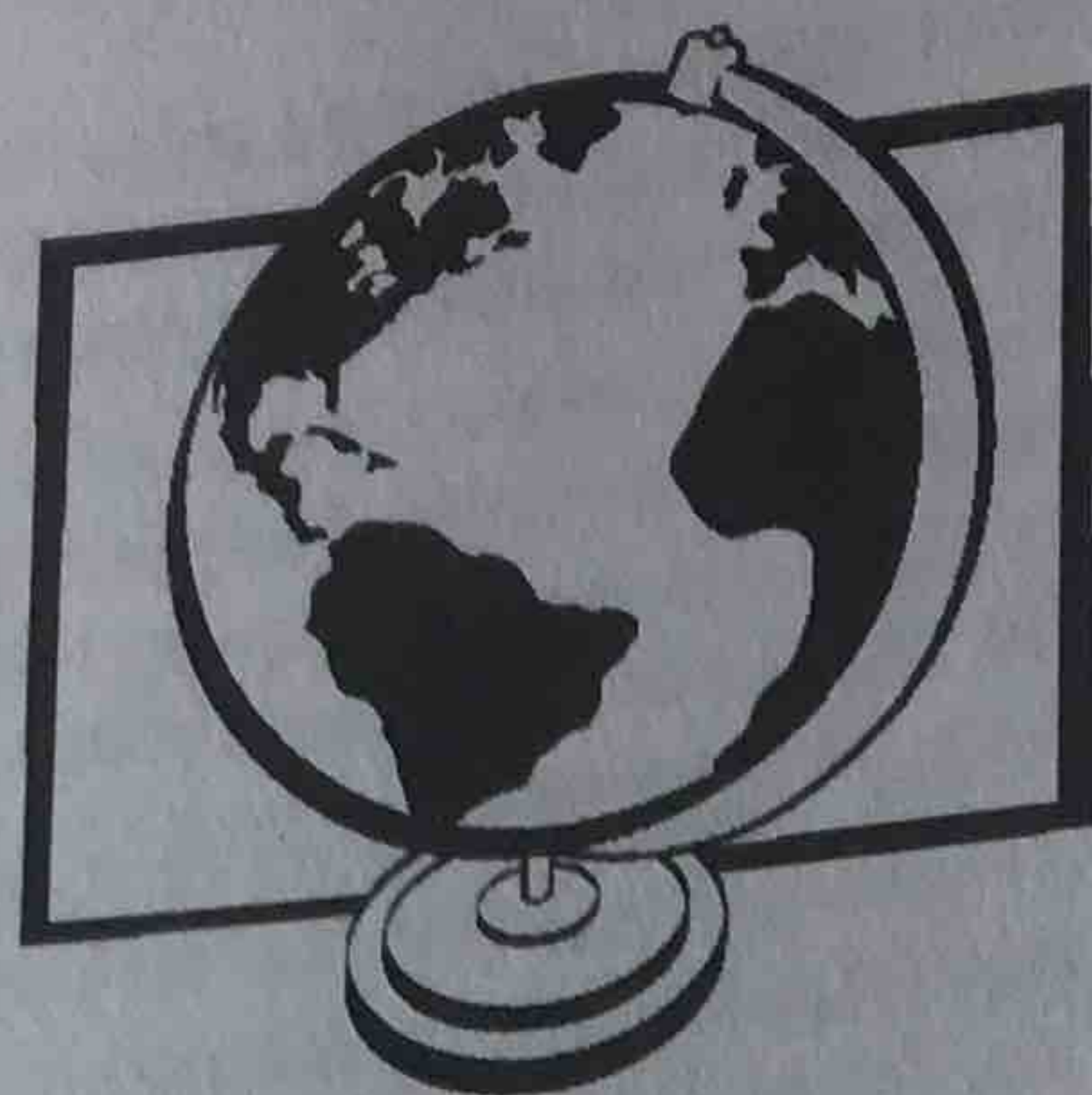




## CHAPTER 8

# Orientation to the Engineering Education System

*Destiny is not a matter of chance,  
it is a matter of choice.*

— William Jennings Bryan

### INTRODUCTION

The purpose of this chapter is to orient you to the engineering education system of which you are a part. If you are to take full advantage of your education, it is important that you understand how that educational system works. And there is an added bonus. As you better understand the engineering education system and make that system work for you, you will develop the ability to understand other systems you will encounter in the future, and you will gain the skills needed to make those systems work for you as well.

First, we will provide an overview of how engineering education is organized in the United States and how engineering programs are organized within colleges and universities.

Next, we will consider the important role community colleges play in engineering education. You may currently be a community college student, or you may have transferred from a community college to a four-year institution. Completing your first two years of engineering study at a community college can have distinct advantages. And even if the community college does not have a formal engineering program, you should be able to complete the majority of the lower-division engineering requirements there.

Then we will give you an overview of the engineering education system. To do this, we will use the criteria the Accreditation Board for Engineering and Technology (ABET) requires all engineering programs to meet. By understanding these criteria, you will gain insight into the key elements that comprise your engineering program: program educational objectives, student outcomes, continuous improvement, curriculum, faculty, students, facilities, and institutional support.

Next, we will examine important academic regulations, policies, and procedures in three areas: (1) academic performance, (2) enrollment, and (3) student rights. Knowing these

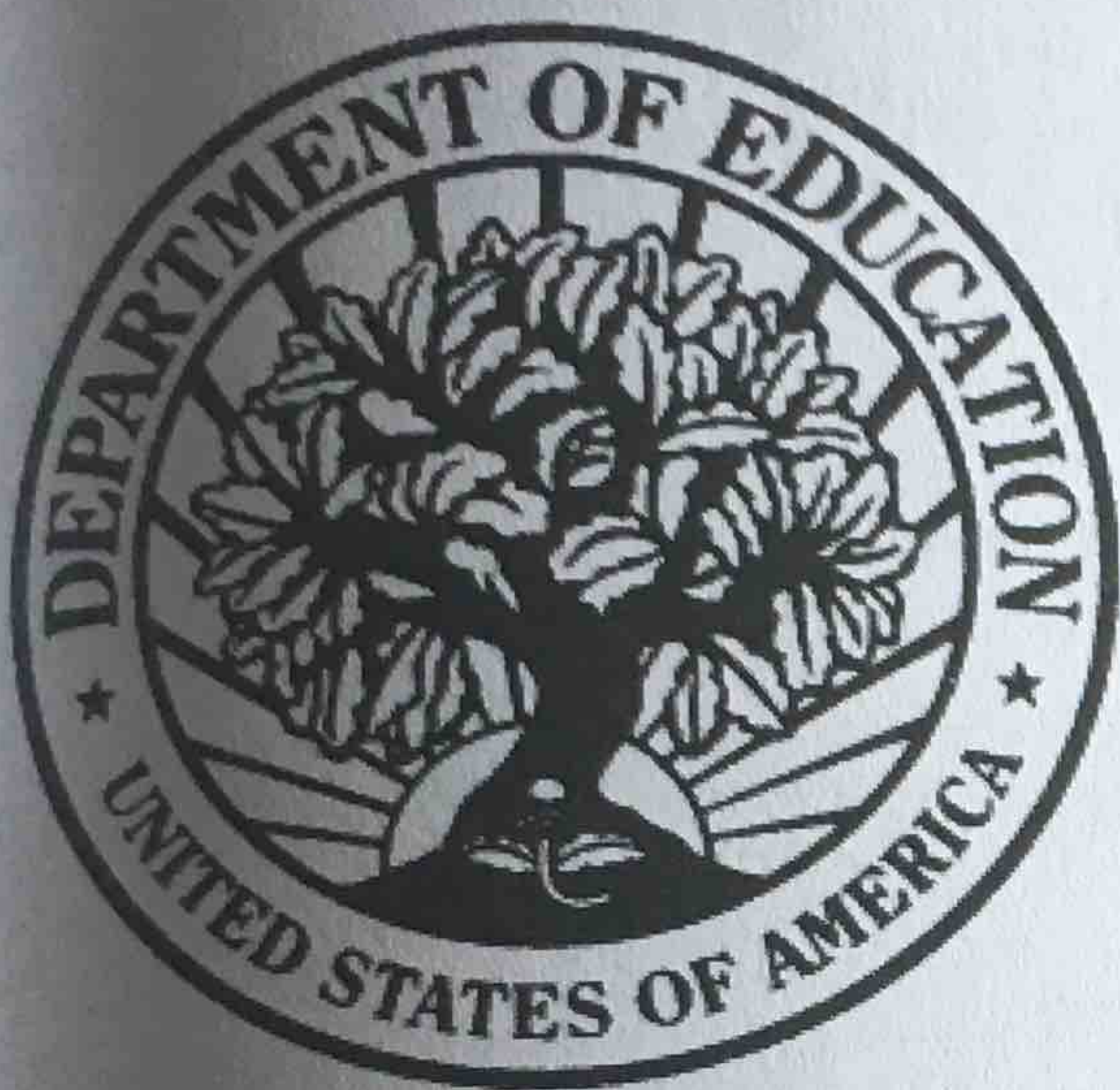
regulations, policies, and procedures at your institution will enable you to make optimal use of the educational system.

Finally, we will consider opportunities for education beyond the B.S. degree in engineering. The benefits of pursuing an M.S. or Ph.D. degree in engineering will be discussed. Among those benefits are the advanced technical knowledge you will derive from the additional coursework and the research skills you will gain by completing a thesis or dissertation under close supervision of a faculty advisor.

We will close by exploring opportunities for post-graduate study in business administration, law, and medicine – three areas outside of engineering that many engineering graduates pursue.

## 8.1 ORGANIZATION OF ENGINEERING EDUCATION

According to statistics compiled by the U.S. Department of Education [1], in 2011 more than 21 million students were enrolled in 4,599 colleges and universities in the United States. Sixty-two percent were full-time students, and 38 percent studied part-time. Eighty-six percent were enrolled in undergraduate study; 14 percent were engaged in graduate and professional study. Among the 4,599 colleges and universities are 1,729 two-year institutions, 678 public four-year institutions, and 2,192 private four-year institutions.



### OVERVIEW OF ENGINEERING EDUCATION IN THE U.S.

Of the 2,870 four-year colleges and universities (678 public and 2,192 private) in the U.S., only 389 (13.6 percent) offer one or more accredited engineering programs [2]. As we learned in Chapter 2 (Section 2.4), these 389 institutions offer a total of 1,885 accredited engineering programs – an average of 4.8 programs per institution. The number is not uniform, however. A few institutions offer as many as 15 different engineering programs, while others offer only one program.

Each of the nation's 1,885 accredited engineering programs is evaluated by the Accreditation Board for Engineering and Technology (ABET). Gaining ABET accreditation is extremely important. It is unlikely that any program could survive without being accredited.

To earn that accreditation, a program must meet high standards of quality for students, faculty, curriculum, administration, facilities, and institutional support and resources. Each program must also demonstrate that its graduates have acquired specific knowledge and skills; and each program must have a "continuous improvement" process in place to further develop and improve its quality. We will discuss the accreditation process in more detail in a later section.

### ORGANIZATION OF THE ENGINEERING UNIT

Each engineering program is administered by a department (e.g., Department of Industrial Engineering). Generally, a department administers only one engineering program, but it is not uncommon to find two or three programs administered by a single department (e.g., Department of Mechanical and Aerospace Engineering). At the head of each department is the department chair (or department head).

The engineering departments at most institutions are organized into a "school" or "college" of engineering, headed by the dean.

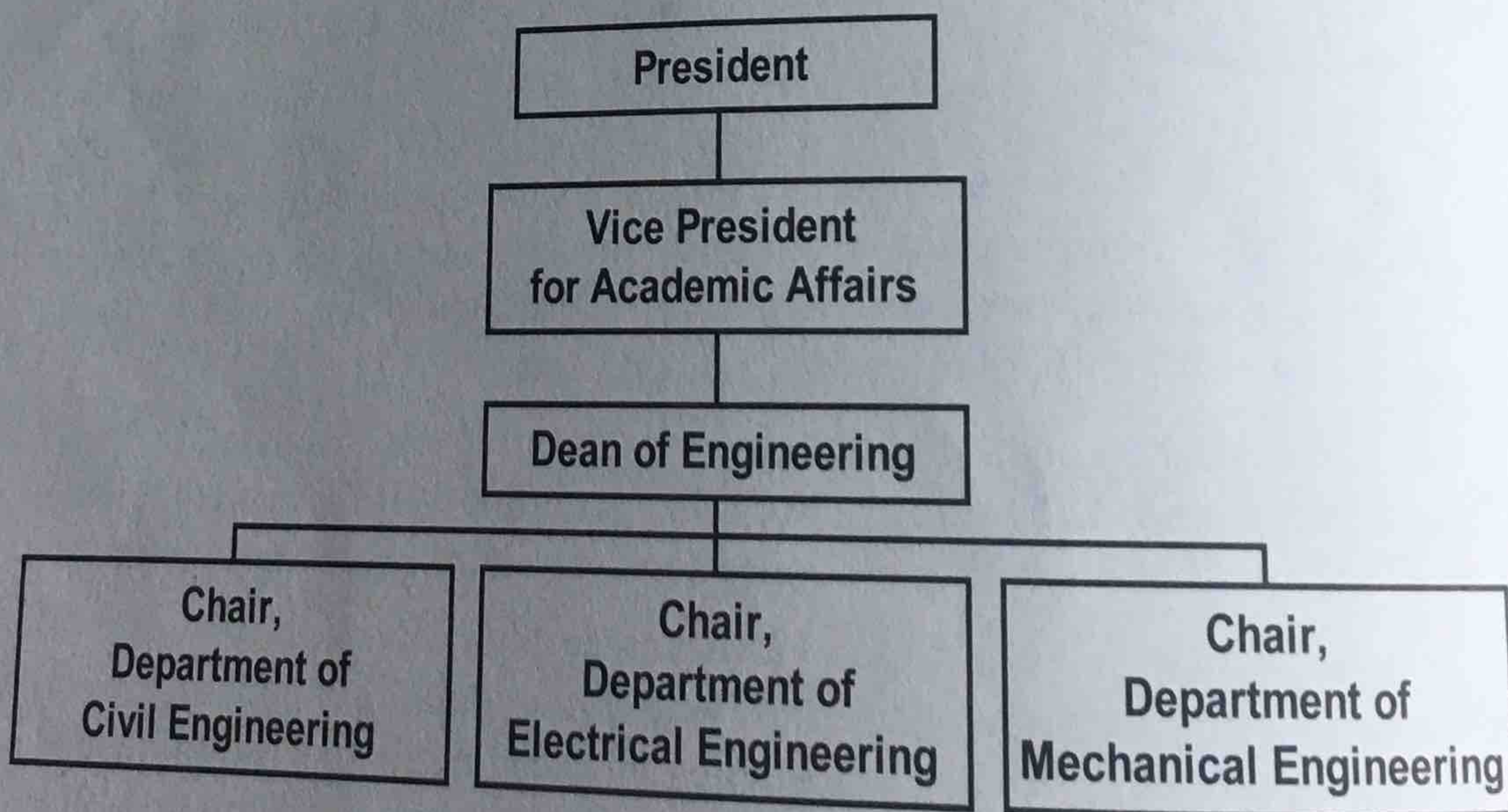
Non-engineering departments may also be part of the school or college in which the engineering departments reside. Computer science, engineering technology, and industrial technology are the three most common of these. Or the engineering departments and the computer science department could be organized into a College of Engineering and Computer Science. At some small institutions, the engineering programs may be combined administratively with the mathematics and science departments to form a College of Science and Engineering.

### **POSITION OF THE ENGINEERING UNIT WITHIN THE UNIVERSITY**

The engineering college is only one of several schools or colleges on a university campus. Other colleges typically include the College of Business, the College of Arts and Letters, the College of Natural Science, the College of Education, and the College of Health and Human Services. All of the colleges on a campus are organized into the "Academic Affairs" unit headed by the vice president or vice chancellor for academic affairs. (Often this person also carries the title of provost.)

The vice president or vice chancellor for academic affairs reports to the president or chancellor, who oversees the entire university. In addition to academic affairs, the president or chancellor is also responsible for such ancillary operations as fiscal management, facilities management, information resources management, student affairs, institutional advancement, and auxiliary services.

The organization of the academic side of the university from the president to the engineering department chairs, is shown below.



### **REFLECTION (FOR STUDENTS AT FOUR-YEAR INSTITUTIONS)**

Do you understand the academic organization of your institution? How many ABET-accredited engineering programs does your institution offer? Do you know your department chair? Who is your dean? Who is your vice president for academic affairs? Would it be beneficial for you to know those people and for them to know you? What could you do to bring that about?

## 8.2 THE ROLE OF COMMUNITY COLLEGES IN ENGINEERING EDUCATION

Community colleges comprise a major part of the nation's higher education system. As previously indicated, there are 1,729 community colleges in the U.S. Forty-two percent of the nation's 18.6 million undergraduate college students are enrolled in community colleges [1].



Community colleges are a very important part of the engineering education system. Many engineering graduates started their study at a community college and then transferred to a four-year institution to complete their B.S. degree. In fact, a recent study by the National Science Foundation [3] indicated that 40 percent of engineering graduates had attended a community college at some time.

Many community colleges offer lower-division engineering or pre-engineering programs that enable students to complete all of their lower-division requirements and then transfer to a four-year institution for their upper-division engineering coursework. Some community colleges offer Associate of Science (A.S.) degrees in engineering, but only a small fraction of engineering students complete the requirements for that degree. For example, in the 2009/10 academic year, only 2,508 A.S. degrees in engineering were awarded in the U.S. compared to 72,654 B.S. degrees in engineering [1].

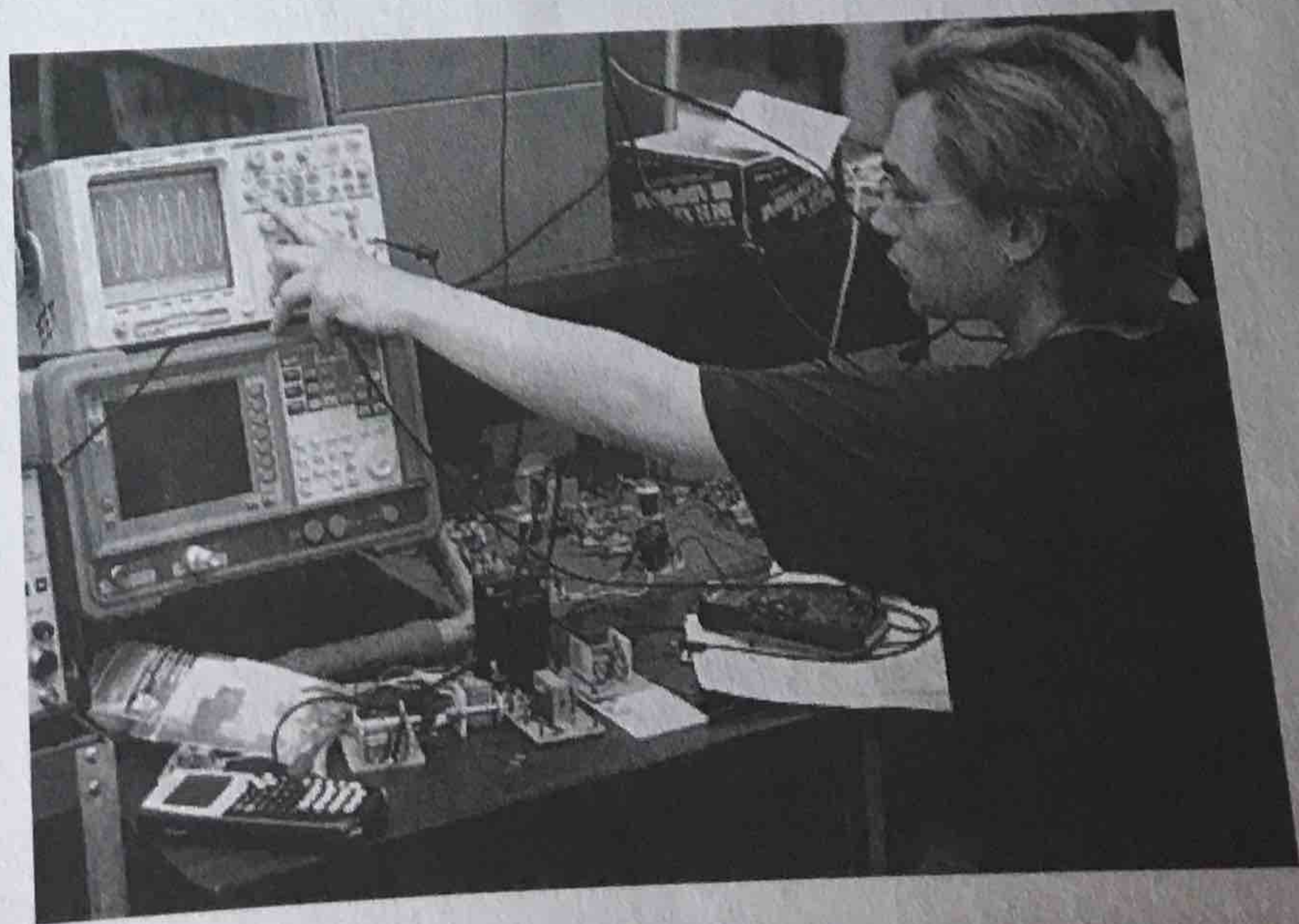
Where community colleges do not have formal engineering programs, students can still complete about 70 to 80 percent of the lower-division engineering requirements by taking the required calculus, chemistry, physics, and lower-division general education courses – courses offered by virtually all community colleges.

### ENGINEERING TECHNOLOGY

Community colleges also offer engineering technology programs. Engineering technology is a field closely related to engineering, but has a more practical focus. The difference is explained by Lawrence J. Wolf, former president of Oregon Institute of Technology [4]:

“Engineering technology draws upon the same body of knowledge as engineering but centers more heavily on the applications related to manufacturing, testing, construction, maintenance, field service, and marketing.”

Although the opportunity exists for engineering technology students to transfer to four-year institutions to pursue their B.S. degree in engineering technology, the majority of engineering technology students terminate their education with the A.S. degree. This is evidenced by the fact that 31,850 A.S. degrees in engineering technology were awarded in 2009/10 by both two-year and four-year institutions; whereas, only 16,075 B.S. degrees in engineering technology were awarded in the same year by four-year institutions [1].



Some A.S. and most B.S. degree programs in engineering technology are accredited by the Accreditation Board for Engineering and Technology (ABET). A listing of these programs by discipline, degree level, and state or region can be found on the ABET website at: [www.main.abet.org/aps/Accreditedprogramsearch.aspx](http://www.main.abet.org/aps/Accreditedprogramsearch.aspx).

An excellent source of information about engineering technology is Chapter 2, "The Field of Engineering Technology," from Stephen R. Cheshier's now out-of-print text *Studying Engineering Technology: A Blueprint for Success* [5]. Chapter 2 of that book has been updated and is available on the web at: [www.discovery-press.com/discovery-press/studyent/Chap2.pdf](http://www.discovery-press.com/discovery-press/studyent/Chap2.pdf).

### **ARTICULATION AND COURSE SELECTION**

Community colleges with formal engineering programs generally develop *articulation agreements* with four-year institutions in their geographic area. The articulation agreements guarantee students that specific courses taken at the community college will be transferable to the four-year institution. Articulation agreements can be on a course-by-course basis, or they can apply to the full lower-division program ("2+2" articulation agreements).

Where such articulation agreements exist, they can provide you with the road map you need to plan your lower-division coursework.

Particular attention should be provided to the selection of the general education courses (humanities, social sciences, communication skills) you take at your community college. The general education requirements for an engineering degree at a four-year institution may differ from those for other majors. Unless you are careful, you might find later that you have taken courses that will not be counted among the requirements for your B.S. degree in engineering.

**One additional point regarding general education courses.** You may receive advice or encouragement to complete most or all of your general education requirements at your community college. I suggest that you ignore this advice and save about one-half of your general education courses to balance your technical course load during your last two years of engineering study. By doing so you'll avoid the daunting task of having to take full loads of advanced-level engineering courses during your junior and senior years.

### **ADVANTAGES OF STARTING AT A COMMUNITY COLLEGE**

High school graduates have the choice of starting their engineering study at a community college or at a four-year institution. There are advantages and disadvantages associated with either choice. The choice usually depends on your high school record, financial situation, and personal needs. The following is a discussion of the advantages of starting at a community college.

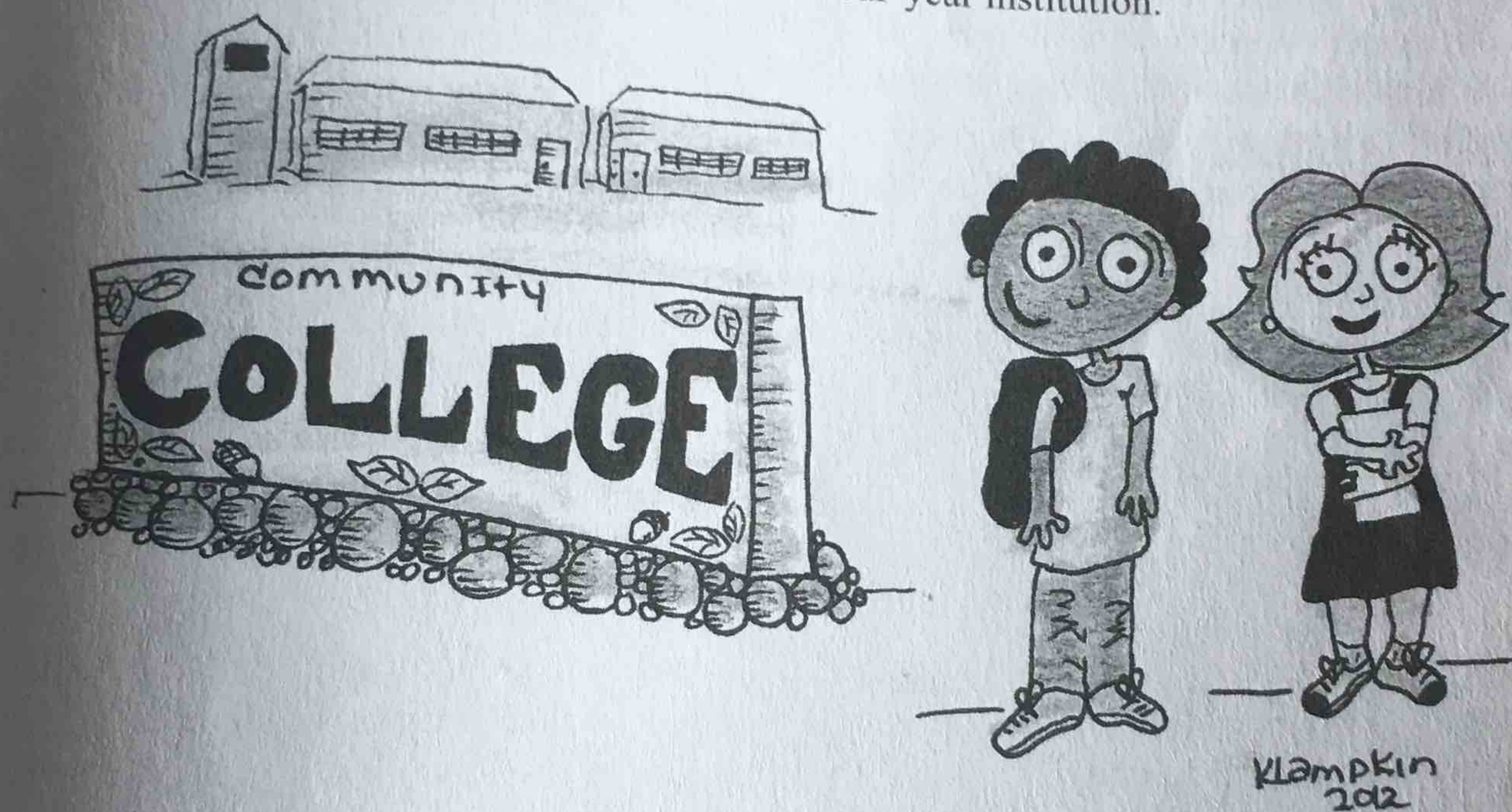
If your record from high school does not qualify you for admission to the four-year institution of your choice, by attending a community college you, in effect, get a second chance. By building a strong academic record at the community college, you will then be able to transfer to the four-year institution of your choice. If you need to bring your math, science, and English skills up to the university level, generally a greater range of developmental courses in these areas are available at a community college than at a four-year institution.



Your time at a community college could very well provide you with the luxury of taking courses designed to give you one or more marketable skills. Examples include computer-aided-drafting, surveying, webpage design, computer programming, machine tool operation, and electronic troubleshooting. The value of taking courses in such areas is that they provide you with skills that can help you find engineering-related jobs during your tenure as a student – skills that may also come in handy later during your engineering career.

Lower cost is another advantage of attending a community college. A student who lives at home can meet his or her community college educational expenses by working as little as ten to 15 hours per week.

Finally, the community college environment lies somewhere between the warm, friendly, small-school environment you experienced in high school and the less friendly, large-school college is a place that will provide you a more supportive learning environment in which to mature, grow, and develop before transferring to a four-year institution.



### APPLICABILITY OF THIS BOOK TO COMMUNITY COLLEGE STUDENTS

If you are a community college engineering major, you will find that the concepts put forth in this book will apply directly to your situation. The first two years of engineering study at a community college are similar in virtually all regards to the first two years of engineering study at a four-year institution.

There is one exception. Various co-curricular opportunities discussed in Chapter 7 – such as research projects, engineering student organizations, engineering student design projects, and study abroad programs – are generally more available to students at four-year institutions than at community colleges. However, involvement in such activities is more likely to occur during a student's junior and senior years, so you won't miss too much.

In any case, if you are a community college student, the sections in this book that apply primarily to four-year institutions should give you a useful preview of what you can expect when you transfer to one.

### REFLECTION (FOR COMMUNITY COLLEGE STUDENTS)

Are you committed to completing your lower division requirements at your community college and transferring to a four-year institution to complete your B.S. degree in engineering? Do you know what institution you plan to transfer to? Does your college have an engineering articulation agreement with that institution? Are you choosing courses based on that agreement? If you haven't decided on a university, what can you do to move closer to that decision?

## 8.3 THE ENGINEERING EDUCATION SYSTEM

The ABET accreditation process provides a useful framework for understanding the engineering education system. At least once every six years, a team comprised of practicing engineers and engineering educators representing the **Accreditation Board for Engineering and Technology** conducts a three-day visit to your institution to evaluate all aspects of your engineering program. The purpose of the evaluation is to ensure that the engineering program meets or exceeds specific criteria in the following eight areas discussed briefly below [6]. You can read the full criteria at: [www.discovery-press.com](http://www.discovery-press.com) (Click on "ABET Criteria").

**CRITERION 1 - STUDENTS.** This criterion addresses evaluation and monitoring of student progress, curricular and career advising, admission and transfer policies, awarding of transfer credit, and ensuring that graduates meet all graduation requirements.

**CRITERION 2 - PROGRAM EDUCATIONAL OBJECTIVES.** This criterion mandates that each program publish broad statements that describe what graduates are expected to attain within a few years of graduation.

**CRITERION 3 - STUDENT OUTCOMES.** This criterion requires each program to identify a set of student outcomes – i.e., what students are expected to know and be able to do by the time of graduation. In addition to the ABET a) – k) outcomes listed under the Attributes Model in Chapter 1 (See Page 23), programs are encouraged to articulate additional outcomes.

**CRITERION 4 - CONTINUOUS IMPROVEMENT.** This criterion mandates that each program have (1) a process in place for measuring whether program educational objectives and student outcomes are being attained and (2) using what is learned to continuously improve the program.

**CRITERION 5 - CURRICULUM.** This criterion specifies the curriculum must include one year (32 semester units) of mathematics and science, one-and-a-half years of engineering sciences and engineering design, a general education component, and a major culminating design experience.

**CRITERION 6 - FACULTY.** This criterion requires that faculty must be of sufficient number and have the competencies to cover all of the curricular areas of the program. Faculty must have appropriate qualifications and sufficient authority to ensure the proper guidance of the program.

**CRITERION 7 - FACILITIES.** This criterion mandates that adequate classrooms, offices, laboratories, and computing equipment and software be provided

**CRITERION 8. INSTITUTIONAL SUPPORT.** This criterion requires that adequate resources be provided for administrative and technical staff and faculty, for maintaining physical plant and infrastructure, and for acquiring and maintaining equipment. Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

In addition to the eight General Criteria, each program must satisfy applicable Program Criteria, which include additional requirements in the areas of curricular topics and faculty specific to the given discipline.

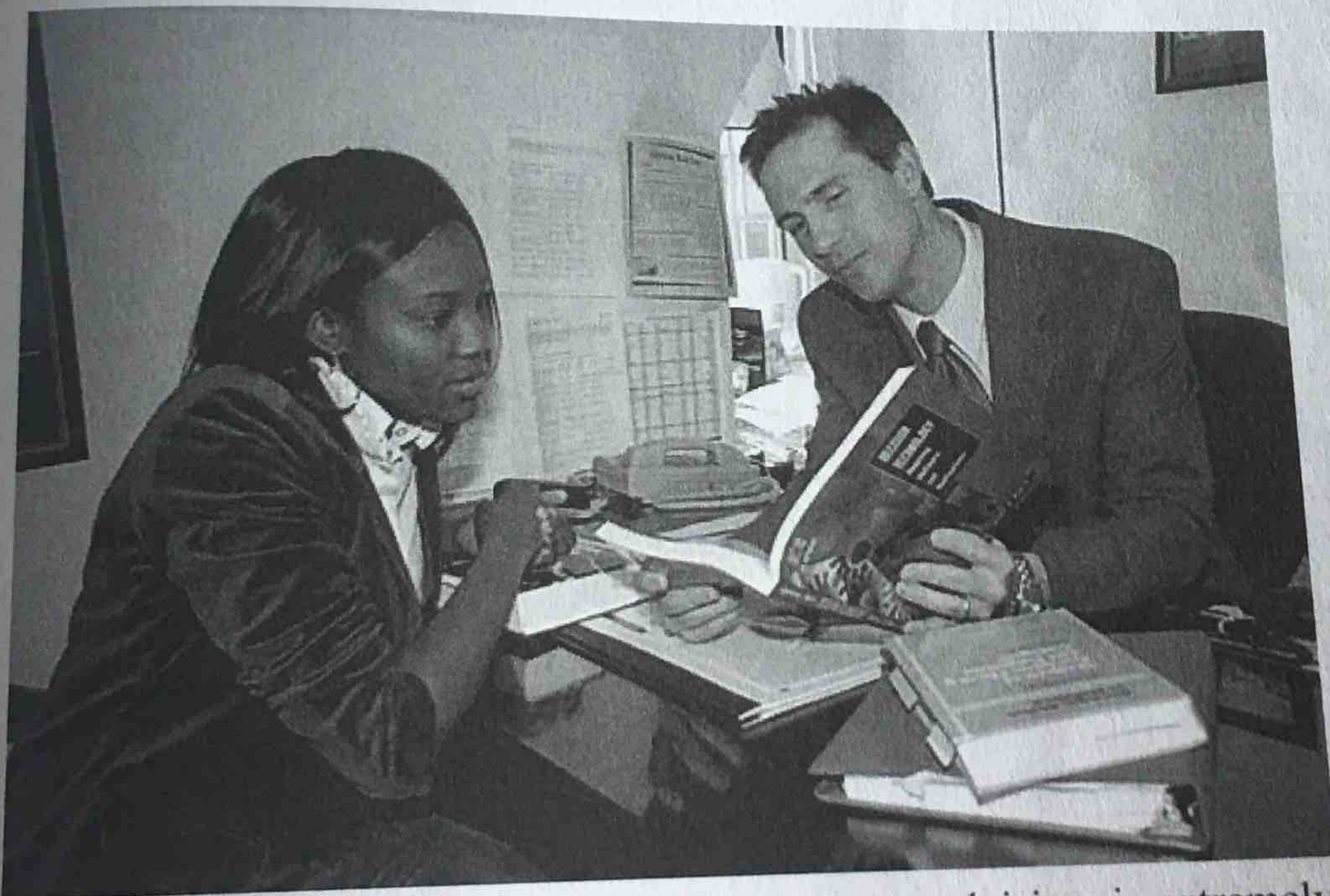
Programs that meet or exceed all criteria are accredited for a six-year period. Programs with minor deficiencies will either be revisited in two years or required to write a report documenting progress in correcting the deficiencies. Serious deficiencies can result in the program being put on probation, which could lead to the loss of ABET's accreditation.

### REFLECTION

Review the eight ABET accreditation criteria presented in the previous section. Make up a list of questions on things you would like to know more about. For example: What are the "program educational objectives" for our engineering program? Do we have "student sustainability"? What "modern engineering tools" will I learn to use? What course(s) address the ABET requirement for a "major design experience"? When you have the opportunity, ask your professors, your department chair, or your dean these questions.

## 8.4 ACADEMIC ADVISING

ABET Criterion 1 states that "Students must be advised regarding curriculum and career matters," and Criterion 6 states that "There must be sufficient faculty to accommodate adequate levels of . . . student advising and counseling . . ."



Academic advising, including both curricular and career advising, is extremely important. I hope you are studying in an engineering college in which the engineering faculty members take academic advising seriously.

You may, however, not be getting the quality of academic advising you need. Unfortunately, engineering faculty sometimes neglect their advising responsibilities in favor of the demands of teaching and research. According to Phillip C. Wankat, Professor of Engineering at Purdue University [7]:

*Probably the most neglected area in engineering education is advising, and certainly this is the area where students show the least satisfaction.*

Wankat's statement is borne out by my personal experiences.

### *Another Personal Anecdote*

I recall the academic advising I received when I first began my Ph.D. program. I had been working in industry for five years and had to readjust to the demands of academic work. I was assigned an advisor who told me, "Take Dr. Johnson's course. Prove yourself by doing well in that course, and you'll have no problem from then on." Little did I know that Dr. Johnson's course was the capstone course in my field that brought together all that would be learned by completing all of the department's graduate courses. Try as hard as I could, I just couldn't handle the course. I dropped it after the midterm exam, and from then on Dr. Johnson had me pegged as a poor student.

### **QUALITY OF ADVISING CAN BE A PROBLEM**

The absence – or minimal presence – of academic advising is not the only problem. An equally serious problem is bad advising.

One area of bad advice to look out for comes from faculty who believe that you "won't measure up" unless you graduate in four years. Such advisors will insist that you take 16-18 units, whether this is best for you or not. These faculty members can fail to account for the fact that you may be working 20 hours a week or might have been out of school for a few years and need to start slowly to work up to full speed.

Bad advice can also come from advisors who have inaccurate or out-of-date information about the curriculum or who lack information about various rules and regulations that affect your academic status. I have a constant stream of students telling me things like the following: "My advisor told me I could try out this course and drop it later." "My advisor told me it would be okay to take 20 units." "My advisor told me that ENGR 322 has been eliminated from the curriculum." Sometimes I can remedy the situation; other times I can't. Don't forget, *ignorance of the law is no excuse!*

### **TAKE PERSONAL RESPONSIBILITY FOR GETTING PROPER ADVISING**

My recommendation to you is that you take personal responsibility for getting proper advising. After all, who suffers when you fail to be advised or get bad advice? You do!

There are several possible sources for academic advising: professors, advising staff, or other students. You certainly can be your own advisor for matters such as identifying courses you need to take, drawing up a workable schedule for a term, and so on. But you will still need sound academic and career advice from others.

To find a good advisor, first make sure you understand how the advising system works at your institution. At some institutions, advising is mandatory; at others it is optional. One department may assign students individual faculty advisors; another department may have a principal faculty advisor who advises all first-year students. Some engineering schools have advising centers where professional staff do the advising.

If you are assigned an academic advisor, whether a faculty member or professional staff member, you should meet with that person at least once each term when you plan your courses for the next term. An advising session will give you feedback on your academic performance, answer any questions you might have about academic policies or regulations, help you work out your course program for the next term, and provide you with career information.

Fellow students can be good sources of information as well. Students can be helpful in directing you to the best teachers. One warning, however. Just because one student likes a professor, doesn't mean you will. Professors are not just good or bad; they are also hard or easy. Sometimes when a student says that Professor "X" is good, he might really mean that Professor "X" is easy. I hope you will seek out professors who are good teachers, but also set high standards of performance.



Any advice you get should be tempered with your own judgment and information you can gain from sources such as your institution's catalog, schedule of classes, website, or student handbook. These sources contain an enormous wealth of information. But you won't get that information unless you take advantage of them.

The ideal advisement arrangement is a combination of all sources. As discussed in Chapter 1, you should develop a road map that lays out the courses you plan to take each term during your undergraduate years. Share this road map regularly with your academic advisor and fellow students. Check it against the four-year curriculum outlined in your school's catalog. Based on all this input – plus your own – follow that road map or revise it whenever appropriate until you graduate.

### REFLECTION

Reflect on the academic advising you have received thus far. Was it mandatory or optional? Was the advisor a professor or a student services staff member? During the advising session, did you discuss your past academic performance? Did you work out your course program for the next term? Did you discuss your long-term career goals? Were you satisfied with the quality of your advising? What could you do to ensure that you get quality advising in the future?

## 8.5 ACADEMIC REGULATIONS

It is also helpful to understand your institution's many academic regulations, policies, and procedures. Not knowing about some of these can hurt you; knowing about others can help you. You can find much of this information in the university catalog or on your university's webpage.

I'm not sure exactly why, but I have always been a person who has been able to get the most out of systems. Here's an example.

### *One Last Personal Story*

As I was about to complete my B.S. degree, I realized that I could finish my M.S. degree in seven months (a summer and a semester) by taking advantage of three regulations most students had never heard of:

- (1) Senior-level courses beyond those needed to meet the B.S. degree requirements could be applied toward an M.S. degree.
- (2) Students in the last semester of undergraduate study could take two graduate-level courses toward their M.S. degree.
- (3) M.S. students could petition to enroll in more units than the rules allowed for a student with a full-time graduate assistantship.

I knew that my GPA was marginal for admission to graduate school, so I met with the professor in charge of graduate admissions and persuaded him that my junior and senior year grades justified giving me a chance.

I couldn't even start to tell you all the many ways my career has been enhanced because I stayed for those seven months and completed my M.S. degree.

I hope my story convinces you that you will benefit from understanding your institution's academic regulations, policies, and procedures. By learning them, you might be able to accomplish things that you would not otherwise even think of.

The following sections give brief overviews of important regulations, policies, and procedures that you should know about. These are divided into three categories: (1) academic performance; (2) enrollment policies; and (3) student rights.

### **ACADEMIC PERFORMANCE**

There are a number of regulations, policies, and procedures that affect your overall academic performance. First and foremost are policies related to your grade point average and the way it is calculated. But there are other policies and procedures – such as whether you are allowed to take courses on a credit/no credit basis, how incompletes are handled, repeat grade policies, opportunities for academic renewal, and credit by examination policies – that if used optimally can help you build a strong grade point average.

**GRADE POINT AVERAGE.** Your success as a student will be measured in large part by your grade point average (GPA). I can assure you from personal experience that grades are important. Unlike other factors that are qualitative and difficult to evaluate, your grade point average is quantitative and therefore likely to get more emphasis than it might deserve.

When I interviewed for the position of dean of engineering at California State University, Los Angeles, I was asked to submit transcripts of all my college work, and I had completed my B.S. degree 23 years before! When you interview for your first job, you may or may not be asked to submit transcripts, but you will assuredly be asked about your grade point average. If your GPA is below a certain level, some employers will eliminate you from consideration solely on that basis. Whether this practice is fair doesn't matter; it is a reality you have to face.

Most colleges and universities operate on a 4.0 grade point system as follows:

| Grade Symbol | Explanation    | Grade Points/Unit |
|--------------|----------------|-------------------|
| A            | Outstanding    |                   |
| B            | Very Good      | 4                 |
| C            | Average        | 3                 |
| D            | Barely Passing | 2                 |
| F            | Failure        | 1                 |
|              |                | 0                 |

Many universities give plus and minus grades as well. This makes it easier for faculty to grade. Deciding between an "A" and a "B" or a "B" and a "C" in borderline cases can be a difficult decision for faculty. Having "A-" and "B+" or "B-" and "C+" as options makes assigning grades a lot easier, while giving a more accurate assessment of your performance.

Your total grade points are computed by summing up the product of the credit hours for each course times the grade points per unit corresponding to the letter grade you receive. Your grade point average is computed by dividing the total grade points by the total number of units taken.

One last point about your GPA. It's very important that you get off to a good start. Once you have several years behind you, it's very difficult to change your GPA. If you get your GPA off to a bad start, it'll be very difficult to raise it. But the converse is true as well. If you establish a good GPA early on, it's difficult to pull it down.

### REFLECTION

One of Stephen Covey's "habits" from his excellent book *Seven Habits of Highly Effective People* is "Begin with the end in mind." As you begin your engineering study, you might want to have in mind that as you near completion of your engineering degree, you will be sitting in an interview room, perhaps at your university's career center, being interviewed for a job you would love to have. At some point in that interview, you are certain to be asked, "By the way, what's your grade point average?" How are you going to feel if you respond "3.5"? What about "3.0"? What about "2.5" or even lower? Now is the time to do the things that will make that future event a positive experience for you. This is the time to "Begin with the end in mind."

**CREDIT/NO CREDIT.** Many universities offer students the opportunity to take courses on a credit/no credit (CR/NC) basis. Courses taken CR/NC do not enter into the calculation of your grade point average. Generally, major requirements cannot be taken CR/NC, and the number of units that can be taken on this basis is limited. The benefit of this option, if available, is that it allows you to take courses outside of your areas of strength without the risk of lowering your GPA.

**INCOMPLETES.** When you are unable to complete a course for justifiable reasons (e.g., illness, family crisis, job change), you probably can request a grade of incomplete (I) from your professor. Generally, the incomplete must be made up within a certain time period. The additional time, however, provides you the opportunity to achieve a higher level of mastery in the course than if you tried to complete it in the midst of a personal crisis.

**REPEAT GRADE POLICY.** Your university may allow you, under specific conditions, to repeat a course and to count only the higher of the two grades you receive in your grade point average. Generally, you are only allowed to take advantage of this regulation for a limited number of courses. Some universities only allow you to repeat courses in which you have received a grade

of "D" or "F." At other universities, you can even repeat a course to raise a grade of "C" to a "B" or "A." Check your campus regulations on this.

**ACADEMIC RENEWAL.** Your university may have a policy that allows students to remove one or more entire terms of coursework from their academic record. Generally, this can only be done under very restrictive circumstances. The policy is designed to forgive students who had one or two terms in which their academic performance was extremely low and not representative of what they are capable of. Once again, check your campus policies.

**CREDIT BY EXAMINATION.** Most universities permit students to challenge courses by examination. This is not a "free ride," however, because whatever grade you receive on the examination, including an "F," is generally averaged into your grade point average.

### **CONSEQUENCES OF POOR ACADEMIC PERFORMANCE**

Poor academic performance can lead to probation and eventual disqualification. It goes without saying that probation and disqualification should be avoided if at all possible. I have friends who flunked out of college 40 years ago and they still feel ashamed about it.

**PROBATION.** If your grades fall below a certain level, you will be placed on probation. Being placed on probation is a serious warning and indicates that unless your academic performance improves, you will be disqualified. Some universities require that students on probation receive mandatory academic advising and/or reduce the number of units they take.

**DISQUALIFICATION.** Continued poor academic performance will lead to disqualification. As previously indicated, flunking out is no fun and should be avoided at all costs. Policies for reinstatement following disqualification vary from one institution to the next. Some institutions reinstate students immediately following a first disqualification; whereas others require students to drop out of school for a period of time. If you are disqualified a second or third time, you could be permanently barred from the university.

### **RECOGNITION FOR GOOD ACADEMIC PERFORMANCE**

The most positive recognition you can receive for your academic performance is to be granted your B.S. degree. Other positive recognitions include the Dean's List and Graduation with Honors.

#### **GRADUATION REQUIREMENTS.**

To graduate, you must complete all course requirements for your major with at least a 2.0 overall grade point average. Your university may also require that you have at least a 2.0 GPA in certain categories of courses such as those courses in your major field, all general education courses, and all courses attempted at your university. Other typical graduation requirements could include a time limit on courses taken and evidence



of skills acquisition such as passing an "exit" writing proficiency exam.

**DEAN'S LIST.** The Dean's List is a very prestigious honor awarded each term to students who achieve a certain level of excellence. "Dean's List" status generally goes to full-time students whose grades are in the top five percent of students in their major or have achieved a certain grade point average (e.g., 3.5 GPA). Check your university's requirements, as they vary from institution to institution.

**GRADUATION WITH HONORS.** One of the top recognitions you can receive is to graduate with honors. There are typically three levels of honors: (1) Cum Laude (top 5%); (2) Magna cum Laude (top 3%); and (3) Summa cum Laude (top 1%). Receipt of these honors will be designated on your diploma and permanent transcript.

### REFLECTION

Reflect on the various ways you can receive recognition for your academic performance. Imagine that you have just received notification that you have been placed on the Dean's List based on your academic performance for the past term. How would you feel about this? You're nearing graduation and you receive notification that you will be graduating Magna Cum Laude. How would you feel about that? It's graduation day and your family and close friends have gathered to celebrate completion of your engineering degree. How would that be?

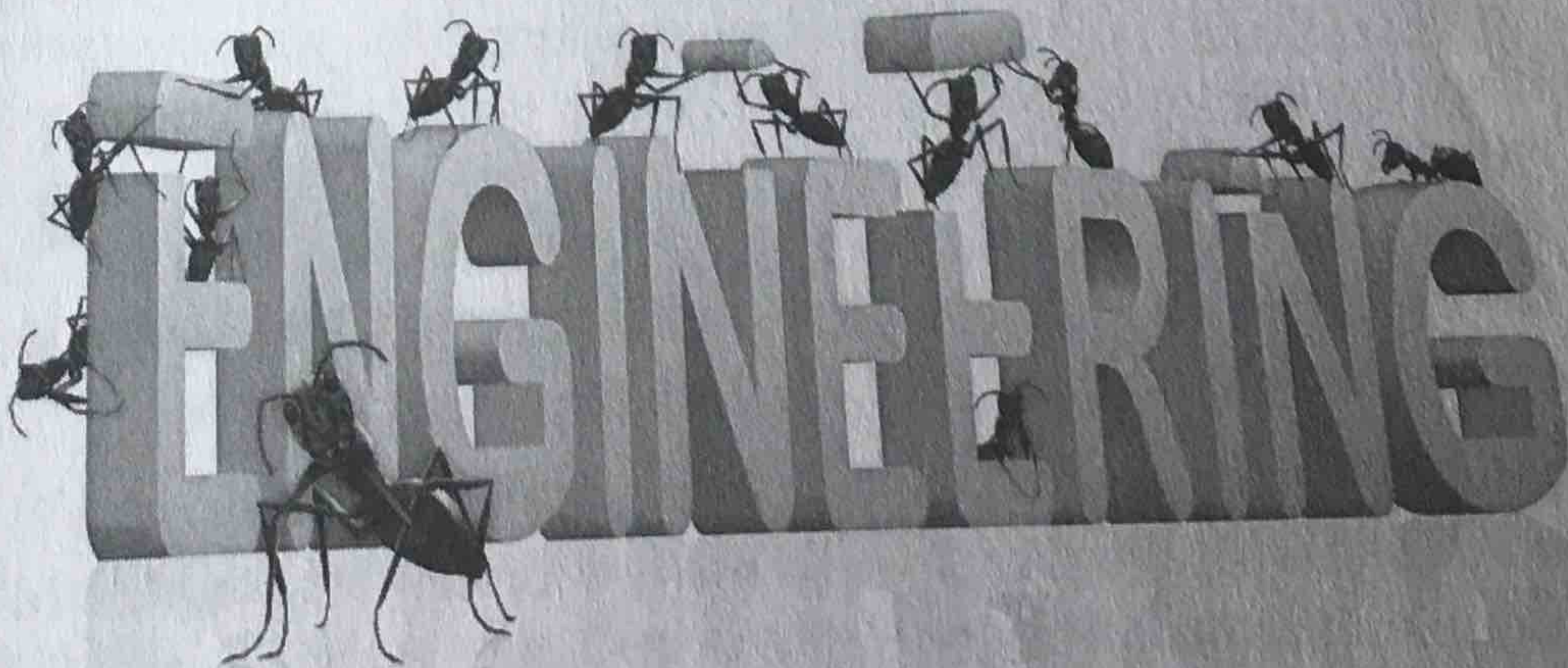
### ENROLLMENT POLICIES

Every university has a number of policies and procedures related to enrollment. These range from how you go about selecting or changing your major to how you register for your classes. Some of the most important of these policies are outlined below.

**SELECTING YOUR MAJOR.** The procedure by which students select their major differs among institutions. Some require students to designate an engineering discipline during their initial application process. Others will admit students as *engineering (undecided)*, and students must then apply after their first or second year for admission into a specific discipline based on their academic performance.

Selecting an engineering discipline can be difficult. Your selection should be based on such factors as your aptitude, interest, and employment opportunities – factors about which you may have limited information. At universities where engineering programs have a common lower-division core for all disciplines, the decision can be postponed until the junior or even senior year. For programs that have a highly specialized curriculum requiring an early decision, you may be forced into a decision before you have adequate information.

My advice is to postpone your decision as long as your institution will permit. As you progress through the curriculum, you will be in a better position to choose because of what you learn from your coursework, pre-professional employment, and discussions with students, professors, and practicing engineers.



**CHANGING YOUR MAJOR.** Don't feel that you must stay with your initial choice of major. As indicated in the previous section, you will gain insights along the way that will enable you to make more judicious decisions about your major. I started out as an electrical engineering major. I didn't like my first "Circuit Theory" course, so I changed to aeronautical engineering. Midway through a course in "Wing Design," I realized that this major was too specialized for me, so I changed to mechanical engineering. Mechanical engineering has turned out to be a great choice for me. My philosophy is summarized by the thought that:

*If you get to a good end point, then the path that took you there must have been a good path.*

Don't be worried if you're not sure about what you want to do. View your college years as a chance to explore the possibilities with the purpose of finding out what you like. Take advantage of that opportunity.

**One warning.** You should check out the procedures for changing your major from one engineering discipline to another. Some disciplines may be easy to get into, while others may be oversubscribed and difficult to enter. Don't assume you will be able to change to whatever major you choose.

**DOUBLE MAJORS.** You can elect to have more than one major. Students with double majors must complete all requirements for both majors and receive two bachelor's degrees when they graduate. However, completing the graduation requirements for two majors generally takes at least one full additional year. The extra time can be reduced by choosing a second major that has a great deal of curricular overlap with the first major. For an engineering student, second majors that fit well are mathematics, physics, or computer science.

I, however, wouldn't advocate a double major. In the additional year you would spend to fulfill the requirements for the second major, you could complete a master's degree. An M.S. degree would probably be more beneficial to you than a second bachelor's degree.

**MINORS.** You can also elect to have a minor field. A minor can offer you most of the benefits of a second major while requiring less additional coursework. A typical minor might entail about 12 semester units (18 quarter units) of courses. The minor can be used to strengthen your preparation in an area related to your major (e.g., mathematics, physics, biology) or to gain breadth in a completely unrelated area (e.g., music, philosophy, creative writing).

**REGISTRATION.** The process of registering for your courses is extremely important. Through the registration process, you can ensure you get the courses you need, the best instructors, and a workable schedule. Not getting the courses you need can impede your progress, particularly in cases where the courses are prerequisites for future courses. Having the best instructors can also have a major impact on your academic success. And having a good schedule can ensure that you have adequate time for studying and other commitments.

At most institutions, registration is done online. You will generally receive a time at which you are allowed to register based on priorities established by your registrar's office. For example, the order might be new freshmen register first, followed by seniors, juniors, sophomores, and continuing freshmen.

If you are given a low-priority time slot, making it difficult to get your classes, you may be able to do something about it. Perhaps the registrar needs volunteers to work at some part of the

orientation or registration process and in return allows those students to register early. Often, athletes, band members, and student government leaders are given priority registration. Research all the ways to get priority registration and see if you can qualify for one.

**DROP/ADD POLICY.** You should become fully versed in your institution's drop/add policy. You can probably add a course until the end of the second or third week of the term, but if you don't start attending from the beginning, you may have great difficulty catching up. Generally, you can drop a course without any penalty up to a specific date. After that, it becomes more and more difficult to do.

**LEAVE OF ABSENCE/WITHDRAWAL.** If you decide to leave your institution, either temporarily or permanently, be sure to follow official procedures. It is generally easy to gain approval for a leave of absence for purposes such as other professional or academic opportunities, travel or study abroad, employment related to your educational goals, field study, medical problems, or financial need. Even if you think you want to leave permanently, don't burn your bridges. Your situation may change, and you may want to return at some point in the future.

**COURSE SUBSTITUTIONS.** Although the engineering course requirements may seem very rigid to you, most universities have a mechanism for substituting one course for another. For example, you may want to conduct an independent study with a professor rather than taking a specific required course. Or you may want to substitute a course taught by the economics department for a required course in engineering economics. Generally, such substitutions can be made if you gain necessary approvals.

**OVERLOAD POLICY.** Do you know the maximum number of units you can register for? If you want to exceed that number, your college or university usually has a procedure for you to seek approval to do so. And if your GPA is high, approval will probably be granted.

**CREDIT FOR COURSES AT OTHER INSTITUTIONS.** You may want to take a course at a community college or other university at some point during your engineering education. Before you do so, be sure to check out your institution's policy on this. Most likely, you must get written approval in advance if you expect to receive transfer credit when you return.

## **STUDENT RIGHTS**

There are regulations, policies, and procedures in the area of student rights that you should know about. Most universities have a "Statement of Students Rights." For example, my university puts forth the following statement to students:

1. Students have the right to reasonable **access to professional advisement** relative to all segments of their academic programs and to their career goals related to those academic programs.
2. Students have the right to **substantial instruction** in the course content at the time scheduled for class meetings except in mitigating circumstances.
3. Students have a right to expect that **their records will not be subject to unauthorized disclosure or access.**
4. Students have the right to **know about existing student record systems** and to **examine their own records**, including letters of recommendation, and to include any additional information or responses bearing on information they find objectionable.
5. Students have the right to reasonable **access to university, college, and department policies, procedures, standards, and regulations** which affect the right of a student to enroll, remain enrolled, or withdraw from any course or program of study.

6. Students have the right to **information from each professor at the first class session about the general requirements and goals of a course** in which they are enrolled, and the general criteria upon which they will be evaluated in that course.

Items #3 and #4 are dictated by the Family Educational Rights and Privacy Act (FERPA) – a law designed to protect the privacy of your educational records.

Check to see if your university or college has a similar statement of student rights. Make sure you know what your rights are!

Of course, there are also many other rights that come through the U.S. Constitution or federal or state law such as freedom of speech, freedom against discrimination, right to assemble, freedom of religion, and right to privacy. These rights may or may not be explicitly stated in your college or university's statement of student rights.

Let's look briefly at student rights in two important categories:

(1) Petitions

(2) Grievances

**PETITIONS.** In the previous sections, we gave examples of the many rules, regulations, policies, and procedures that are traditionally part of most educational systems. However, as the saying goes, "Every rule is made to be broken." If you find yourself constrained by a rule or regulation in a way that just doesn't make sense, you do have a recourse. Every university has a petition for waiver of regulations policy. My university catalog, for example, states:

"Students who believe that extenuating circumstances might justify the waiver of a particular regulation or requirement may file a petition at their major department/division/college office, according to established procedures, for consideration by a faculty committee."

The particular approval process can vary from case to case. Suffice it to say, if the necessary signatures can be obtained, almost anything is possible.

**STUDENT GRIEVANCES.** Grievances are formal complaints by students against the institution. The complaint might be about a specific instructor or administrator. Grievances generally involve an allegation by a student of unauthorized or unjustified actions that adversely affect the student's status, rights, or privileges, including but not limited to actions based on ethnicity, religion, gender, sexual orientation, age, disability, or veteran status.

You should check on your institution's student grievance policy. Generally, such policies outline specific procedures for filing grievances. At my university, for example, the process a student follows to resolve a grievance against a faculty member has five steps. First, the student is required to attempt to resolve the grievance informally with the faculty member. If this is not satisfactory, the student is then required to seek the help of the department chair to resolve the grievance informally. If that doesn't solve the problem, the student must file a formal written grievance with the department chair, who may appoint a committee to make a recommendation. The fourth step, if necessary, is to contact the school dean, who will seek the recommendation of a school-wide committee. The fifth and last step is to notify the university student grievance committee – only if the previous four steps have failed to resolve the issue.

## 8.6 STUDENT CONDUCT AND ETHICS

Along with rights come responsibilities. Your university has a code of conduct that delineates actions on your part that can result in disciplinary action. As an example, the

following is a list of actions that warrant disciplinary action for all public universities in California [8]:

- Cheating, plagiarism, or other forms of academic dishonesty that are intended to gain unfair academic advantage
- Furnishing false information to a campus official, faculty member, or campus office
- Forgery, alteration, or misuse of a campus document, key, or identification instrument
- Misrepresentation of oneself or an organization to be an authorized agent of a campus
- Willful, material and substantial disruption or obstruction of a university-related activity or any on-campus activity
- Participating in an activity that substantially and materially disrupts the normal operations of the university or infringes on the rights of members of the university community
- Theft of property or services from the university community or misappropriation of university resources
- Unauthorized destruction, or damage to university property or other property in the university community
- Willful, material and substantial obstruction of the free flow of pedestrian or other traffic, on or leading to campus property or an off-campus university related activity
- Unauthorized entry into, presence in, use of, or misuse of campus property
- Use, possession, manufacture, or distribution of illegal drugs or drug-related paraphernalia, or the misuse of legal pharmaceutical drugs
- Use, possession, manufacture, or distribution of alcoholic beverages, or public intoxication while on campus or at a campus-related activity
- Possession or misuse of firearms or guns, replicas, ammunition, explosives, fireworks, knives, other weapons, or dangerous chemicals on campus or at a campus-related activity
- Disorderly, lewd, indecent, or obscene behavior at a campus-related activity, or directed toward a member of the campus community
- Conduct that threatens or endangers the health or safety of any person within or related to the campus community, including physical abuse, threats, intimidation, harassment, or sexual misconduct
- Hazing, or conspiracy to haze
- Misuse of computer facilities or resources including use of another's identification or password; unauthorized entry into or transfer of a file; violation of copyright laws; sending obscene, intimidating, or abusive messages; interference with the work of another member of the campus community or with campus operations
- Violation of any published campus policy, rule, regulation, or presidential order

Each of the above behaviors can bring about disciplinary sanctions including assignment of a failing grade in a course, probation, suspension, or expulsion. Many of these acts are also crimes that can result in criminal prosecution in addition to university discipline.

Of these actions, the one that occurs most often is academic dishonesty. Because of its importance, let's review what this entails.

## **ACADEMIC DISHONESTY**

During your engineering study, you will address the topic of engineering ethics. Ethics is the study of what, on a social level, is right and wrong. Engineering ethics considers how engineers should behave in different situations: what behaviors are right and what are wrong.

**NSPE CODE OF ETHICS.** The preamble to the Code of Ethics of the National Society of Professional Engineers (NSPE) provides a perspective on the importance of ethics in engineering:

“Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.”

I would encourage you to review the *NSPE Code of Ethics for Engineers* ([www.nspe.org/Ethics/CodeofEthics/index.html](http://www.nspe.org/Ethics/CodeofEthics/index.html)). The Code will give you an idea of the standards of behavior expected of engineers. Hopefully, doing so will motivate you to begin to practice these high standards during your tenure as an engineering student.

According to the Fundamental Canons of the NSPE Code of Ethics for Engineering, engineers, in the fulfillment of their professional duties, will:

1. Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

**Ethical Dilemmas.** Ethics is a difficult subject because it is not always clear whether a certain behavior is ethical or unethical. Often engineers face dilemmas – problems for which there are no satisfactory solutions. Thus engineers might be faced with making the “least” unethical choice. As an engineering student, you also could face ethical dilemmas. Consider the following examples:

- Your professor incorrectly totaled the points on your midterm, giving you a 78 when you really only scored 58.
- A friend has been sick and asks to copy your homework that is due in a few hours.
- A fellow student notices that you have just purchased *Adobe InDesign* software and asks to borrow the CD so he can install it on his computer.
- You have a lousy professor who gives you a student opinion survey at the end of the course to evaluate his teaching. He asks you to complete it and insert it into an envelope with your final exam.
- Your professor has announced that her office hours are “Mondays and Wednesdays 10 a.m. - 12 noon.” You have gone to her office during this time interval on four occasions, and she has not been there.

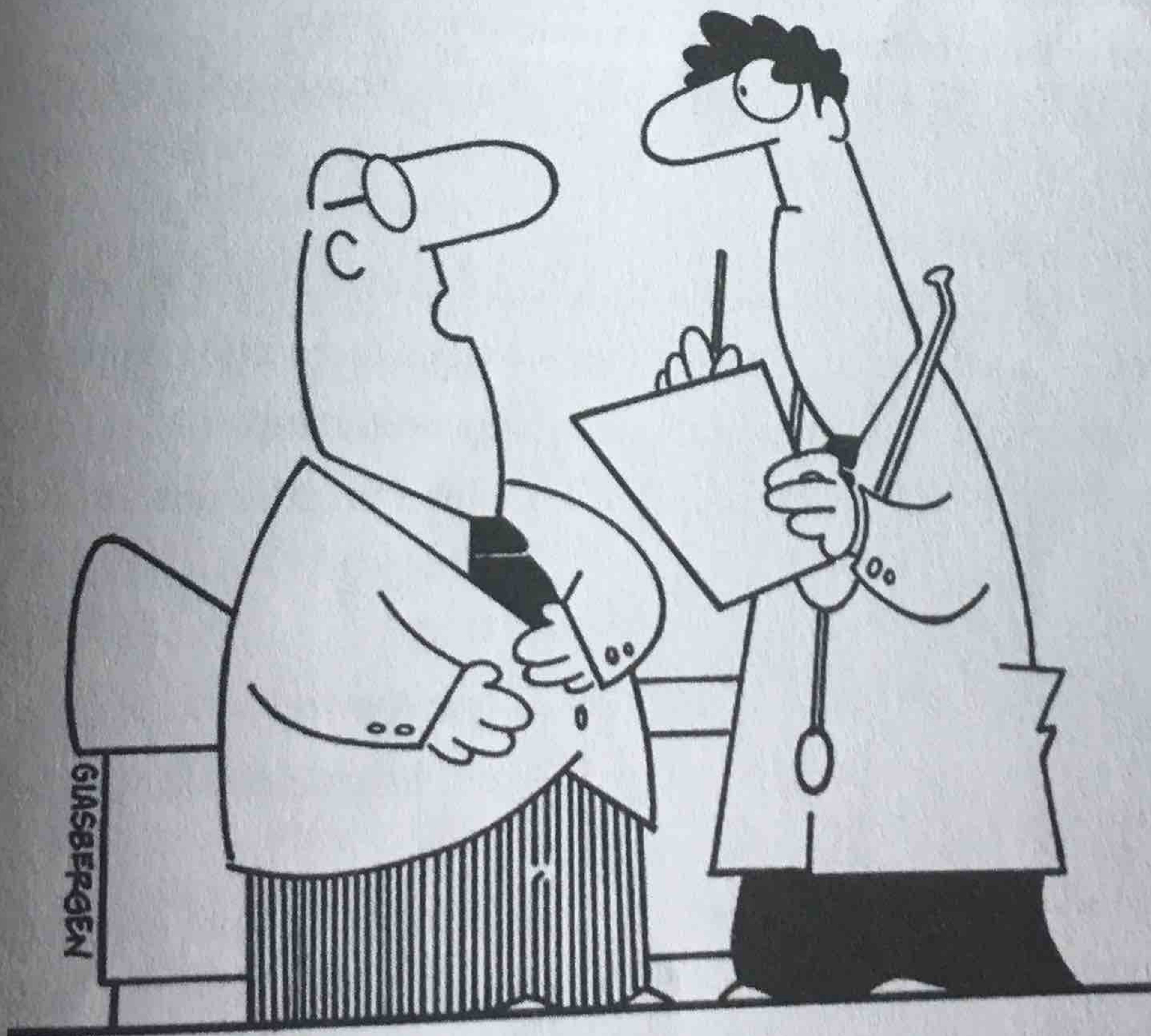
- The data from your laboratory experiment doesn't make any sense. Your lab partner brings you a lab report from last term and suggests that you just use the data from that report.
- Your dean invites you to be part of a group of students to meet with the chair of the visiting ABET team. The dean asks you not to say anything negative about the engineering program.
- You notice two students in your class exchange their test papers during the final exam.
- You work part-time as a student assistant in the department office. The department secretary tells you to feel free to take whatever office supplies (paper, pencils, etc.) you need from the department office supply stock room.

### REFLECTION

Reflect on the ethical dilemmas just presented. In each of these situations, what alternate courses of action could you take? Do you see that the alternate courses of action reflect competing values (e.g., pleasing someone vs. doing the right thing)? What would you do in each of these situations? Note that in some cases, it is very easy to decide what's right. In other cases, it is much more difficult.

I hope this cartoon doesn't describe you.

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**"Lately I've been feeling ethical.  
Can you prescribe something for that?"**

There are some areas of academic honesty for which there should be no confusion over right and wrong. These include cheating, fabrication, facilitating academic dishonesty, and plagiarism.

**CHEATING.** Cheating is defined as the act of obtaining or attempting to obtain credit for academic work through the use of any dishonest, deceptive, or fraudulent means. The following examples are intended to be representative, but not all-inclusive:

Examinations/Tests Administered by Faculty or the University

- Copying from another student's paper
- Employing signals to obtain answers from or provide answers to others
- Stealing or arranging for the theft of an examination
- Knowingly reviewing an unauthorized copy of an examination
- Using prohibited lecture notes or textbooks during an examination
- Using crib notes during an examination
- Having someone else take an examination in your place
- Feigning illness or telling falsehoods to avoid taking an examination at the scheduled time
- Claiming falsely that you took an examination at the scheduled time
- Storing and/or accessing course subject matter in a calculator, computer or recording device, without authorization from the instructor, when such instruments are otherwise permitted to be used during an examination period
- Utilizing calculators and/or other learning aids forbidden by the instructor
- Obtaining assistance in answering questions on a take-home examination, when such action is specifically prohibited
- Attempting to use or using bribery to obtain an undeserved grade
- Changing an answer on a graded test and claiming your response to the question was incorrectly marked wrong

Papers/Laboratory Reports/Homework

- Copying the work of other persons in whole or in part and claiming it as your own
- Submitting a paper obtained from any source that provides research/term papers
- Paying another writer to compose a paper and claiming authorship
- Claiming an assigned share of a team report, toward which insufficient or no contribution was made
- Lying about the reason for not submitting a report on time
- Stealing another student's report and submitting it as one's own work
- Submitting the same term paper to two or more different instructors for credit in their courses without their prior permission
- Inventing, falsifying, or altering data for a research survey or laboratory experiment
- Misrepresenting the authorship of an experiment or exercise
- Depending upon others to complete laboratory assignments or homework when instructions call for independent work
- Sabotaging someone else's laboratory work or other exercise
- Fabricating bibliographic references

Cheating on any academic assignment, including coursework, comprehensive exams, or theses, is subject to discipline for academic dishonesty.

**FABRICATION.** Fabrication is the intentional, unauthorized falsification or invention of information or citations in an academic exercise. One example would be to make up or alter laboratory data.

**FACILITATING ACADEMIC DISHONESTY.** Facilitating academic dishonesty is intentionally or knowingly helping or attempting to help another to commit an act of academic dishonesty.

**PLAGIARISM.** Plagiarism is knowingly representing the works or ideas of another as one's own in any academic exercise. The most extreme forms of plagiarism are the use of a paper written by another person or obtained from a commercial source, or the use of passages copied word for word without attributing the passage to the writer.

## 8.7 GRADUATE STUDY IN ENGINEERING

Most of our discussion to this point has been directed at completing your B.S. degree in engineering. When you do complete your undergraduate work, you can go to work as a practicing engineer in industry or government or you can continue your education by working toward a graduate degree.

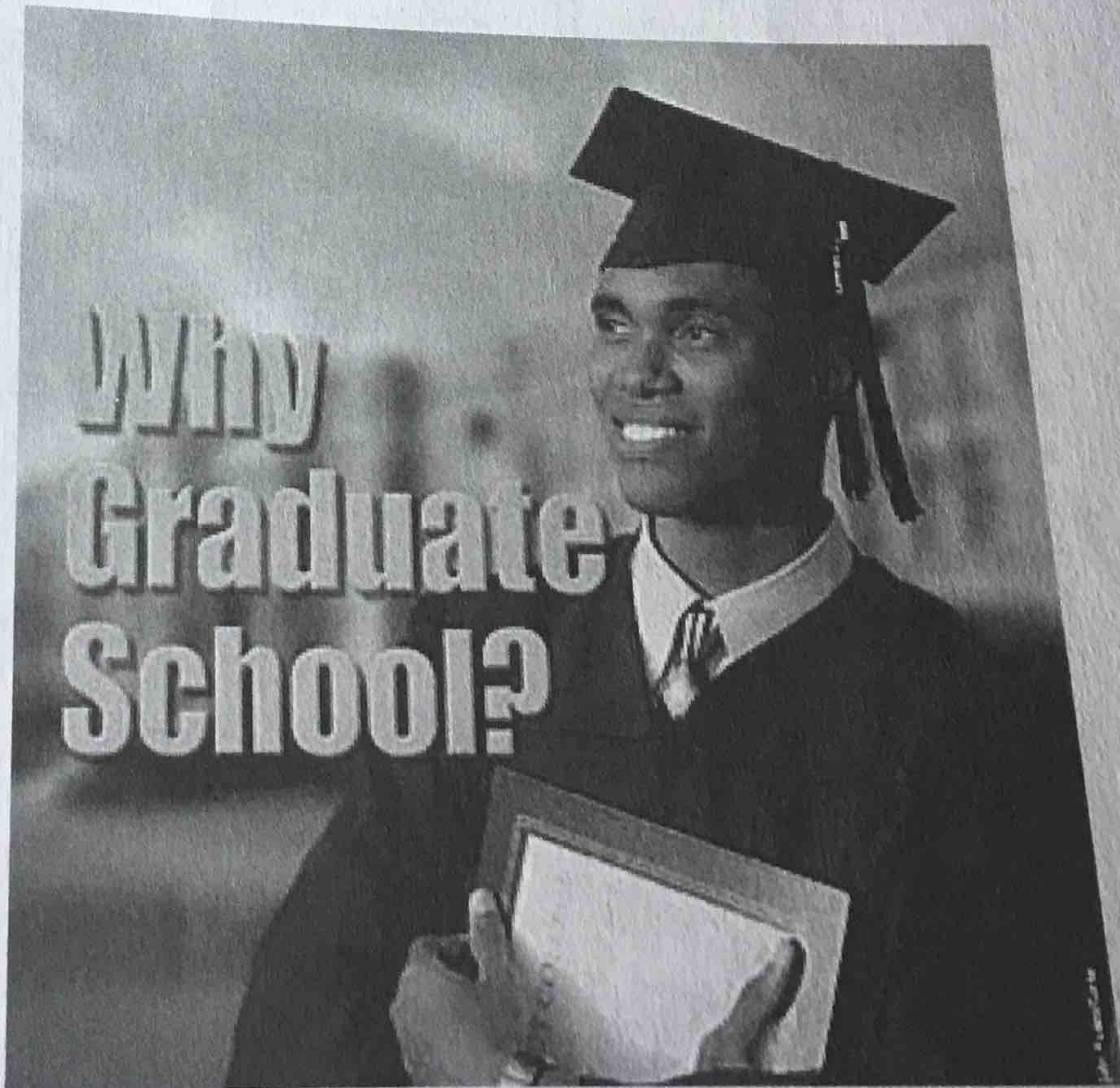
The graduate degree could be in engineering or in other areas such as business, law, or medicine. Several of these opportunities for continuing your education are discussed in the following sections.

### BENEFITS OF GRADUATE STUDY IN ENGINEERING

Continuing your study through an M.S. or Ph.D. degree in engineering is an invaluable investment in yourself and in your future, regardless of what you plan to do professionally. The additional years you devote to graduate study will pay off again and again throughout your career in the following ways:

- You will bolster your self-esteem and self-confidence.
- You will broaden your career choices and open doors to more challenging jobs — either in academia or in industry.
- You will increase your potential earnings over your lifetime.
- You will gain increased prestige, and others will accord you more respect.

I can't tell you how many times I have seen people's opinion of me rise when they learn that I have a Ph.D. in engineering. I can say without reservation that I would have missed much of what has been significant in my life had I not decided to seek a Ph.D.



### **M.S. DEGREE IN ENGINEERING**

The first degree after the B.S. degree is the Master of Science (M.S.). Getting your master's degree takes about one year of full-time study or two years of part-time study. There are three possible options for obtaining an M.S. degree: (1) all coursework, (2) coursework plus a project, or (3) coursework plus a thesis. Some engineering colleges may offer only one option, while others offer two or even all three options.

Generally, option #1 requires about ten courses; option #2 about nine courses plus a project; and option #3 about eight courses plus a thesis. A limited number of these courses can be at the senior level with the remainder at the graduate level.

The project and thesis are similar but differ in the type and amount of work. The project can generally be completed in one term and tends to be more practical. The thesis generally takes two or more terms and involves the development of new knowledge through research.

### **PH.D. DEGREE IN ENGINEERING**

The Doctor of Philosophy (Ph.D.) is the highest educational degree in engineering. It generally takes four to five years or longer of full-time study beyond the B.S. degree. Typically, a Ph.D. program consists of about two years of coursework, culminating in a comprehensive examination (comps) covering your area of specialty. After you pass the comps, you work full-time on a research project, which will become your Ph.D. dissertation.

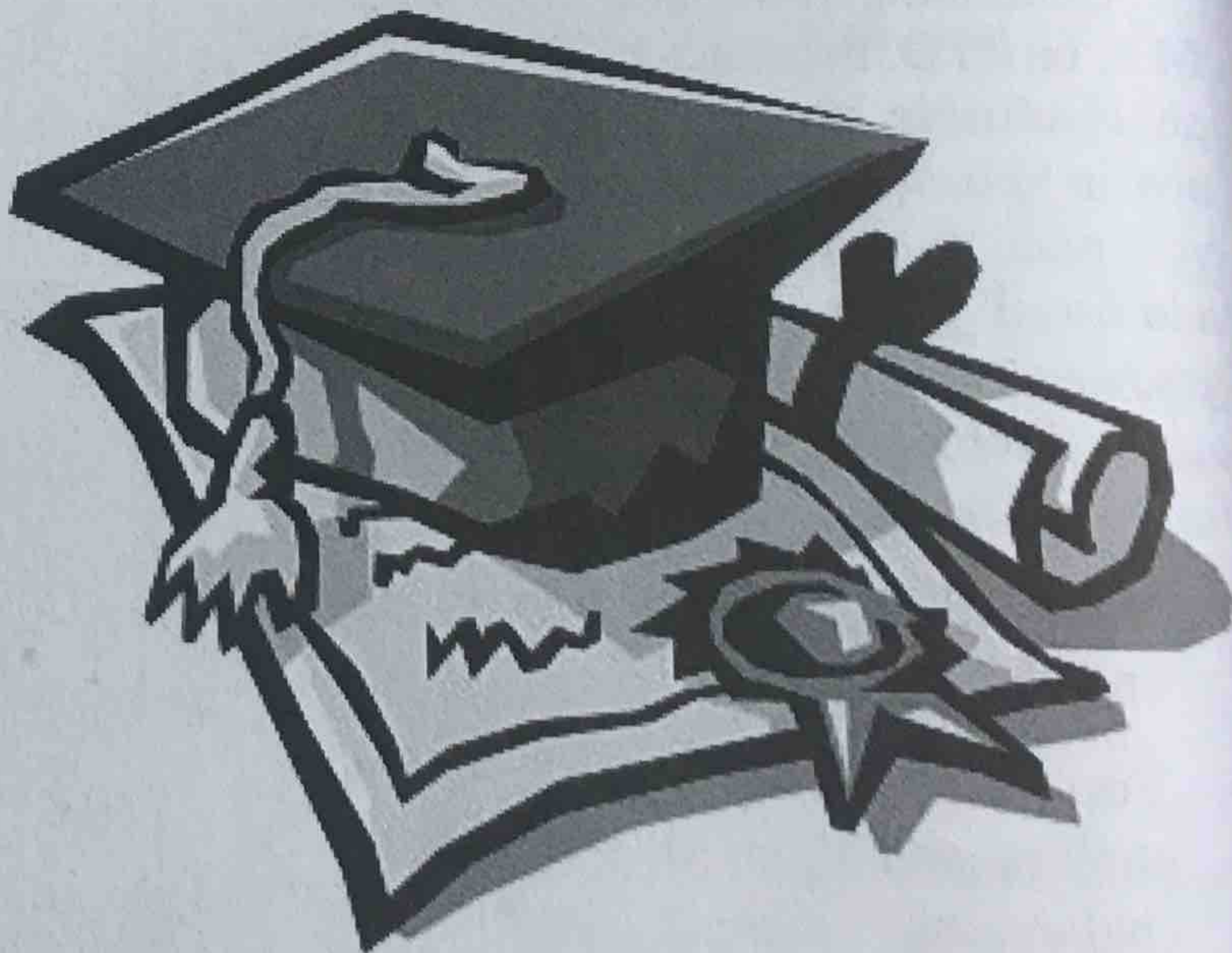
Normally, you would apply for admission to a Ph.D. program following completion of your M.S. degree. If you continue on at the same institution, you will generally save time. You can also complete the M.S. degree at one university and then move to another for the Ph.D. While this can be a broadening experience, it will generally extend the time required to obtain the Ph.D. degree.

At some institutions, you can be admitted directly into the Ph.D. program upon completion of your B.S. degree. In some cases you simply "pick up" the M.S. along the way with little or no additional work. At others places you may be required to take a special exam or complete a thesis to get the M.S. degree. At still other places, you can elect to skip the M.S. degree completely.

The Ph.D. degree can prepare you for a career in both industry and academia. A career as an engineering professor can provide special rewards. If you would like to know more about these, I suggest that you read "An Academic Career: It Could Be for You" [9].

### **FULL-TIME OR PART-TIME?**

It is possible to work full-time and pursue graduate study in engineering on a part-time basis. This is the way many engineers obtain their M.S. degree. But it is much more difficult, if not impossible, to complete a Ph.D. degree on a part-time basis. Whether earning an M.S. or a Ph.D., I advise you to consider full-time graduate study if you can arrange it. Many of the benefits of graduate education come from being fully immersed in the academic environment –



concentrated study in your area of specialty, engaging in dialogue and working closely with faculty and other graduate students, and carrying out research under the close supervision of a faculty advisor.

There may be some benefits to working full-time in industry for a period after you receive your B.S. degree and then returning to full-time graduate study. You may want a break from school. You may have incurred debts you need to pay off. You may be anxious to apply what you have learned. There is, however, a potential problem with working too long in industry. You may get used to a full-time engineering salary, making it difficult to return to the more modest student life. Of course, this depends on you and your commitment to your education.

### HOW WILL YOU SUPPORT YOURSELF?

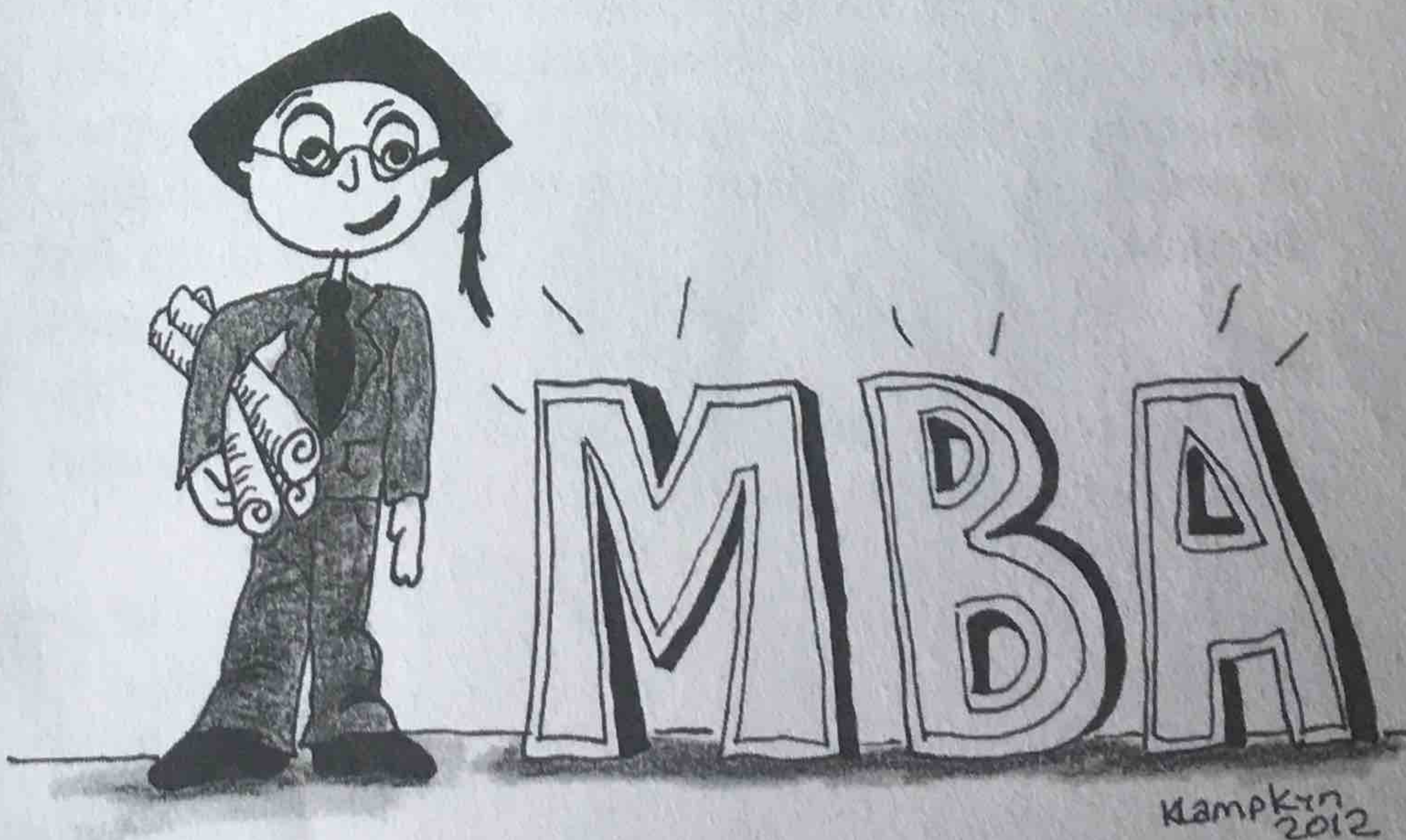
Graduate study is different from undergraduate study in that *there is a good chance you will be paid to do it*. Any engineering graduate who has the potential to get a Ph.D. has a good chance of lining up adequate financial support for full-time graduate study. There are three kinds of financial support for graduate study: fellowships, teaching assistantships, and research assistantships. All three usually cover tuition and fees and provide a stipend for living expenses. Although fellowships and assistantships provide you much less money than full-time industrial positions, they can support you adequately to work full-time on your degree.

## 8.8 ENGINEERING STUDY AS PREPARATION FOR OTHER CAREERS

In Chapter 2, we made the point that an undergraduate engineering education is excellent preparation for whatever you want to do. Engineering study is particularly good preparation for graduate study in fields such as business, law, and medicine. Each of these opportunities is discussed below.

### MASTER OF BUSINESS ADMINISTRATION (MBA)

One of the engineering job functions described in Chapter 2 was management, which typically involves either *line supervision* or *project management*. Your engineering education will not prepare you fully for these management functions. As a manager you may very well need background in economics, accounting, finance, marketing, business law, and personnel management. You will receive very little, if any, training in these subjects as part of your engineering program. The ideal academic program to give you this additional background is the Master of Business Administration (MBA).



The MBA differs from the M.S. degree in business administration. Whereas the M.S. degree in business is designed for those who did their undergraduate work in business administration, the MBA is designed for those who did their undergraduate work in other academic fields.

Admission to an MBA program does not require any prior background in business administration. Completing the MBA takes two years of full-time study. The first year is spent

developing your background in accounting, economics, marketing, business law, finance, computer information systems, and management. The second year is devoted to more advanced study in these subjects, with the opportunity to specialize in one or more of them.

Admission to an MBA program is based on your undergraduate record in engineering, letters of recommendation, and scores on the Graduate Management Admission Test (GMAT). The GMAT is a national standardized test administered by the Graduation Management Admission Council (GMAC) and is offered year-round at test centers throughout the world. The test covers quantitative, verbal, and analytical writing skills.

You can learn about MBA programs and the GMAT exam by visiting the Graduate Management Admission Council (GMAC) website: [www.mba.com](http://www.mba.com).

Engineering students generally do very well both on the GMAT and in MBA programs. The mathematical background and strong problem-solving skills gained through an undergraduate engineering education are excellent preparation for the MBA program. If you wish to prepare further for an MBA, you should use any free electives you have as an undergraduate to take courses in economics, accounting, or behavioral science.

There are two schools of thought regarding the best path to an MBA degree. One is that you should first work for several years in a technical position to gain professional engineering experience. If you are chosen for management or decide you want to seek a management position, you would then pursue the MBA either part-time while continuing to work or by returning to school full-time.

The second school of thought is that it is better to get the MBA prior to entering the workforce. The combination of an engineering degree and MBA could lead you directly into an entry-level management position, but if it doesn't, you will be in a good position to land a management position within a short time.

One last thing regarding the MBA. If you have any thoughts of eventually starting your own company, the MBA will provide you excellent training for doing so. Being a successful entrepreneur requires competence in finance, accounting, marketing, business law, and personnel management – all areas that receive significant coverage in the MBA program.

## LAW

Excellent opportunities exist for engineers in the legal profession. The primary opportunity is in patent law, where technical expertise combined with legal knowledge are essential. But other legal specialties such as environmental law and product liability law also fit well with an engineering background.

There are no specific undergraduate course requirements for law school. The most traditional pre-law majors include history, English, philosophy, political science, economics, and business, but



any major including engineering is acceptable.

According to the American Bar Association (ABA) [10]:

"The core skills and values that are essential for competent lawyering include analytic and problem-solving skills, critical reading abilities, writing skills, oral communication and listening abilities, general research skills, [and] task organization and management skills."

This would suggest that engineering study is, indeed, excellent preparation for law school, since an engineering graduate would already possess many of these skills.

There are 201 law schools approved by the ABA to offer J.D. degrees in the U.S. Admission to these approved law schools is based on undergraduate transcripts, letters of recommendation, and scores on the Law School Admissions Test (LSAT).

The LSAT is a multiple-choice exam designed to measure the following skills: reading and comprehension of complex texts with accuracy and insight; organization and management of information and the ability to draw reasonable inferences from it; the ability to reason critically; and the analysis and evaluation of the reasoning and arguments of others. The test is administered by the Law School Admission Council (LSAC) and is offered four times a year at designated centers throughout the world.

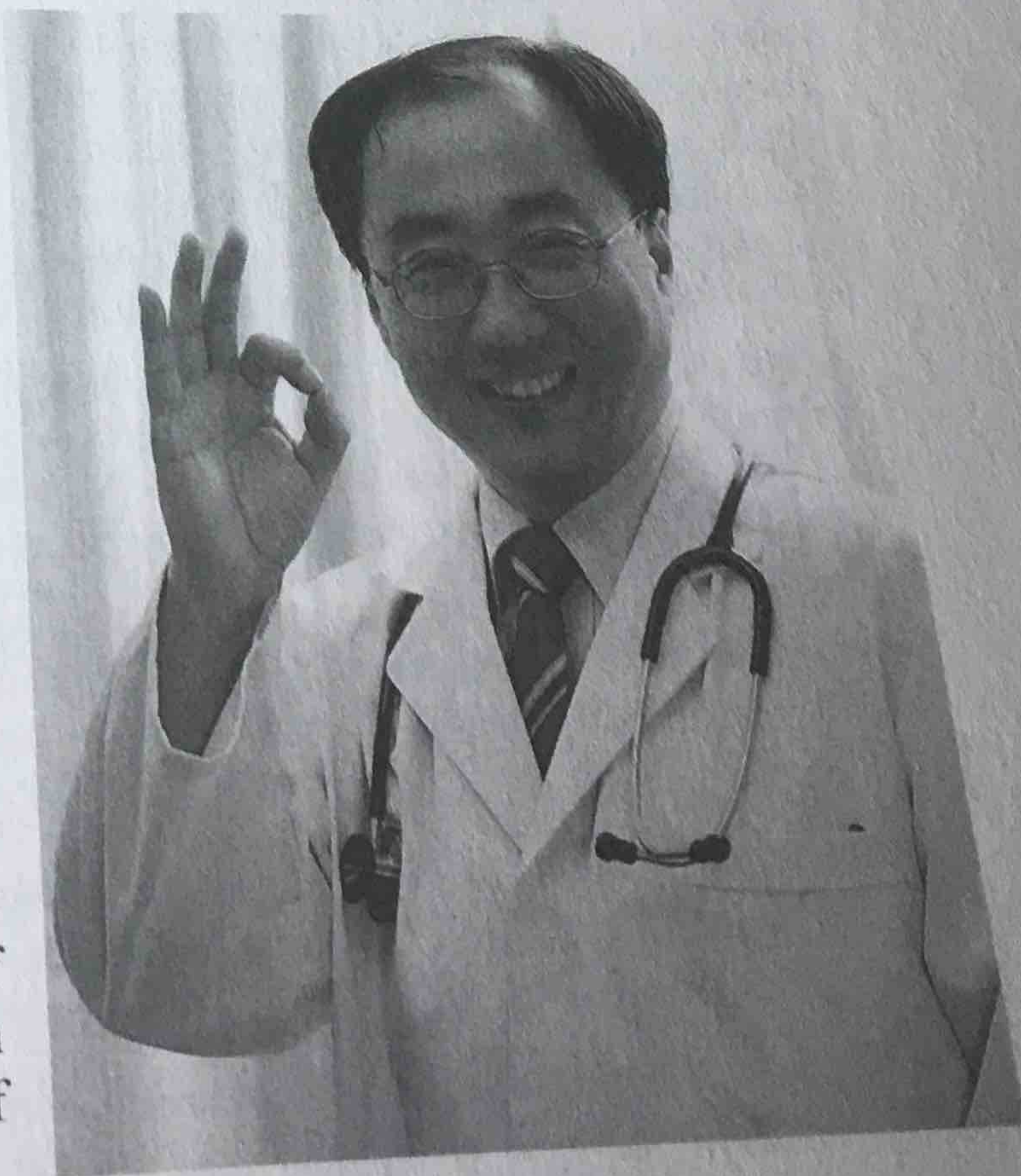
You can obtain information about law schools and the LSAT at the Law School Admission Council website: [www.lsac.org](http://www.lsac.org).

If you are interested in law school, you should concentrate your elective undergraduate courses in history, economics, political science, and logic. Strong reading, writing, and oral communication skills are also important. Any opportunities you have to gain familiarity with legal terminology and the judicial process will also be beneficial in law school.

## MEDICINE

Engineering study is also excellent preparation for medical school. Over the past several years, engineering was the third-ranked undergraduate major (behind biology and biochemistry) in the number of students who entered the nation's 137 medical schools. Perhaps more significant is that a higher percentage of engineering majors who applied were accepted and entered medical school than the average for all other undergraduate majors [11].

It is no accident that medical school admissions rates are high for engineering graduates. The logical thinking and problem-solving skills developed through engineering study have a direct carryover to the diagnostic skills practiced by physicians. The combination of engineering and medicine can lead to careers in medical research or the development of biomedical devices and equipment.



Engineering has a particular benefit over the more traditional pre-med majors such as biology, chemistry, and health science. Engineering offers students an excellent fall-back career option if they are either unable to gain admission to medical school or lose interest in a medical career.

Medical school admission requirements vary from school to school. Undergraduate course requirements include one year of biology, one year of physics, one year of English, and two years of chemistry. Experience in the health professions, extracurricular activities, and work experience are also encouraged.

Admission to medical school is based on undergraduate grades, scores on the Medical College Admission Test (MCAT), letters of recommendation, a personal statement, and a personal interview. The MCAT is a standardized, multiple-choice examination designed to assess the examinee's problem solving, critical thinking, and knowledge of science concepts and principles prerequisite to the study of medicine. The MCAT is a computer-based exam offered multiple times each year at testing sites throughout the world.

You can get information about medical schools, the MCAT exam, and the application process by visiting the Association of American Medical Colleges (AAMC) website: [www.aamc.org](http://www.aamc.org).

The calculus, chemistry, and physics required in the engineering curriculum provide much of what is needed to prepare for the MCAT and to be admitted to medical school. Additional requirements in biology and chemistry must be taken either as elective courses or as extra courses. Biomedical engineering and chemical engineering are the two engineering disciplines that best meet the needs of a pre-med program, because additional biology and chemistry courses are part of the required curriculum.

### REFLECTION

Reflect on the opportunities presented in the previous section for continuing your education beyond your B.S. degree in engineering. Do any of them appeal to you? Getting your M.S. or Ph.D. degree in engineering? Getting your MBA? Going to law school? Going to medical school? If one does, what do you need to do in the next few years to ensure that you will be prepared for and will be admitted to post-graduate study in that field?

### SUMMARY

The purpose of this chapter was to orient you to the engineering education system. By understanding that system, you will be better able to make it work for you.

First, we described how the engineering college fits into the overall organization of the institution. We then discussed the role of community colleges in delivering the first two years of the engineering curriculum.

Next, we reviewed the criteria that each engineering program must meet or exceed to receive accreditation from the Accreditation Board for Engineering and Technology (ABET). The various criteria apply to eight areas: students, program educational objectives, student outcomes, continuous improvement, curriculum, faculty, facilities, and institutional support.

We also discussed academic advising, which addresses curricular and career matters. Ways were outlined for you to ensure that you receive sound academic advising, regardless of the advising system in place at your engineering college.

Then we described various academic regulations, policies, and procedures. By understanding what these entail, you can ensure that the system works for you, not against you. We also discussed the important area of student rights, including the right to petition and to file grievances.

Along with these rights comes responsibility. We therefore discussed the responsibility of students to behave ethically and honestly.

Finally, we discussed opportunities to continue your education beyond the B.S. degree. Graduate study in engineering can lead you to M.S. and Ph.D. degrees. Opportunities to seek post-graduate education in other professional fields including business administration, law, and medicine were also described.

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## PROBLEMS

1. Find out the names of the people in the following positions:
  - a. The chair or head of your engineering department
  - b. The dean of your engineering school or college
  - c. The vice chancellor or vice president for academic affairs
  - d. The chancellor or president of your university

2. Locate and read the following:
  - a. The mission statement of your institution
  - b. Educational objectives and student outcomes of your engineering programAre the educational objectives and student outcomes consistent with the mission statement of the institution? Write a one-page paper discussing how they are or are not consistent.
3. Rank the (a) - (k) outcomes in Criterion 3 of the ABET Engineering Criteria 2000 in order of importance in preparing an engineering graduate for a productive career as a practicing engineer. Prepare a two-minute talk describing why you ranked the #1 item as most important.
4. Visit two engineering professors during their office hours. Ask each to rank the (a) - (k) outcomes in Criterion 3 of the ABET Engineering Criteria 2000 in order of importance. Ask each to explain why they ranked their #1 item as most important. How does their ranking compare to yours? Prepare a five-minute presentation about what you learned.
5. Identify the courses in your engineering curriculum that meet the ABET requirement for one year of mathematics and basic sciences. Do these courses equal or exceed 32 semester units (or 48 quarter units)?
6. Find out where you will learn the following computer skills in your engineering curriculum:
  - a. Programming languages
  - b. Word processing
  - c. Computer-aided design
  - d. Spread sheets
  - e. Database management systems
  - f. Computer graphics
  - g. Data acquisition
7. Assuming you have already devised a road map showing the courses you will take to meet the requirements for your engineering major, review this plan with your academic advisor and revise it based on the feedback you receive.
8. Research the academic advising system in place in your engineering college. Write a one-page description of that advising system, including your critique of how well it works for students.
9. Does either your engineering college or your engineering department publish an *Engineering Student Handbook*? Obtain a copy and read it thoroughly. Write a one-page paper summarizing what you learned that will be of benefit to you.
10. Find out your university's regulations regarding the following academic issues:
  - a. Taking courses Credit/No Credit
  - b. Incompletes
  - c. Repeat Grade Policy
  - d. Credit by Examination
  - e. Probation
  - f. Disqualification
  - g. Dean's List
  - h. Honors at graduation

11. A student completes one semester with the following grades:

| Course         | Units | Grade |
|----------------|-------|-------|
| Math 181       | 5     | A     |
| Chemistry 150  | 5     | C     |
| Engineering 10 | 1     | A     |
| Physics 110    | 3     | B     |

- What is the student's GPA for the semester? Give the answer to two decimal places.
12. After you have completed 100 units, your overall GPA is 2.4. During the next term you take 16 units and achieve a 3.4 GPA for the term. What is your overall GPA then? If your overall GPA was 3.4 after 100 units and you take 16 units and make a 2.4 GPA for the term, what is your overall GPA then? What is the point or *message* of this exercise?
13. Determine whether your university has a *Statement of Student Rights*. Obtain a copy and compare it to the rights discussed in Section 8.5.
14. Determine whether your university has a *Student Code of Conduct*. If it does, obtain a copy and review the list of actions that warrant disciplinary action.
15. Write a brief opinion as to how you would handle each of the ethical dilemmas posed in Section 8.6. Discuss your responses with at least one other student.
16. Find out how you go about changing your major from one engineering discipline to another at your institution. Are some disciplines more difficult to get into than others? Which discipline is the most difficult to get into?
17. Investigate the graduate programs available in engineering at your institution. Which engineering programs offer M.S. degrees? Which engineering programs offer Ph.D. degrees? Write down the requirements (e.g., GPA, Graduate Record Examination scores, etc.) one needs to be admitted to a graduate program in your major.
18. Consider whether you are interested in pursuing one of the three non-engineering careers discussed in Section 8.8. Locate an advisor in the area of your greatest interest (MBA, pre-law, pre-medicine) and seek additional information.