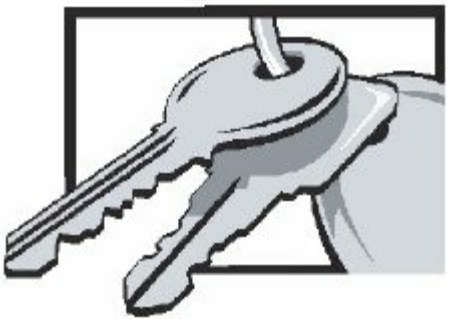


CHAPTER 1

KEYS TO SUCCESS IN ENGINEERING STUDY

Success is getting what you want;
happiness is wanting what you get.
— Dale Carnegie

INTRODUCTION

This chapter introduces you to engineering study – both the process that will ensure you succeed and the benefits you will get from doing so.

First, we make our best effort to convince you that you can do it: that success in engineering study, like success in anything you attempt, is a process that you can learn and master just like the many, many other successful students who came before you did.

We point out, however, a mindset that keeps some high-ability, well-prepared students from mastering that process – overconfidence. Students who naively assume that their ability will carry them through engineering study as it did in high school can have a rude awakening.

Next, we discuss two concepts fundamental to success: "goal identification" and "goal clarification." We also emphasize the importance of strongly committing to your goals once you have identified and clarified them.

Then, we present three important keys to success in engineering study:

Effort – *Work hard*

Approach – *Work smart*
Attitude – *Think positively*

As these keys to success suggest, achieving any challenging goal depends largely on your attitudes and behaviors – and for many students that means changing them.

Next, we offer two models to help you understand the skills and knowledge you will get from a quality engineering education, plus a third model to guide you towards obtaining that quality education.

We close the chapter by discussing the need for you to structure your life in ways that will minimize distractions and interferences. Only by doing so will you be able to devote adequate time and energy to your studies and take advantage of the many resources available to you.

The material introduced in this chapter will provide a foundation for you to build on as you study the other chapters of this text.

1.1 YOU CAN DO IT!

From time to time, I meet practicing engineers who tell me about the time when they were first-year engineering students and the dean told the students in their *Introduction to Engineering* class:

Look to your right; look to your left. Two of the three of you won't be here at graduation.

It doesn't surprise me that engineering deans (and professors) may say such upsetting things to students. They think that by scaring students about engineering study, the students will be more motivated to succeed.

What does strike me, however, is how angry these practicing engineers are at the dean for having given them such a negative message. And in some cases the event happened some 30 years before! These former students are still upset that the dean tried to frighten them at a time when they were unsure of themselves and easily intimidated.

When I meet with first-year engineering students, I convey a very different message. My message to them and to you is:

Each and every one of you can be successful in graduating with your Bachelor of Science degree in engineering.

How can I make such a bold statement without any specific information about your background or your ability? I'll tell you how.

POORLY PREPARED STUDENTS HAVE SUCCEEDED

For ten years I directed a program designed to enhance the academic success of engineering students. During that period I worked closely with more than 1,000 students. We had students with very poor preparation and limited ability: students who had to take college algebra three times before making a passing grade; students who failed trigonometry and had to repeat it, and then took Calculus I, received a *"D"* and had to repeat it. Some of those students took more than nine years of full-time study to complete their engineering degree.

I ran into one of those students many years later. He was a successful professional engineer and a respected member of his community. When I saw him, he was on the way to drop his daughter off at a relative's home so he could fly to Washington, D.C. for an important meeting.

HIGHLY QUALIFIED STUDENTS HAVE FAILED

I also worked with students who had all the preparation in the world – students who had gone to the best high schools and had excelled in their advanced mathematics and science courses. Yet they did not succeed in engineering study. Some flunked out. Some just dropped out.

The common denominator for such students was that they were overconfident. They had been able to excel in high school without a great deal of effort or a need to adopt effective learning strategies. And they made the mistake of assuming that engineering study would be like high school. They naively believed that their ability would carry them through as it had before. They failed to account for the fact that the faster pace and higher expectations for learning would require substantially more effort and improved learning skills. They didn't recognize that they had moved from the minor leagues to the major leagues, where the students they were competing against had much more ability.

A few of those students have come back to see me. They express their deep regret for not sticking it out. It saddens me to hear they're

working in unrewarding jobs for minimum salaries and would like to come back to school, but now the circumstances of their lives prevent them from having a second chance.

I hope you are not such a student. One early indication of this is how receptive you are to the material presented in this book. Thinking there is nothing of value here for you is a sign that you are overconfident. If you are, I hope you will consider this section as a **wake-up call**.

You can ignore this warning with the intent of shifting gears later. The problem with that approach is your early courses, particularly in mathematics and science, provide the foundation on which your entire engineering education will be built. If you start out with a weak foundation, you will find it difficult, if not impossible, to build a sound structure on top of it.

REFLECTION

In the previous two sections, we noted that "poorly prepared students have succeeded" while "highly qualified students have failed." Do you see something of yourself in either category? Do you lack confidence? If so, are you beginning to believe you can do it? Or are you overconfident? If so, are you beginning to become receptive to learning new strategies and approaches for your engineering studies?

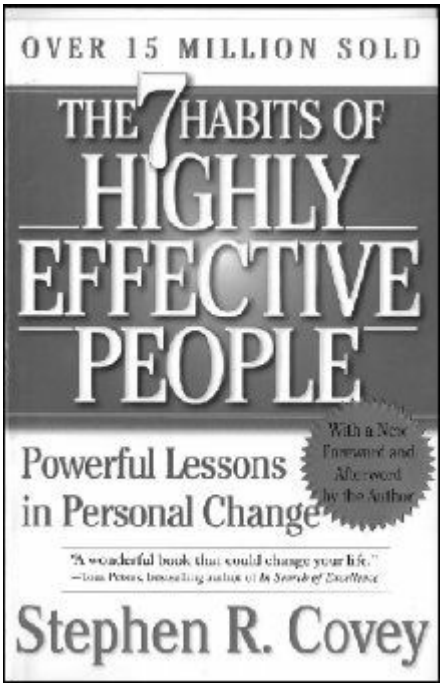
WHAT MAKES THE DIFFERENCE?

One student with seemingly limited ability and poor preparation succeeds. Another student with outstanding ability and excellent preparation fails. How can that happen? What are the keys to success in engineering study? What are those things you can do that will virtually ensure your success – those things that, if not done, will at best result in your working below potential and even lead to failure?

Success in engineering study is not unlike success in anything you have attempted or will attempt. Achieving success is a process, and each step in the process can be learned. I would encourage you to make a

commitment to become an "expert" on success. It's something that you can do. And the payoff will be enormous.

Lots of resources are available to help you. You can learn from others, from reading books such as Stephen Covey's *The Seven Habits of Highly Effective People* [1], listening to audio CDs, tapping the wealth of information available on the Internet, and attending short courses and workshops.



The Internet is an easy, reliable guide for identifying the resources that best speak to you.

For online reading material, Google "success." If the results are overwhelming, try narrowing your search to "student success strategies" or even "engineering student success strategies." Play around with keywords until you hit on the most promising results.

For books and CDs, www.amazon.com is golden. Under "books" enter the keyword "success." To locate audio CDs, click on "audiobooks," followed by the keyword "success."

You'll find videos and lectures about success on www.YouTube.com and www.ted.com. Go to one of these websites and

conduct a search on the keyword "success."

Then too, don't ignore the many resources listed at the end of each chapter of this book. Make learning about success one of your life goals. If you work at it, your capacity to be successful will expand and grow. You might even surprise yourself at what you can achieve.

And who knows? Maybe someday you'll write a book on *success* for others. When I was sitting in your seat, I could never have imagined I would someday write a book like this one.

1.2 WHAT IS "SUCCESS"?

I assume you want to be successful. I hope that's why you are reading this book. But just wanting to be successful is not enough. Everyone wants to be successful. Often when speaking to an *Introduction to Engineering* class, I'll ask the question, "How many of you want to be successful?" All of the students raise their hands. But what do the students mean when they indicate they want to be successful? Are they all thinking about the same thing? Probably not.

When I ask the same students, "What is *success*?" I get a variety of answers:

- *Success* is being happy.

- *Success* is making money.
- *Success* is having control over your life.

But almost always one or more students will give the correct answer:

- *Success* is the achievement of goals.

Webster's Dictionary says essentially the same thing:

> ***Success* is the achievement of something desired, planned, or attempted.**

The point is that unless you have something "desired, planned, or attempted," there can be no success.

Unfortunately, many students lack a clear goal and commitment to that goal necessary for success. According to Vincent Tinto, author of an excellent book on student success [2], the top two reasons that students do not succeed in college are:

(1) Lack of Intention – Students do not have a clear educational and/or career goal.

(2) Lack of Commitment – Students do not have the motivation and drive to work toward attaining their educational/career goals.

Identifying a clear goal and developing a strong commitment to that goal are the essential first two steps in the process of achieving success.

REFLECTION

Reflect on the relationship between *success* and *happiness*. What does each of these words mean to you? Does success bring happiness? Can people be happy if they are not successful? Think about Dale Carnegie's quote at the beginning of this chapter: *Success is getting what you want; happiness is wanting what you get*. Do you usually get what you want? Do you usually want what you get? What insights can you derive by contemplating the relationship between *success* and *happiness*?

GOAL SETTING

If success requires a goal, let's discuss goal setting. Obvious though it may sound, the basic idea behind goal setting is:

How can you ever expect to get somewhere if you don't know where you want to go?

That is, setting goals – having specific ideas of what you want to accomplish in the short and long term – is a key requirement to becoming an effective student and professional. Only when you set goals will you have something to strive for and something against which to measure your progress.

<u>GOALS GIVE YOU SOMETHING TO MEASURE YOURSELF AGAINST</u>. Consider, for example, two engineering students in a calculus class who score a "*B*" on their first exam. One student is extremely unhappy and resolves to study much harder for the next exam. She has set a goal of earning an "*A*" in the course and by falling short on the first exam, she knows that she must work more. The other student, however, is content with the "*B*" grade and so decides he can increase his outside work hours since even less study is necessary than he thought.

These different responses results from the different expectations these two students have , based on their goals. This illustrates how

success or failure can only be measured according to self-imposed goals.

Goals Give Your Life Direction. I'm sure you were asked many times during your childhood, "What do you want to be when you grow up?" If you didn't know, you probably felt a bit frustrated and even irritated at people who asked you that question.

I hope you realize by now that they were trying to help you. They were trying to alert you to the importance of setting directions for your life. They probably even realized intuitively that the more reluctant you were to grapple with this question, the more important it was that you of all people do so.

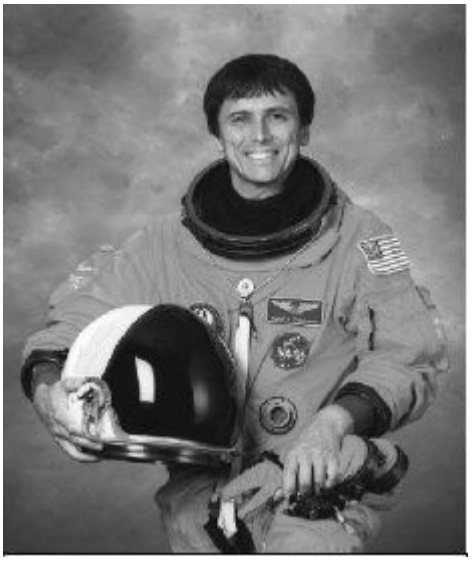
Setting goals may not be easy, but the payoff is definitely worth the effort, as the stories of many successful people indicate. Following is but one such story.

Astronaut Franklin Chang-Diaz

Dr. Franklin Chang-Diaz is one of the most accomplished astronauts at NASA. A veteran of six space missions, he has logged nearly 1,300 hours in space. But when you hear the story of his life, you wouldn't think he'd end up in such a prestigious position.

Chang-Diaz was born and raised in Costa Rica. As a child he was enamored by U.S. space program. He and his friends used to build

spacecrafts out of cardboard boxes, equipping them with broken radios, furniture, and other discarded material. They would then go through a countdown and lift-off and pretend to travel to distant planets.



Franklin Chang-Diaz

Because of his interest, Chang-Diaz set a personal goal of becoming a U.S. astronaut. Imagine a young Costa Rican citizen who didn't speak a word of English aspiring to be a U.S. astronaut!

When he finished high school, he worked for a year and saved enough money to buy a one-way airplane ticket to Hartford, Connecticut, where he had some distant relatives. In Hartford he repeated his senior year of high school, learned English, and was admitted to the University of Connecticut, where he majored in engineering. After graduating with honors, he began graduate study at MIT, eventually receiving his Ph.D. in plasma physics. He then applied for the astronaut program, was accepted, and became the U.S.'s first Hispanic astronaut.

To learn more about Dr. Chang-Diaz and his career as a U.S. astronaut, visit his NASA website at: www.jsc.nasa.gov/Bios/htmlbios/chang.html.

The point that the story of Dr. Chang-Diaz drives home so convincingly is the need to have goals. His story makes me wonder what I might have accomplished had I set such lofty goals.

WRITE DOWN YOUR GOALS. Right now your primary goal should be to graduate with your degree in engineering. But what else would you like to accomplish? Become president of your own company? Become a multimillionaire? Become a college professor? And what about your more immediate goals? Maybe you want to make a 3.0 GPA next term, improve your writing skills, or become president of one of the engineering student organizations.

A good exercise would be for you to write down your short-term, intermediate-term, and long-term goals. Consider what you want to accomplish in the next week, in the next month, in the next year, in the next five years. Review and update these lists regularly.

Start by making graduation in engineering one of your primary life goals.

REFLECTION

Think about how goals, dreams, and fantasies differ. What distinguishes each? Do you have goals? Dreams? Fantasies? What does it take to convert a dream into a goal?

STRENGTHENING YOUR COMMITMENT

Why did you choose engineering as your major? Perhaps because you were good in math and science, one of your high school teachers or counselors recommended that you study it. Or maybe you are doing it to please your parents, or you don't know what else to study. It is likely that you don't know a great deal about engineering. Few students do.

Regardless of your reasons for electing engineering, it is critically important that you develop a strong motivation to succeed. Engineering is a demanding field of study. Even a student with excellent preparation and strong ability will not succeed without a high level of commitment.

There are at least three practical strategies you can use to strengthen your commitment to success in engineering study:

(1) Clarifying your goals

(2) Learning as much as you can about engineering

(3) Developing a "road map"

CLARIFYING YOUR GOALS. What does it mean to clarify your goals? Very simply, it means answering such questions as, "Why do I want to achieve the goal?" "What will the payoff be?" "What will it mean to the quality of my life if I am successful in achieving the goal?" Clarifying your goals helps you understand their value to you. And by better understanding their value, you will become more committed to achieving them.

As noted earlier, many students know very little about engineering and what engineers do. In particular, they tend not to know about the tremendous rewards and opportunities that an engineering degree offers. Learning about these rewards and opportunities, as we will do in Chapter 2, will figure significantly into clarifying your personal goals.

LEARNING AS MUCH AS YOU CAN ABOUT ENGINEERING. As you

have grown up, you have been exposed to teachers, doctors, dentists, and numerous other professionals. You have a feel for what accountants do if you have had to manage your personal finances. You have seen lawyers at work on TV shows such as *Law and Order.* Through your coursework, you have developed some feel for what mathematicians, chemists, and physicists do. It is doubtful, however, that you have had much exposure to engineering. The exposure you have had has probably been indirect, through contact with the products that engineers design.

Learning about engineering is a lifelong process, but it should begin now. Take advantage of every opportunity that presents itself. You can start by studying Chapter 2 of this text thoroughly. Explore some of the many Internet websites referred to there, particularly those whose purpose is to help students learn about engineering. Attend seminars on career opportunities, go on field trips to industry, and talk with company representatives at career day programs. Browse the resource library in your career center. Become active in the student chapter of the professional engineering society for your major. Talk to your professors. Read biographies of successful engineers [3, 4, 5, 6, 7]. If you land a summer job in industry, be curious and inquisitive. Look around. Talk to the engineers there and find out what they do.

Over time, these efforts will pay off and your understanding of engineering will increase. Increased knowledge brings increased motivation. We tend to like things we know a lot about.

PREPARING A ROAD MAP. Remember when you were in elementary school and heard the term "algebra" and thought, "I'll never be able to learn that!" And later you were overwhelmed with the thought of mastering trigonometry or calculus. You assumed you wouldn't be able to handle such advanced subjects, but you were wrong. Each time you reached the next higher level, you were able to handle it, even excel at it. How did you do it? By taking lots of little steps, each one building on previous steps.

Often students ask me, “What does it take to succeed in engineering study?” My answer is, “You must be able to pass Calculus I at the university level.” My reason for this is very simple. If you can pass Calculus I, you can pass Calculus II. And if you can pass Calculus II, you can pass Calculus III. If you can pass Calculus III, you can then pass Calculus IV. And if you can pass these calculus requirements, you can pass the junior engineering courses. If you can pass the junior engineering courses, you can pass the senior engineering courses.

So you see, succeeding in your engineering program is a process of taking one little step after another. Progressing through the engineering curriculum is just an extension of what you have already demonstrated you can do.

I suggest you develop a “road map” that will lead you to graduation in engineering. Lay out a plan of what you will need to take each semester or quarter. Having a step-by-step road map to follow will increase your confidence and strengthen your commitment to achieve your ultimate goal: that B.S. degree in engineering.

Lou Holtz

DON'T LET ADVERSITY STOP YOU. Highly successful football coach, ESPN sports analyst, and motivational speaker Lou Holtz notes a primary difference between people who succeed and people who fail.

> ***People who succeed are people who, when they get knocked down by some adversity, get up; whereas, people who fail are people who, when they get knocked down, stay down.***

I would encourage you to read Coach Holtz's autobiography *Wins, Losses, and Lessons* [8]. Or you can hear from Coach Holtz by watching his 14-minute University of Portland 2012 commencement speech at www.youtube.com/watch?v=nkR0iVEcDEE.

The most likely reason you will fail to graduate in engineering is that you will encounter adversity and give up. You will have difficulty with a course or a professor. You might have a personal problem. Whatever adversity you are bound to experience, you will be tempted to use it as an excuse or justification for quitting. DON'T!

By strengthening your commitment following the steps outlined in the previous three sections, you will develop determination. The dictionary defines determination as "a firmness of purpose … [and] having one's mind made up." Determination means having an unwavering commitment to your goal: the goal of graduating in engineering. You must be determined to persist, particularly in the face of adversity.

A Personal Story

I dropped out of college early in my sophomore year. When I attempted to register for my second year, I learned I had lost my full tuition scholarship because of poor grades. Faced with having to take out a massive student loan and having broken my leg playing intramural football, I dropped out.

I had always wanted to be a jet pilot, so as soon as my leg healed, I went directly to the local Air Force Recruiting Office. To my chagrin I was told a college degree was required for acceptance into flight training. Soon I was back in school with newfound determination. That experience was a significant lesson to me that doors would be shut without a college education.

Adopt the view that you are going to achieve your goal and that nothing is going to stop you. And how do you keep adversity from stopping you? How can you keep failures from discouraging you? I find this age-old saying to be very helpful as a philosophical basis for overcoming adversity:

We learn more from our failures than we do from our successes.

It's true! Think about it.

Another Personal Story

When I was in the 7th grade, I took a gymnastics class. I was the best in the class on the pommel horse. So when we had a competition at the end of the term, everyone expected I would win that event. But when I began performing, I was so nervous I felt as if needles were pricking my skin all over. I came in last place. I was terribly embarrassed and ashamed. It took me a long time to get over that failure. But that experience showed me that if I take myself too seriously and want to win too much, I can actually perform much worse than I am capable of. That experience has helped me deal effectively with high-pressure situations ever since.

Learning to overcome adversity as a student will also benefit you during your professional career. Joseph J. Jacobs, founder and former CEO of Jacobs Engineering and one of the nation's most successful engineers, gives his "Nine Commandments for the Entrepreneur." The first four are:

(1) You must be willing to risk failure.

(2) You must passionately hate failure.

(3) Persistence is a necessity, as is the willingness to acknowledge defeat and to move on.

(4) A measure of your potential to succeed is how you handle adversity.

(I encourage you to read Mr. Jacobs' highly motivational autobiography, *The Anatomy of an Entrepreneur* [6].)

If you are determined to graduate in engineering, if you persist even in the face of adversity, if you take the view that you will not allow anything to stop you, the chances are very good that you will succeed.

Believe in yourself. You can do it!

REFLECTION

What do you think about the claim that "You learn more from your failures than you do from your successes"? Have you ever experienced a significant failure? What was it? What did you learn from that experience?

1.3 KEYS TO SUCCESS IN ENGINEERING STUDY

Setting a goal and making it important to you are only the first steps. The real challenge remains – achieving the goal. Once your goal is identified and you have done everything you can to develop a strong

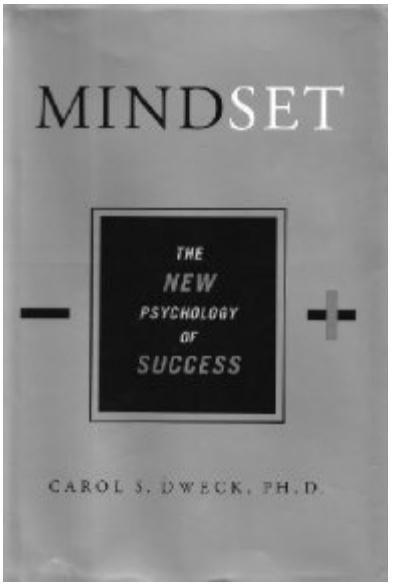
commitment to that goal, achieving it requires that you adjust both your attitudes and your behaviors. This means that you base your day-to-day decisions and choices on whether a particular action supports your goal (i.e., moves you closer to it) or conflicts with your goal (i.e., moves you farther away from it). The same applies to attitudes you hold.

In my experience there are three keys to success in engineering study:

Effort - ***Work hard***
Approach - ***Work smart***
Attitude - ***Think positively***

Let's examine each of these.

EFFORT – "WORK HARD"



Do you believe that people succeed because of their **ability** – that some people "have it" while others don't? Or do you believe that people succeed because of their **effort**? An excellent book that contrasts these two ways of looking at the world is *Mindset: The New Psychology of Success* by Carol S. Dweck [10].

The first belief – that some people have it and some don't – is self-defeating. Thinking you don't have as much ability as others provides a rationale for you to accept personal failures: You may as well give up. After all, if success is related to some natural quality that you have no control over, then it doesn't matter what you do or how hard you work.

Believing you're the smartest kid on the block has pitfalls as well. If you do, you're likely to feel the need to prove yourself over and over, trying to look smart and talented at all costs. Research has shown that people with this fixed mindset are more likely to stick with approaches that clearly don't work, while ignoring suggestions from others.

The second belief – that people succeed because of their effort – is empowering because the amount of effort you put in is in your direct control. You can choose to put in more effort and in doing so significantly affect your success.

The following table compares how people with fixed mindsets view challenges, obstacles, effort, criticism, and the success of others with

how people with a growth mindset view the same items.

	FIXED MINDSET	GROWTH MINDSET
Challenges	Avoid challenges; stick to what you know well	Embrace challenges; overcoming challenges makes you stronger, smarter
Obstacles	Give up easily when you encounter obstacles	Persist in the face of setbacks; failure is an opportunity to learn
Effort	See effort as unpleasant and fruitless; the need for effort is a sign of low ability	See effort as the path to growth and mastery
Criticism	Ignore useful criticism; see negative feedback as an insult	Seek feedback and learn from criticism
Success of Others	Feel threatened by the success of others	Find lessons and inspiration in the success of others

REFLECTION

Would you say you tend to have a fixed mindset or growth mindset? Think about the way you deal with challenges and obstacles. What is your view about effort? How do you deal with criticism? How do you view other peoples' success? Which mindset do you think would bring a person more success and more happiness in life? If you see some of the fixed mindset traits in yourself, what could you do to change your mindset?

ABILITY VS. EFFORT. The relative importance of ability and effort was perhaps best explained by the famous American inventor Thomas Edison:

Genius is one percent inspiration and 99 percent perspiration.

Does the following dialogue sound familiar to you? Over the years, I've had a variation of it with many of my students.

Landis: How's everything going?
Student: *Fine!*

Landis: What's your hardest course this term?
Student: *Physics: Electricity and Magnetism.*
Landis: How are you doing in that course?
Student: *Fine!*
Landis: What score did you make on the last exam?
Student: *Forty-three.*
Landis: What grade is that?
Student: *I don't know.*
Landis: Is it an *"A"*?
Student: *No.*
Landis: A *"B"*?
Student: *No.*
Landis: A *"C"*?
Student: *Probably not.*
Landis: A *"D"*?
Student: *Maybe.*
Landis: 'Sounds like an *"F"* to me. How many hours are you putting into your physics course?
Student: *About 15 hours a week.*
Landis: How many hours have you studied today?
Student: *I haven't done any studying today.*
Landis: How many hours did you study yesterday?
Student: *None.*
Landis: How about over the weekend?
Student: *I meant to, but just never got to it.*
Landis: So you're planning to study physics for five hours a day for the next three days to get your 15 hours in this week?

EFFORT IS BOTH TIME AND ENERGY. In my experience, poor academic performance can usually be traced to insufficient effort. Just what do I mean by "effort"? It is using energy, particularly mental power, to get something done.

The effort you devote to your studies has two components: time and

energy. An analogy can be made using the well-known physics formula:

Distance = Rate x Time

Completing a specific task (distance) requires that you devote energy or mental power (rate) and spend time on the task (time). In later sections, we will consider how much time is sufficient, what is the best use of that time, and when to put in that time if you want to be an effective and efficient student.

The important point here is that your success in studying engineering is largely **in your control**. How well you perform will depend, in large measure, on how much effort you put in. Accomplishing an academic task, like completing a homework assignment, will require you to devote adequate time and to focus your mental energy. These are things that you can choose to do or choose not do.

APPROACH – "WORK SMART"

"Approach" refers to ***how*** you go about your engineering studies. It

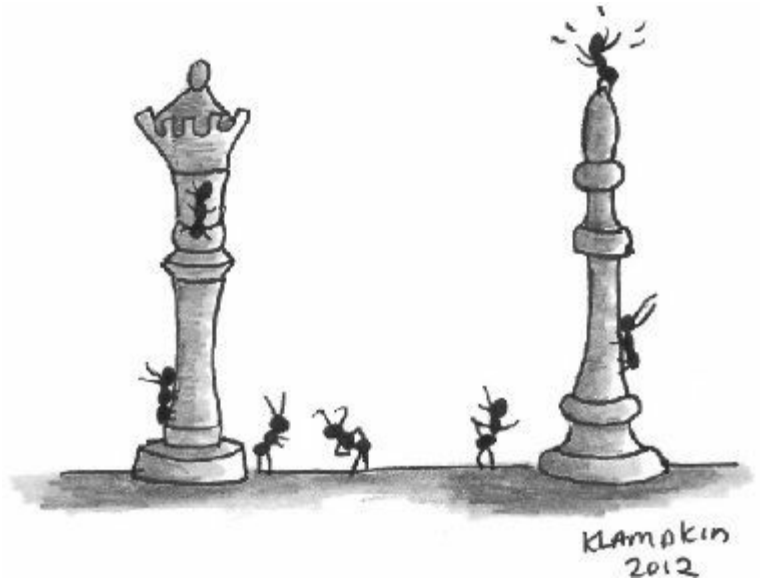
means that you work not only hard but smart. In large measure, your approach to your engineering studies depends on the ideas we have already discussed. It assumes that:

- You know why you want to be an engineer and appreciate the value of a technical education.
- You have clarified your goals and developed a road map to lead you to them.
- You have a strong commitment to achieving your goals, even in the face of adversity.
- You have gotten your life situation in order, so that you are not overburdened with problems and distractions.

Above all, however, your approach to your engineering studies – working "smart"– means that you learn to become a ***master*** engineering student.

BECOMING A MASTER STUDENT. To understand what I mean by becoming a *master* student, consider the following analogy. If you were to take up chess, what would you do? Learn the basic objectives, rules, and moves and then begin to play? Probably. But you'd soon discover that mastering a game of skill like chess requires much more. So you might read a book, take a lesson, or watch experts play. You would realize that to become a chess *master*, you need to spend time both playing the game and learning how to play it.

Your approach to the study of engineering can be likened to a game. To become a *master* student, you must not only play the game (i.e., be a student); you must also devote time and energy to learning how to play it (i.e., learn to excel as a student).



The first step in playing the game of becoming a master engineering student is to get a clear picture of what is required to earn your B.S. degree. Earlier, when discussing what it means to prepare a road map for yourself, I gave a brief synopsis of what you need to do to graduate in engineering. Let me give you a related description here.

You become an engineer when you pass a set of courses required for an engineering degree. What is required to pass each course in the set? Primarily passing a series of tests and exams. To pass the series of tests, you must pass each test one at a time. So by breaking down the education process this way, you can see that to become an engineer, you must become a master at preparing for and taking tests.

Of course, this is easier said than done, because many other factors are involved. But by approaching your engineering studies in this light, the "game" of becoming a master student and, ultimately, earning your engineering degree becomes less daunting.

As you read the subsequent chapters in this book, you will discover different ideas and perspectives on how best to approach your studies.

Learning to be a master engineering student will be a tremendously rewarding and beneficial experience. It will enhance your immediate success as a student, while developing important skills you will later need as a practicing professional engineer. Indeed, many of the

approaches you learn in this book will work for you in whatever you do in your life.

ATTITUDE – "THINK POSITIVELY"

Are you a positive or negative person? Are you aware of the role attitude plays in your success? What do you think of the following statement?

Positive attitudes produce positive results.
Negative attitudes produce negative results.

Among those negative attitudes that could produce negative results in engineering study are:

- Weak commitment to the goal of graduating in engineering
- Low self-confidence
- Unrealistic view of what's expected to succeed in engineering studies (overconfidence, naiveté)
- Lack of self-worth (leading to tendency to sabotage your success)
- External "locus-of-control" (i.e., adopting a "victim" role)
- Unwillingness to seek help (thinking that seeking help is a sign of

weakness)

- Resistance to change your behaviors and attitudes
- Tendency to procrastinate (having a negative view about the idea of managing your time)
- Avoidance of areas of weakness or perceived unpleasantness (e.g., writing, oral presentations, difficult courses)
- Reluctance to study with other students
- Negative view toward authority figures (parents, professors, engineering professionals)

REFLECTION

Think about each of the negative attitudes in the list above. Do any of the items describe you? If so, in what ways could you see that particular attitude interfering with your success in engineering study? Do you know why you hold this attitude? Are you willing to try to change the attitude? What would be a more positive attitude that you could adopt?

One of the primary purposes of this book is to help you become conscious of and change any negative attitudes you may hold that will impede your success in engineering study. You will learn the process for this change when you study Chapter 6: *Personal Growth and Student Development*.

SUMMARY OF THE SUCCESS PROCESS

In the previous sections we have discussed the "success process." Below is a summary of this four-step process as it applies to the goal of becoming an engineer.

Step 1: Setting goals	Do I want to be an engineer?
Step 2: Strengthening commitment to goals	How important is it to me to become an engineer?

Step 3: Changing negative attitudes	What attitudes will interfere with my goal of becoming an engineer?
Step 4: Changing non-productive behaviors	What do I need to do differently to achieve my goal of becoming an engineer?

This book will help you navigate this process.

- Chapter 2 will help you firm up your goal of becoming an engineer and deciding which discipline to specialize in.
- Chapter 2 will help you strengthen your commitment to becoming an engineer by providing knowledge about the field of engineering, while exposing you to the rewards and opportunities of an engineering career.
- Chapter 6 will aid you in the process of changing any negative attitudes to positive ones appropriate to success in math/ science/engineering coursework.
- Chapters 3, 4, and 5 will help you adopt the behaviors that will ensure you are studying "smart."

You can choose to devote time and energy to each step in the success process. For example, you might schedule Saturdays from noon to 2:00 p.m. to work on strengthening your commitment to success in engineering

study. Or you could devote another block of time to figuring out what behaviors you need to change to be a more effective student.

1.4 MODELS FOR VIEWING YOUR EDUCATION

One of the most positive and unique aspects of your college experience is that you are working for yourself to prepare yourself for your future. Consider the saying:

No deposit, no return.

Your education represents a major deposit, or investment, you are making in yourself. Your return will be in direct relation to what you put in. You must realize that whenever you take the easiest instructor, avoid a tough course, or cut a class, you are hurting yourself. Whenever you make a conscious choice to avoid learning, growing, or developing, you are not getting away with something: **You are working against yourself.**

Having a model from which to view your education will assist you in getting the most out of it. Earlier in this chapter, I gave simplified explanations of the engineering curriculum in order to demystify it for you. First, I described it as a required set of courses you must take.

Later, I broke down each course as a series of exams you must pass.

It is time now to broaden your view of your engineering studies because a quality education involves much more.

The purpose of the next three sections is to give you three models from which to view your education. These models will assist you in answering such important questions as:

- What is the purpose of my education?
- What should I know when I graduate?
- How do I know if I am getting an excellent education?
- How can I enhance the quality of my education?
- Will I have the knowledge and skills to get a job and be a successful engineering professional?

These models are also useful for all kinds of personal assessment or self-evaluation. My suggestion is that you measure yourself against each item presented in these models. In other words, ask yourself on a scale of zero to ten (ten being highest): *How would I rate myself on this item?* In areas you feel you are strong, just keep doing what you have been doing. In areas you need to improve, map out a plan to strengthen them. Personal assessment and development plans will be discussed in more detail in Chapter 6.

ATTRIBUTES MODEL

In today's tight fiscal climate, universities are being held more accountable for their productivity. Institutions are being asked to establish educational objectives (desired results) and student outcomes (achieved results), demonstrate how they plan to achieve these objectives and outcomes. This process is called *institutional assessment*. It is not unlike what happens to you in your classes. Your professor sets course objectives and has expectations of how well you should do in achieving these objectives. At the end of the term, the degree to which you meet these expectations is measured and translated in the form of a final grade.

One way engineering programs are held accountable is through the accreditation process administered by the Accreditation Board for Engineering and Technology (ABET). Understanding the accreditation process (discussed in more detail in Chapter 8) will help you better understand the engineering education you are receiving.

ABET, through its *Engineering Criteria 2000* [11], mandates that engineering programs must demonstrate their graduates have the following attributes:

ABET Attributes of Engineering Graduates

a. An ability to apply knowledge of mathematics, science, and engineering

b. An ability to design and conduct experiments, as well as to analyze and interpret data

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. An ability to function on multi-disciplinary teams

e. An ability to identify, formulate, and solve engineering problems

f. An understanding of professional and ethical responsibility

g. An ability to communicate effectively

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. A recognition of the need for, and an ability to engage in, lifelong learning

j. A knowledge of contemporary issues

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

This list of attributes provides a clear picture of what you should get from your engineering education. That is, when you complete your engineering degree, you will have the knowledge, skills, and attitudes you will need for a successful and rewarding career.

REFLECTION

Reflect on each of the attributes of engineering graduates required by ABET. Think about what is meant by each item on the list. Reflect on the perspective that this is a type of blueprint for what you should gain from your engineering education. Consider which areas are most appealing to you. Which areas are you likely to excel in? Design? Communication skills? Teamwork? Problem solving? Use of engineering tools? Experimentation? Ethical responsibility? Other?

EMPLOYMENT MODEL

A second model that may be useful to you in viewing your education is the Employment Model. Certainly, one reason why many students choose to major in engineering is the availability of jobs. In light of this, you need to consider what characteristics are important to employers and work to develop yourself in these areas.

An excellent recent study [12] conducted by the Corporate Member Council of the American Society of Engineering Education ranked the following attributes in order of importance for early-career engineering professionals:

1. Communicates effectively in a variety of different ways, methods, and media
2. Possesses the ability to think both critically and creatively
3. Shows initiative and demonstrates a willingness to learn
4. Functions effectively on a team
5. Possesses the ability to think both individually and cooperatively
6. Demonstrates an understanding of engineering, science, and mathematics fundamentals
7. Demonstrates an understanding of information technology, digital competency, and information literacy
8. Maintains a positive self-image and possesses positive self-confidence

Note that the top-ranked items are personal traits (communication skills, initiative, willingness to learn, critical and creative thinking skills, self-image and confidence, etc.). Technical knowledge, including understanding of math, science, engineering fundamentals and information technology, are ranked #6 and #7.

As you approach graduation, you will undoubtedly participate in a number of interviews with prospective employers. How you fare in those interviews will depend largely on how well you have prepared

yourself in the eight areas listed above.

Subsequent chapters in this book offer guidance and suggestions to help you acquire these attributes.

- **Chapters 3, 4, and 5** will address academic success strategies that will ensure you have strong scholastic qualifications.
- **Chapter 6** will instruct you in ways to develop your personal qualifications.
- **Chapter 7** will explain the value of active involvement in student organizations and engineering-related work experience.

STUDENT INVOLVEMENT MODEL

Let's assume that you want to get a *quality education* – i.e., to acquire the knowledge, skills, and attitudes that will result in your being highly sought after by engineering employers. How can you guarantee that you get that *quality education*? In fact, what do we mean by "quality" or "excellence" in education? We can find the answer in a classic paper by Alexander W. Astin titled "Involvement: The Cornerstone of Excellence" [13].

GETTING AN EXCELLENT EDUCATION. According to Astin, an "excellent" education is one that maximizes students' intellectual and personal development. He says the key to students' intellectual and personal development is a high level of "student involvement." Astin defines student involvement as:

the amount of physical and psychological energy that the student devotes to the academic experience.

He gives five measures of student involvement:

(1) Time and energy devoted to studying

(2) Time spent on campus

(3) Participation in student organizations

(4) Interaction with faculty members

(5) Interaction with other students

Put simply by Astin:

*A **highly involved student** is one who, for example, devotes considerable energy to studying, spends a lot of time on campus, participates actively in student organizations, and interacts frequently with faculty members and other students.*

Conversely, according to Astin:

*An **uninvolved student** may neglect studies, spend little time on campus, abstain from extracurricular activities, and have little contact with faculty members or other students.*

REFLECTION

Evaluate yourself based on Astin's five measures of student involvement. Would you describe yourself as a "highly involved student"? Or would you describe yourself as an "uninvolved student"? Do you agree that Astin's five measures relate to the quality of the education you are receiving? Are you willing to make changes to take advantage of Astin's model?

INVOLVEMENT IS UP TO YOU. The Astin "student involvement" model suggests that the quality of the education you get will depend primarily on the approach you take to your studies. Although your institution can do things to encourage you to study more, spend more time on campus, become involved in student organizations, and interact with your professors and fellow students, ***increasing your level of involvement is mostly up to you***. Don't leave it to chance. Be proactive!

You can choose to devote more time and energy to your studies, spend more time on campus, and become active in student organizations. You can choose to interact more with your professors and become more involved with other students. In doing so, you will greatly enhance the quality of your education.

1.5 STRUCTURE YOUR LIFE SITUATION

I hope that the ideas presented thus far in this chapter have convinced

you of the importance of making success in engineering study one of your primary life goals and have strengthened your commitment to that goal. One of the key objectives of Chapter 2 is to strengthen that commitment even more by increasing your understanding of engineering as a profession and giving you a clear picture of the rewards and opportunities that an engineering career offers you. With a clear goal and strong commitment to it, you are well on your way to achieving it. All that remains is to do it.

The first step in "doing it" is to create a life situation that supports your goal. Full-time engineering study is a major commitment, so you must be prepared to devote most of your time and energy to it. This means eliminating or minimizing any distractions or obligations that will interfere with your studies and work against your achieving your goal.

I often encounter students who are taking a full load of math/science/engineering courses while commuting over an hour each way to school, working 20 or more hours per week, meeting demands placed on them by their family, and trying to maintain an active social life. Students in such situations are very likely destined for failure.

Whether demands outside of school come from family, friends, work, or commuting, you need to make whatever changes are necessary so that you, too, don't program yourself for failure.

Living Arrangements

If at all possible, live on or near your college or university campus. The more immersed you can get in the academic environment of your institution, the better your chances of success will be. Commuting takes time, energy, and money; and living at home can present problems. Parents may expect you to help with the household duties. Little brothers and sisters may be noisy and distracting. Neighborhood friends may not understand your need to put your studies ahead of them. Wherever you live, however, remember that now is a time in your life when it's appropriate to be a bit selfish. Place a high value on your time and learn to say no when necessary.

Regardless of your living arrangement – at home with parents, in an apartment alone or with a roommate, or in an on-campus residence hall – I would suggest that you come to campus early in the day and do your work there, rather than coming only to take classes and leaving as soon as possible. Your university or college campus is an academic place. Its primary purpose is to facilitate the teaching/learning process. And it's set up to do just that. Whereas, at home, apartment, or residence hall there are many distractions (TV, DVR, refrigerator, friends, parents, siblings), on campus there are lots of resources (professors, other students, places to study, library resources, tutors).

I would encourage you to approach your engineering study much as you would a full-time job in that you go to your "place of work" and do the greater share of your work there, perhaps bringing some work home, but certainly not all.

Sometimes you'll hear the viewpoint that students at residential campuses get more out of their education than students at commuter campuses. Putting the approach outlined in the previous paragraph into

operation, in effect, brings all the benefits of a residential student to a commuting student.

Part-Time Work

As noted above, full-time engineering study is a full-time commitment. Working up to ten hours a week at a part-time job is probably okay, but more is almost certain to take its toll on your academic performance. While it may be essential for you to work, it may also be that you are working to afford a nice car, expensive clothes, or other non-essentials. Look at it this way. You may get a job for $8-10 an hour now, but in doing so you will jeopardize your education or at best extend the time to graduation.

The average starting salary for engineering graduates is around $30 an hour ($60,000/year). If your career is successful, someday you might make more per hour than students make per day. So try to delay as many material wants and minimize family obligations as possible. By doing so, you will have much more in the long term.

If you must work while going to school, particularly if your work exceeds ten hours per week, how can you achieve a reasonable balance between working and studying? One way is to follow the guidelines below.

Hours worked	Course load
10 hrs/wk	full load
20 hrs/wk	12 units
40 hrs/wk	8 units

Another way to manage your study and workload is to follow the "60-Hour Rule" espoused by Dr. Tom Mulinazzi, Associate Dean of Engineering at the University of Kansas [14]. His is not a rigid rule, but rather a guideline. It doesn't apply to a single week but is a pretty good rule-of-thumb over the long haul.

The 60-Hour Rule (according to Dean Tom Mulinazzi)

The "60-Hour Rule" is an excellent guideline to follow. I have shared it with first-year students in an *Introduction to Engineering* course each fall.

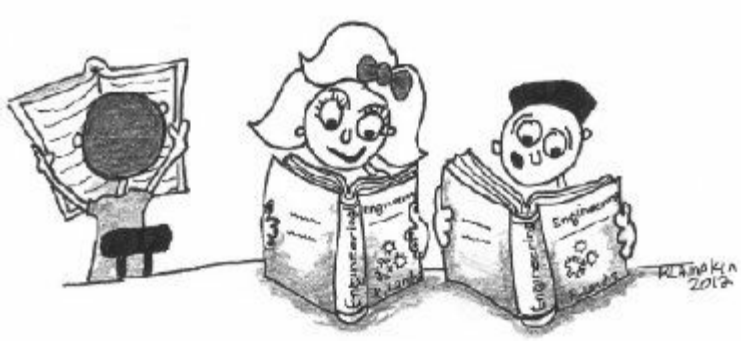
The Rule assumes that a student can work for 60 hours a week over the period of a term. This work includes academic work, work at a paying job, and time spent commuting. It also assumes that a student studies two hours for every hour spent in the classroom.

Let's say that a student is working 20 hours on campus. Subtract 20 from 60 and the result is 40. Divide 40 by three (one hour in class and two hours studying per week for every credit hour) and the result is 13. This means that most students can take 13 units of coursework and derive satisfactory results while working 20 hours. Ninety-five percent of the engineering students who are dismissed from the University of Kansas, School of Engineering, violate the 60-Hour Rule.

From time to time, I encounter a student who is taking four courses each term but passing only two of them. When I suggest that the student reduce his or her course load, the typical response is, "I can't do that. It'll take me forever to graduate!" Obviously, though, such students are moving through the curriculum at the rate of only two courses per term. The point is, be realistic about your situation. Don't create an unmanageable workload and then deceive yourself into thinking it is working.

Influence of Family and Friends

Because family member and friends may not understand the demands of engineering study, they may unintentionally distract you. If your family members pose problems, have a frank talk with them. Let them know that you want to make school your number-one priority. Ask for their help and negotiate clear agreements about their demands on you.



If you are a recent high school graduate, dealing with friends from high school – especially those who are not pursuing a college education – may be difficult. These friends may put pressure on you to spend as much time with them as you did in high school, while you may find you not only don't have time for them, you also have less and less in common with them.

If you find yourself in this situation, you alone will have to decide how to handle it, as there are no easy answers. But it is important to be realistic and understand the consequences of your choice to study engineering. By making this choice, you are moving yourself in a different direction that may increasingly distance you from your old friends, while bringing you into contact with new people and peers – and opportunities for new friendships.

However you decide to deal with your old friends, by all means do not let them keep you from the opportunities to develop new friendships at school.

I can't encourage you enough to cultivate relationships with your fellow engineering students, for befriending them will be tremendously rewarding. Not only will you likely be initiating important lifelong relationships, you also will derive the immediate benefits of being able to integrate your academic and social lives, while building a support system in which "friends help friends" achieve the same academic goals. If you've watched the TV series *Community*, you know what I'm talking about.

REFLECTION

Think about your life situation in terms of the factors presented in the previous sections. Are there things that come to mind about your living arrangements, workload, or expectations/demands of family and friends that need to be changed if you are going to be successful in engineering study? List those things and come up with ways to bring about the needed changes.

SUMMARY

This chapter introduced you to the keys to success in engineering study. We first focused on the importance of making graduation in engineering your primary goal.

Next we presented three strategies for strengthening your commitment to that goal: (1) clarifying why you want to be an engineer, (2) learning as much as you can about engineering, and (3) developing a step-by-step guide, or "road map," for you to follow.

We noted that achieving a goal requires you to adopt appropriate attitudes and behaviors. We also discussed the importance of effort, in terms of both time-on-task and mental energy. Last, we explored the importance of the approach you take to your engineering studies. We saw that success not only means that you study hard but also that you study smart.

Three models were then presented to help you understand what a quality education entails.

(1) The first model lists the attributes all engineering graduates should have as mandated by the Accreditation Board for Engineering and Technology (ABET).

(2) The second model focuses on the qualifications that employers seek when considering candidates for entry-level engineering positions.

(3) The third model stresses the importance of "student involvement" to ensure you get a quality education.

Each of these models identifies the knowledge, skills, personal qualities, and behaviors that you need to develop during your college years. Each model also identifies specific areas against which you can assess yourself. Doing periodic personal assessments will call attention to your strengths and areas for improvement.

The chapter closed by talking about the need to structure your life situation so that it supports your goal of graduating with an engineering degree. The gist of this discussion centered on your ability to balance the demands of your school work with outside demands – jobs, family, friends, and all other sources – so that you reserve adequate time to

devote to your studies.

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PROBLEMS

1. Have any of your teachers or professors ever done anything to make you feel as though you couldn't make it? What did they say or do? Why do you think they said or did that?
2. Discuss the relationship between *success* and *happiness*. What is the definition of each of these words? Does success bring happiness? Can people be happy if they are not successful?
3. Do you have a personal goal of graduating with your bachelor of science degree in engineering? How important is that goal to you? How can you make it more important?
4. Develop a list of 20 goals you would like to accomplish in your lifetime. Be bold!
5. Establish a goal for the grade you want to achieve in each of your courses this term. What GPA would this give you? How would it compare to your overall GPA?
6. List ten benefits that will come to you when you graduate in engineering. Rank them in order of importance to you.
7. List ten tasks that an engineer might perform (e.g., write a report, conduct a meeting, perform a calculation). Rank them in the order that you would most enjoy doing. Explain your ranking.
8. Read a biography of a famous engineer. Write a critique of the biography. Include a discussion of what you learned from the book that will help you succeed in engineering study.
9. Do you believe the statement, "You learn more from your failures than you do from your successes"? Have you ever experienced a significant failure? What was it? What did you learn from that experience?
10. Have you ever achieved anything that others thought you couldn't achieve through sheer determination? What was it?
11. How many hours do you think you should study for each hour of class time in your mathematics, science, and engineering courses? Is this the same for all courses? If not, list four factors that determine how much you need to study for a specific class.

12. Ask one of your professors why he or she chose teaching as a career (rather than professional practice).
13. Would you rather tackle an easy problem or a difficult one? Which do you think would benefit you more? Make an analogy with the task of developing your physical strength.
14. List five things you could do to study "smart" that you are not currently doing. Pick the two most important ones and try to implement them. Prepare a brief presentation for your *Introduction to Engineering* class that discusses your success or lack of success in implementing them.
15. List six things that your professors can do for you beyond classroom instruction.
16. If you spend 100 hours studying, how many of those hours would you be studying alone? How many would you be studying with at least one other student? If you study primarily alone, why? List three benefits of studying with other students.
17. Check off any of the statements below that describe your attitude.

ATTITUDE	
My commitment to success in engineering study is weak.	
I lack confidence in my ability to succeed in engineering study.	
I have a tendency to sabotage my success.	
I tend to blame others for my failures.	
I don't see any need to change myself or to grow or develop.	
I am generally unwilling to seek help from others.	
I tend to procrastinate, putting off the things I need to do.	
I tend to avoid doing things that I don't enjoy.	
I avoid contact with my professors outside of class.	
I prefer to study alone rather than with other students.	

For any of the items you checked, answer the following questions:

a. Is this attitude working for you (positive attitude) or working against you (negative attitude)?

b. If the attitude is working against you, can you change it? How?

18. Rank ABET's list of attributes of engineering graduates presented in Section 1.4 in your order of importance. Meet with your engineering advisor or an engineering professor to discuss your ranking.

19. List ten skills or attributes that you need to work effectively with other people. How can you go about acquiring these skills and attributes?

20. Find out if your engineering college has a list of attributes it strives to impart to its graduates. If so, how does it compare with the list in Section 1.4?

21. Rate yourself on a scale of zero to ten (ten being highest) on the following items:

DESCRIPTION	RATING
Writing skills	
Oral communication skills	
Ability to work on teams	
Commitment to becoming an engineer	
Understanding of professional and ethical responsibility	
Knowledge of contemporary issues	
Recognition of the need for lifelong learning	
Knowledge of contemporary issues	
Computer skills	
Ability to apply knowledge of mathematics	
Ability to apply knowledge of science	
Participation in student organizations	
Studying collaboratively with other students	
Time and energy devoted to studying	
Time spent on campus	

Interaction with faculty members	
Overall grade point average	

22. Rate the items in Problem #21 above on a scale of zero to ten (ten being highest) as to their importance.
23. Develop a method for determining which of the items in Problem #21 need your greatest attention. (Hint: Use the 2 × 2 matrix below.) Which quadrant contains items that need your greatest attention? Which quadrant contains items that need the least attention?

ATTITUDE	
My commitment to success in engineering study is weak.	
I lack confidence in my ability to succeed in engineering study.	
I have a tendency to sabotage my success.	
I tend to blame others for my failures.	
I don't see any need to change myself or to grow or develop.	
I am generally unwilling to seek help from others.	
I tend to procrastinate, putting off the things I need to do.	
I tend to avoid doing things that I don't enjoy.	
I avoid contact with my professors outside of class.	
I prefer to study alone rather than with other students.	

24. From the list in Problem #21, pick the three items that need your greatest attention and the three items that need your least attention. Develop a plan for self-improvement for those that need your greatest attention. Implement the plan.
25. Which of the items in Problem #21 have to do with your skills? With your attitude? With your approach to your studies?
26. Make a list of factors that interfere with your ability to perform academically up to your full potential. How many of these are external (e.g., job, family, friends)? How many are internal (e.g., lack of motivation, poor study habits, etc.)? Which of these interferences can you reduce or eliminate? Develop a plan to do so.
27. Apply the "60-Hour Rule" presented in Section 1.5 to your situation. Based on that rule, how many credit hours should you be taking? How

many are you taking? Are you Overcommitted? What can you do about it?

28. Who are your best friends? Are they engineering majors? How many engineering majors do you know by name? What percentage of the students in your key math, science, and engineering classes do you know? How could you get to know more of them?