### LAYOUT OF A RESEARCH REPORT / PH.D. THESIS / M.PHIL. DISSERTATION Lecture-13

The layout of a research report is the list of various parts of the report/thesis. Generally, a research report should consist of the following three components:

1. Preliminary pages
2. Main text
3. End matters

###  A. Preliminary Pages

*Preliminary pages include title of the report, acknowledgment, certificate page, list of publications and table of contents*. Acknowledgments are written to thank those who have helped the researcher during their course of investigation. For a book it is in the form of preface or forward. Acknowledgment should be brief, simple, modest and given only to substantial assistance provided by the guide, head of the department, staff of the department, agencies which provided financial support, collaborators and institutions where part of the work has been carried out. Acknowledgments made for routine participation by members of the researcher’s family, librarian, friends, clerical helpers and god are normally considered superfluous. Acknowledgment should be made at the time of public viva-voce also. There is a chance for a researcher to forget to say acknowledgment at the end of an oral presentation. To avoid this he may do it at the beginning of the presentation.

Declaration in the certificate page by the scholar is generally done using phrases such as “I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of any university or institute of higher learning, except where due acknowledgment has been made in the text.

*Every research report should have an abstract*. It is a necessary part of any scientific and nonscientific research report. In a research article it appears next to the author’s name and affiliation. In the case of Ph.D. thesis, before its submission an elaborated abstract of the thesis called *synopsis* has to be submitted to the institution where registration for Ph.D. degree is made. Abstract and synopsis convey the essence and brief details about the report. It should contain a very short statement of the problem, methodology and procedures adapted in the work and results of the study in a very condensed form. *The abstract can act as a tool to control the flow of ideas in the thesis*. It can help you link in a logical way the reasons for the research and aims of the work. It should contain answers to the questions: What was done in the project? Why is it of interest? How was it done? What were the outcomes of the work done? What is the significance of the results? One should emphasize the original contribution in the abstract. The abstract of a Ph.D. thesis will be about three or four pages.

*Table of contents gives title of the chapters, section headings, title of appendices and their page numbers*. All the preliminary pages should be numbered with lower-case roman numbers.

###  B. Main Text

The main text presents the details of the research work and results. This part of the thesis should provide the following, about the research work:

1. Introduction.
2. Actual research work performed and the findings.
3. Summary and conclusion.

## *1.* Introduction

The purpose of the introduction is to give a brief outline of the field of research. In this part one can bring clearly the importance of the field and the current status of it. It should contain an overview of the problem, its importance, statements about the hypothesis or specific questions to be explored. This is followed by a preview of the scheme of the following chapters, that is an outline of plan of the work. Here, aim of each of the chapters and their contents can be briefly stated. Related and relevant work done by others must be pointed out. Various concepts and definitions of scientific and technical terms necessary for understanding the research work undertaken are to be defined and explained. Details of statistical tools or quantities used in the study can be given in a separate chapter.

Irrelevant and less informative materials need not be presented. For example, regular and irregular behaviour of solution of a system or differential equation can be characterized by calculating the statistical tools such as Lyapunov exponents, correlation function, correlation dimension, power spectrum, periodicity of the solution and probability distribution. If the power spectrum is not used in a research work then there is no need to discuss in detail the systematic way of calculating it. Similarly, suppose the effect of noise in a theoretical model equation is studied by including, say, Gaussian random numbers in the simulation. There are many methods available to generate Gaussian random numbers. If the Box–Muller method is used then it can be described. In this case describing other methods, for example, rejection technique is redundant to the present thesis report. The theory and experimental set up used should be clearly described with proper references. Define the technical terms used in the dissertation either by a reference to a previously published definition or by a precise definition. Such a definition should be given only once in the report.

The introductory chapter(s) should be prepared in such a way that it should interest the reader in the subject matter of research. It should not be aimless, confused and lacking in precision. Introductory part may contain one or two chapters.

To be precise, the introductory part should cover the following aspects:

1. Features of the topic
2. Present status of the field
3. Some unsolved problems
4. Statement of the problem undertaken
5. Importance and justification of the present problem
6. Preview of the scheme of the following chapters and their interrelationship definition of various scientific terms used
7. Methodology used

## *2.* Actual Research Work

This is the heart of the research report/thesis. The actual research work undertaken, difficulties faced, technical details, results, conclusion and future direction form the main part of this portion. This part can be presented in a few chapters. Each chapter should contain introduction, research work, results and conclusion. Materials should be organized systematically and presented under appropriate headings and subheadings. First, write the chapters that describe your actual research work. After this, prepare the conclusion and introduction parts. When writing the actual work collect the terms and note down the matter which are to be defined and described in the introduction.

As Professor P.R. Subramanian points out, *for preparing the Ph.D. thesis report one should not simply copy word by word from his research articles*. Even if the content of the thesis is the work reported in his research publications, the student should reword the material without changing the meaning, give much more details, explanations, suggestions and possibly a better reorganization of the content.

Wherever possible, the results should be presented in the form of figures, illustrations and tables. They can make the report quite attractive. Tables should be as precise as possible. All the figures should clearly specify the variables of the axes, units used and other necessary information. Figure caption should not be a reproduction of sentences of the text. It must clearly state what it is. Figures should be clearly explained in the text. Data should be fitted to an appropriate mathematical expression. Nowadays, sophisticated softwares are available for curve fitting. After making a curve fit or plotting a set of data, proper explanation for observed variation of the data should be given. A set of data measurement without any analysis and discussion is of no use.

Arguments may be conveniently presented as a series of numbered or bulleted points, rather than as one chunk in a crowded paragraph. Mention further unexplored areas, which future researchers may conquer.

Extreme care must be taken in type setting mathematical equations, variables and parameters involved in the study. Italic or Greek letters or mathematical symbols can be used for variables and parameters. For example, x or X should not be used as a variable name. The correct usage is *x* or *X* (or typeset in italics). All the equations should be centered and numbered. Vectors should be clearly specified by an arrow over the name or by bold face name. Equations should not be repeated.

Jokes or puns should not find a place in the report. Use “correct” or “incorrect” to refer to the results of others. Don’t use the words “bad”, “terrible” and “stupid”. Avoid use of “today”, “modern times”, “soon”, “seems”, “in terms of”, “based on”, “lots of”, “type of”, “something like”, “just about”, “number of”, “probably”, “obviously”, “along with”, “you”, “I”, “hopefully” and “may”. There is no need to mention the circumstances in which the results are obtained.

An error often made is wasting valuable time for the physical embellishment of the document beyond a point, without paying careful attention to the correctness and accuracy of the content. Even a couple of typos can give the impression that you have failed to pay adequate attention to detail. Errors in the spelling or technical or general words show in the poor light an otherwise worthy thesis that tells a vital story.



**Assignment:**

(10) Reword/rephrase the following and give the reason for the change:

1. Dinesh and Geethan [1] reported that ...
2. The following algorithm represents a major breakthrough ....
3. Even though the above method is not earthshaking ....
4. Geethan and I obtained ....
5. There is a method to calculate ....
6. The program will use the data after it stored them to a CD ...
7. The method is started by calculating the value of *δ* ....



## *3.* Conclusion

At the end of each chapter (except in the introductory chapter(s)), one can place a brief summary of the outcome of the work presented in that chapter under the heading conclusion. They should be clear and precise.

The relevant questions which are still not answered and new questions raised by the work of the present chapter have to be mentioned. Whether the answers to the questions are obtained or not, if obtained in which chapter(s) they are presented should be specified. Mention possible future research. It is important to make a connection between two consecutive chapters either at the end of the first or at the beginning of the second.

Chapters should not look like reports of isolated work. There should be a link between consecutive chapters and the link should be clearly brought out.

###  C. End Matters

The end part of the report generally consists of references, appendices, computer programs (if they are not easy to develop) and copies of research publications that came out from the research work done.

## *1.* Appendices

Appendices are supplementary contents which are not placed in the main report in order to keep the continuity of the discussion; however, they are relevant for understanding the particular part of the report. An appendix may present

1. a brief summary of a theory or a numerical method used which can be found elsewhere,
2. a lengthy mathematical derivation or a large set of equations,
3. technical details and
4. a list of values of constants and parameters used in the work.

Appendices can be placed at the end of report after references. They should be numbered by capital alphabets.

## *2.* References/Bibliography

References or bibliographies are sources consulted. Each reference should contain name(s) of author(s), title of the paper, journal name, volume number of the issue in which the article appeared, starting page number, end page number and year of publication. In the case of a book source its author(s), title, publishers’s name, place of publication, year of publication and edition should be given. Some examples are given below.

1. Suppose the reference is the paper of K. Murali, Sudeshna Sinha and W.L. Ditto with title “Implementation of NOR gate by a chaotic Chua’s circuit” appeared in the journal called ‘International Journal of Bifurcations and Chaos’ in the year 2003, the volume number of corresponding issue is 13 and the starting and ending page numbers of the article are 2669 and 2672 respectively. The above article can be specified as (without mentioning the title of the article)

K. Murali, Sudeshna Sinha and W.L. Ditto, Int. J Bifur. and Chaos 13 (2003) 2669– 2672.

1. For an article which appeared in a conference proceedings a typical format is given below:
	1. Harish and K.P.N. Murthy, *Intermittency and multifractality in iterated function systems*. In: Nonlinear Systems. Eds. R. Sahadevan and M. Lakshmanan (Narosa, New Delhi, 2002) pp. 361–371.

In the above *Intermittency....* is the title of the report of R. Harish and K.P.N. Murthy. *Nonlinear Systems* is the title of the conference proceedings edited by R. Sahadevan and M. Lakshmanan. The proceeding was published in the year 2002 by Narosa Publishing House, New Delhi. In the proceedings the article appears from the page 361 to page 371.

1. A book can be noted down as, for example

T. Kapitaniak, *Controlling Chaos* (Academic Press, San Diego, 1996).

1. A Ph.D. thesis can be referred as shown below:
	1. Parthasarathy, *On the analytic structure and chaotic dynamics of certain damped driven nonlinear oscillators*. Ph.D. thesis. (Bharathidasan University, 1993, Unpublished).
2. For an unpublished manuscript downloaded from internet one can note down the web site where it is available (see for example the references 7 and 8 of the references section of this manuscript).

References can be either in alphabetical order according to author’s name or the order in which they are referred in the report. Make sure that each reference cited in the text is correctly entered into the list of references. Repetition of references in the list should be avoided.

###  D. Typing the Report

Typing should conform to the set of requirements of the institution. The thesis should be double line spaced and not more than 25 lines per page. It may be typed on both sides. Chapter heading must be in large size with bold face. Each paragraph should be right margin aligned. Important terms when used first time can be in italic letters and bold face. First word of a sentence should not be an abbreviation. Latest softwares such as LATEX or WORD can be used for thesis, dissertation and report preparation. One could download the software LATEX a free of cost from the web sites:

1. http://www.ctan.org
2. http://www.miktex.org

If a report is prepared keeping all the above precautions in mind, there is every likelihood of it becoming useful for proper study. Such report enables the reader to comprehend the data and to determine for himself the validity of the conclusion.

*Before or immediately after submitting hard copies of the Ph.D. dissertation to a university, show it to your colleagues, teachers, scientists of your department, your parents and friends*.

### XIX. ACKNOWLEDGMENT

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**REFERENCES:**

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### Some quotations on Research

*Research is what I’m doing when I don’t know what I’m doing*. – von Neuman

After the discovery of X-rays by Ro¨ntgen a journalist interviewed him.

Journalist: *What did you think?*

Ro¨ntgen: I didn’t think, I investigated.

Journaist: *What is it?*

Ro¨ntgen: I don’t know.

*Research is key to our long-term position*. – Bill Gates

*It appears at first incredible that any discovery should be made, and when it has been made, it appears incredible that it should so long have escaped men’s research. All of which affords good reason for hope that a vast mass of inventions yet remains.* – Francis Bacon

Enrico Fermi was asked what characteristics physics Nobelists had in common. He answered, “*I cannot think of a single one, not even intelligence.*”

*All progress is born of inquiry. Doubt is often better than over confidence, for it leads to inquiry, and inquiry leads to invention.*–Hudson Maxim

*Whenever one of my students came to me with a scientific project, I asked only one question: “Will it bring you nearer to God?”*–I.I. Rabi

*Scientific discovery and scientific knowledge have been achieved only by those who have gone in pursuit of it without any practical purpose whatsoever in view*–Max Planck

*My success if you could call it that, lies in the fact that I have kept at my work all these years. It is not genius or anything, like that, it is merly patience*. – Annie Jump Cannon

*It seems to me that scientific research should be regarded as a painter regards his art, a poet his poems, and a composer his music*. – Albert A. Michelson

*Failing to plan is planning to fail*. – Allen Lakein

*The average Ph.D. thesis is nothing but transference of bones from one graveyard to another*. – Frank J. Dobie

*When I got by B.S., I would be able to bullshit... When I got by M.S. I would have more shit, and that finally, upon reaching my Ph.D., it would be piled higher and deeper*. – S.

Baker

*Works are of value only if they give rise to better ones*. – Alexander von Humboldt

*A hypothesis or theory is clear, decisive, and positive, but it is believed by no one but the man who created it. Experimental findings, on the other hand, are messy, inexact things, which are believed by everyone except the man who did the work*. – Harlow Shapley

*I keep six serving men,*

*They taught me all I knew;*

*Their names are What and Why and When*,

*And Where and How and Who.* – Rudyard Kipling

*The difficulty of literature is not to write , but to write what you mean. – R.L. Stevenson*

*I always preferred to try to imagine new possibilities rather than merely to follow specific lines of reasoning or make concrete calculations. Some have this trait to a greater extent than others. But imagining new possibilities is more trying than pursuing calculations and cannot be continued for too long a time*–S.M. Ulam

*My own research life has been greatly enriched by having been broken into by periods of enforced change. I was not idle while I had my three children; far from it. But it gave me the opportunity of standing back, as it were, and looking at my work. And I came back with new ideas*. – Kathleen Lonsdale

My advice to young women students: *Don’t quit. Muddle through. Get your ’union card’ (Ph.D.) if you want to do research. Don’t think you can’t succeed if you’re not first in your class, or even in the middle; or even below that. You will increase your confidence as you go along ...* – Vera C. Rubin

My advice to young women scientists: *To persevere, to love work and to love to do good work, to be independent, to be scientifically honest, and to embrace your ambitions, all the while respecting culture and responsibility to your family. Knowledge and know-how are the way of liberty and equality. Neither gender, nor religion, nor age will stand as a barrier to research.* – Zohra Ben Lakhdar

*Research needs an inquisitive mind which is never satisfied with the current solution or state of affairs* – R. Biswas

*An age when the pizza delivery companies promise you a free dinner if they take more than half an hour to deliver is counter to the mindset needed for research*. – R. Biswas

*In science, self-satisfaction is death. Personal self-satisfaction is the death of the scientist. Collective self-satisfaction is the death of research. It is the restlessness, anxiety, dissatisfaction and agony of mind that nourish science.* . –R. Jeyaraman