and be very satisfied with service to the department and the profession. Professors need encouragement and help to be most effective in each of these stages.

Faculty development can be accomplished by the individual faculty member, but it is helpful if the department chair or dean provides encouragement in the form of modest financial support. Unfortunately, funding for faculty development is often the first item axed when money becomes tight (Altman, 2004). Growth or creativity contracts, in which the professor lists what
will be done over a three to five-year period, are useful (Boyer, 1990; Simpson and Oggel, 1984). The advantage of a growth contract agreed-to by the chair and the dean is that the professor knows that successful completion will be recognized and rewarded. Otherwise, a professor embarking on a new path may find his or her efforts ignored. The growth contract recognizes that universities need faculty with interest and strength in a variety of areas, not just research.

Mentoring is another type of faculty development that can be advantageous for both new and experienced faculty. New faculty with mentors often get off to a much faster start in teaching and research (Boice, 2000). Those who receive role-specific modeling in teaching or research receive higher teaching ratings or are more productive in research. However, since people prefer mentors of the same gender, women are at a disadvantage in engineering. Women faculty get less faculty support than men but need more (Creamer, 1998; Gibbons, 1992). Experienced faculty who serve as mentors often feel that their mentoring is an opportunity to give back to the profession and may feel joy when their mentee succeeds (Veslind, 2001).

An obvious area for faculty growth is in teaching (Felder et al., 2011; McCrickerd, 2012; Wankat, 2002). Many professors are acquainted only with a non-interactive lecture style of teaching. Better teachers know instinctively what works, but usually do not know why and cannot explain how someone else can improve. For good teachers a very modest amount of study can have a major impact on their understanding of the teaching process, since they already have a rudimentary knowledge structure and are usually motivated to do better. However, major changes such as switching from lectures to active learning usually require support. Support is very helpful in overcoming fear, a major reason professors do not innovate more (McCrickerd, 2012). Poor teachers need to attend a teaching workshop (see Chapter 1). Then they need to experiment, receive feedback and encouragement, and try again. Of course, poor teachers must also have the motivation to improve. Boice (2000) found that new faculty wanted more help with teaching, and he observed that formal teaching development programs worked if new faculty enrolled in them.

In engineering, ASEE Prism is the most accessible source of teaching information on a monthly basis. The annual meeting of ASEE and the Frontiers in Education Conference cosponsored by ASEE and IEEE are good choices for workshops, symposia, and personal contact. Most universities have in-house teaching improvement programs, which can be useful for the knowledge and skills learned, and for the opportunity to meet other professors who are vitally interested in teaching. There may also be for-credit courses with titles such as “Educational Psychology for College Teachers.”

Even if there are no courses, good teachers can be talked to and observed. One possibility is to work with a mentor (Felder, 1993; Gibbons, 1992), either on campus or while on sabbatical. A word of caution when you observe any professor: Many teachers are good teachers because they have major strengths in the second dimension of good teaching—rapport. The performance (lecture) ability of these professors may just be adequate, but the students respond to the rapport. Thus you must watch much more than just lectures. A formal mentoring program that assigns new professors to teach recitation sections and expects them to attend lectures is also useful. It involves an assistant professor closely with an experienced teacher and encourages informal discussions on teaching methods. In addition, since it is a rare professor who does not prepare for class when he or she knows a colleague will be present, the lectures will be well done.
Another approach is to become a student again and do all the work required to earn a grade (Culver, 2014; Wankat, 2003). As a student, professors will remember what it is like to learn new material from someone who knows more than they do, and the importance of encouragement will become very clear. Students also are users of the technology, which is very different than assigning students to use that technology, and as a student the professor will experience being dependent on the technology to succeed (Culver, 2014). Finally, while acting as a student faculty can learn more about student culture and probe into what students consider to be cheating.

Once you see, read, or hear about something you think will work for you, try it on a small scale. Students usually interpret small-scale changes and experiments as non-threatening, and they respond favorably. Large-scale changes in teaching are often seen by students as threatening (see Section 7.12).

A second major problem teachers have is content boredom. This is somewhat ironic since many professors are professors because they love the discipline, but anyone can become bored with teaching the same material semester after semester. Professors who teach because they love students are much less likely to suffer from boredom since the students change every semester. There are several obvious solutions when content boredom sets in, but they require extra work.

- Teach a new course.
- Team-teach, particularly a multidisciplinary course.
- Teach outside your discipline. Examples include teaching mathematics or physics or another area of engineering.
- Write a textbook.
- Develop courseware.
- Teach the same content with a radically different teaching method.

The university can help a faculty member develop skill in teaching. Paying for trips to ASEE meetings sends a not-so-subtle message that these meetings are as important as technical society meetings. Modest engineering-wide grants awarded competitively can help professors develop innovative teaching methods. Sabbaticals can be granted for teaching as well as for research reasons. Departments can organize mentoring programs, luncheons to discuss teaching, workshops and seminars. Teaching awards are nice but are most effective if made as a salary increase so that faculty benefit from them year after year.

Faculty members also need to consider development in research. New faculty will benefit from mentoring in being a research advisor. Research in the same area year after year can also become routine. To get past the routine and develop new ideas, a professor can start a totally new research area, though this is very time-consuming and is often easiest to do while on sabbatical. Perhaps one can ease into a new area by joining an interdisciplinary research team. Somewhat less drastic steps to invigorate a research program include going to different research conferences, auditing a graduate-level course in a new area, writing a critical review or research monograph, serving as an NSF program director on a rotating assignment, and integrating research and teaching by teaching a graduate-level seminar.

Faculty may also want to have a long-term development plan in engineering practice. For young faculty with no, or very little, practical engineering experience, summer jobs in industry can be helpful. Since the common wisdom is that this should not be done until tenure has been obtained, this is another case where tenure skews the educational system. Industrial sabbaticals can be useful, particularly in research areas where industry is at the forefront.
Consulting is also helpful, although the contact is usually too short to get a complete industrial flavor. To a lesser extent, working with other engineers through professional societies can be useful.

Finally, some professors may want to include service or administration in their development plans. One of the duties of faculty is to do their fair share in faculty governance (see Section 17.6). The faculty member may decide to do this by becoming involved in the university senate, the faculty union, the American Association of University Professors (AAUP), or heavy university committee duties. An alternative is administrative duties such as assistant department chair, department chair, or assistant dean (Greene and Van Kuren, 1995; Buller, 2012; Chu, 2012). A few universities actually train professors for these positions, but in the absence of a formal training program the professor can talk to professors who have held these positions in the past, read a few books, and perhaps find a suitable workshop.

A fully functioning department needs faculty who are interested in all areas of research, teaching, engineering practice, service, and administration. Felder (1994) calls this “the myth of the superhuman professor.” Very few professors can be good in all areas simultaneously. Departments need professors who specialize in one or two areas. The current problem and challenge for the future is that research receives many more rewards than the others. A department can find itself with few professors interested in students, service, engineering practice, or administration. The results can include student revolts, a breakdown in service and a lack of curriculum development, difficulty at accreditation time, and a lack of leadership. Balance is needed but is difficult to maintain for long periods.

**17.6. PROFESSIONAL ETHICS**

The privileges of academic freedom, the latitude given to professors to choose research areas, and the security of tenure must be balanced with self-policed ethical behavior. Engineering professors have fewer constraints than their industrial counterparts and fewer external agencies watching their behavior than medical doctors or lawyers, so ethical behavior must be self-directed. Since ethical behavior must come from within, it is useful to study codes of ethics and to reflect on the applications of these codes. Henninger (1991) has a useful list of older references on academic ethics.

Some behavior, upon reflection, will clearly be seen as unethical. Other behavior falls into grey areas where it is arguable whether it is ethical or not. The professor may decide to avoid this behavior so that there is no question of impropriety. Alternatively, she or he may decide that the behavior is ethical, but to avoid the appearance of unethical behavior will inform the proper administrative authorities in advance. An example of a grey area involves a professor who commercializes the results of university research by starting a high-technology company. Since large amounts of money may be involved, some people will question the ethics of almost any arrangement.

A general code of ethics for engineers was introduced and discussed in Table 12-1. Naturally, this code applies to engineering professors as well as other engineers. The ramifications of any ethical code for an individual are often not clear until particular cases are discussed in detail. For example, does teaching when one is not a competent teacher violate Canon 2 (“Engineers shall perform services only in areas of their competence.”)?
The engineers’ code of ethics was not written with the requirements of engineering professors in mind. The professorial aspects of the engineering professor’s position are more closely related to the statement of professional ethics made by the AAUP summarized in Table 17-6 (AAUP, 2014). Engineering professors should adhere to both the engineering code of ethics and to the AAUP statement.

There are many ramifications of the AAUP statement of ethics. A complete enumeration is obviously impossible, and each case must be looked at individually. As an example, a few of the ramifications of each paragraph of the AAUP statement are delineated below.

1. Intellectual honesty obviously requires that research data be reported accurately. Falsification of data is unethical and illegal. Data which may be questionable can be reported, but all questions about the data must be fully discussed. Prior work must be acknowledged (see also item 3).

2. Exploitation of students includes the sexual exploitation of students. It is obviously unethical to exchange grades for sexual favors. Dating a student can inadvertently lead to ethical problems. It is better to wait until the person is a former student to begin a romantic relationship.

   A grey area of the ethical code involves the ethics of requiring students to purchase your textbook for a course. Authors are probably incapable of objectively determining that their book is not the best. One solution to this problem is to donate the royalty income from your students to the university.

3. Professors should not let personal differences cloud professional evaluations of the work of colleagues. Accepting a share of institutional governance requires that the professor do his or her fair share of committee duties. This may also mean that the professor should accept her or his turn as a member of the faculty senate or as the departmental chair.
4. Professors should observe the regulations of the institution as long as they do not compromise academic freedom. (The AAUP is very clear that academic freedom is a higher value than following the institution’s regulations. Your institution probably sees this issue differently.) The professor may constructively criticize and try to change institutional regulations. However, we interpret this as meaning that trying to punish the institution would be unethical. Thus, a professor could ethically sue her or his university, but collecting punitive damages may well be unethical. If there is a conflict between outside work such as consulting and university duties, the university duties should be considered more important.

5. The professor has all the rights and obligations of a citizen. This can be interpreted to mean that outside her or his subject area the professor has no special privilege of academic freedom beyond those of every citizen.

Intellectual honesty and responsibility in research has become a topic of national importance, and the federal government through the US Department of Health and Human Services has established a number of policies. The Office of Research Integrity (ORI; http://ori.hhs.gov/) has a number of misconduct case studies and access to policies and regulations (all written in legal terms). “Research misconduct means fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results” (PHS, 2005, p. 28386). The ORI system depends on complainants (aka whistle blowers) making good faith charges of misconduct. This is both a strength since complainants often have access to the specialized knowledge necessary to realize that misconduct has occurred, but also a weakness since many researchers believe that whistle blowers are at risk of reprisals, even though reprisals are illegal.

The rules on monetary conflicts of interest have been tightened up and the minimum threshold for reporting has been reduced to $5,000 (NIH, 2011).

In actual practice professors have been very reluctant to accuse others formally of unethical scholarship, cheating on research results, or conflicts of interest. Such allegations can become very time-consuming, and it is widely perceived that whistle blowers often receive reprisals in some form. Clearly informing all students doing research of the ethical standards they are expected to follow can help eliminate the need to report others.

It is useful to insert a healthy note of skepticism. “In all of this, however, we must be on guard against any group which seeks recognition as spokesman for ‘the profession,’ and then seeks to impose its narrow definition of engineering ethics on us all” (Florman, 1976, p. 31).

17.7. GUIDEPOSTS FOR ENGINEERING EDUCATION (HOUGEN’S PRINCIPLES)

Olaf Hougen was one of the pioneers in chemical engineering education. In a memoriam, Bird (1986) shared the principles that Hougen used to guide the development of the Department of Chemical Engineering at the University of Wisconsin. We repeat these principles here since we believe that many of them will prove to be useful guiding principles for all engineering educators. The quotations are from Bird (1986).

1. “The undergraduate program should be practical and conservative, whereas the graduate program should be imaginative and exploratory.” Undergraduate programs are
to a large extent training for industry and thus should prepare students for respon-
sible engineering jobs. Graduate research should move boldly into new areas.

2. “There should be a smooth flow of information from graduate research to graduate teach-
ing to undergraduate teaching.” Since the graduate program moves boldly into new areas,
it can serve as a testing ground for new material. Once this material has proved its worth,
it should be moved into the undergraduate program. This implies that professors are
involved in teaching at both the graduate and undergraduate levels, and in research.

3. “If you can’t find relevant problems to give the student, then you shouldn’t be teaching
the material to the students.” If there are no industrial problems currently or in the
future which can be solved with a method, then that material should not be part of
an engineering curriculum.

4. “Use the best available information from the modern sciences.” Engineering should be
based on scientific knowledge, and it should be up-to-date.

5. “Well-founded and well-tested empiricisms are to be preferred over theories that have
only a limited range of applicability.” Correlations should be scientifically based, and
found on extensive data. The data should be as comprehensive as possible since
graduates will hold responsible industrial positions.

6. “It is vital for engineers to know how to solve problems with limited and incomplete
data.” Complete data is a luxury that is often unavailable. Students must be well-
versed in estimation methods, particularly for physical properties.

7. “Students are impressionable and learn quickly, and therefore a professor must make
certain that he [or she] teaches in a responsible way.” Wild conjectures presented as
fact or unethical behavior have no place in teaching.

8. “It is important that the students have a good grounding in the basic fundamentals;
there’s nothing worse than a student who has a thin veneer of high-powered theory.”
The basic ideas need to be stressed. Both undergraduate and graduate students with
weak backgrounds should be encouraged to take remedial coursework.

9. “We must always recognize that our students and our teaching assistants are young
professionals.” The students and teaching assistants need the challenge and reward of
helping to develop the engineering profession.

10. “Faculty members have an obligation to assist colleagues in other institutions.”
Visitors, particularly those from other countries, should be treated with respect and
be provided with whatever information they need. In addition, faculty members
have a responsibility to prepare excellent textbooks.

11. “We have, as faculty members in a state-supported institution, a responsibility to serve
the taxpayers by performing our job well.” Even though resources might be limited,
the faculty needs to perform its assignments as well as possible.

12. “Do not show emotions of bitterness or beratement or belittlement; ascribe the best
motives to your associates; say nothing derogatory.” Florman (1987) points out that
there is a fine line between useful argument and divisiveness. We must believe that
all our associates have the best wishes of the university and the engineering disci-
pline at heart. Hougen’s is difficult advice to follow; however, if followed, it will lead
to a collegial atmosphere within a department.
17.8. CHAPTER COMMENTS

Many of the topics in this chapter are only indirectly related to teaching in the classroom, yet they can have a major impact on how well a professor teaches. Tenure and promotion are issues of vital interest to potential faculty members. The other topics in this chapter seem to be of more interest to older faculty. Ethical concerns don’t suddenly arise when one becomes a professor; courses at all levels should consider ethics (see Chapter 12). As is often the case, however, the topic is appended awkwardly to the end of a class, with the result that students don’t appreciate its relevance. Graduate students are no different in this regard; however, they do find case studies to be of considerable interest.

HOMEWORK

1. Make a list of ten advantages of tenure. Make a counter list of ten disadvantages. Develop an alternative to tenure which would retain many of the advantages but have fewer disadvantages.
2. Develop a plan for how you will get promoted to associate professor.
3. The h-index was defined in Section 17.3.3, and the h-index of Prof. A was calculated. Example B: Professor B has 35 papers and 500 citations. The top paper (#1) has 45 citations, paper #16 has 18 citations, paper #17 has 15 citations, and paper #35 has 0 citations. Prof. B has an h-index of 16. Does the h-index give a fair representation of which professor has had more impact through their research? Explain your reasoning.
4. Assume that you have just been appointed department chair. At your university the department chairs set raises within broad guidelines. However, the total dollar pool for raises is a fixed sum which averages to 4% of the total faculty salaries. Determine a scenario for how you will reward faculty. Consider the following faculty members:
   a. Professor R does research. He is nationally known and has a standing offer for a position from another university. His teaching ratings are abysmal.
   b. Professor T is a wonderful teacher, but he has not done research for ten years. He routinely alternates winning the best teacher award with Professor S.
   c. Professor E is a good teacher, does modest research, and serves the department whenever asked to do so.
   d. Professor A has a national reputation and is a member of the National Academy of Engineering. He is getting ready to retire in a year or two and is no longer doing research.
   e. Professor S is the chairman of the undergraduate curriculum committee, does all the departmental advising of undergraduates, is adviser to the student professional society, and is a good teacher. The students talk to him all the time, and he single-handedly prevented a revolt of the seniors in Prof. R’s class. He is not doing research.
   f. Professor D has been an associate professor for twenty years. He is the outstanding racquetball player on the faculty, but you cannot think of anything else outstanding about him. He is a member of the organizing committee for a proposed faculty union.
g. Professor N is a new assistant professor who has been with the department for one year. She seems to be off to a fast start in her career and already has one research grant.

5. Discuss the following scenarios. Is the professor’s behavior ethical?
   a. Professor B is single. She has started dating one of the graduate students at your university. Consider three cases: 1) The graduate student is not in Prof. B’s department, 2) The graduate student is in Prof. B’s department, but she is not his adviser and he is not taking any courses from her, 3) Professor B is the graduate student’s research adviser.
   b. Professor C is a highly sought-after consultant. He normally teaches Monday, Wednesday and Friday and is often gone on Tuesday or Thursday. He has the opportunity to make a great deal of money consulting for a new client, but would have to miss his Wednesday and Friday classes.
   c. Professor K is the department chair. He has allowed other professors in the department $1,000 for travel to professional meetings. So far this year Prof. K has spent $3,000 from departmental funds for travel to professional meetings himself.

REFERENCES


