TIPS FOR BUSY NEW PROFESSORS

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New faculty are often surprised how busy they have become setting up a research program, writing papers and proposals, teaching and learning to teach, prioritizing competing tasks, and understanding a new work environment. The focus of the first part of the paper is balancing one's life while earning tenure and promotion. After discussing the promotion and tenure (P&T) procedures at research and undergraduate institutions, time management techniques are presented for teaching, research, and service. Since more experienced professors also often have difficulty balancing myriad urgent tasks, they may also benefit from some of the suggestions.

PROMOTION AND TENURE

Assistant professors should start their careers by clarifying their vision and deciding what goals are important to them. Some of the goals that other people in this position have thought are important include: P&T, focus and time with a significant other, family (and a key question is when to have a baby?), starting a company, becoming rich or famous, running a marathon, or spending significant time playing golf, fishing, or reading. The assistant professors' major professors and the other professors at their new institutions will assume that P&T is the absolute number one priority. But it is not their life. Everyone should periodically spend some time deciding what is truly important.

Most people have multiple goals. For example, they want to become a respected member of the academic community and earn P&T, but they also want to have a life. Having a life means that additional goals are also important. To achieve multiple goals most people need to prioritize and balance. Some engineering professors have decided, after prioritizing, that a tenure-track position at a major research university was too all consuming and did not leave time for other important goals. Thus, they made the decision to be instructors (non-tenure track), go into industry, pursue another career, or quit and raise a family.

Assistant professors who decide that P&T is one of their important goals should obtain and study the written rules. The written rules will help them understand the procedure and timing. Although the written rules are normally followed (not following them invites a lawsuit), they are never the entire story. To fill out the details of the entire story assistant professors need to discuss the unwritten requirements with knowledgeable professors both inside and outside their department. Because unwritten rules can be interpreted differently, knowledgeable professors will disagree; however, one can usually triangulate closely enough to what will happen during the process to provide useful guidelines.

Typical P&T requirements differ for research universities and undergraduate institutions.[1-3] At research universities the number one requirement is ***Money!*** The goal is to raise at least enough money to support the professor's research. Once money is obtained quality publications in good journals are expected. Some of these publications should be with graduate students, some should be collaborations with other professors, and some can be sole author publications. The ultimate goal of the publications is **Impact** which is measured by looking at quality, citations, invitations to present plenary lectures and seminars at other institutions, and a general buzz that one is doing great research. It helps to have Ph.D. graduates accept academic positions. Since impact takes time, for promotion to associate professor in-

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stitutions look for the **Potential** for impact through research. At many research institutions good, but not great, teaching is a minimal requirement although great teaching may help for early or slightly marginal promotions. Usually the only measure used by research institutions to assess teaching is student evaluations. Good citizenship and service—typically being friendly and doing one's share of the menial work—is expected. Professors are rarely promoted for citizenship and service although lack of citizenship and service may block promotion.

At undergraduate institutions the number one priority for P&T is good to great **Teaching**. The goal is still **Impact**, but it is impact through graduates. Because teaching is more important, additional measures such as peer reviews and teaching portfolios may be used in addition to student evaluations to assess teaching. Advising, service, and citizenship are usually more important than at research institutions, and advising may be considered as another form of teaching. Most undergraduate institutions expect a modest amount of research, but most of the research will be done with undergraduates. Grants still need to be obtained to support the research, but the amount of money required is significantly less than at a research university.

Usually in research universities (computer engineering is an exception) archival journal publications are the gold standard and publications in proceedings are almost ignored. Determine which archival journals are most prestigious. The same tends to be true for research grants—in general, NSF and National Institutes of Health grants are prestigious. Once assistant professors have some idea of what their departments and institutions are looking for, they can develop activities that will satisfy promotion and tenure committees. Then spend time *every week* on at least one of these activities. Of course, at the same time they need to balance their lives, and being efficient can help them do this.

EFFICIENCY TIPS

Goals and Activities

One immutable fact of academic life is *there is never enough time*. This does not change after promotion. Because of this, most professors will benefit from better time management.[2-4] A good place to start is by setting goals and prioritizing. Goals are what one would like to accomplish in a given time frame. Unfortunately, most professors have multiple goals that compete for time. Multiple goals can either be worked on simultaneously or one can delay working on some goals until other goals have been achieved. For example, common advice for engineering assistant professors is to not write a book until they have been promoted. This is normally good advice, but the danger with waiting is one may never achieve some important goals. On the other hand, working on a number of goals simultaneously tends to dilute the effort on every goal and it is easy to become unfocused.

New assistant professors often find that a semester goal list and a six-year goal list (the usual time frame for promotion to associate professor) are useful. For example, the six-year goal list may include being promoted and taking a vacation in the Bahamas. Once the goal list is prepared, prioritize it. Prioritizing may show that the vacation in the Bahamas should be delayed until after promotion is received—and then it will serve as a reward.

Achievement of many goals such as being promoted depends on the decision of others. After triangulating the requirements for promotion at their schools, assistant professors need to determine activities that will help them achieve this and other goals. The analysis of the P&T process should have identified these activities. At research universities writing proposals and papers are appropriate activities for the goal of being promoted.

Efficiency Tools

A To-Do list delineates items that one hopes to accomplish in a given time frame. It is useful to have several To-Do lists such as semester, weekly, and daily To-Do lists. For assistant professors the semester and weekly lists typically include goals for the P&T committee, their own work goals (which hopefully will partially overlap with the goals for the P&T committee), and high-priority non-work goals such as exercising. The daily list, which is often on a desk calendar, will include the mundane tasks such as attending committee meetings and writing lectures plus one activity that will help achieve a long-term goal. If an item is not finished one day, it is moved to the next.

Another important efficiency tool is to learn how to delegate work. Professors often do menial tasks that could be done by a secretary or work-study student. There are other tasks such as helping to prepare proposals and submitting papers that graduate students can do and that will help prepare them for research positions when they graduate. When delegating, give clear assignments and delegate responsibility for the details. Check on progress and provide feedback on the final product, not on the details of how the work was accomplished. Finally, give credit for good work. A sincere thank you, acknowledgment in a paper, or flowers will be greatly appreciated, and they help later tasks go smoothly.

Learn to say no pleasantly. One very useful response is "Let me think about it." Even if one eventually says no, the appearance of due diligence is helpful. Another useful response, particularly with supervisors, is "What would you like me to stop doing to take on this task?" Since department heads are not always aware of what extra work a professor does, reminding them can be useful.

The 55-Hour Rule and Family

It is very easy to work too much. Maximum productivity occurs with a steady rate of about 55 hours of work per week with one day off per week. Everyone needs to have time for other parts of their lives.

Professors need to reserve time for themselves and their families ("family" broadly represents people who are important to the professor). Five 10-hour days plus 1/2 a day on the weekend with at most six work days per week will be close to maximum productivity and allows for significant family time. Balancing work and family is often a stress point, and all studies indicate that balancing is harder for women because society has expectations that women will do more care giving.[5] Most people also need some alone time to refresh their batteries. This can be as simple as driving or walking to work, or losing oneself in a computer game for an hour. Developing a flow activity in which one's brain is focused entirely on the activity (examples include golf, cooking, jogging, fishing, or wood working) also refreshes and recharges one's brain.[6] A nice way to engage in a flow activity is to take short vacations by leaving a day early for a conference and spending one day engaging in the flow activity.

TEACHING

Numerous studies[7] have shown that the following elements lead to student learning.

1. *Students involved in learning*
2. *Students actively processing material*
3. *Both students and faculty have positive expectations*
4. *Practice – reflection – feedback, and repeat*
5. *Student time on task*
6. *Challenged, yet successful students*
7. *Enthusiastic, engaging teacher.*

Note that this list implies that lecturing to a passive audience will not lead to optimum learning. *What the students do is much more important than what the instructor does.*

Lecturing

Straight lecturing with passive students is not the optimum teaching method. Lecture can, however, be a good method for transferring information (only mastery learning is clearly superior); thus, it is reasonable that lecturing be part of everyone's teaching arsenal. Because lecture is not a good method for teaching higher-order skills such as critical thinking, creativity, design, communication skills, and team skills, do not overdo it.[3, 4, 8] Lecture has a number of advantages for new faculty. New professors are familiar with the lecture mode of teaching because they were probably taught that way. Departments and students usually expect that new faculty will lecture as their primary teaching method. In addition, lecturing does not require preparing far in advance. Lectures can be prepared a day or even a few hours before the class, and it is easy to adjust lectures if the class moves ahead or behind the course schedule.

One key to a good lecture is to be sure that the students are not passive for long periods. Remember that the average attention span of undergraduates sitting passively in lecture (10 to 15 minutes) puts a constraint on lectures. If the instructor keeps talking past students' attention spans he/she will lose them for a few minutes. As the passive lecture continues, attention spans tend to decrease. To combat this, use **mini-lectures** with active learning **breaks**. The 10- to 15-minute mini-lecture is organized in a straightforward manner. Start with a short (30 seconds to one minute) *opener* that connects with previous work.

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Then the *main body* of the mini-lecture explains the critical information. This is followed with a *brief summary* that also connects to the next step.

Breaks are used in between mini-lectures to provide time for the students to be active (or occasionally reflective). Breaks could be used for student introductions, small group discussions, stretch/restroom, one-minute quiz, demonstration, catch up on note-taking and share notes with a neighbor, quiz, reflection, and so-forth. The breaks should connect to the course objectives although an occasional break for fun is OK. Most breaks have to be prepared for in advance, although there are a few break methods such as brainstorming that can be used with little preparation. Active breaks will energize the class and provide enough student focus for another 10 to 15 minutes of mini-lecture. Initially students will be hesitant to start an activity. They have to be trained to talk to each other! But once they start they will not want to stop—it helps to have a signal such as a bell or flashing the room lights that the break is over. In order to have time for breaks the instructor must control *content tyranny*, which is letting the need to cover content control the teaching method. Relaxing in class and acting human is more important than covering everything.

New professors often believe they need a long chunk of uninterrupted time to prepare lectures. Then when they find that long chunks of uninterrupted time are very rare, they do not know how to proceed. A more efficient and effective approach is to build a lecture like a house. Houses are built by starting with the foundation, frame, outer walls, and roof first, then finishing touches are done room by room. It is also

not unusual to move into a house before many of the finishing touches are finished. Houses and lectures are not built in one day. Start building a lecture with 10 to 15 minutes on the foundation and frame, and finish later. If "later" turns out to be after the lecture, instead of apologizing for the lack of preparation, lecture from the detailed outline. Most new professors are pleasantly surprised with how well this lecture is received. Most new professors spend *too much time* preparing lectures. They need to force themselves to learn how to prepare a new lecture—assuming they already *know* the material—in a maximum of two hours for a 50-minute lecture. Since controlling content tyranny starts at the preparation stage, also resist the urge to add those additional details that were just discovered last week.

Active Learning

Because it is what students do that leads to learning, teaching methods that force students to be active are often very effective.[9] In small classes students can be asked to solve problems at the board, and then selected students can explain their solution to the class. In classes of any size *cooperative groups* can be formed in which students work together to learn the material.[4, 9-10] Successful use of long-term cooperative groups requires that individual group members can only be successful if the entire group is successful, but at the same time each member is held individually responsible for learning the material. Thus, there must be some type of individual assessment such as quizzes. Project- and problem-based learning (PBL) are similar group methods except in project-based learning (commonly used in capstone design classes) students integrate what they have learned in previous courses to complete a project while in PBL new material must be used to solve the problem.[3, 9, 11] PBL can be difficult for less mature students particularly if there is not considerable tutorial support. The professor needs to have some skill as a facilitator if any groups become dysfunctional or student learning will be impaired.

Both hands-on and computer simulation laboratories require students to be actively involved in the process. Although a certain amount of cookbook instruction may be required initially, student learning is enhanced if they can ask and attempt "what-if" questions and learn by exploring. *Mastery learning*[4] takes the usual college formula for learning (time is fixed and the amount learned is variable) and reverses it by giving students opportunities to master the material with no or modest time constraints. For example, in a computer simulation lab we use a two-hour time limit for a mastery quiz that some students finish in 20 minutes. The students complete the quiz, have it scored, and are told what is wrong but not why it is wrong. They then return to their computer to fix their errors. This process is continued until they either have the quiz perfect with no penalty for repeated trials, or they run out of time. Over 95% successfully complete the quiz. Mastery learning is an excellent approach to bring students up to minimal standards on a critical skill.

Since these methods are unfamiliar to most professors and they, like lecture, can fail, professors trying the methods for the first time should obtain assistance. Either find a professor locally who has successfully used the method or attend a teaching workshop that provides hands-on experience with the method. It is often a good idea to start slowly and use the method for only parts of a course. For example, it is relatively easy to start using informal groups during break periods in a lecture class. Since groups are together for only a short period and student grades do not depend upon the group work, dysfunctional groups are rarely a problem.

A Baker's Dozen Useful Teaching Tips[2, 3, 8, 9]

1. *Write and share course objectives. Students are more likely to learn what the instructor wants them to if they know what that is.*
2. *Come to class early and stay late. Before or after class is the easiest time for students to talk to the professor and many students will never come to office hours. Before and after class is the most efficient time for the professor. In addition, coming to class early sends the subtle psychological message that the professor wants to be there.*
3. *Solve tests, quizzes, and homework before handing them out. If problems are not solved in advance sooner or later one of the problems will be unsolvable, and fair grading becomes very difficult if not impossible.*
4. *Make sure there is enough time available for tests. Students typically take 3 to 5 times longer than the professor to solve problems.*
5. *Allow students to request test regrades, but require that requests be in writing on a separate sheet of paper that is attached to their test. Occasionally a student who uses an unusual but correct solution method will make a simple algebraic or arithmetic error. In the rush of grading a large number of tests it is easy to overlook that the method was essentially correct and give too low a score. Allowing regrades provides redress. The requirement of written regrades reduces the amount of trivial requests.*
6. *If teaching assistants are used, train them. Go over a number of test problems and show how to grade them. Discuss the best way to tutor students. Explain how to operate a laboratory, computer, or recitation section. Discuss proper interactions with undergraduates.*
7. *After the first test, ask the students what will help them learn and make some of the changes suggested. I find that 3×5 cards turned in anonymously are useful for this.*
8. *List office hours and* be available *during office hours. Tell students that other times can be arranged by appointment.*
9. *Lecture less! Use active-learning methods.*
10. *Learn the students' names. This will increase rapport and reduce the amount of cheating.*

11. *Use an absolute grading scale* (e.g., *90 and above is an A) as a guarantee of grades, but give yourself the right to lower the cut-off points.*

12. *Attend at least one teaching workshop. The ASEE National Effective Teaching Institute (NETI), which is held immediately before the ASEE annual meeting, is highly recommended. Use of a modest amount of an assistant professor's start-up package to attend a teaching workshop will pay handsome* research *dividends because he/she will do a better job teaching in less time. This will provide more time and energy to start research.*

13. *Remember:* what students do is more important than what the instructor does.

RESEARCH

Research changes when one becomes a professor.[2, 3, 12] Less time will be available to actually do research; instead, professors become managers and funders of research groups. Obtaining money through grants and contracts becomes a major responsibility. In many engineering departments if a professor has no money there will be no graduate students. Budgeting is also a major responsibility. Careful budgeting and use of start-up money can greatly increase the amount of research that can be accomplished.

Money and Proposals[13]

How much money is needed to support an active engineering research program? Assume a professor at a research university plans to average one Ph.D./year at steady state and that the average time for a Ph.D. to graduate is between four and five years. In addition, assume that this professor will graduate one terminal M.S. every two years. At major research universities this group of five to six students is of moderate size. Depending on the type of research done and the stipend paid to graduate students, the current cost of one graduate student including tuition, equipment, supplies, and overhead will be in the range from $40,000 to $100,000 per year. For certain types of research these estimates are low. Plus at most schools professors need to raise money for two to three months of summer salary plus from 5 to 15 % of academic year salary, and they have to pay overhead on these amounts. The estimated total is between $250,000 to $600,000/year. In order to raise this much money every year professors need to become proficient at writing successful proposals. Attending a proposal writing workshop will probably pay dividends.

Unfortunately, obtaining funding is a challenge. Approximately 60% of science and engineering support is from federal agencies. The typical success rate is 10 to 15% in the engineering directorate, about 15% for NSF CAREER proposals and about 15% for NIH R01 for new faculty. In order to survive with these low percentages, many new faculty will submit close to 10 proposals/year. Of course, many of these proposals are revisions of previous unsuccessful proposals, with revisions following the advice of the reviewers.

For NSF and similar government proposals do not give the panel obvious reasons to decline your proposal. First, follow the proposal preparation rules. If the limit on number of pages of text is 15 with 11-point font do not try to turn in 20 pages and do not try to turn in 15 pages with 10-point font. Failure to follow the rules will usually disqualify the proposal. If the page limit is 15 pages, use very close to the full 15 pages. A 10-page proposal looks like the proposer does not have enough ideas. Complaining or whining about the lack of university support or how difficult it has been to obtain research funds will not endear oneself to the reviewers. Proofread the proposal carefully. Reviewers tend to think that writers of sloppy proposals will do sloppy research. Since there is always prior research, cite the work of other researchers in a positive fashion. The presentation of research needs to balance the broad picture with details. Most of the members of the review panel will not be expert in the research details. Thus, the proposal needs to explain the importance of the research. There will probably be at least one expert in the research area on the panel, however, and the opinion of this expert will be given a lot of weight by the other panelists. Thus, the proposal should provide sufficient research details to convince the expert that the proposer understands the research area, has chosen an important problem to work on, and has a clear approach to solve the problem.

Although the research part of NSF CAREER proposals is the most important part, the final decision of who receives a grant is often made based on the teaching part of the CAREER proposal. This apparent paradox occurs because there is usually too little money to fund all of the proposals with excellent research. Thus, the teaching part of the proposal often becomes the tie-breaker. Because of this, the teaching part must be prepared as carefully as the research part. There must be a literature review with appropriate references for both the content and the proposed pedagogy (*e.g.*, refer to the books in the References and to appropriate articles in *Chemical Engineering Education* and the *Journal of Engineering Education*). CAREER proposals typically include new course development and involving undergraduates in research; however, chances of receiving funding increase when a creative idea is included. The teaching part of the proposal is much more believable if the proposer documents long-standing interest in teaching and in training undergraduate researchers. In addition, reviewers like proposals that include plausible efforts to increase diversity and do K-12 outreach. NSF also requires evaluation and dissemination of results. Thus, the teaching part should include an educational research project.

There are strategies to learn quickly what the funding agencies want. Ask successful professors in your department to share the narrative portion of successful proposals with you. Collaborate with a more experienced professor and help develop a proposal as co-PI. Attend the NSF sessions at AIChE meetings and make a point to talk individually with the program directors. Contact the appropriate program direc-

tor and volunteer to serve on a review panel for a proposal round that you do not intend to submit a proposal to. Watch the reactions of the panelists and the program director to different proposals and see which ones are funded. E-mail the program director a short description of the proposed research and a list of specific questions, or take a few minutes at a review panel to discuss proposal ideas with the program director. Surprisingly, advice to not submit (you will have to interpret the program director's lack of enthusiasm as a no) is just as valuable as advice to submit.

Effective Research

Running a research program and directing graduate students is quite different from doing research as a graduate student. The assistant professor must develop and fund research. Although it is common for assistant professors to stay in the same general area as their Ph.D./postdoctoral research and to finish some promising ideas from that research, P&T committees like new professors to go beyond this area. A balanced portfolio of initial research projects will have one or two projects that continue Ph.D./post-doc research, one or two new projects within the same research field and, if interested, one or two projects in a new research field. The portfolio can also balance high-risk with low-risk projects and balance slow publication/high-impact articles with fast publication/low-impact articles, although the impact of articles can be a surprise. Because of the time it takes to start a research program, assistant professors should not expect their graduate students to produce all the publications needed for promotion. Research papers need to be written with graduate students, in collaboration with another professor, and alone.

Students doing research are engaged in a type of experiential learning with their advisor as the teacher/guide. The pedagogical goal is to provide enough assistance to help students avoid costly errors, but to allow them enough freedom to discover how to conduct research. Unfortunately, there is a built-in conflict of interest since professors want to obtain research results as quickly as possible, but still need to allow students enough freedom to make mistakes, grow, and become independent researchers. Ph.D. students should not be treated as highly competent technicians who are expected to do what they are told. Keep the welfare of each graduate student paramount. Since different students have different needs, the amount of direction and help provided to hone their skills will be different and should decrease as students mature as researchers. The goal is to help the students achieve their career goals, not to produce clones unless that is the student's career goal.

Once the research reaches a certain state, research papers need to be written. Writing is the hardest part for most graduate students and many new professors.[3, 14] As noted in the discussion on preparing lectures, long periods of uninterrupted time are unlikely to appear. Fortunately, long uninterrupted periods of time are not needed to write. The key is to write several times every week and if possible every day.

A scheduled 30-minute writing/editing period every day will result in a completed paper much faster than waiting for that elusive block of free time. Although it is tempting to perfect each sentence before proceeding, most professors (there clearly are exceptions) will produce a high-quality paper faster if they write the first draft as quickly as they can and then edit.

Co-authoring papers is part of the education of graduate students. It is a truly rare graduate student who knows how to write a research paper. Even students with an excellent command of English will have difficulty properly structuring a research paper. Thus, the professor needs to provide sufficient scaffolding in the form of example papers, step-by-step critiques of several outlines and word-by-word critiques of several drafts of the paper. The first paper that a graduate student "writes" will take the professor more time than if the professor had written it alone. Fortunately, there will be improvement and time spent on the first paper will be saved in later papers and in the student's thesis.

COLLEGIALITY AND SERVICE

Assistant professors are rarely promoted and tenured on the basis of collegiality and service, although the lack of collegiality and service may prevent promotion and tenure.[1, 3] Since schools are making roughly a 30-year commitment when a new professor is tenured, some expectation that the professor will be collegial and pleasant is reasonable. Be collegial—smile! Say hello to colleagues in the hall. Network roughly two hours per week with colleagues. An occasional lunch or coffee with colleagues can help them get to know you and make any charges of lack of collegiality harder to sustain. It is neither realistic nor necessary to like all of your colleagues, but polite social behavior is expected. If possible, assistant professors are advised to avoid controversy.

Assistant professors should aim to be considered a good contributor to the departmental service load without spending too much time on this service. This is true for both undergraduate institutions and research universities, although expectations for service are typically higher at the former. In other words, assistant professors should do their share within the department and engage in a reasonable number of the common duties that every department has to perform. These common duties include attending committee meetings, meeting with visitors, hosting alumni, helping to write and grade qualifying examinations, and so forth. Volunteer to be in charge of one task or committee. For example, being in charge of the departmental seminar program is useful for assistant professors since it is great opportunity to network with professors from other schools.

Most engineering programs are trying very hard to attract more women and underrepresented minorities to engineering. When women and underrepresented minorities are hired as assistant professors, there is a natural tendency to ask them

to serve on committees, advise undergraduate organizations, and help in recruiting. Unfortunately, the positive good of these roles is rarely reflected in the primary P&T requirements. A chat with the department chair may be very helpful in deciding how to respond to an invitation from the Dean or upper administrators. At a minimum the chat will make the chair aware of the extra service burden requested of women and underrepresented minorities. Since the decision of what extra duties to accept is ultimately up to the professor, it may be helpful to remember that upper administrators seldom vote on P&T decisions.

Finally, become involved in the profession. Join AIChE and ASEE and attend some regional and national meetings. Volunteering to serve on committees and co-chair symposia helps one to be known by other professors, which will make it easier to obtain letters of recommendation. Since presenting seminars at other universities is considered a sign of impact, leap at this opportunity.

CLOSURE

So far, we have focused on the challenges of being a new engineering professor without discussing the joys of being a professor. Being a professor is a job, but for people with the right skills and attitude it is the best job in the world. Working with students can be a joy. The growth of a student from fresh high school graduate to accomplished college graduate ready to start an engineering career is often amazing. And engineering professors make a significant contribution to that growth. Professors also have freedom to develop and conduct the research that they find interesting. They have the opportunity to help graduate students blossom into accomplished researchers who may eventually outstrip the accomplishments of their major professor. Despite the challenges and occasional disappointments, being an engineering professor remains one of the best occupations in the United States.

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