# The Keys to Success

The most successful engineering students exhibit the following characteristics in their approach to study:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Associated Behavior</th>
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</table>
| **Commitment** | • Decide to be successful. Failure is *not* an option!  
• Set appropriate goals  
• Stay focused  
• Stay determined to succeed  
• Believe in yourself and your own abilities. You are college material, and you *can* do the work!  
• Remember: You are doing this for you and for no one else! |
| **Application** | • Apply yourself fully to attain your goals  
• Work hard – you cannot be successful without hard work! |
| **Strategy** | • Work smartly and efficiently  
• Maximize effectiveness  
• Learn the rules of the game and play accordingly |
| **Perseverance** | • Don’t give up after the first, second, or even third tries  
• Expect to get stuck at some point. Adversity is inherent in engineering study: it’s part of the process  
• Keep going, and work through your adversity  
• Stay focused on your goals  
• Use power thinking! Ingenuity increases with perseverance |
| **Associations** | • Associate with people that maintain a positive attitude; people that will help you attain your goals  
• Avoid underachievers and those who do not share your objectives |

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## Working Smart: The Rules of the Game

- Before starting a course, be familiar with the prerequisite materials
  - Most engineering courses start from where the prerequisite course ended
  - If you are “fuzzy” on the prerequisite course material, spend some time reviewing
  - If in doubt, ask the course instructor
- Make the most of lectures and classroom time.
  - Lectures are used by the course instructor to…
    - …highlight the most important material
    - …demonstrate important problem solving techniques
  - Textbooks should be used as a supplement, and not a substitute, for classes
- Write structured, clear solutions to all problems
  - A clear solution procedure makes it easier for you to identify errors
  - A clear solution procedure makes it easier for the course instructor to grant partial credit
  - Keep any problems you have completed available for later study. A compendium of detailed solutions facilitates exam review
- Know the difference between a *solution* and an *answer*
- Assignments indicate a required standard, and represent the most important portions of the course material
- Practice solving problems, and *ask* if you need help.
  - Forming study groups with other students may be helpful
The Keys to Success

Working Smart: The Rules of the Game (continued)

- Develop an effective examination technique
  - Simply knowing the material does not necessarily translate into success on examinations. You must specifically train and study towards each exam
  - Rehearse for each exam
    - Use old practice tests from previous semesters
    - Work in a quiet place, and try to avoid being interrupted
    - Time yourself, so that you will be working under the same constraints as will be present during the real exam
  - During the exam, write clear, logical and detailed solutions to win as much partial credit as possible
- Develop an effective solution technique for homework and test problems
  - Stage 1
    - Acquaint yourself with the details of the problem
    - Define the goal
    - Decide that the goal is attainable
  - Stage 2
    - Try some obvious solutions, working from your class notes or textbook (if available)
    - Adversity is likely to set in at this stage. Don’t give up!
  - Stage 3
    - At this stage, you are well-acquainted with all the details of the problem, and are highly focussed
    - You continue to try various solution techniques, and may seek help from your instructor or another student
    - At this point, you are likely to solve the problem

Introduction to Engineering

- Engineering: A process that applies mathematics and physical science to the design and manufacture of a product or service for the benefit of society
- The traditional engineering disciplines include
  - Mechanical Engineering
  - Electrical Engineering
  - Civil Engineering
  - Chemical Engineering
  - Industrial Engineering
- More recently, the following have been recognized as full-fledged engineering disciplines
  - Materials Engineering
  - Computer Engineering
- Areas of specialization within mechanical engineering include
  - Solid Mechanics
  - Fluid Mechanics
  - Thermodynamics
  - Mechanical Design
- Areas of specialization within electrical engineering include
  - Electric Power Engineering
  - Communications
  - Control Systems Engineering
  - Digital Systems Engineering
  - Electronics
Areas of specialization within civil engineering include:
- Construction Engineering
- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Surveying
- Transportation Engineering
- Water Resources Engineering

Areas of specialization within chemical engineering include:
- Polymer Engineering
- Biotechnology
- Process Control Engineering
- Environmental Engineering
- Engineering Management
- Oil and Natural Gas

Industrial engineering is concerned with how to design, organize, implement and operate the basic factors of production (materials, equipment, people, information and energy) in the most efficient manner possible.

Materials engineering deals with the production, processing, application and design of new materials.

Computer engineering draws from both electrical engineering and computer science. It deals with the design and implementation of computer systems in which both the hardware and software components are critical to the success of the design.

Analytical Engineer: Deals with the mathematical modeling and analysis of engineering problems.

Experimental Engineer: Concerned mainly with testing and evaluating physical prototypes. Experimental engineers tend to spend more time in a laboratory or out in the field than in the office.

Design Engineer: Involved in all aspects of the design process, and produces a detailed plan, or design, from which an actual product can be assembled.

Test Engineer: Tests new and existing products and processes to see whether they comply with the required design specifications.

Research Engineer: Concerned with the development of new and novel products, designs and processes. This research is usually applied, in that it is directed towards a fixed goal rather than being open ended.

Consulting Engineer: Works as an independent professional, and sells his/her expertise to clients, usually on a contract basis. Consulting engineers work in every engineering specialty.

Engineering Management: Engineers who combine engineering skills with managerial abilities to direct resources towards the efficient production of goods and services.
Introduction to Engineering Study

Success in a program of engineering study requires a different set of skills than you used to succeed in high school. The reasons for this include the following:

- Attending a university is not the same as attending high school
  - Higher standards
  - Better competition
  - Additional pressures (financial, social, etc.)
- You will need to obtain the skills necessary for success in college “on the fly.” These include
  - Appropriate study skills and strategies
  - Appropriate attitudes towards course work and study
  - Communication skills
  - Team skills -- the ability to work as part of a team
  - Time management skills -- the ability to prioritize
- Professors often assume that you know more than you really do when you enter their course, and they generally start with new material, without taking time at the beginning to review. This could pose a problem
  - You may have forgotten some of the prerequisite material
  - A prerequisite course taken at another institution may not have completely covered all required material
  - The upshot is that you may have to “catch up” on your own. At the very least, see the course instructor for help if you find yourself in this situation

Strategies for coping with the requirements of university study

- Expect the unexpected, and be willing to change your approach to a problem when necessary
- Ask questions. Course instructors, advisors, and upper class students are all willing to share advice with you on how to maximize your performance
- Get together with other first year students
  - Share problems, concerns and information
  - Study in groups, if at all possible
  - Socialize informally with your new university friends
- Get organized and manage your time efficiently
  - Use a notebook or calendar to write down your appointments, commitments and obligations
  - Establish both short term and long term goals
  - Create a schedule, and establish blocks of time for both study and other tasks. It is unrealistic to expect that you will devote all of your free time to studying
  - Try to stick to your schedule. Be willing to make adjustments to your schedule if you find that it is unworkable
- Before a course begins, know what your instructor assumes you know. Review prerequisite material, if necessary
Introduction to Engineering Study

- Cooperative Education Programs (Co-ops) and Engineering Internships: Programs which allow you relevant and productive paid work experience while still a student

- Why pursue a co-op or internship?
  - You gain valuable real work experience which prepares you for the future job market
  - You learn on-the-job skills which cannot be learned in the classroom
  - You have improved employment opportunities upon graduation
  - You gain exposure to the demands and expectations of an engineering career
  - You get to apply theory learned in the classroom to real problems
  - You learn to work in groups of people with various backgrounds
  - You make valuable networking contacts
  - You have the experience to make more informed decisions about your career path
  - You may get opportunities to sample more than one work environment

- There are subtle differences between co-ops and internships; however, both provide students with valuable experience that will give them a head start in their careers

The Role of the University

Lectures

- Attributes of a lecture
  - Most common of all instructional methods
  - Little interaction between the students and the instructor
  - Most often used in large (>50 students) classes

- What to expect from a lecture
  - Clear, logical presentation of material taken from a variety of sources
  - Material selected is geared towards assigned problems and exams
  - Generally covers relevant examples, required standards and other pertinent information

- Your role in a lecture
  - Prepare by reading assigned material
  - Do not expect to be entertained!
  - Sit towards the front of the room, and pay attention
  - Feel free to ask for a quick clarification (or to point out an error), but save longer questions for office hours
  - Reread, rewrite and review notes taken during lecture. See the instructor to clarify any unclear points
  - Expect that most real learning will take place during your study time, and not during the lecture itself
The Role of the University

Lectures with Student Participation (Active Lectures)

- Attributes of an active lecture
  - Most common in high schools
  - Most often used in smaller (<20 students) classes
- What to expect from an active lecture
  - Material is presented at a slower pace
  - Instructor will engage the class - ask questions, and present the material in a more conversational style
- Your role in an active lecture
  - Prepare by keeping up with all the readings and assignments
  - Pay attention
  - Participate
  - Think, respond and take notes

Tutorials, Seminars or Laboratories

- Often required in addition to scheduled lectures
- Mostly one-on-one and in small groups
- Questions which come up during lecture or while doing homework can be dealt with here
- Emphasis is placed on mastering the material
- Students benefit most by participating actively, and by preparing adequately at home before class (pre-labs, assigned problems, etc.)

The Role of the University

The role of a university professor is varied, and generally includes the following

**Duty**
- **Teaching:** Most professors generally teach between one and four courses per semester
  - Presentation of lectures in both undergraduate and graduate classes
  - Development of lectures and course materials (preparation)
  - Selection of course textbooks
- **Research**
  - Generating new knowledge in their field
  - Publishing results in peer-reviewed, scholarly journals
  - Presenting research results at conferences
  - Supervising graduate student research
  - Writing grant proposals to support future research
- **Service**
  - Serving on university and departmental committees
  - Service to professional organizations (ASME, IEEE, etc.)
- **Other**
  - Academic advising: Students are generally assigned to a professor who helps plan his/her course schedule
  - Office hours: Time which a professor sets aside to answer any student questions regarding course material (or any other issue which arises)
  - Career Counseling
  - Writing professional letters of reference for students applying to graduate school, for scholarships, or for jobs

**Requirements**

- Presentation of lectures in both undergraduate and graduate classes
- Development of lectures and course materials (preparation)
- Selection of course textbooks
- Supervision of undergraduate projects and graduate theses and dissertations
- Generating new knowledge in their field
- Publishing results in peer-reviewed, scholarly journals
- Presenting research results at conferences
- Supervising graduate student research
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The Role of the University

Dos and Don’ts for Office Hours

- **Do**
  - Arrive on time, either during the prescheduled office hours, or at the time of your prearranged appointment
  - Arrive prepared and organized. Know what to ask!
  - Show what you have done so far on any problems you wish to discuss
  - Stay targeted and focused
  - Be professional, polite and courteous
  - Encourage your professor to write down any help or information s/he provides
  - Ask as many questions as you need to ask

- **Don’t**
  - Show up outside of scheduled office hours unless you have a prearranged appointment
  - Ask unfocussed or general questions
  - Ask for help on problems you have not yet attempted or thought about
  - Argue with the professor

Other Campus Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description of Services Available</th>
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</table>
| Learning Resource Center  | • Offers assistance with reading, writing, mathematics, computer skills, study skills, time management, test anxiety, etc.  
                           | • Both one-on-one and group sessions are generally available                                     |
| Student Counseling        | • Designed to help you work more efficiently                                                    |
|                           | • Assist with non-academic problems which may be detracting from your classroom performance      |
|                           | • Both one-on-one and group sessions may be available                                             |
| Office of Student Financial Aid | • Counselors often just act as friendly “ears” to help you work through a problem               |
|                           | • Confidential – counseling records are not shared or released to other university departments  |
| Student Health Services   | • Information and advice on student loans, scholarships and grants                                |
|                           | • May offer emergency student loans                                                                |
| Career and Placement Services | • Health care services, both walk-in and by appointment                                          |
|                           | • Usually costs much less than off-campus health care                                              |
| Campus Libraries          | • Information for both summer and full-time employment                                            |
|                           | • Advice on finding a job                                                                         |
|                           | • Database of companies                                                                           |
|                           | • Central location for on-campus interviews                                                       |
|                           | • Source of reference materials                                                                   |
|                           | • Some supplemental course materials may be placed “on-reserve”                                   |
|                           | • Distraction-free environment which is conducive to study                                         |
Learning in the University Environment

Teaching and Learning Styles

- It is helpful when your learning style matches the teaching style of your professor
- Most of us fit into more than one category
- Types of learning styles include...

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>• Learn more effectively through the use of demonstrations, pictures, graphs and other visual representations</td>
</tr>
</tbody>
</table>
| Verbal         |  • Respond more to the written or spoken word  
                 • Like to hear about things or hear explanations |
| Sensing        |  • Focus on things that can be sensed  
                 • Prefer facts, data and relevant ideas |
| Intuitive      |  • Prefer ideas, possibilities, theories and abstractions  
                 • Prefer variety and dislike repetition  
                 • Miss details, make careless mistakes, and often don’t check their work |
| Active         |  • Best at processing information while doing something active  
                 • Tend to think out loud, try things out, work in groups, and learn while doing |
| Reflective     |  • Think to themselves, and prefer working alone  
                 • Want to fully understand something before attempting to do it |

Don’t blame the professor! Be proactive and take matters into your own hands

- Determine what you need to make the course material come alive. Ask the professor for supplemental material (which could include more examples, theory, worked out examples, real-world examples or formulas)
- Find someone else (teaching assistant, classmate, another professor) to explain the material to you in another way
- Find supplemental material on your own. Sources could include other textbooks, internet, journal articles, videos, CD-ROMs, etc. Begin your search in the engineering library
**Benefits of Working with a Team of Student Peers**

- Provides opportunities for collaborative learning
  - It is unlikely that all will have trouble with the same material. Group members will be able to help each other over hurdles
  - It has been shown that students who study in groups... 
    - ...get higher grades
    - ...retain what they learn longer
    - ...enjoy classes more
    - ...gain more self-confidence
  - Teaching something is the most effective way to learn it well. Group members gain from teaching each other
- Keeps you motivated and on track
  - It’s easier to keep going if you know you are not alone
  - Someone else’s success may depend on your active participation
- Good practice for the real world (after graduation)
  - Teamwork is the norm in the real world
  - Most projects are too large and broad for one person
  - Project teams consist of people with a variety of expertise and backgrounds

**“Best Practice” Techniques for Group Learning**

- Try to work in groups of three or four
  - Groups of two may not have enough of a variety of ideas, and will not be able to effectively resolve conflicts
  - Some members of large groups (five or more) may be left out, and not act as full participants
- Think about and outline problems individually before getting together as a group
- Make sure that all group members understand every solution

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**Introduction to Student Organizations**

- Student organizations on a typical student campus may include the following
  - Sports clubs
  - Religious organizations
  - Social fraternities and sororities
  - Academic organizations
  - Political clubs and associations
  - Culture clubs and associations
  - Professional student organizations
- For the engineering student interested in an academic organization, the following may be of interest
  - Local, department-based clubs, e.g.
    - Mechanical Engineering Club
    - First Year Engineering Students’ Association
  - Student chapters of professional engineering organizations (which often hold joint events with senior-level chapters), e.g.
    - Society of Petroleum Engineers (SPE)
    - American Society of Civil Engineers (ASCE)
    - American Society of Mechanical Engineers (ASME)
  - Ethnic and gender based engineering organizations, e.g.
    - National Society of Black Engineers (NSBE)
    - Society of Women Engineers (SWE)
    - Society of Hispanic Professional Engineers (SHPE)
Learning in the University Environment

Student Ethical Responsibility

- Students are obligated to conduct themselves in an ethical manner.
- Most schools have a Code of Student Ethics which students are required to follow.
- While some situations and behaviors may be subject to interpretation (ethically ambiguous), others are clear-cut, and generally recognized as unethical. These include:
  - **Plagiarism**: intentionally claiming other people’s work as your own.
  - **Cheating**: Unauthorized sharing of information.
  - False representation (representing yourself as another person, or having someone else represent themselves as you).
  - Changing a solution or answer on a paper after it has been graded.
  - **Using confidential materials** without permission (upcoming tests, solutions manuals, etc.).
  - **Fabrication**: falsification of information in any academic exercise (paper, assignment, lab report, etc.).

Key Strategies for Maximizing Performance

- As an engineering student you have three main priorities when it comes to spending time:
  - **Priority #1**: Commitments - the inflexibly allocated periods of time in your schedule.
    - Scheduled classes, labs seminars and meetings.
    - Work (part-time job).
  - **Priority #1A**: Necessities of life! Can be rescheduled, but you can’t live without them.
    - Eating.
    - Sleeping.
  - **Priority #2**: Study time. Time devoted to:
    - …completing assignments.
    - …reading the text; going over class notes.
    - …reviewing for tests.
    - …group study.
  - **Priority #3**: Entertainment, leisure, recreation.
    - Socializing with friends and family.
    - Exercise.
    - TV, movies, etc.
- Obviously, there may be some overlap between categories (eating with friends, etc.).
- Best ways to manage your time and fit everything in:
  - Create a schedule which includes all activities (long term, short term, and recurring: academic and non-academic).
  - Create an on-going list of errands and one-time appointments. Items can be crossed off as they are completed.
### Key Strategies for Maximizing Performance

#### Weekly Planner for a Six-Course Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday (Mon.)</th>
<th>Tuesday (Tues.)</th>
<th>Wednesday (Wed.)</th>
<th>Thursday (Thurs.)</th>
<th>Friday (Fri.)</th>
<th>Saturday (Sat.)</th>
<th>Sunday (Sun.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0700</td>
<td>B/fast</td>
<td>Workout</td>
<td>B/fast</td>
<td>Workout</td>
<td>B/fast</td>
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<td>Free</td>
</tr>
<tr>
<td>0800</td>
<td>Class (1)</td>
<td>Class (3)</td>
<td>Class (1)</td>
<td>Class (3)</td>
<td>Class (1)</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>0900</td>
<td>Class (2)</td>
<td>Study-Library</td>
<td>Library</td>
<td>Study-Library</td>
<td>Research</td>
<td>Class (2)</td>
<td>Class (3)</td>
</tr>
<tr>
<td>1000</td>
<td>Research</td>
<td>See Prof.</td>
<td>Study-Library</td>
<td>Library</td>
<td>Free</td>
<td>Free</td>
<td>Free</td>
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<tr>
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<td>Class (4)</td>
<td>Study-Library</td>
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<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Free</td>
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<tr>
<td>1400</td>
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<td>Class (6)</td>
<td>Lab (1)</td>
<td>Class (6)</td>
<td>Lab (3)</td>
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<tr>
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<td>Class (6)</td>
<td>Lab (1)</td>
<td>Class (6)</td>
<td>Lab (3)</td>
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<td>Study-Library</td>
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<td>Review</td>
<td>Lecture Notes</td>
<td>Dinner</td>
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<tr>
<td>1900</td>
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<td>Relax</td>
<td>Work</td>
<td>Relax</td>
<td>Work</td>
<td>Review</td>
<td>Review</td>
</tr>
<tr>
<td>2000</td>
<td>Study (Home)</td>
<td>Study (Home)</td>
<td>Work</td>
<td>Fun!</td>
<td>Work</td>
<td>Review</td>
<td>Review</td>
</tr>
<tr>
<td>2100</td>
<td>Study (Home)</td>
<td>Study (Home)</td>
<td>Work</td>
<td>Fun!</td>
<td>Work</td>
<td>Review</td>
<td>Review</td>
</tr>
<tr>
<td>2200</td>
<td>Study (Home)</td>
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<td>Work</td>
<td>Fun!</td>
<td>Work</td>
<td>Sleep</td>
<td></td>
</tr>
</tbody>
</table>

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#### Key Strategies for Maximizing Performance

* **Regarding course prerequisites**
  - Make sure that you are aware of what your instructor assumes you know
  - Make sure that you have mastered what your instructor assumes you know -- make sure your prerequisite skills work!
  - Many students fail because they don't have adequate mastery of course prerequisite material. Take the prerequisite material seriously, and ask if you are not sure

* **Effective note taking techniques**
  - Make sure you write down whatever the instructor writes down. This is a strong indication of what s/he feels are the most important points
  - During oral presentations, take notes on what the instructor is saying. Don't try to write every word, but do include the most important points. You can always review later
  - As soon as possible after the lecture, review and complete your notes. Write them out as if you were going to use them to teach the subject
  - Date and number each page; leave ample space for further comments and clarification
  - When you miss class, get notes from another conscientious and successful student, or (if possible) the course instructor

* **Purpose of the course textbook**
  - To provide a backup source of course material. The textbook will serve as your primary source for supplementary material
  - To provide a source of illustrative examples
  - To provide a good supply of practice problems
  - Don't try to do every problem, or to read every chapter. Stick to material that is similar to that presented in class unless the instructor says otherwise
Key Strategies for Maximizing Performance

- Strategies for maximizing the effectiveness of assignments
  - Try to do all of the assigned problems. Those that complete their homework assignments tend to, as a group, perform better on exams
  - Don’t simply study example problems and homework solutions. The only way to learn how to solve problems is to solve problems. (It’s similar to riding a bicycle — you can’t learn how to ride a bike without getting on one!)
  - Collaboration and group work is beneficial as long as it is not abused. Working in groups should not reduce the amount of effort that each individual puts forth; instead, fellow group members should use each other to get through the roughest spots in a problem, and to brainstorm alternative solution techniques
- Posted solutions to assignments and exams
  - Good examples of what constitutes a proper, correct solution
  - Good way of reviewing for exams as posted solutions illustrate exactly what is expected by the course instructor
  - Posted solutions from previous semesters may be a useful source of review problems
- Getting extra help
  - Make use of any free tutoring services available through your college. Members of engineering honor societies often provide free tutoring as a service to the university community
  - If hiring a tutor, make sure s/he knows the material well, and is an effective communicator
  - Prepare for your tutoring session by reviewing the material and listing all questions that you have in advance. Do not expect the tutor to do the work, as that is your job!
  - Self-study manuals and problem solvers may be helpful. As there are many available, ask your instructor for a recommendation!

How to be Successful on Exams

- Exams are generally the single largest contributor to your grade in an engineering course
- Success on your exam depends upon mastery of
  - the course material
  - effective study techniques (smart practice)
  - effective examination technique
- Divide your test preparation into long term (ongoing) and short term (1-2 weeks beforehand) phases
  - Long term
    - Make sure your class notes are complete and well organized
    - Pay special attention to topics emphasized in class, as these often show up on exams
    - Write clear, complete and logical homework solutions
    - Completely redo any homework problems you may have answered incorrectly
    - Use assigned problems to gauge what material the professor thinks is most important, and direct your study towards those topics
    - Get help on any issues and problems you may have as they arise
  - Short term: Apply smart practice
    - Find out what will be covered on the exam
    - Review the relevant theory and relevant examples from course notes and the course textbook
    - Review your solved assignments
    - Work through relevant practice problems, previously assigned problems, and problems from past exams
How to be Successful on Exams

Effective Exam Review Techniques

- Incorporate exam review periods in your schedule, and specify what material you will review in each.
- Choose your study environment carefully. Continue to maintain a healthy lifestyle despite the extra stress which accompanies exams.
  - Pick a quiet room that is free of distractions
  - Get comfortable
  - Take frequent breaks
  - Eat well and get plenty of rest
  - Engage in some physical activity
- During your study periods
  - Make notes and summarize the important points as you review. These will be useful if your professor allows you to bring in formula sheets
  - Choose practice problems randomly, and solve them blindly, without any supplemental information or help from others
- As the exam approaches, you may wish to schedule some group review sessions

How to be Successful on Exams

Taking the Examination

- Before the exam: eat something, dress comfortably, and make sure you have everything you will need
- Get to the exam early, and select a seat that will be relatively free of distraction
- The first few minutes
  - Put your name on all exam sheets
  - Read through the exam, and note
    - Relative point values
    - Relative difficulty of each problem
- Effective exam techniques
  - Pace yourself. Make sure you are not spending too much time on any one problem
  - Attempt to solve every problem
  - Write your solution with the purpose of getting the maximum number of points
    - Include sufficient detail
    - Write neat, well-structured solutions
- Remember what the instructor is looking for
  - A set procedure or method illustrating clear, logical thinking and understanding, leading to the correct answer
  - An ability to use the most appropriate technique in the most efficient way possible
  - An ability to communicate ideas effectively
  - An ability to develop a valid, step-by-step scientific argument, incorporated with any necessary mathematics
  - An ability to explain the significance of any results obtained
How to be Successful on Exams

Taking the Examination (continued)

- On multiple choice tests
  - Read the question, and identify what it is asking
  - Ignore the (given) answers, and solve the problem for yourself
  - Compare your answer to the given choices, and rework, if necessary
  - If you are completely stumped, try to eliminate any answers you know to be false
  - Work backwards to check your problem (if time)
  - Don’t leave any questions out. Guess if you have to, to maximize your score

- After the examination
  - Check for errors in grading. If there is a problem, see the professor as soon as possible. Remember to be courteous and professional at all times!
  - Learn from your mistakes by redoing incorrect problems
  - Start working towards your next exam. Make any adjustments in your preparation technique that you think are necessary based on your performance

Procedures for Effective Problem Solving

- The solution of practical problems is an essential part of engineering
- A significant amount of time in the engineering curriculum is devoted to developing students’ problem solving skills
- Engineering problems encountered in most undergraduate courses generally fall into two basic categories
  - (A) Those that require mainly the application of known techniques, and minimal amounts of original thought
    - Problems of this type may be mathematically intensive
    - Once the applicable formula is identified, “plug and chug” to get the solution
    - Often, the problem is directly stated in terms of a formula, which then must be solved
  - (B) Those that require original thought, and minimal application of established techniques. Often posed as word problems. Solution procedure includes
    - Mathematical modeling
    - Evaluation and application of selected mathematical techniques
    - Interpretation of results with respect to the context of the original problem statement
    - Problems such as these include word problems, where the problem must be translated from English to mathematics. This process is known as mathematical modeling
Procedures for Effective Problem Solving

Solving Applications Problems  (A)

- Carefully read through the problem
- Classify the problem by identifying which area of the course it is from
- Identify the specific area, technique, formula or rule that will form the basis of the solution
- Find a worked-out example similar to the one you are trying to solve. This will generally be an example problem from the textbook or class notes
- Apply the known problem solving procedure to your specific problem

Solving Word Problems  (B)

- Read the problem. Try to identify what you have (given) and what you want (find). Assign variables to those quantities. Draw a diagram, if applicable
- Translate the problem from English to mathematics. This will often involve identifying formulas that relate what you know to what you want to know
- Try to find a similar, solved example from your course notes or textbook
- Sometimes it will be necessary to split a complicated problem into a series of simpler sub-problems
- Include appropriate dimensions in your equations, and make sure they remain consistent throughout your solution
- Evaluate your answer, and see if it makes physical sense

How to Succeed in Mathematics Courses

- Mathematics is a cumulative subject. The understanding of one part depends heavily on the understanding of previous parts
- Students often have more problems with mathematical manipulation than they do with engineering concepts
- Keys to success in mathematics courses
  - Identify and become fluent in key prerequisites
  - Make the most of class time
  - Make effective use of the textbook
  - Get help when necessary
  - Do your assignments
  - Follow effective problem solving procedures
  - Carefully prepare for exams by working test problems from previous semesters, and compare your answers to test solutions (if they are available)
Developing Engineering Skills

- Skills prized by employers include
  - The ability to work effectively in diverse teams
  - The ability to keep up to date and current in your field
  - The ability to effectively manage personnel and resources in engineering projects
  - Effective written communication skills
  - Effective interpersonal (one-to-one) skills
  - The ability to design and present effective formal presentations (in front of groups)
  - The ability to demonstrate creativity in all aspects of your job
- Developing effective writing skills requires effort and commitment
  - Take writing classes. Many colleges and universities offer noncredit writing courses in their continuing education programs that can be taken during evening and weekend hours
  - Write as much as you can
  - Read as much as possible, because…
    - …reading exposes you to good, professional writing
    - …reading expands your vocabulary and grammar skills
  - Seek out good examples of writing
  - Get lots of feedback from others
  - Read your own work out loud to yourself

Developing Engineering Skills

- Effective interpersonal skills include
  - Good listening skills
  - The ability to define what you need, and to ask for it
  - The power of persuasion
  - Sensitivity to the beliefs and perceptions of others
  - The ability to understand another’s point of view
- Preparation and poise are vital for effective formal presentations
  - Prepare presentation materials well beforehand. Make sure that…
    - …they are technically correct and contain no errors
    - …they are clear and legible from anywhere in the room
    - …your talk contains neither too much nor too little content
    - …you can effectively handle any questions which may be posed
  - Divide your talk into three parts
    - Introduction and overview of presentation
    - Main body
    - Conclusion, summary and recommendations for future consideration
  - Leave sufficient time for rehearsal. Try to rehearse in a room similar to the one which will be used
  - Relax, and believe in yourself. Don’t belittle yourself
  - Don’t entertain your audience, although one quick, well-placed joke can be an effective ice-breaker
  - Experience is unbeatable. Your confidence will increase a bit every time you give a presentation
Developing Engineering Skills

- Attributes of creativity include
  - Originality of thought
  - Ability to use your imagination to come up with innovative ideas

- Creativity cannot be learned, but can be improved and nurtured through the following techniques
  - Increase your knowledge of engineering. Read about advances in the state-of-the-art, and new and novel solutions
  - Maintain an interest in things outside of engineering. Engineering innovation can often be spurred by something related to another discipline
  - Brainstorm, and think creatively about new solutions to old (previously solved) problems. Play with ideas. This can be done alone, or with colleagues
  - “Sleep” on problems. Allow your subconscious time to work
  - Allow yourself some time to relax and recharge. Your mind gets tired if it is constantly thinking, so it needs some time to rest
  - Focus on the ultimate objective. Don’t obsess on the detail (which become the focus much later in the design process)

What’s After Graduation?

- Career options include
  - One of the engineering job descriptions described previously
  - A job in a non-engineering field that requires some of the skills acquired as engineering students. These include areas where problem solving, mathematics and creative thought are important, such as insurance, financial and accounting firms
  - A job involving government or military work (national laboratories, transportation, municipal services, etc.)
  - Working abroad, either for a multi-national corporation, or for a service organization (e.g. Peace Corps)

- Continuing education is now a requirement of most jobs!
  - Read journals and trade publications and attend seminars to stay in touch with advances in technology
  - Many employers will pay you to attend advanced courses, as long as they are relevant to your work. Some colleges offer courses, and even entire degree programs, via satellite or computer that can be completed without requiring attendance in actual classes

- Job search tips
  - Take advantage of personal contacts by networking
  - Maximize your chances by applying for many jobs simultaneously
  - Prepare your resume carefully. Get advice from employed friends and your school’s writing center. Proof-read carefully!
  - Prepare for your interview by practicing with friends. Treat your interview as a formal presentation of yourself. Be sure to research the company so you can ask intelligent questions
  - Highlight your ability to learn and think independently
  - Don’t “sell yourself short” to a prospective employer
What’s After Graduation?

Obtaining an Advanced Degree (or two)

- Typical advanced degree paths include
  - Master of Science in Engineering
    - Requires 18 months to three years
    - Some programs require only course work
    - Others require both course work and thesis-based research
    - A M.S. degree leads to either doctoral study, or a more advanced job in the field
  - Doctoral Degree (Ph. D.) in Engineering
    - Takes three to five additional years
    - Some course work plus extensive research leading to a dissertation
    - A doctoral degree in engineering does not increase employment prospects, but typically leads to a job in academia or research
- Other disciplines
  - Medicine
  - Law
  - Business (MBA)
- Financial considerations
  - Students pursuing advanced degrees in engineering typically receive financial support in the form of research or teaching assistantships, as well as reduced or free tuition
  - Students pursuing advanced degrees in areas other than engineering are typically “on their own”