CHAPTER SIX - S&T REPORTS

★ TYPES OF S&T REPORTS

completion	library
construction	operation
design	partial
evaluative	periodic
examination	preliminary
experimental	**progress**
failure	research
feasibility	service
final	status
formal	technical
industrial shop	test
information	trade
inspection	training
interim	trip
investigation	work
laboratory	…

★ ACADEMIC LABORATORY REPORTS (LAB REPORTS)

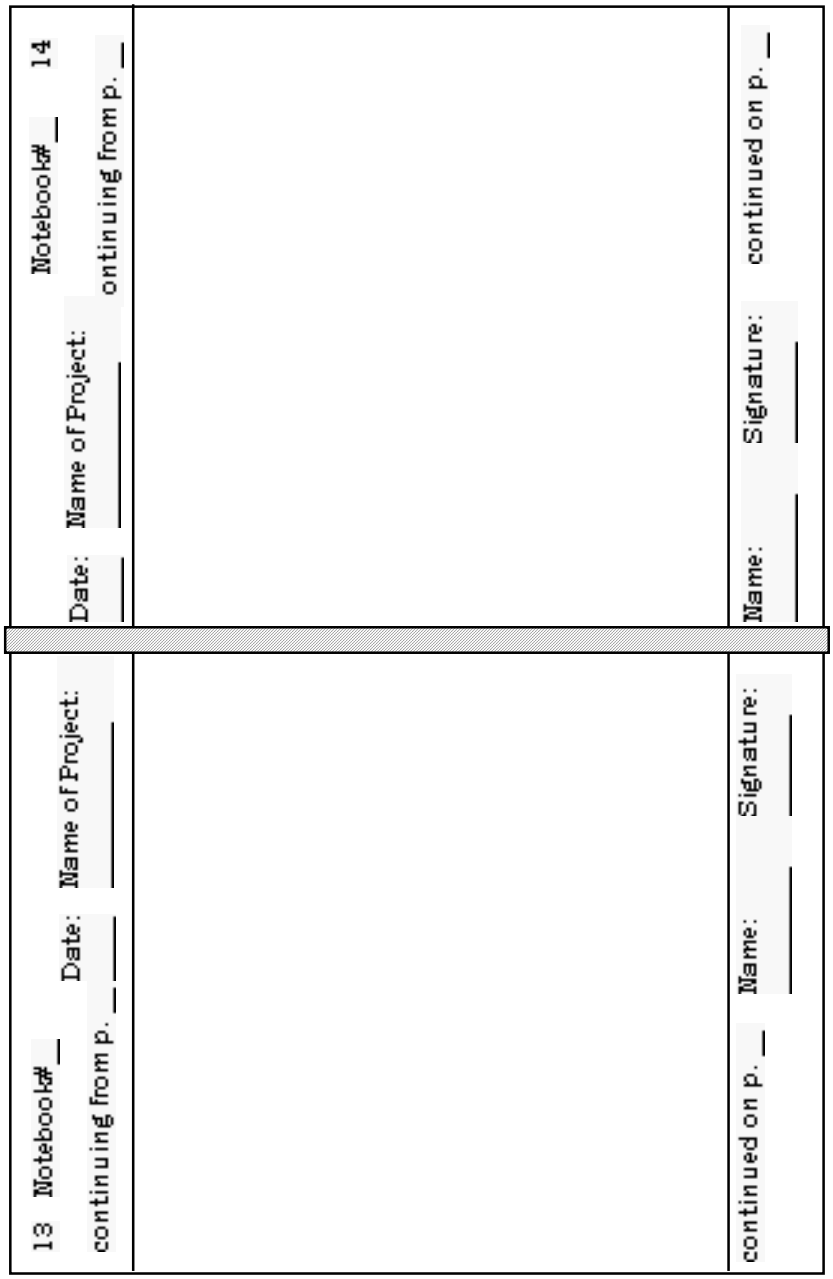
- Very familiar to every engineering student!

Requirements for a good lab report

- maintaining **a well-kept and complete lab notebook**, such that all sources of data and/or information are available for assessment and evaluation by others
- **honesty** and **integrity**

The (Laboratory) Notebook

- ✦ is one of the most **useful tools** of a professional engineer/ scientist/researcher
- ✦ should contain a **record of all work** done by the professional engineer/scientist/ researcher
- ✦ should be so **detailed** that another person could read it, follow the instructions, and obtain the same results as the original experimenter



Sample laboratory notebook format

✦ is more than a personal record. Entries in lab notebooks

- have played important role in **copyright and patent claims**.
- are frequently used as **evidence in legal matters** involving product performance, discovery and liability.

★ Many well known international companies as wall as universities have developed **policies** of signing data pages or officially stamping them with the date and signatures to bear witness.

Basic Guidelines for Keeping a Lab Notebook

- ✓ The **name and the address of the owner** should be on the cover and inside the lab notebook.
- ✓ The notebook should be **bound** and pages should be **pre-numbered**.
- ✓ The first 5-6 pages should be allocated for a **table of contents** and be **continually updated**.
- ✓ All entries must be **recorded in ink** and not pencil!
- ✓ All entries must be **dated**.
- ✓ **No pages** should be **removed**!
- ✓ **Erasures** are **not permitted**!
- ✓ Wrong entries can only be **crossed out**.
- ✓ All entries should be **directly recorded** in the book and not on any scrap paper!
- ✓ Everything should be noted **regardless of significance**.
- ✓ **Opinions and ideas** should be entered regardless of significance.
- ✓ Any **graphic or tabulated** entries should be **included and pasted** in the notebook.
- ✓ If computers are used for note taking, **hard copies** of the material should be made **daily**.

Typical Sections of an Academic Laboratory/Project Report

FRONT MATTER

- Title Page
- Table of Contents
- List of Figures
- List of Tables
- Nomenclature (= symbols)
- Abbreviations
- The Abstract

BODY

- Purpose/Objective/Scope
- Procedure
- Findings
- (Sample) Calculations
- Results
- Analysis and Discussion
- Conclusion(s)
- Recommendation(s)

BACK MATTER

- Appendix/Appendices
- References
- Illustrative Material

Additional Sections

- Theory
- Background Material
- Equipment
- Materials List
- Description of Apparatus
- Illustration of Results
- Error Analysis
- … as specified by instructor

NOTE: In the text each section should begin on a new page.

Other Sections of the Laboratory Report:

★ **Purpose/Objective/Scope -** should answer the following:

- Why are you doing this? (<u>in addition to the fact</u> that you must do it to pass the course!)
- What do you hope to find? (prove, make, show)
- What principle will be illustrated?

<u>A Poor Example:</u>

Purpose:	To see the performance of isolation amplifiers.

<u>A Good Example:</u>

Purpose:	To compare performance of amplifier circuits built using instrumentation amplifiers and isolation amplifiers.

- Title page example:

A Project Report

on

Dynamic Infrared Radiation Thermometer

by

İnci Çilesiz

submitted to

Professor J. Valvano

for

BME 385J Computer-Based Biomedical Instrumentation

The University of Texas at Austin

Biomedical Engineering Program

13 December 1992

Examples:

Table of Contents

LIST OF FIGURES ..... *II*
LIST OF TABLES ..... *III*
NOMENCLATURE ..... *IV*
LIST OF ABBREVIATIONS ..... *V*
0. ABSTRACT *1*
1. INTRODUCTION *2*
1.1 STATEMENT OF PROBLEM *2*
1.2 MOTIVATION *2*
1.3 SIGNIFICANCE *3*
2 EXPERIMENTAL DEVICE DESIGN *4*
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Nomenclature

A_d	detector area [m^2]
D^*	detectivity [cm $\sqrt{\text{Hz}}$ W^{-1}]
h	Planck's constant = (6.625±0.0005) 10^{-34} [W sec^2]
λ	wavelength [m]
k	Boltzmann's constant = (1.38054±0.00018) 10^{-23} [J K^{-1}]
ΔP	incremental radiated power [W]
σ	Stefan-Boltzmann constant = (5.6697±0.0029) 10^{-12} [W m^{-2} K^{-4}]
T	absolute temperature [K]
ϖ	solid angle [sr]
Z_{in}	input impedance [Ω]
…	

Abbreviations

ac	alternative current
A/D	analog to digital
BPF	band pass filter
BW	bandwidth
CaF_2	calcium fluoride
CMRR	common mode rejection ratio
…	

★ **Procedure(s) -** should answer questions on methods used

✓ The amount of descriptive material may vary according to the instructor's directions.

- If a standard procedure is used, giving it a reference and stating any alterations may be sufficient.

Procedure:	The method followed in Experiment #4, of (give reference)

- Sometimes it may be necessary to paraphrase the procedure.

Procedure:	The method followed in Experiment #4, of (give reference) Briefly explain the method in your own words.

- For a very formal laboratory report, the method should be referenced and you should be very specific about what you exactly did, so that a reader could repeat your experiment looking at your report.
- It may be very useful to include a diagram/illustration of your experimental setup to clarify the procedure.

★ **Findings/Data**

✓ Enter all measurements and observations made during the experiment into the laboratory notebook in an **organized manner**.
✓ If many measurements were made, present the most **representative data**.
✓ Not all data are numerical. Computer programs, spectra, chromatograms and alike might be attached to the report.
✓ Sometimes, data may be more easily represented in graphs.

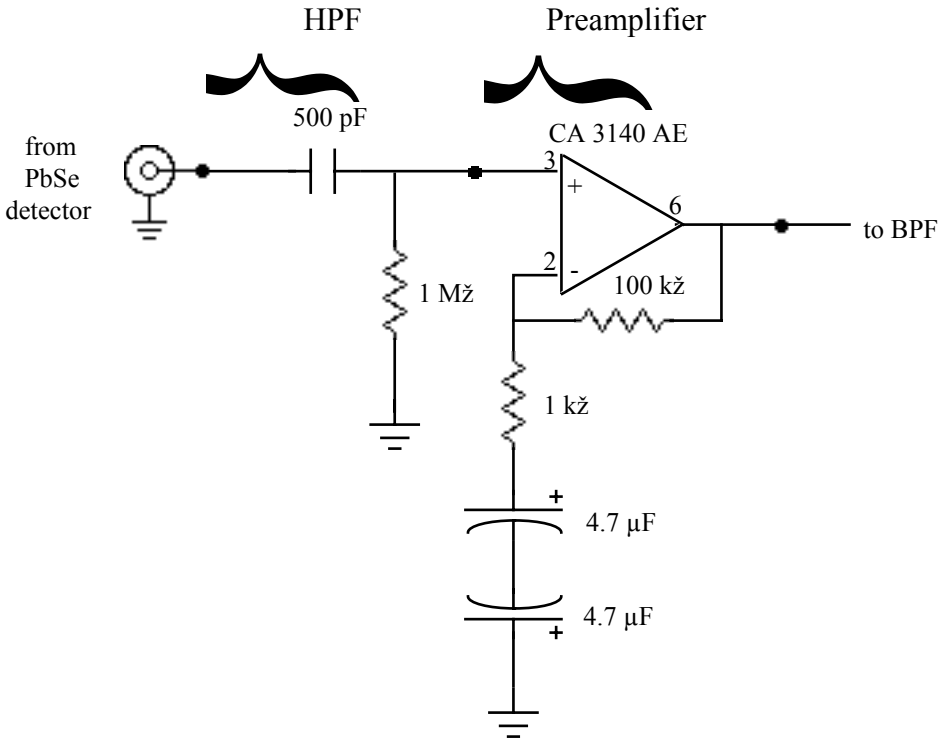

Figure 4: Passive high pass filter and preamplifier. CA 3140 AE is powered by +15 and -15 V. All resistors are 1%. Offset potentiometer is used but not shown. 4.7 µF capacitors are tantalum. 500 pF capacitor is ceramic. Gain = (100 kΩ / 1kΩ) + 1 = 101.

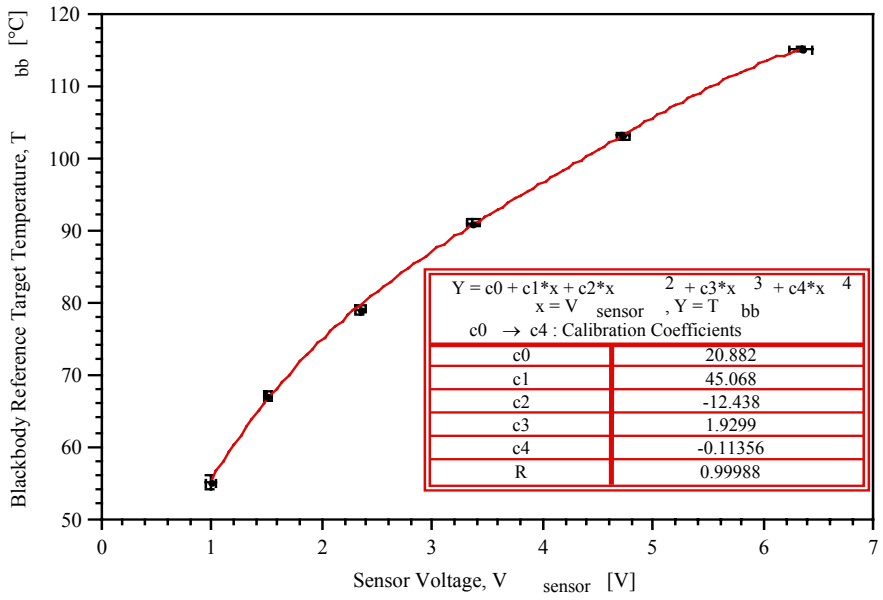

Figure 5: Typical calibration curve of the IR radiometer. Error bars show the uncertainty in temperature readings due to electronic and thermal noise referred to the output of the lock-in amplifier. Up to 80°C the maximum uncertainty in temperature readings is ~1°C, at and above 90°C it is less than 0.5 °C.

★ **(Sample) Calculations/Results/Analysis**

✓ To check the mathematical validity of (= analyze) the results, many laboratory reports include an example of the calculation used to obtain the answer.

Example:

$$\textit{Average accuracy of reading} = \frac{1}{n}\sum_{i=1}^{n} \left| T_i^{true} - T_i^{measured} \right| \quad [^\circ C] \qquad (2)$$

$$\textit{Maximum error of reading} = \max\left(T_i^{true} - T_i^{measured} \right| \Big) \quad [^\circ C] \qquad (3)$$

Table 1: Reading errors of the IR radiometer over a 30 second period.

Black Body Reference Target Temperature [˚C]	Average Accuracy [˚C] {Eq. (2)}	Maximum Error [˚C] {Eq. (3)}	Average ± Standard Deviation [˚C]
56.1	2.0	5.1	58.1 ± 0.9
68.7	0.8	3.0	69.5 ± 0.7
77.8	0.4	2.0	78.2 ± 0.6
84.8	0.5	1.8	85.3 ± 0.5
91.3	0.4	1.9	91.7 ± 0.5

★ **Discussion**

✓ This section is the place to **discuss validity** of your results and **compare** your results and expectations.

★ **Conclusion**

✓ This section should give an **interpretation** of the results.

✓ You can make **recommendations/suggestions** regarding future work on the subject.

★ PROGRESS REPORTS

- ✓ Very familiar to professionals (engineers, scientists, researchers, etc.) working on projects
- ✓ A progress report is written for those (executives, administrators, supervisors, etc.) who need to keep in touch with what is going on.
- ✦ Main objective is to present information about work done on a particular project during a particular period of time.
- ✦ A progress report is like an installment of a continued story.
- ✦ Depending on the progress made by the professionals, the executives, administrators, supervisors, and alike could decide whether the project in progress should be continued, given a new direction or emphasis, or completely discontinued.

Typical Sections of a Progress Report

- Transitional Introduction
- Body
- Conclusion

- ✦ The progress report should at least provide the following information:
  - What is it about?
  - What precisely has been done in the period covered?
  - What are the plans for the immediate future?

Transitional Introduction

- Nature and scope of the subject matter of the report should be identified and related to previous report(s).
- A brief statement of the conclusions reached in the present unit of work should be presented.
- This part should be short, because it is essentially a **reminder** to the readers

Body of the Report

- The detailed account of **current progress** should be given.

- Organization could be by **topic** and/or **chronological**, depending on the amount of work done.
- Data could be presented with a **reasonable amount** of tables and/or graphs/charts placed in an appendix or in appendices.

Conclusion

- Depends on the **nature of work** done.
- The readers should be told **what to expect** in the next progress report.
- The readers could be told the **estimate time** necessary to complete the project without promising too much!

* The progress report should be **brief but complete**. Simple terminology should be used.

Example:

To: Professor J. Valvano

From: İnci Çilesiz

Subject: Progress on term project "Dynamic Infrared Radiation Thermometer"

Date: 8 November 1992

In the previous progress report, completion of the testing of the hardware for IR remote sensing thermometer was announced.

During the past week, I started working on the interactive data acquisition program and made some temperature measurements using a recently acquired radiation black body.

In the coming week I am planning on refining the software and making actual temperature measurements.

Measurements will be finished within a week. After analyzing the findings, I will start working on the final report by early to mid December.

★ FORMAL (INDUSTRIAL AND BUSINESS) REPORTS

- ✓ Very familiar to professionals (engineers, scientists, researchers, etc.)
- ✓ Encountered in **everyday activities** within an organization, industry or business.

➡ The audience in the industrial or business world comes from a wide variety of educational backgrounds.

➡ Depending on the audience the report should be well tailored.

- For a **diverse audience**, the report should give a **clear explanation** and/or interpretation of the results with **simple words**.
- The author is the responsible party to provide the necessary information in a technically correct manner.
- The author should use explanations that a reasonably intelligent non-scientist can comprehend.

Components of a Formal Report

- Letter of Transmittal
- Cover and Title Page
- Abstract/Executive Summary
- Table of Contents
- List of Tables/Illustrations/Figures
- Body of Text
- Bibliography/Endnotes
- Appendix/Appendices/Index

- **Letter of Transmittal**

★ Letter of transmittal should present the report to the reader in the same manner that one would introduce a speaker to an audience.

★ In the letter of transmittal, the author should state

- how and why the report originated and at whose request
- the scope and subject matter of the report
- important recommendations and conclusions
- unexpected findings or particular troubles

- **Cover and Title Page**

  ✶ should contain the following information

  - title
  - date
  - to whom the report is being submitted
  - author
  - business address
  - a project number

- **Executive Summary**

  ✶ should be a **complete summary** of the project, usually 2-3 pages long, including

  - rationale for doing the project
  - nature and scope of the study
  - techniques used
  - difficulties and problems encountered
  - results obtained
  - conclusions and interpretations of results
  - recommendations

- **Appendix/Appendices**

  ✶ Specific details of the study/project are usually included in the appendices. These include

  - formulae or sample calculations
  - extended details of experimental procedures
  - samples of letters or exams
  - samples of questionnaires or surveys used
  - photographs or diagrams that are supportive of the report, but do not require insertion into the text
  - long lists of tabulated data
  - résumés of authors or contributors to the report
  - very long quotations, such as court decisions, specific agency guidelines, specific requirements, etc.

- **Index**

✶ A long report (over 20 pages) should have an index to quickly find specific information.

✶ An index should be alphabetically arranged.

- **Distribution**

➡ In the report, in an appropriate point or in the transmittal letter, the author should state and clearly indicate the list of recipients.

Example:

Cc: Mr. A. Bcdefg
Ms. H. Ijklmnop

References:

Beer, D. F., Ed. (1992). Writing & Speaking in the Technology Professions: A Practical Guide. IEEE Professional Communication Society Selected Reprints. New York, NY, IEEE Press, pp. 3-6, 73-78.

Cain, B. E. (1988). The Basics of Technical Communication. Washington, DC, American Chemical Society, Chs. 6, 12-13.

Mills, G. H. and J. A. Walter (1978). Technical Writing. New York, Holt, Reinhart and Winston, Chs. 13, 16, 20.