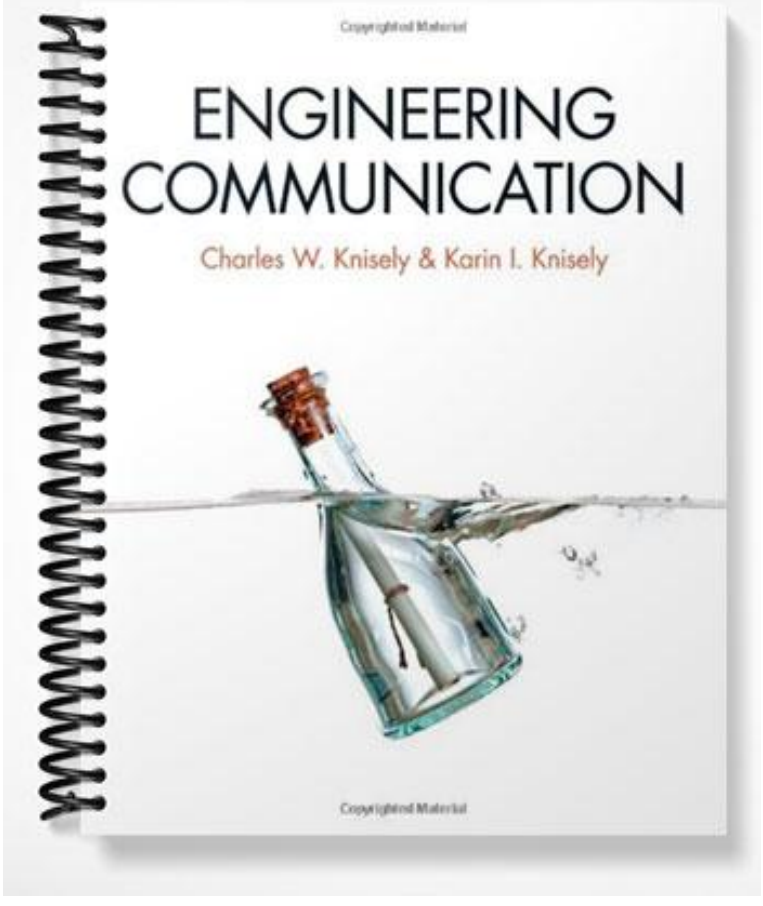
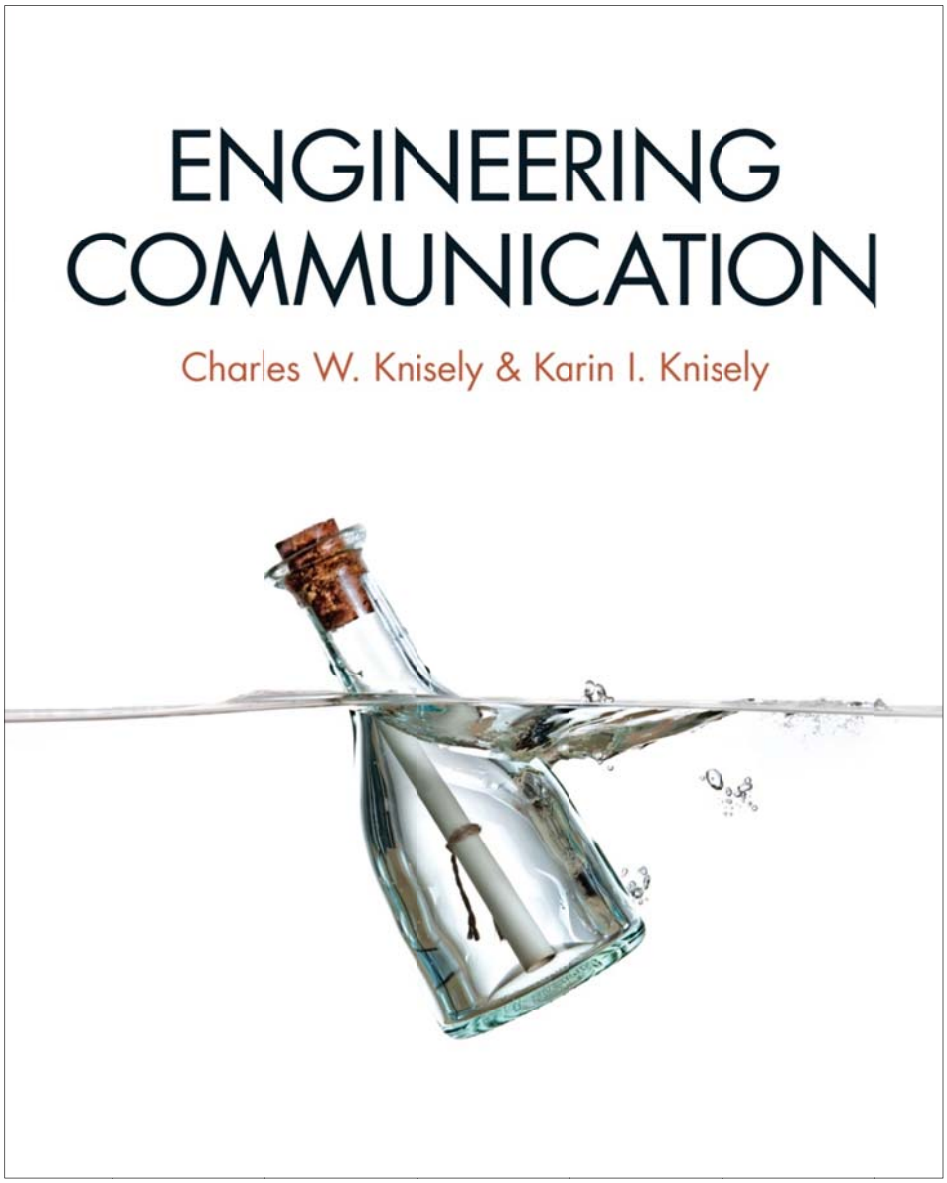
SOLUTIONS MANUAL



An Instructor's Solutions Manual to Accompany

ENGINEERING COMMUNICATION

CHARLES W. KNISELY
KARIN I. KNISELY



CENGAGE Learning™

ISBN-13: 978-1-133-59876-3
ISBN-10: 1-133-59876-5

Cengage Learning
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Stamford, CT 06902
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Printed in the United States of America
1 2 3 4 5 6 7 16 15 14 13

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Instructor's Manual to Accompany
Engineering Communication
C.W. Knisely and K.I. Knisely

Contents

The authors have worked hard to produce an error-free Instructor's Manual, but in spite of our best intentions, we expect that you may find some mistakes we missed. We would appreciate hearing from you about mistakes (large or small), broken links, inaccuracies, and any other successful teaching methods you might want to contribute so that we might be able to improve this manual in the future. Please email us at knisely@bucknell.edu.

Foreword

The preparation of engineering communications (written, oral, and visual elements) is in many respects a process parallel to engineering design. Often there is no single "right" answer, but rather an array of alternatives that ranges from utterly unacceptable to superbly suited to the assignment. Engineering communication emerges from the requirements of the presenter or organization to document concisely a product, a process, a method, a concept, or a design in a manner that takes into account the needs of the audience.

The Instructor's Manual for a writing or communications course (technical or otherwise) cannot be like a Solutions Manual for a Thermodynamics course. Whereas thermodynamics problems have right and wrong answers, a high quality communication is hard to define in quantitative terms. Humans seem capable of recognizing good writing, but struggle with defining precisely what elements distinguish good writing from poor writing. Yes, correct spelling is a requirement. Appropriate use of words is essential. Brevity has far greater impact in effective technical communication than simply being the source of wit. Good logic flow, organization, and appropriate reading level facilitate audience comprehension. Yet none of these components, alone or even in combination, necessarily guarantee that the communication will be of high quality.

To attempt to illustrate the difficulty of defining quality in technical writing, one of our colleagues suggested the following exercise. Try to describe the taste of a fresh fruit – an orange, a pineapple, a watermelon or any other fruit – to someone who has never tasted the fruit. Our description must translate the information transmitted by multiple senses – taste, smell, touch, and sight – into words that allow inexperienced tasters to recognize the taste and distinguish it from that of other fruits they have sampled. The new flavor becomes part of the taster's repertoire of experienced flavors, which the person is able to put into context in subsequent experiences. Similarly, trying to explain the "flavor" of high quality communication forces an inexperienced person to recognize that good writing is substantially greater than the sum of its components.

Because high quality writing is so hard to define, rather than providing "answers" to the chapter exercises, we provide suggestions, examples of student writing with faculty feedback to students, and comments on exercises. Only a few of the exercises (primarily those in Chapter 5 on editing) will have traditional "answers" as you would expect to find in a more quantitative course.

Overview of Chapters

This book is divided into four parts plus the appendices:

- Part 1 Introduction to finding, reading, and citing technical resources
- Part 2 Preparing technical reports
- Part 3 Other types of professional writing
- Part 4 Oral presentations and poster preparation
- Appendices (Microsoft Word, Excel, and PowerPoint)

The individual chapters in Parts 1 and 2 are intended to be covered sequentially. Chapter 1 addresses the question "Why do engineers need to communicate?" We suggest that

communication skills are as important as problem-solving skills in the workplace. We provide evidence in the form of published studies and comments from recent graduates that engineers prepare a wide range of technical communications, that the time spent on communications increases with seniority, and the ability to communicate effectively leads to faster career advancement. The end-of-chapter exercises are designed to give students the opportunity to collect their own data and prove to themselves that there are immediate and long-term benefits to developing their own professional voice while still in college.

In Chapter 2 we introduce discipline-specific search engines and databases that help engineers find authoritative and reliable information. We then suggest strategies for searching these databases efficiently. Students have the opportunity to apply these strategies to a topic of their choice in the exercises. Once the desired information has been found, engineers need to read and process that information to acquire knowledge. In Chapter 3 we introduce technical report structure and discuss the content of the individual sections. Although the well-defined structure makes it possible to find information quickly, technical reports are usually hard to read and understand for students and entry-level engineers. We suggest strategies for reading technical reports, which include acquiring sufficient background information on the topic from textbooks and other secondary sources. The exercises at the end of Chapter 3 give students practice identifying the sections of technical documents available on the Internet. Each exercise has prompts on document structure, the content of individual sections, the format of the visual elements, the citation format, and other components.

After reading and intensively thinking about the information contained in the literature, engineers apply their new-found knowledge to a specific problem. They then describe the problem solution in their own words, usually in the form of a written or oral communication. Because the solution relies heavily on the work of others, citing reputable sources (giving credit) is not only the right thing to do, it lends authority to your own work. The process of acquiring knowledge discussed in Chapter 3 is thus closely tied to the source of that knowledge in the published literature, as discussed in Chapter 2. Because it makes sense to record the information about your sources when searching databases, we discuss the two most common reference systems in Chapter 2. We introduce the name-year and citation-sequence systems of citing references and illustrate how the actual format varies depending on publisher or engineering professional society. We explain the difference between information that is considered to be common knowledge, and therefore does not need to be referenced, and information that needs to be referenced. Through examples in the book and recommendations of online tutorials, we try to show students how to avoid plagiarism.

Chapters 4, 5, and 6 provide step-by-step instructions for preparing technical communications. In Chapter 4, we use a laboratory report to illustrate the process, because lab reports are one of the first types of technical documents engineering students are asked to write. Chapter 5 provides a systematic approach to revision. We emphasize the need to write drafts, alternating writing time with thinking time, which provides students with time to process what they have already written. The time for reflection may then help students come up with ideas on how to improve their writing. Small revisions in the course of the writing process make revising the final product less arduous. The exercises at the end of Chapters 4 and 5 give students practice in writing and

revising lab reports. In addition, some of the Chapter 5 exercises are intended to build awareness of different organizational structures, wordy sentences, and easily confused word pairs.

Visual elements (figures and tables) are integral components of technical communications. The following topics are relevant to preparing effective visuals and are covered in Chapter 6:

- Engineering nomenclature (symbols, units, and dimensions)
- Significant figures and how they are used to express the precision and accuracy of measurements honestly
- Different types of visual elements and when to use them
- How to format graphs
- How to connect data points, or not
- How underlying theory guides the choice of trendlines added to data points
- Graphs of standard functions
- Graphical analysis using log-log and semi-log coordinate grids

Many engineering students will use Chapter 6 to review concepts they have learned in their engineering classes. The exercises provide students with sample data and are designed to help them correct formatting errors in various types of visual elements. Instructors who are not technically trained will find this chapter a useful resource when they discuss the preparation of graphs.

How instructors choose to use the chapters in Parts 3 and 4 will depend on the objectives, scope, and depth of the technical communication course. Chapters 7 through 10 cover a wide range of communications that engineers may be asked to write in academia and industry: memos, business email, letters, resumes, proposals, progress reports, design specifications, patent applications, overview reports, site visits, white papers, and trade journal articles. Chapter 8 includes a section on the special challenges of writing collaboratively. Chapter 11 on oral presentations and Chapter 12 on posters cover forms of communication that rely more on the presenter's delivery than the printed word. Meetings are another venue in which good oral presentation skills are important. Chapter 11 includes a section on preparing for and running meetings. All of the chapters in Parts 3 and 4 have exercises that give students practice preparing these different types of communications.

We expect students to use the appendices on Microsoft Word, Excel, and PowerPoint as a reference when they work on certain assignments. Appendix I (Word) provides detailed instructions on word processing tasks that are unique to technical communications, such as writing equations and inserting Greek letters, mathematical symbols, and sub- and superscripted characters. This appendix also contains a wealth of information intended to help engineers prepare documents more efficiently. Appendix II (Excel) describes how to use formulas to carry out repetitive calculations quickly. Most of this appendix, however, provides step-by-step instructions on preparing a variety of graphs (*x*-*y* graphs, bar graphs, and pie charts) in the appropriate format. Appendix III discusses how to design, prepare, and run an effective oral presentation using PowerPoint.

Sample Outcomes

Course Outcomes

At the end of this course, students will

- be cognizant of various formats for technical writing including technical reports, business letters, memos, resumes, work-related emails, site visit reports, white papers, specifications, and patents;
- be able to write with precision in a concise style appropriate for technical communications;
- understand the peer review process and the importance of revision in technical writing;
- be able to edit technical text to eliminate wordiness;
- be cognizant of the hallmarks of appropriate graphics and their applications in technical writing;
- be able to present technical content orally, both as a structured presentation and as a less formal poster presentation.

ABET Student Outcomes Addressed

The student outcomes for baccalaureate level programs in engineering can be found at the ABET website, <http://www.abet.org/accreditation-criteria-policies-documents/>. Among the criteria are several that might be addressed, or at least partially addressed, in a technical communication course depending on the nature of the writing assignments chosen.

ABET student outcome (g) requires students have "an ability to communicate effectively." This outcome is one than can be assessed readily at the end of a course in technical writing.

In addition, if the reading and writing assignments have themes related to other abilities listed in the ABET student outcomes, the course may also serve as an assessment opportunity for the following:

(d) an ability to function on multidisciplinary teams

> If the course is a stand-alone technical writing course, group assignments such as review reports, oral presentations, and poster preparations lend themselves to multi-disciplinary collaboration if the instructor can assign teams with differing majors to collaborate on projects that touch on each of the majors in some manner.

(f) an understanding of professional and ethical responsibility

> Instruction in proper workplace use of electronic communication devices, proper forms of email and letters, and development of a "professional voice" can be used as training in professional responsibility. In addition, selection of one or more writing assignments related to professional and ethical responsibilities can be used to bolster the contribution to outcome (f).

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

> Developing the awareness that "proper" formatting of engineering reports differs from

one country to the next contributes to greater awareness of global engineering practice. Many American students are surprised to learn that 8.5 x 11" paper in used almost exclusively in the US, while A4 paper is used in most other countries. It may be possible to assess outcome (h) when the instructor selects assignments in which students are asked to explore topics such as "Differences in design practice in country X, Y, and Z," "The role of economics in engineering decision making," "Global warming issues," or other similar themes.

(i) a recognition of the need for, and an ability to engage in life-long learning

Teaching students

- how to evaluate the validity of an internet source
- how to use engineering databases efficiently
- how to select database search criteria
- how to quickly assess if a given information source is applicable to their assignment

provides them with tools to be used in life-long learning and promotes the students' abilities to engage in life-long learning.

(j) a knowledge of contemporary issues

Again, judicious selection of topics including energy awareness, population growth, clean water, and food supply for the world can be used to form a basis for assessment of student outcome (j)

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Students' ability to properly prepare, access, use, and cite

- memos
- letters
- engineering reports
- engineering graphics
- engineering specifications
- white papers
- site visit reports
- patents

can be defined as contributing to "the techniques, skills, and modern engineering tools necessary for engineering practice" should a program choose to do so.

Classroom Management

One of the lessons learned through years of teaching is that each instructor must develop a teaching style with a variety of presentation methods that suit the personality of the instructor and the class. Teaching a required sophomore-level introductory thermodynamics course for mechanical engineers, for example, is substantially different from teaching a technical communication course to a diverse group of engineering and non-engineering students.

As we discovered in the course of writing our book, we never stop learning. Sharing that piece of wisdom with your students on the first day of class not only breaks the ice and permits students to discover that faculty are indeed human, but highlights the give-and-take nature of education. The lessons we learn from our students help us become better teachers. When we encourage our students to evaluate our communications, we foster empathy and help them develop critical reading skills. Our students' constructive criticism in turn helps us to improve our own writing and speaking skills. Thus, teaching a communications course may have a very positive impact on our career, especially if we embrace the course as a part of our continuing education for professional development.

We recommend that students and instructors take advantage of the human and other resources at their university's Writing Center, Communications Department, and multicultural centers. Technically-trained instructors should meet with Writing Center staff to discuss the technical communication course syllabus and differences between technical writing and writing in the humanities. When students in the technical communication course are then referred to the Writing Center, the staff will already understand the objectives of the course and can anticipate the needs of the students. For instructors with a non-technical background, reviewing the concepts presented in Chapter 6 of this book is a good starting point for understanding why using visual elements that have the appropriate format are so important in technical communications. Discussing these concepts with technically-trained colleagues speeds comprehension and builds camaraderie.

Here are some suggestions to consider for your technical communication class, which have worked in ours:

- Add variety to the instruction. Have a routine, but add other in-class activities to promote active learning, group dynamics, and reflection.
- Minimize lecture time, providing just enough information to get students started on the assignment. Let students work on the assignment, give them time to struggle a bit, and wait a while until they are ready to ask questions. Resolving issues or solving problems on their own gives them a greater sense of satisfaction than being handed the answers. A flexible approach also reinforces the proposition that there may be more than one right solution or approach.
- Anticipate what the students will ask, and after class compare the actual questions with those you anticipated. The questions they ask may well reflect the "story" they heard from you. What students hear and what you believe you told them often differ. Gathering feedback by comparing your expected questions with the students actual questions may help you provide better guidance in subsequent classes.
- Allow students to work in pairs for some of the assignments. Particularly in the peer review process, students with strong writing skills can be paired with the weaker

students to provide high quality first-level feedback for the students who most need it. Instructors whose native language is not English can also learn from the comments of native speakers on these drafts.

- Expose students to a variety of technical communications that help them see the commonalities as well as the differences among them.
- Use real-life examples of communications that are neither too simplistic nor too difficult and that are relevant to the cohort of students taking the class; our students seem to especially enjoy commenting on each other's work. Remind students that as they progress in their careers, they will spend more time reviewing the communications of the engineers that report to them.
- Give timely feedback on writing assignments, feedback that provides direction without revealing exactly how to achieve the solution.

Assessment Rubrics

When there are multiple sections of a course with multiple instructors, it is very beneficial for instructors to use a common grading rubric in an attempt to standardize expectations for student performance. Even in a course with a single section, a grading rubric, when shared with the students, can substantially improve the writing of the class as a whole because the students know before submitting their writing what details will affect their grade.

In the sample rubric that follows, the technical content is weighted twice as heavily as the writing mechanics. Such weighting of content versus writing mechanics might be appropriate when the writing instruction is embedded in a technical engineering course, in which both technical content and writing are being assessed. In an engineering lab course where the results must also be correctly determined, a weighting of 2:1 of content to writing style seems fitting, although instructors may choose to vary the ratio from one exercise to the next. The instructor might choose to weigh the writing component more heavily if the course is a stand-alone writing course.

Lab Report Rubric Student Name(s) _____
Lab Topic _____
Instructor _____ Date of Assessment _____

Component and content	Points earned	Points available
Title and Authors Title is a concise and accurate description of the content of your paper.		**1**
Individual Report: The author is listed first with all lab partners listed as co-authors in alphabetical order. Group Report: All authors listed in alphabetical order. Authors of individual sections clearly identified. All group members contribute to writing.		**1**
Abstract Summary of your entire paper in 200-250 words. It includes an introduction, brief description of the methods, results, and conclusions. It does not contain references to figures or cited sources.		**2**
Introduction Give sufficient background information on topic. Move from general overview to specific information. Cite the source of information that is not common knowledge.		**2**
Clearly state the objectives of the experiment.		**1**
Apparatus and Procedures Provide a clear schematic or sketch of the system setup. Explain logically the procedures carried out with/on each piece of equipment used. Include manufacturer and model for any special equipment used. Make special note of any deviations in procedures from those provided by the instructor.		**2**
Results Process data to provide correctly calculated and concisely presented results. Choose and prepare appropriate graphs.		**3**
Discussion Relate the results to the expected trends based on theory or data from other sources. Explain any statistically unreliable data points. Discuss potential error sources and how they might be reduced if the experiment were repeated.		**3**
Conclusion Discuss the results in terms of the objectives. Discuss the 'big picture' implications of the results.		**2**
References Correct format for both in-text citations and end references		**2**
All citations included and all listed references cited		**1**

Writing skills	Points earned	Points available
Layout The report is typed double space with 1.25" (or other specified) left and right margins and 1" margins top and bottom. Font size 12 pt (or as specified) is used. Page numbers are included on each page except the first. Pages are stapled top left in the correct order.		**2**
Report organization The report is organized into 8 sections (title page, Abstract, Introduction, Apparatus and Procedures, Results, Discussion, Conclusions, and References). Each section, with the exception of the title page, is clearly labeled with a heading on a separate line.		**2**
Mechanics Grammatical and spelling errors are absent or minimal. Subjects and verbs agree (especially the word "data"). Writing is done in complete sentences; run-on sentences are absent. The right words are used in the appropriate context.		**2**
Tense and Voice Use past tense to state objectives, describe a procedure, and when you describe your own results. Use present tense only to make generally accepted statements or to state the findings of published authors. Do not use personal pronouns when the action itself is more important than who performed it. Use personal pronouns when they make a statement more clear and concise.		**2**
Clarity Each section of the report is well organized, so that each sentence and paragraph follows logically from the previous one. Connecting words and repetition are used to improve the flow. Wordiness, redundancy, empty phrases, and ambiguity have been eliminated.		**2**
Total points		**30**

Additional comments:

Sample Syllabi

Syllabus for a Two Semester-Hour Course

The class is assumed to meet twice a week for 14 weeks.

Week	Date	Topic	Assignments
1	Hour 1 Hour 2	Course introduction; Why engineers need to communicate; How to become a more effective writer. Student reports on their investigations of workplace professionalism and communications. In-class discussion: What professional qualities are needed to fit into a workplace environment? What advice on career development using communication is available? What does it mean to be a professional?	1. Find and read three articles with advice on professional behavior, professional communication, and workplace re-acculturation 2. Chapter 1, Exercise 2
2	Hour 1 Hour 2	Finding technical information using databases. Sample searches using various search engines. Citation formats: name-year system and citation-sequence; Introduction to RefWorks to generate reference lists (optional).	3. Find three peer-reviewed journals in your discipline, and *Information for authors*. Select one article from each journal and prepare a heading and sub-heading outline of the paper. Note citation style and format. 4. Complete one exercise (1 to 18) from Chapter 2.
3	Hour 1 Hour 2	Students submit reports on the commonality of formats of three peer-reviewed technical journals; introduction to reading strategies Report reading exercise –assessing the intended audience of selected reports Audience – identify all readers, who do you target?	5. Complete exercise 10 from Chapter 3 6. Complete one of the exercises (1 to 9) from Chapter 3
4	Hour 1 Hour 2	Differences between providing instructions and writing procedures. Grammar, sentences, paragraphs, connections; ESL issues;	7. Write explicit procedures explaining how a common task was accomplished (using past tense)

Week	Date	Topic	Assignments
		in-class grammar exercises	8. Read carefully the peer review templates (Tables 5.10 and 5.11)
5	Hour 1 Hour 2	Peer review concepts and methods Writing a lab report – audience, format, content; in-class writing practice – writing an abstract; writing an introduction.	9. Prepare a lab report based on an exercise in a previous course (Chapter 4, exercise 1). Have it peer reviewed and revise as appropriate before submitting.
6	Hour 1 Hour 2	Editing and revision. Engineering graphics, line graphs, bar charts, pie charts	10. Complete one exercise (1 to 6) from Chapter 6.
7	Hour 1 Hour 2	Business use of email – protocol; rules for business emails; review of sample emails. Memo formats and memo writing Resume – what to include, order – chronological/reverse chronological? What is a skill-based resume and when is it appropriate?	11. Prepare a memo about a hypothetical controversial policy change in your organization or institution. 12. Prepare a resume for a summer internship or entry-level job.
8	Hour 1 Hour 2	Letter formats; letter of complaint; letter for employment Review of full lab reports	13. Write (a) a letter of complaint, and (b) a letter for employment to accompany your resume. 14.
9	Hour 1 Hour 2	Proposals and collaborative writing Proposal formats	15. Write a group proposal for a course project in short-proposal format. 16. Prepare a hypothetical progress report on your proposal. Use your imagination to create fictitious results that seem reasonable. Use other sources (journals, reviews, and textbooks) to "invent" realistic data since there is insufficient time to undertake the proposed work.
10	Hour 1 Hour 2	White paper – what is it? How do you write one? In-class critique of sample white papers Critique of proposal drafts. Introduction to specification	17. Assess writings claimed to be white papers. Do they fit the definition? 18. Assignment: assess and correct errors in

Week	Date	Topic	Assignments
		writing	sample design specifications.
11	Hour 1 Hour 2	Design specifications. Patents and intellectual property Poster preparation; critique of sample posters	19. Assignment: assess and correct errors in sample design specifications. 20. Prepare a poster on the hypothetical results from your progress report on your previously proposed project.
12	Hour 1 Hour 2	Oral presentation of design specifications revisions PowerPoint presentation guidelines – DOs and DON'Ts; Critique of sample PowerPoint slides.	
13	Hour 1 Hour 2	Poster presentation (maximum of 3 minutes per person); Poster presentation (maximum of 3 minutes per person)	21. Prepare an individual poster presentation of a published article as if you were the author
14	Hour 1 Hour 2	Group presentations and peer assessment of presentations Group presentations and peer assessment of presentations	22. Select a published paper and prepare an oral group presentation of the work in the paper as if you were the author.

Syllabus for a Four Semester-Hour Course

The class is assumed to meet four times a week for 14 weeks. This syllabus is similar to the two-hour course syllabus, but covers topics at a more leisurely pace with more time for feedback and revision. Many of the same assignments, listed above, can also be used in a four semester-hour course, with additional in-class exercises.

Week	Date	Topic
1	Hour 1	Course introduction; Why engineers need to communicate? What type of writing do engineers undertake? How much time during the workday does an engineer work on communications? ASME Vision 2030 and similar surveys
	Hour 2	How to become a more effective writer
	Hour 3	Student reports on their investigations of workplace professionalism and communications.
	Hour 4	In-class discussion: What professional qualities are needed to fit into a workplace environment? What advice is available on career development using communication? What does it mean to be a professional?
2	Hour 1	Finding technical information using databases; sample searches in various databases. Appropriate use of Google and Scirus search engines. Appropriate use of Wikipedia.
	Hour 2	Citation formats: name-year system and citation-sequence; APA, Chicago (name-year), ASME, IEEE, AIChE, ASCE, and ACM formats
	Hour 3	Intro to RefWorks to generate reference lists (optional)
	Hour 4	Comparative analysis and practice with identifying APA, ASME, AIChE, ASCE, ACM, and IEEE references.
3	Hour 1	Students submit reports on the commonality of formats of three peer-reviewed technical journals; introduction to reading strategies
	Hour 2	In-class reading exercises of selected journal articles
	Hour 3	Report reading exercise – assessing the intended audience of selected reports. Audience – identify all readers; who do you target?
	Hour 4	In-class writing exercise – writing a similarly themed article for two different audiences: one article is an introduction to the topic for 8th grade students and the other a summary review of the same topic for college engineering students
4	Hour 1	Differences between providing instructions and writing procedures.
	Hour 2	In-class exercises on writing and revising procedures
	Hour 3	Sentences and paragraphs; coherence and connecting words and phrases
	Hour 4	Grammar, ESL issues; in-class grammar exercises

Week	Date	Topic
5	Hour 1 Hour 2 Hour 3 Hour 4	Peer review concepts and methods In-class peer review exercises using procedures assignment Writing a lab report – audience, format, content; time table for a report In-class writing practice – writing an abstract; writing an introduction.
6	Hour 1 Hour 2 Hour 3 Hour 4	Engineering reports – Differences and commonalities Format and writing strategy Editing and revision In-class editing and revision exercises
7	Hour 1 Hour 2 Hour 3 Hour 4	Business use of email; company has right to monitor; rules for business emails; critique of sample emails Memo format; progress report memos In-class exercises – editing and revising memos Resume – what to include, order – chronological/reverse chronological? What is a skill-based resume and when it is appropriate? In-class writing – editing and converting a chronological resume to a skills based resume
8	Hour 1 Hour 2 Hour 3 Hour 4	Differences between CV and resume; critiquing sample resumes Letter formats; letter of reference; letter of complaint; cover letter for employment Review of submitted full lab reports, common errors and omissions, suggested revisions Preparing a literature review
9	Hour 1 Hour 2 Hour 3 Hour 4	Critiquing sample literature reviews Site visit reports Proposals and collaborative writing Proposal formats
10	Hour 1 Hour 2 Hour 3 Hour 4	White paper – what is it? How do you write one? In-class critique of sample white papers. Patents and intellectual property Critique of proposal drafts Introduction to specification writing; software specifications. Word usage in specifications.
11	Hour 1 Hour 2 Hour 3	Design specifications; construction specifications Manufacturing specifications; procurement specifications Poster preparation; Critique of sample posters.

Week	Date	Topic
	Hour 4	Running a meeting
12	Hour 1 Hour 2 Hour 3 Hour 4	Students run mock meetings (3 meetings each 15 minutes long) Student oral presentations of design specifications revisions PowerPoint presentation guidelines – DOs and DON'Ts Critique of sample PowerPoint slides
13	Hour 1 Hour 2 Hour 3 Hour 4	Poster presentation (max of 3 minutes per person) with critique Poster presentation (max of 3 minutes per person) with critique Poster presentation (max of 3 minutes per person) with critique Review of presentation guidelines
14	Hour 1 Hour 2 Hour 3 Hour 4	Group presentations and peer assessment of presentations with critique Group presentations and peer assessment of presentations with critique Group presentations and peer assessment of presentations with critique Review of main points for the semester

Chapter Exercises

As mentioned previously, this manual provides suggestions and comments on the exercises rather than specific solutions. Only a few of the exercises in Chapter 5 will have traditional "answers" as you would expect to find in a more quantitative course.

Chapter 1 – Commentary and suggestions on exercises

Chapter 1 is about developing professional habits and the student's professional voice. Exploring the expectations of the workforce cannot start too early in an engineer's college career. Assignment 1 is an attempt to guide the students to find other sources of input on the expectations for a professional engineer. The sidebar to the right highlights issues related to the lack of professional behavior during interviews and the first year of employment.

Comment: on assignment 1 that follows the syllabus for two semester-hour course

Assignment 1: Find and read three articles with advice on professional behavior, professional communication, and workplace re-acculturation.

Students may find a variety of references. A few selected sources are provided below for faculty review:

ASME Vision 2030 has been cited in many forms:

See Chapter 1 references, also

Danielson, S. Kirkpatrick, A. Ervin, E. 2011. ASME Vision 2030: Helping to Inform Mechanical Engineering Education, Session T1J, 41st ASEE/IEEE Frontiers in Education Conference, Rapid City, SD, pp. T1J-1 to T1J-6. < http://fie-conference.org/fie2011/papers/1589.pdf>

Kirkpatrick, A. 2013. Designing the Future of Mechanical Engineering Education, ASEE College Industry Education Conference, Phoenix, Arizona, February 6-8, 2013. Accessed 4 Aug 2013 at <http://www.indiana.edu/~ciec/Proceedings_2013/CEED/CEED512_Kirkpatrick.pdf>

The Disappearance of Professional Behavior

Many of today's Millennials apparently lack awareness of business etiquette, according to a published report in *USA Today* [1] and summarized in The Week [2] news magazine. Much of the behavior exhibited on campus—taking calls during meetings, texting in the middle of a conversation, using slang expressions in formal settings, and dressing inappropriately—also appears during formal interviews. According to one account, a student brought her cat with her to an interview and amused herself with the cat during the entire interview. The interviewer was left wondering how the student could possibly think that her behavior was in anyway acceptable. Equally disturbing is the statistic that 20% of recent graduates display unprofessional behavior during the interview process. In a recent survey of Human Resources personnel, about half of the professionals interviewed felt that most recent hires do not exhibit professional behavior during their first year of employment.

[1] USA Today available at http://usatoday30.usatoday.com/MONEY/usaedition/2013-04-30-Managers-to-Millennials-Polish-interview-skills_ST_U.htm

[2] *The Week* news magazine from May 10, 2013, p. 32.

Colwell, B. 2008. How to Succeed in Engineering by Trying Really, Really Hard! Accessed 4 Aug 2013 at <http://people.cs.clemson.edu/~mark/330/colwell/How%20To%20Be%20A%20Successful%20Engineer.pdf>

Dowden, S. 2012. How To Succeed In The Entry Level Engineering Job Market. UC Riverside, Department of Electrical Engineering. Accessed 4 Aug 2013 at <http://www.ee.ucr.edu/news-events/article.php?EID=40>

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"This is an innovative and motivational book for STEM professionals participating in today's global knowledge economy. It urges them to establish a personal strategic plan and to develop transformational skills as well as academic knowledge and industry-specific skills. To be rewarded in today's marketplace the authors point out that STEM professional must be nimble, entrepreneurial and innovative, be a source of new solutions, but also take personal responsibility for continually developing those skills throughout their career." --Prof. A. Galip Ulsoy, C.D. Mote Jr. Distinguished University Professor of Mechanical Engineering and the W.C. Ford Professor of Manufacturing, University of Michigan, Ann Arbor, MI, USA

In this book, the authors advise an alternative approach to career development for science, technology, engineering, and mathematics (STEM) professionals. The authors believe that self-help is the best help and hence technical professionals should take ownership of their future in a strategic way -- just as businesses and corporations have to rely on a strategic approach for long-term survival and success. The authors incorporate concepts of systems thinking, as well as global knowledge, to develop strategic solutions to identified industry needs.

Possible Solutions to Exercises

1. Answers to this exercise will strongly depend on the individuals interviewed. The range of professional communication activities will be undoubtedly of the same scope as shown in Figure 1.3.
2. (Assignment 2) If students struggle finding local job listings, encourage them to consider online listing such as

   <http://www.monster.com/>

   <http://jobs.sciencecareers.org>

   <http://www.engineering.com/Jobs/tabid/5120/Default.aspx>

   <http://www.careerbuilder.com/Jobs/Category/Engineering/>

3. Steven King’s advice is to be a voracious reader in order to become a good fiction writer. The same can be said about reading technical work to improve technical writing skills.

4. As an “ice breaker,” ask students to imagine (1) What does the message say? (2) What is the writer trying to accomplish by sending the message? (3) What style would the writer use if he/she did not know who would read the message? (4) Give examples on how the writing style would change if the writer knew who would read the message.

   First encourage students to be creative; tell them that the message does not have to be about engineering communication. After students have shared their answers, ask them to think of an engineering topic they are interested in and then to answer the questions again. The goal of this exercise is to get students to discover for themselves that audience, objectives, and writing style are all important for communicating with maximal impact.

Alternatively, give students 10 min to write their own message and exchange their message with a partner, who would then try to guess the writer's motivation from the content and the target audience from the style.

We chose the message in the bottle theme for this book for several reasons:

- A message that fits into a bottle must be precise and concise, which are characteristics of effective technical communications.
- Writers who do not know their audience are at a decided disadvantage. The writer of the message in the bottle, for example, must write the message in general terms so that anyone finding the message can correctly understand and interpret it. On the other hand, if the writer knew who would find the message, he or she could adjust the content and style according to the expectations of the target audience, producing a message with much greater impact.
- What might be the genre of the message? The possibilities are nearly endless. Similarly, engineers must be prepared to tackle a wide variety of technical communications in their career.
- What motivated the writer to write the message in the bottle? We can speculate that there had to have been a very specific reason. In general terms, however, we suggest that to get what you want in life, you have to be able to communicate your needs to others. Good communication is one of the most important skills to develop for a successful career in engineering.

Chapter 2 – Commentary and suggestions on exercises

Assignment 3: Find three peer-reviewed journals in your discipline, and read the *Instructions for authors* in each journal. Select one article from each journal and prepare a heading and sub-heading outline of the paper. Note citation style and format.

Comment: Depending upon the discipline, the journal section headings may differ from those presented in Chapter 2. This seems to be especially true of certain journals in the computer science area, which focus on software development. Usually with this exercise, we find that more than 85% of the journals investigated by the students have section headings very similar to the traditional section headings presented in Chapter 2.

Assignment 4: Complete one exercise (1 to 18) from Chapter 2.

Possible Solutions to Exercises

In the text below, sample database search criteria are listed with the resulting number of hits. As with all database searches, the search criteria can be progressively refined. The number of hits should give the instructor some sense of the difficulty students might encounter when trying to answer the exercise prompt.

1. Anthropogenic global warming has been widely reported and widely discussed in technical journals, engineering trade journals, popular science magazines, and in daily newspapers. There is no definitive proof, but many studies suggest that there may be anthropogenic contributions to the currently increasing global temperature. Students should have no difficulty finding sources on “anthropogenic global warming.” On 4 Aug 2013, using the search string “anthropogenic global warming”
   Web of Knowledge found 133 hits
   Engineering Village found 3185 hits
   Google Scholar found 3780 hits
   Scirus found 7174 hits

2. Bench-top experiments for the determination of the acceleration of gravity are easily found. On 4 Aug 2013, using the search string "acceleration of gravity”
   Web of Knowledge found 483 hits
   Engineering Village found 6,773 hits
   Google Scholar found 71,100 hits
   Scirus found 33,292 hits
   Not all hits will be relevant and the search criteria must be made more restrictive to find the desired information.

3. “Carbon capture technologies” have been discussed although no one has yet to find an economically and technologically viable process for doing so. On 4 Aug 2013, using the search string "carbon capture technologies”
   Web of Knowledge found 42 hits
   Engineering Village found 7,691 hits
   Google Scholar found 1,210 hits

Scirus found 4,021 hits

4. “Heat removal technologies for cooling microelectronics” range from immersing the chip in cryogenic liquids to water-filled heat exchangers. On 4 Aug 2013, using the search string "cooling electronic devices"
   Web of Knowledge found 196 hits
   Engineering Village found 8,088 hits
   Google Scholar found 821 hits
   Scirus found 805 hits

5. Agricultural and aquacultural regenerative heating has been implemented in multiple locations. Searching for specific articles is complex because with general terms such as either “waste heat uses” or “aquaculture” too many hits are returned. More restrictive criteria miss many potentially applicable sources. On 4 Aug 2013, using two different search criteria (a) "waste heat" and "agriculture" and (b) “waste heat” and "aquaculture"
   Web of Knowledge found 98 hits for (a) and 11 hits for (b)
   Engineering Village found 1.873 hits for (a) and 69 hits for (b)
   Google Scholar found 11,700 hits for (a) and 1,800 for (b)
   Scirus found 15,273 hits for (a) and 2,145 hits for (b)

6. Siting a wind farm requires consideration of wind statistics, but also many other factors including proximity to markets, accessibility to the site, noise regulations, and initial installation costs. On 4 Aug 2013, using the search string "siting wind farms"
   Web of Knowledge found 33 hits
   Engineering Village found 1,505 hits
   Google Scholar found 184 hits
   Scirus found 426 hits

7. Nanoparticle risks and safety procedures are issues that have received considerable attention in recent years. On 4 Aug 2013, using the search string "nanoparticle safety"
   Web of Knowledge found 8 hits
   Engineering Village found 1,391 hits
   Google Scholar found 258 hits
   Scirus found 1,466 hits

8. Home theater design is critical to obtaining audio effects that emulate commercial theaters. On 4 Aug 2013, using the search string "home theater design"
   Web of Knowledge found 3 hits
   Engineering Village found 68 hits
   Google Scholar found 36 hits
   Scirus found 134 hits

9. Vortex football aerodynamics and noise generation are interesting for even the casual user; however, the noise and aerodynamics are not high priority issues. On 4 Aug 2013, using the search criteria (a) "vortex football aerodynamics" and (b) “vortex football noise generation”
   Web of Knowledge found 0 hits for (a) and 0 hits for (b)
   Engineering Village found 0 hits for (a) and 0 hits for (b)
   Google Scholar found 645 hits for (a) and 4,370 for (b), but few are relevant
   Scirus found 0 hits for (a) and 0 hits for (b)

   Encourage students to investigate the patent documentation:

   Ring wing toy. A Flatau - US Patent 6,454,623, 2002 - Google Patents

   Throwing toy with distance counter. FD Eddins - US Patent 6,695,728, 2004 - Google Patents

10. Frisbee aerodynamics is another topic related to sports, but technological applications are still limited. On 4 Aug 2013, using the search string "Frisbee aerodynamics"
    Web of Knowledge found 3 hits
    Engineering Village found 7 hits
    Google Scholar found 1,200 hits
    Scirus found 1,006 hits

11. Genetically modified plants that glow in the might be a solution to lighting our cities in a sustainable way. What progress is being made in creating these glowing plants? Is this genetic engineering process really a sustainable technology if it can be achieved? On 4 Aug 2013, using the search string ""“glowing plants”
    Web of Knowledge found 462 hits
    Engineering Village found 176 hits
    Google Scholar found 81 hits
    Scirus found 283 hits

    Glowing plants spark debate. Callaway, E. NATURE, Vol: 498 (7452) pp. 15-16. June 6, 2013.

12. A trailer-able 35-ft sailboat requires an understanding of sailboat performance and market as well as the Department of Transportation regulations in the various U.S. states. On 5 Aug 2013, using search criteria “trailerable sailboat”
    Web of Knowledge found 1 hit
    Engineering Village found 1 hit
    Google Scholar found 12 hits
    Scirus found 18 hits (several were redundant)

13. RFID embedded identification and credit cards may be convenient, but may also pose security risks. What security measures are available for identification cards and credit cards with embedded RFIDs? On 5 Aug 2013, using search criteria “RFID security”
    Web of Knowledge found 189 hits

Engineering Village found 3,434 hits
Google Scholar found 5,110 hits
Scirus found 7,133 hits

14. RFID tags are finding application in merchandise security and in inventory control. What are the challenges associated with the use of passive RFIDs? How are these challenges met by active RFIDs and what new problems result from the use of active RFID? On 5 Aug 2013, using search criteria "RFID inventory control"
    Web of Knowledge found 2 hits
    Engineering Village found 484 hits
    Google Scholar found 77 hits
    Scirus found 59 hits

15. Replacement refrigerants will be needed as we phase out HFCs. What are leading contenders to replace these HFCs in domestic and automotive cooling systems? On Aug 5, using the search string "replacement refrigerants"
    Web of Knowledge found 24 hits
    Engineering Village found 1,455 hits
    Google Scholar found 860 hits
    Scirus found 1,290 hits

    Brown, J Steven, PhD, PE. Methodology for Estimating Thermodynamic Parameters and Performance of Alternative Refrigerants. ASHRAE Transactions 114 (2008): 230-238.

    Galka MD, Lownsbury JM, Blowers P. Greenhouse gas emissions for refrigerant choices in room air conditioner units. Environ Sci Technol. 2012 Dec 4;46(23):12977-85. doi: 10.1021/es302338s. Epub 2012 Nov 20.

16. Field programmable gate arrays (FPGAs) are commonly used in electrical and computer engineering. What are FPGAs and why have they become so common? On Aug 5, using the search criteria (a) "FPGAs" and (b) "FPGA applications"
    Web of Knowledge found 32,668 hits for (a) and 76 hits for (b)
    Engineering Village found 36,299 hits for (a) and 15,594 hits for (b)
    Google Scholar found 550,000 hits for (a) and 1,390 hits for (b)
    Scirus found 514,881 hits for (a) and 3,191 hits for (b)

17. What is quantum computing? What is the current state-of-the-art in quantum computing? On Aug 5, using the search string "quantum computing"
    Web of Knowledge found 4,091 hits
    Engineering Village found 81,309 hits
    Google Scholar found 73,400 hits
    Scirus found 170,965 hits

18. "Big data" has become an increasingly common topic of study. Determine what "big data" means. What significant implications are carried with the access to big data in the short-term

and long-term future? Who records big data? Why is it recorded? What challenges are associated with big data as it continuously grows larger? What concerns exist that “big data” might be abused? On Aug 5, using the search string “big data”

Web of Knowledge found 542 hits
Engineering Village found 16,734 hits
Google Scholar found 22,600 hits
Scirus found 341,496 hits

Big data: How do your data grow? C Lynch - Nature, 2008 - nature.com