GUIDELINES
FOR WRITING
XE 499
SENIOR PROJECT – CAPSTONE DESIGN
REPORTS

Prepared by

Dr. Bahaddin Karagőzoğlu
Electrical and Computer Engineering Department

FACULTY OF ENGINEERING
KING ABDULAZIZ UNIVERSITY
JEDDAH – SAUDI ARABIA

Rabia II 1425 ~ June 2004

Table of Content

GUIDELINES FOR WRITING XE 499 PROJECT REPORT

1 Introduction

1.1 Objectives of the Project

XE 499 – Senior Project course, will provide students with a major capstone design experience, to include (X stands for the abbreviation of the respective department)

1. In depth design work on a practical engineering problem at a technical level similar to that encountered in industry,
2. Technical content drawn from multiple areas of the engineering curriculum,
3. Experience in planning and managing projects, and
4. Further experience in documenting and communicating engineering work.

1.2 Minimum Requirements of Senior Design Projects

Academic programs administered by the Faculty of Engineering have been accredited by the Accreditation Board for Engineering and Technology (ABET) in November 2003. The Faculty of Engineering would like to maintain this achievement and accomplish program goals. As part of our self-evaluation, recommendations of ABET and our preparation for the next evaluation in few years using the new Engineering criteria (EC-2000), the College is focusing on improving the quality of senior engineering projects. Starting from the spring semester of 2004, every design project should satisfy the minimum requirements by ABET. Listing of these requirements is given in Appendix-A. Every project team must make sure that they fulfill them.

1.3 Project Completion

The Senior Project (XE 499) is a two-semester activity. *All projects must result in a finished, working, properly* tested *and evaluated product* in order to successfully complete XE 499. At the end of the second semester, students must submit *complete, detailed final reports* and defend them orally. In the end, XE 499 will provide students with a major capstone design experience, to include in depth design work on a practical engineering problem at a technical level similar to that encountered in industry, experience in planning and managing projects as well as experience in documenting and communicating engineering work. The report writing guidelines are aimed at providing the students with specific formats in articulating the project reports in line with ABET requirements.

1.4 Essentials of the Report

The report should concentrate on important aspects as:

1. What we did,
2. Why we did it,
3. How we did it,
4. What we have found (results we have obtained),
5. Interpretation of the results: What are the results obtained mean to us,
6. Conclusions: How the achievements match the original objectives,
7. Recommendations: How we would proceed if we have started the project now (optional)?.

1.5 Assembling the Report

The report is composed of three main sections as:

1. Preliminary materials,
2. Body of the report, and
3. Reference materials.

2 Preliminary Materials

2.1 Elements of the Preliminary Materials

1. The Title or Cover Page

   The student can design this page according to his wish. However, the following items are essential ingredients of the title page. A san-serif style font (i.e. Arial) should be preferred and underlining or italic should be avoided. The page should be centered with 5 cm top margin. Other margins should be 3 cm for left, 2.5 cm for the right and bottom.

   - Institutional details: it is printed in 14-16 points font size and capital letter either at the bottom or top of the page (XXX represents the name of the department)
     - DEPARTMENT OF XXX ENGINNERING
     - FACULTY OF ENGINEERING
     - KING ABDULAZIZ UNIVERSITY
     - JEDDAH – SAUDI ARABIA
   - Title of the project: 16-24 points font size single-spaced, **bold** and all CAPITAL LETTERS. No abbreviation is used in the title. It should be descriptive of the report

but limited to 15 words (100 characters or less)

- Student(s) name(s): 14-18 points font size and bold
- Supervisor(s) name(s): 14-18 points font size and bold
- Advisory committee (optional): Names and addresses of the advisors (if available) in 14-16 points font size and capital letter
- Customer (optional): Name and address of the customer for whom the project is developed (if available) in 14-16 points font size and capital letter
- Month and year: in Hijri and Gregorian without commas in 14-16 points font size and bold.

2. The cover backbone (كعب التقرير) must contain the following in order: KAAU, XE, Title of the project, Hijri and Gregorian year.
3. Approval page: this page contains
   - Title of the project: same as the title page, it is printed in 16 points font size single-spaced, **bold** and all CAPITAL LETTERS.
   - Student name: 14-18 points font size and bold
   - A statement of the purpose of the report, 14-16 points font size and bold. Example:

A senior project report submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF SCIENCE

In

ELECTRICAL ENGINEERING (Biomedical Engineering)

   - Supervisor's name: 14-18 points font size and bold
   - Names and signatures of report examiners: Names left justified, 14-16 points font size and bold
   - Institutional details: Same as the cover page
4. Remembrance and Dedication page
   - It is a common practice for every Muslim engineer to start any act with statements containing in the name of Allah, thanking to Allah Almighty and praising the last of the prophets Muhammed sallallahu alaihi wa sallam (peace and blessings be upon him).
   - A statement of dedication below the remembrance section (optional, if used).
   - The remembrance section may be centralized in the page if dedication is not used.

5. Project Summary or Abstract (about 1 page, preferably Arabic and English)

It is the summary of the entire report. It should contain all the major points and the following organization is suggested:

- Foreword
  - Give the problem statement including the organizational problem, (the purpose of capstone projects, the context of our particular project) and the general technical problem (the type of project are we doing (software prototype, hardware prototype, simulation, application program for a client, etc)).
  - Give a more specific assignment statement - specifically what the writer(s) of the report was asked to do (an overview of the project goals), the technical questions, task, and perhaps the hypothesis or solution.
  - State the overall purpose of the report.
- Summary
  - Provide the objective and background (how problem was approached, what were the results) including objective or hypothesis, methodology or experimental procedure and results.
  - Give overall conclusions about project including recommendations for improvements and their implications, subsequent action, and cost and benefits.

The recommended format:

- Starting on a separate page
- Margins: left 3.5cm, top 2.5 cm, right and bottom 2.0cm
- Typeface and size: preferably Times Roman, size 12
- No underlining, boldface or italics
- The word ABSTRACT in boldface, 16 point size, centered and above the title
- The title of the project in boldface, 16 point size, must be centered
- Spacing (1.5 lines)
- Length: 350 words, maximum one page
- No citations or references
- Abstract in Arabic (المستخلص): This is an Arabic translation of the Abstract. It should be on a separate page. The same rules as the Abstract Page apply to this page.

6. Acknowledgement (optional): it is the place where the author expresses his appreciation to the contributors. A professional tone must be maintained. A similar format as in the

abstract is preferred.

7. Table of Content: it introduces the text to the reader, indicating its contents, organization, and progression. It should make access easy, not overwhelm the reader with detailed contents. Necessary elements can be listed as
   - Starting on a separate page
   - Margins: left 3.5cm, top 2.5cm, and right and bottom 2.0cm
   - Typeface and size: preferably Arial, size 12
   - No underlining or italics
   - Entries must be consistent, in both style and substance, with headings as they appear in the text (wording, capitalization, style of numerals, etc.)
   - Length: may run more than one page; do not type "continued" at the end of the page or at the beginning of the next page.
   - Each entry should have tab leaders and corresponding page reference numbers must be aligned correctly.
8. List of Tables and List of Figure (if available): a similar format as in the Table of Content is used.
9. List of Symbols and Abbreviations (optional, if available).

2.2 Pagination

Small Roman numeral (ii, iii, iv, etc.) is used. The title and approval pages are assigned the first and second small roman numerals respectively, but those numbers do not actually appear on pages. The page numbers begin with iii, assigned to the Remembrance and Dedication if one is used otherwise to the Table of Content. Page numbers are placed in the bottom center of the pages.

3 Body of the Report

Body of the report contains an introduction, review of the literature (background), methodology, results and discussions, conclusions and recommendations. For senior project, the introduction and literature can be combined in one chapter titled *the introduction*.

3.1 The introduction

3.1.1 Introduction (about 1 or 2 pages)

It includes a clear explanation of goals of the project, the significance of studying the problem. It should orient the reader to the topic of the report by including the following:

- The problem - Explain the particular problem that is addressed in the report.
- The objective - State the assignment (what our project needs to accomplish to solve the problem).
- The method of the report - Describe the organization and structure of the report.

3.1.2 Background (3-6 pages):

Discuss the context and history of this general topic and describe what has been done in the past. Include literature search results for the OVERALL problem and context rather than the options for component parts here. Include pros and cons of the existing solutions. Also motivate need for a new solution. Answer the question: What are the most important issues for this topic in terms of the goals of the project and the effects on society? Write about at least 5 of the following issues:

- Economic: effect of this topic on the economy in the past, possible cost of project development, cost of materials, target cost if project is marketed.
- Environmental: influence on the environment in the past, possible effects for future developments
- Sustainability: product life cycle, future markets
- Manufacturability: material availability, use of off the shelf versus custom components, special needs for hostile environments
- Ethical: uses that could cause harm to society, ethical issues that someone working on this topic might encounter
- Health and safety: positive or negative impacts on the health and safety of individuals or society for past or future applications in this topic
- Social: relationship of this topic to social aspects of society such as education, culture, communication, entertainment
- Political: relationship of this topic to political issues.

3.2 Methodology

It contains alternative approaches to reach the goal, analysis of the problem and design of subsystems, test and evaluation of the designed components, and synthesis of the components

to build the project. Present work plan for project phases (analysis, design, implementation and evaluation) and cost analysis in terms of expected effort and material.

3.2.1 Design Requirements (3 to 6 pages)

- Specifications and requirements for the project: Specify technical and non-technical characteristics. Give the detailed specifications that served as the basis for the project (interpretation of rules of a contest, interpretation of customer requirements, and interpretation of desired features; how they determine or constrain size, velocity, response time, cost, weight, etc.) Consider aspects such as potential users, cost, safety, user-friendliness, performance, compatibility with other things, functionality, acceptance, convenience, capacity, misuses, legal issues, standards or codes, availability, materials, productivity enhancement, entertainment, technology, and design methods.
- Selection of design criterion: Based on our specification, specify goals for performance, reliability, cost, code size, manufacturability, safety, societal factors (human interface, environmental factors, etc) and any other criteria relevant to the project.
- Alternative solutions: Explore alternative solutions. Evaluate alternative solutions based on situation description and design constraints.
- Select the proposed solution with justifications. Provide an overall architecture of the solution.
- Functional decomposition of the project: Explain the major functions required by our design. Figures and tables should be used to supplement discussion.

3.2.2 Feasibility Discussion (2-5 pages)

- Results of literature search: Provide the options and justification for overall approach (hardware, software, choices of methods).
- Analysis: Describe behavior of the system, data and requirements.
- Options and justification for each functional part: Provide the options and justification of design approach and components or methods used in each functional part. Be sure to cite all of the literature used in our discussion.

3.2.3 Final Implementation (5-15 pages)

- Presentation of final implementation:

- Describe the project and its functions (include diagrams, code examples, and other figures in the body of the text and refer to any large engineering drawings, listings, etc. in the appendices in the body of the text).
- We might present the implementation by functional groups. Discuss and present the calculations used in the design of the project in the relevant subsections.
- Summarize repetitive calculations in tables.

- Also, describe
  - Tools used,
  - The way of implementing the solution and
  - Solution requirements.

3.3 Results and Conclusions

This is the final chapter of the project that deals with results, discussions, conclusions and recommendations. In large projects it can be divided into two chapters as Results and Discussions, and Conclusions and Recommendations. It contains:

- Design of experiments to evaluate the system in laboratory environment and in real life situations,
- Statistical evaluation of the experimental data
- An interpretive discussion of the results and thoughtful evaluation of the design methodology adopted.
- Discussion of the lessons learned.

3.3.1 Performance Estimates and Results (2-5 pages)

- Present the estimated performance of the project (and how they were derived) based on the preliminary design (estimates to include speed, cost, power consumption, noise-immunity, ease of use, etc, depending on the project).
- Present the actual performance results. Discuss the results, compare with estimated performance and explain discrepancies. Evaluate performance with respect to legal, illegal, boundary and known cases.
- Compare results with those of other existing solutions.
- Include suggestions for design changes that would improve the performance of the project. Use graphs or other figures to show relationships when appropriate.

3.3.2 Production Schedule (1-2 pages)

Discuss the phases of the design and implementation of our project. (Pert charts may be appropriate in the discussion) Recommend any improvements that could have been made in the scheduling and planning.

3.3.3 Cost Analysis (1-2 pages)

Tabulate component costs and compare to estimated cost and market cost where appropriate.

3.3.4 User's Manual (1-3 pages)

Provide a user's manual for the operation and maintenance of the system designed in the project.

3.3.5 Discussion, Conclusions and Recommendations (2-4 pages)

It includes:

- A restatement of the problem that gave rise to the report
- Brief statement of the problem, a description of the main features of the method omitting most of the details concerning subjects and measure
- A listing of main findings, and conclusions based on these findings.
- A summary of the design performance
- Recommendations, explaining subsequent action or posing specific questions for investigations. We may indicate as suggestions for further work, implications of what would we do and how we would continue if we had available time and opportunities.

3.4 Format of the Report

3.4.1 Margins, Headings and Justification

- We must maintain margins of 3.5cm on the left, 2.5cm on the top, and 2.0cm on the right and bottom of the page.
- Main headings within the text should be consistent with the Table of Contents. Headings should not be underlined. They should be bold, numbered and same size as text. No heading should end with colons (:) and no page should end with a heading.
- All text must be left or full justified.

3.4.2 Paragraphs, Indentation, Spacing and Font Size

- The first paragraph following a heading should have no indentation. Subsequent paragraphs should be separated either by additional spaces between paragraphs or

should start at the first TAB stop.

- All text must be 1.5 line spaced. Materials in tables, appendices, and block quotations, individual footnotes should be single-spaced.
- Times Roman typeface with 12 point size should be used throughout the text.

3.4.3 Pagination

The text, beginning with the Introduction should be numbered consecutively with Arabic numerals, like 1,2,3,4… and so on. Page numbers must be placed at the bottom center of each page.

3.4.4 Tables, Figures and Equations

- Tables and figures must serve the reader and support the text. The titles must be coordinated with the List of Tables, List of Figures. Numbering of Tables and Figures must be done sequentially, including the Chapter number in which it is placed (for example, figures in chapter 2 are numbered as Figure 2.1, 2.2, etc). Technical reports only contain Figures and Tables. Refer to graphs as figures, photos as figures, small code segments as figures, etc.
- Figures and tables should NOT be hand sketched.
- Figures and tables should be used to supplement the discussion. Always introduce a figure or table in the text and never place a figure or table in the text that is not discussed. Discuss the meaning and significance of the table or figure. Be sure to highlight the fine points and structure.
- Figures and tables should be located in the body of the text, AFTER they are introduced in the text.
- It is often appropriate to pull out small segments of code from a main program or to write pseudocode to describe an algorithm or major point of the project. This is considered a figure and should be titled and numbered as such.
- If a group of figures or a long table or code listing takes up too much space, locate them in an appendix.
- Figures and tables can be located at the end of the text but it is less convenient for the reader.
- Every figure must have a descriptive title (caption) located immediately below the figure and centered.
- Every table must have a descriptive caption located above the table and begin at the

same margin of the table.

- Each equation must be written using a proper, standard scientific notation. Equation Editor of Microsoft Office should be used. Each equation must be tabbed centered a separate line of text and numbered on the right, using Chapter number and equation number, separated by a dot, as in the following example:

$$H(s) = \frac{s(s+0.5)}{(5s+1)(s^2+2s+1)} \qquad (1.2)$$

- In-line equations, or expressions may also be used, as follows: "… realizing that $x^2 + y^2 = 1$, it can be concluded that ….."
- References to Tables, Figures and Equations: while referencing a table, figure or an equation or a series of these within the text, use, for example, figure 2.1, table 3.2, equation (2.1), equations 3.5-3.7 and 3.9, etc.

3.4.5 Chapter, Section, and Subsection Headings

Chapter, Section and subsection headings must all be typewritten in bold, with the following rules:

- Chapter headings should start at a new page, starting at 5 cm below the top of the page and centered. Chapter number must be in Arabic numerals, like 1, 2, 3… and so on, followed by Chapter Title both in capital letters, and with Arial, size16.
- Section headings may start anywhere within the text, after a triple space of the text of the previous section. Section titles contain Chapter and Section numbers separated by a dot, followed by the Section Title in small letters, the first letters of main words being capital. Section headings should be in bold, 12 point size.
- Subsection headings should be written similarly as section headings and contain Chapter number, Section number and Subsection number, separated by dots.

4 Reference Materials

Reference materials contain the bibliography (references) and appendices. They are paginated consecutively from the last page of the text. They must meet the same format requirements (margins, fonts, spacing etc) as the rest of the report.

4.1 Citing and Listing References

- Any work used, which is not the actual work of the student, must be cited, and referenced. The citations in the body of the report maybe by numbers inside square brackets "[2]" or by the last name of the author(s) and year of publication as "… Akili (2002) utilized an infrared telemetry system …". In the first case, the references will be listed according to their order of appearances in the text. In the second case, they are ordered alphabetically according to the surname of the first author of the work cited.
- References appear in six different forms as the whole book, part of a book, a journal article, data sheets and other reference material without a known author, a Web cite, and personal communication with authorities in the field. Following list illustrates an example of each.

[1] Sklar B, *Digital Communications: Fundamentals and Applications*, 2nd ed., Prentice-Hall Inc., 2001.

[2] Neuman MR, "Biopotential Electrodes", chapter 5 in Webster JG (ed), *Medical Instrumentation: Application and Design*, 3rd ed. Wiley, 1997.

[3] Karagözoğlu B, "Analysis of Electromagnetic Signals by a Microcomputer", *Bull. Tech. Univ. Istanbul, 48(2)* pp. 197 – 212, 1995.

[4] Anonymous, "Dual Switched Capacitor filter IC", *RS Data Sheet 4850*, March 1983.

[5] http://www.microsoft.com/updates (visited on February 15, 2004).

[6] Gülüt YK, "Interfacing Analog Signals to a Microcomputer Using Game Port", *Personnel communication*, KAU, Faculty of Eng. Dept. of E&CE, Jeddah, Saudi Arabia, Sept. 1994.

4.2 Organizing Appendices

- Materials that may be of interest or importance to some readers but are not sufficiently relevant to be included in the body of the report go to appendices. There may be many appendices supplementing the report. Some material, such as computer printouts, may be so lengthy that placing it in the text would disrupt the reader's attention. Students must discuss with their advisor(s) the need for appendices, carefully considering the value of the material they propose to include.
- Appendices must be designated with a letter (Appendix A, Appendix B, etc) each starting on a fresh page, and a title. Each appendix must be listed in the Table of Contents. All appendices must meet the usual margin requirements.

Appendix – A: Minimum Requirements of Senior Design Project

The Faculty of Engineering has been accredited by the Accreditation Board for Engineering and Technology (ABET) in November 2003. The faculty of Engineering would like to maintain this achievement and accomplish more goals. As part of our self-evaluation, recommendations of ABET and our preparation for the next evaluation in few years using the new Engineering criteria (EC-2000), the school is focusing on improving the quality of senior engineering projects. Starting from the spring semester of 2004, every design project shall satisfy the following minimum requirements. The students, supervisors and examiners will complete senior project checklists. Departments will provide blank copies of the checklists. Appendix – B contains a sample checklist.

Real Life Problem: The project should reflect a real life problem related to the industry.

Advisory Committee: Each project should have at least one advisor from the academia and one advisor from the industry.

Situation Description: A situation should be clearly described by the advisor(s).

Problem definition: The design problem should be defined by the student(s) and should involve some coaching from the advisor(s).

Open-Ended: The project should involve a problem that has no single solution.

Alternative Solutions: At least two different solutions should be discussed by the student(s) for a situation. A comparison should be performed between the alternatives

Specifications & Regulations: Adopted design specifications and regulations should be clarified in each design project.

Aesthetics: It is beauty and appearance.

Rationale of the Project: The roadmap of thinking and the rational of the selected design solution should be clarified. Also, student(s) and advisor(s) should prepare a one sheet

summarizing the curriculum sources contributed to the accumulated knowledge used to address the design project problem.

Statistics & Reliability: An engineer usually uses database(s) or engineering model(s) to solve a specific problem. Statistical analysis should be performed for the used database(s). Design reliability should be assessed. In some cases, risk assessment may be performed.

Team Work: Advisor(s) should emphasize teamwork among students, as applicable

Professional Ethics: All work should be original and not copied from others. In the case of project-team, work should be divided evenly between all members. Grade should be given on individual basis and based on the effort and performance of a student. All referenced materials should be documented. Professional ethics should be implemented and enforced by the advisor(s) and students.

Environmental Impact Statement: Each project should include a section to assess the impact of such a project on the environment including, but not limited to, air, water, soil, etc.

Culture & Social Assessment: The final product in some projects might have a direct or indirect short, medium or long-term impact on some sector(s) from the local, national and/or international society. In this case, the project report should assess the acceptability of the proposed design by the neighboring and/or end-user society.

Marketing & Financial Analysis: Each project should include a cost estimate of the design and its implementation including time and material. Each project should address the marketability of the end product, which could be a manufactured product or service product.

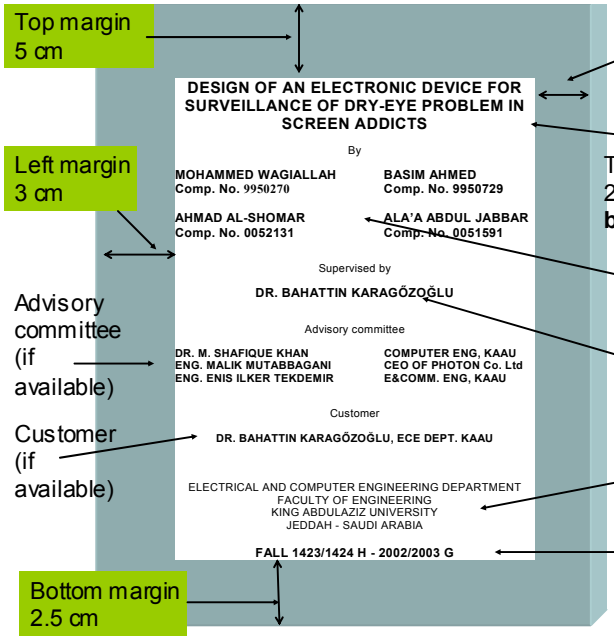
Final Product

A report should be written in clear English. A multimedia presentation is recommended. As a minimum, a power point presentation should be prepared. A one sheet summary should be prepared including the problem statement, design approach, important findings and one or more illustrations.

Also, student(s) and advisor(s) should prepare a one sheet summarizing the curriculum sources contributed to the accumulated knowledge used to address the design project problem.

Appendix – B: Illustrations

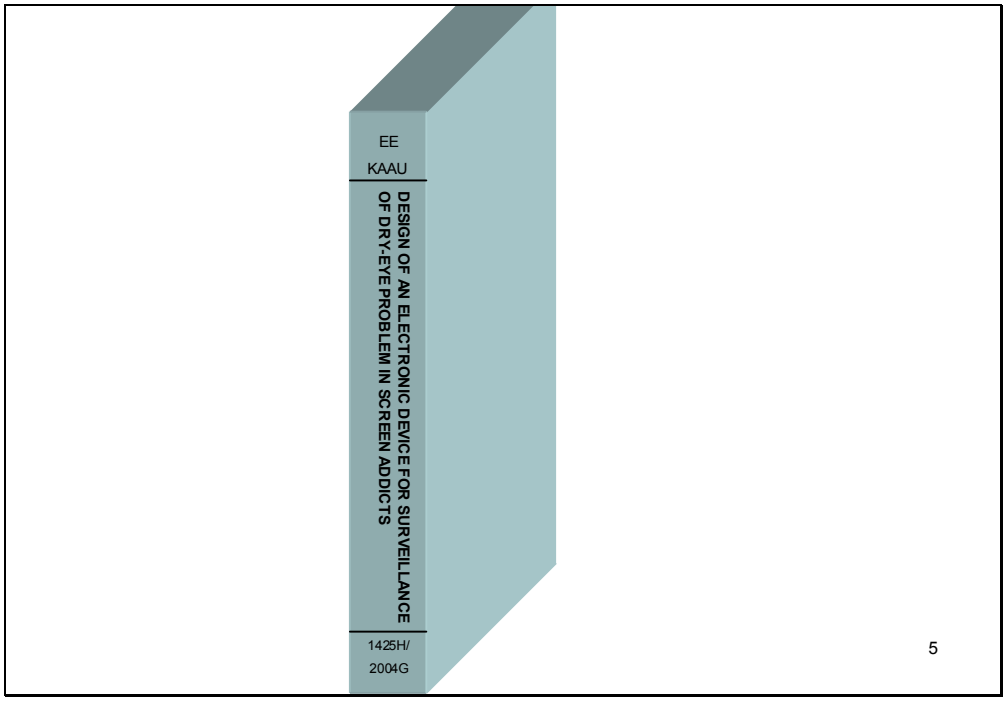
The Cover Page



4

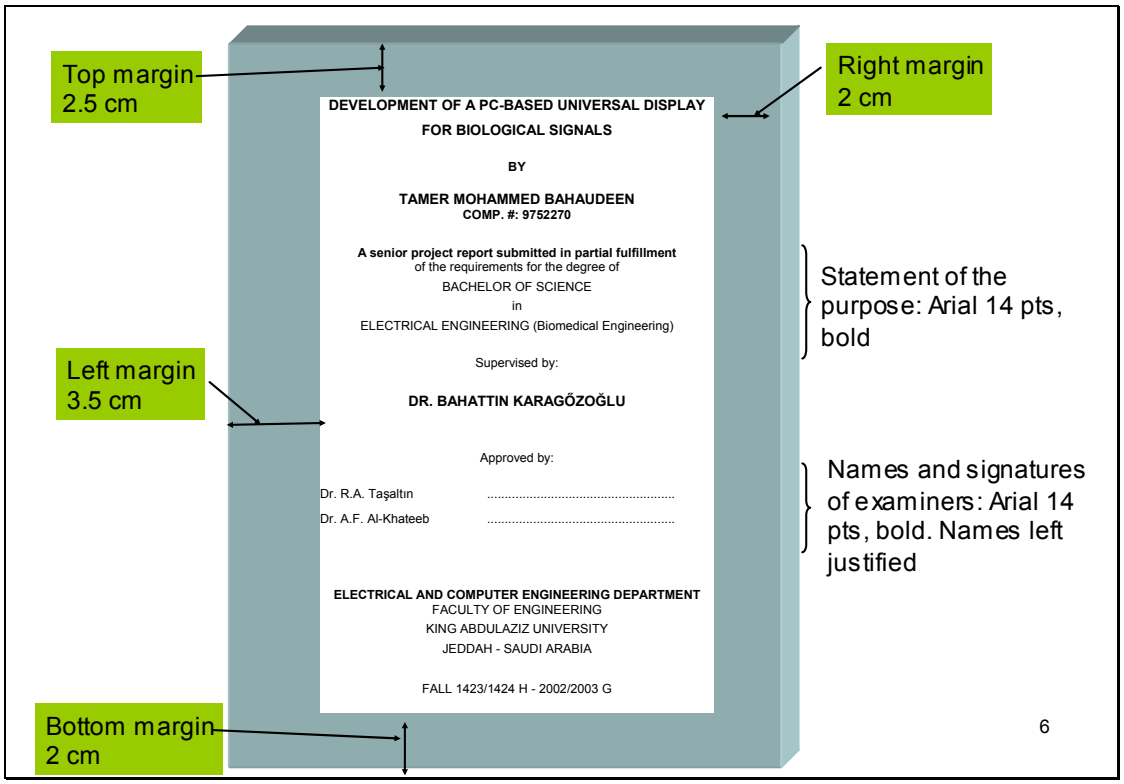
Paper size: A4; height 29.7 cm, width 21 cm

The Cover Backbone

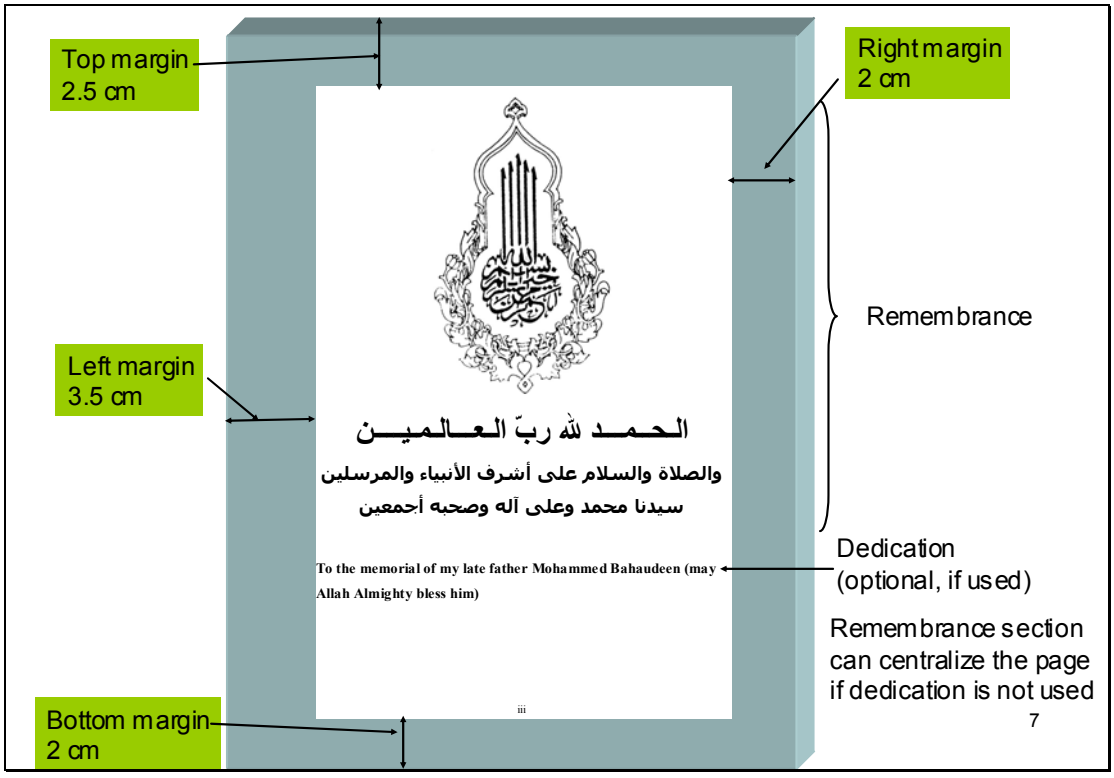


5

The Approval Page



Remembrance and Dedication



Abstract (Project Summary)

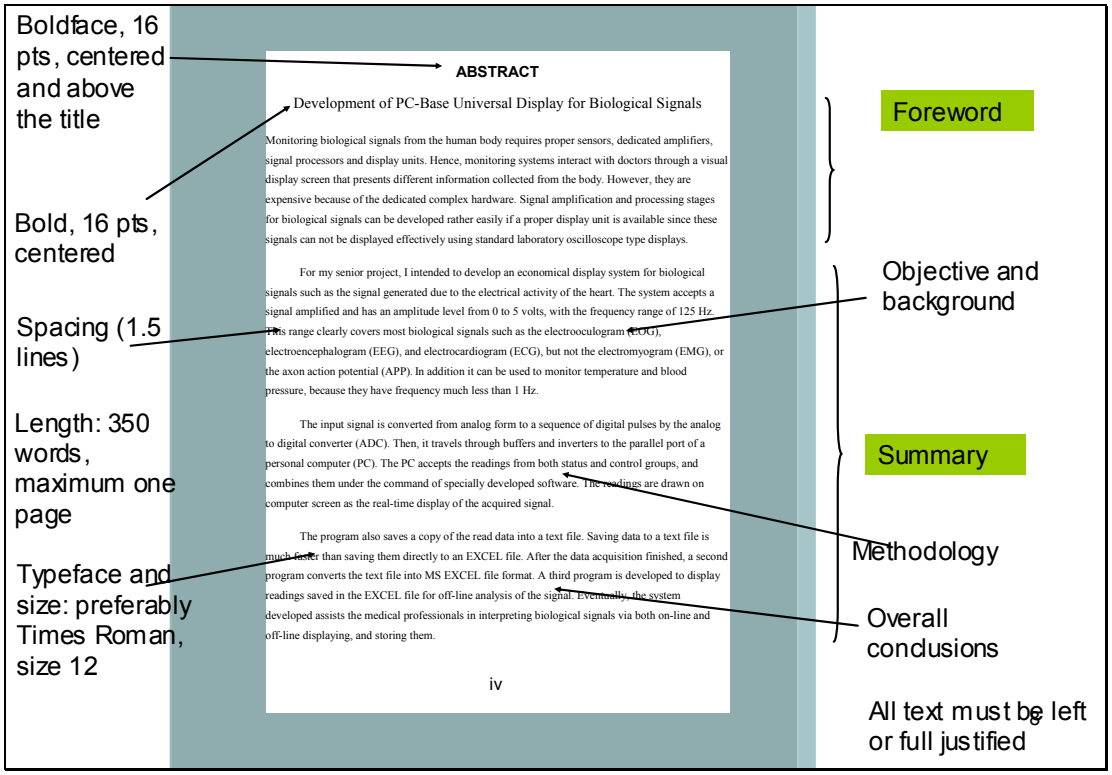
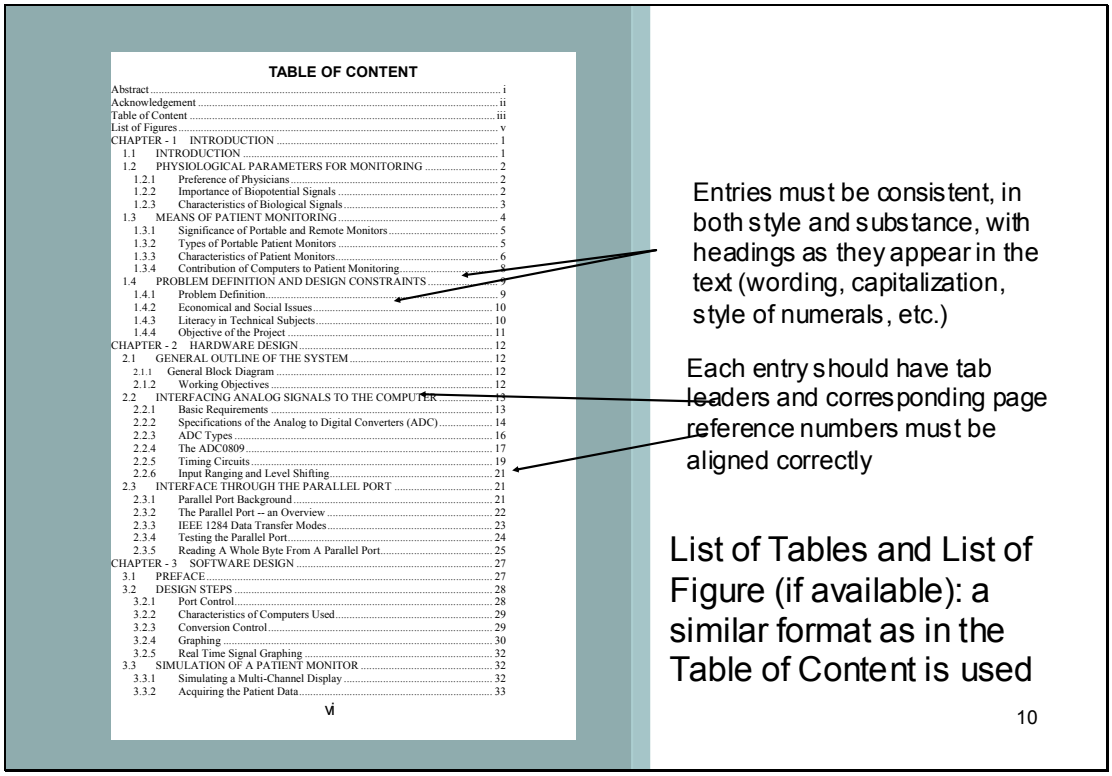
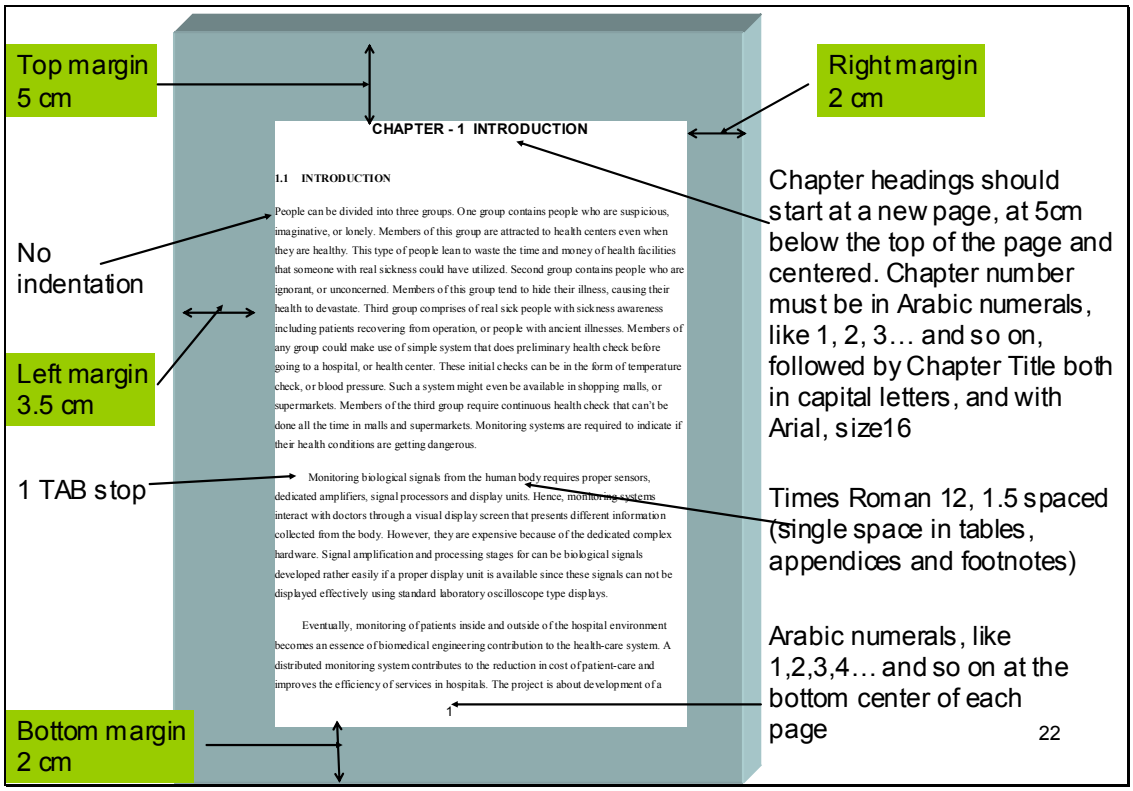
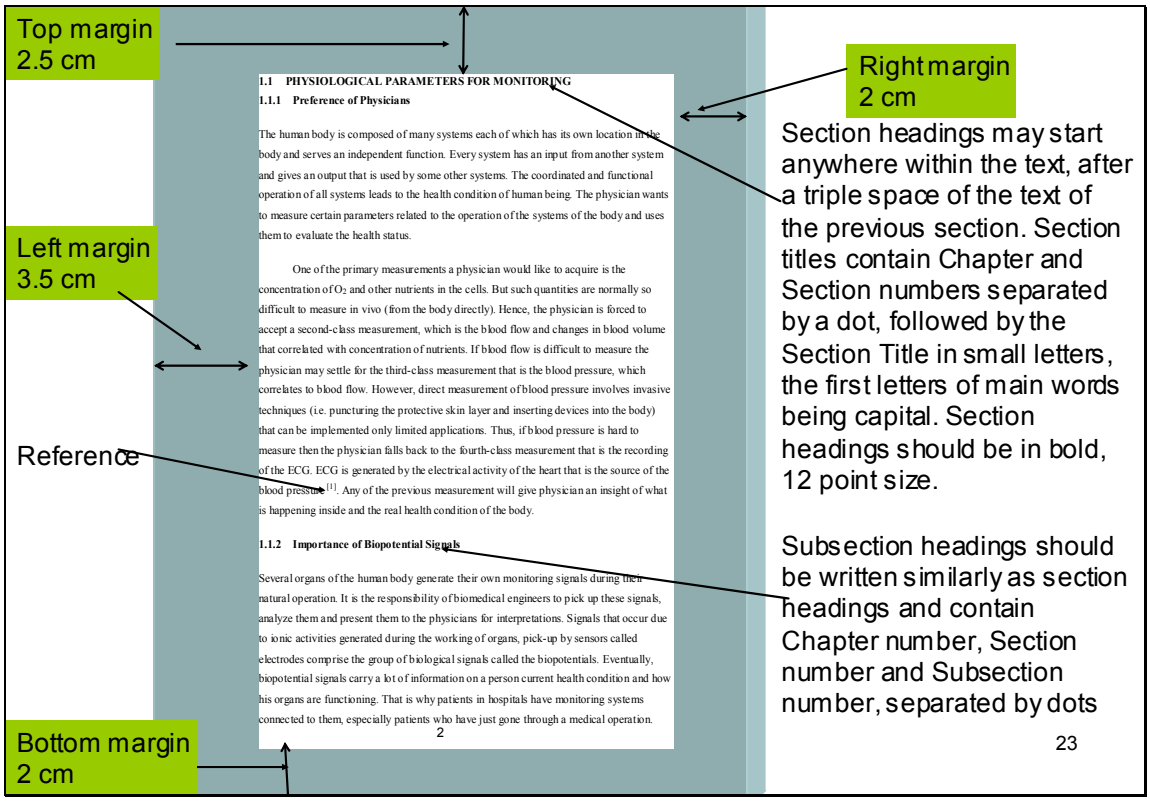


Table of Content



Chapter, Section and Subsection Headings





Figures, Tables and Equations

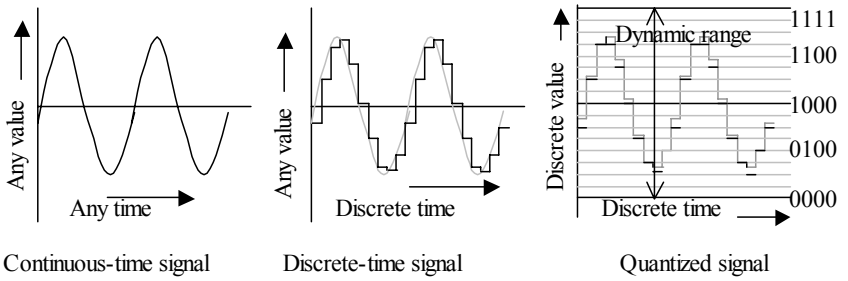


Fig. 1.3 Principle of operation of the analog to digital conversion [2]

Figure caption (title)

Reference

Table 2.1 Conditions of pins of the parallel port

Table caption

Pin #	Pin name	Connection
1	$\overline{C0}$	Inverted
14	$\overline{C1}$	Inverted
16	$C2$	Non Inverted
17	$\overline{C3}$	GND
15	$S3$	Non Inverted
13	$S4$	Non Inverted
12	$S5$	Non Inverted
10	$S6$	Non Inverted
11	$\overline{S7}$	Inverted

Stand-alone equation

Each equation must be written using a proper, standard scientific notation. Equation Editor of Microsoft Office should be used. Each equation must be tabbed centered a separate line of text and numbered on the right, using Chapter number and equation number, separated by a dot, as in the following example:

$$H(s) = \frac{s(s+0.5)}{(5s+1)(s^2+2s+1)} \qquad (1.2$$

In-line equations, or expressions may also be used, as follows: "… realizing that $x^2 + y^2 = 1$, it can be concluded that ….."

In-line equation

A Sample Checklist for Minimum Requirements by ABET

KING ABDULAZIZ UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Advisory Committee Chairman (Supervisor):……..

Project Title:……

……

Student Name(s):……

SENIOR DESIGN PROJECT CHECKLIST

Item*		Implemented		
		Yes	No	***Indicate*** *page(s)* in the report for **yes**, ***cite*** *reason(s)* for **no**
Real life problem				
Advisory committee	One from industry			
	From other specializations			
Situation description				
Problem definition				
Open-ended				
Alternative solutions				
Aesthetics				
Specifications and regulations				
Statistics and reliability				
Teamwork				
Professional ethics				
Environmental impact statement				
Cultural and social assessment				
Financial analysis and marketing				
Final product				

(*) See attachment for definitions

Remarks

Student(s): ***Indicate*** *page(s)* in the report for **yes**, ***cite*** *reason(s)* for **no**
Supervisor(s):***Verify*** *page(s)* in the report for **yes** and ***reason(s)*** for **no**
Examiner(s):***Verify*** *reason(s)* for **yes** or **no**