This book is presented for the prospective PhD or Master Degree student, the supervisor and the university administration in order to serve as a reference point on all issues regarding elements of PhD dissertation/thesis reports. The book covers the most important components of a PhD dissertation-write-up from title to appendix and discussed relevant terminologies and concepts found in each chapter including the preliminary pages. Throughout the book, wherever it is found necessary to be specific, examples from physics have been used. Important terms such as analysis, abstract, table, figure, reference, theory, amongst others have been explained.Many books have been written to address the issue of thesis-reporting but almost all are targeted at education and the social sciences with very few of these authored by scientists. Further, they are also full of assumptions about the competences of prospective postgraduate students. In comparison, this book presents structural elements of theses proposals and reports in an analytical, exploratory, questioning and contexual manner which is situated within the contexts of extant and relevant literatures in the field.

Dr. Umaru Ahmadu is an Associate Professor of Physics who had taught science education courses at the College of Education level for many years and postgraduate research methodology course in the university system. He has supervised several Master and PhD theses and held many administrative positions in the university.

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principles and practice

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Thesis-reporting in science for postgraduate students: principles and practice

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2020

Dedication

to:

…those who stand for truth, hard work and aspire for excellence

Contents

Preface

For about a decade now universities in Nigeria and other tertiary institutions of learning (polytechnics and colleges of education) have been churning out lecturers who have been trained in PhD, generally outside the country and with Malaysia being the foremost destination, apart from those in Europe, China, Africa, amongst others. This is principally as a result of the dearth of lecturers with PhD qualifications.

This state of affairs was changed completely by the Tertiary Education Trust Fund (TETFUND) by providing scholarships to university lecturers to acquire PhD and Master degree qualifications. (Please note that the abbreviations Ph.D./M.Sc. have been simply written as PhD/MSc in this book for simplicity only, while the words postgraduate, student or researcher have been used interchangeably, but where necessary emphasis has been made to distinguish them). Thus, many departments in some universities today may have up to fifty PhD holders, what with one hundred and seventy four universities (federal, state and private) in Nigeria and still counting, in addition to colleges of education and polytechnics. An army of PhD holders had been built within a decade which is phenomenal and unprecedented in the history of universities in Nigeria. The most important issue is that although a reasonable proportion of university lecturers have been locally and internationally trained in PhD, there is problem in understanding the nitty-gritty of PhD, that is in terms of the PhD student's capacity to undertake and write the PhD report and the understanding of the modality of developing its various

elements, such as abstract, introduction, objectives, methodology, literature review, amongst others, and the attributes he/she is expected to exhibit as a learned person/scholar. This observation is true of some PhD holders who studied locally or abroad. Supervisors or advisors eventually take the blame for these failings despite suffering enormously in trying to advise the students on how to carry out the writing of the different sections of a thesis report. Many a time a supervisor had ran into problems with their colleagues, seniors and even the establishment on account of these. This issue rears its ugly head and comes to a climax during departmental seminars during which PhD students make presentations of either their proposals or progress reports and are criticized for poor implementation of the elements of research, such as methodology, research design, conclusion and objectives or that the work is not up to a PhD standard; or that references are too few in number for a PhD dissertation or that the overall length of the PhD thesis is too small, and such other arguments that characterize departmental seminar presentations.

Similarly, there are questions such as who should constitute the external examination team for a PhD? Should a supervisor try to defend his student during seminars or External Defence presentations or should he keep quiet and simply serve as an observer? What should be the characteristics of a PhD holder in terms of knowledge, skills, comportment, orientation and capacity? Is a PhD holder trained just to teach or carry out

research? What is the role of the supervisor and that of the student? How is the society supposed to view a PhD holder?

All these issues are usually raised and argued out among the lecturers in the department and almost invariably there are neither definite answers most of the time nor unanimity on these or an authoritative reference document or book which can provide answers to serve as an arbiter. Such actions have led to many irregularities and corruption in the PhD qualification process. The problem has seemingly global dimensions from various literatures consulted on the matter and discussions held with colleagues, both local foreign-trained.

This book is therefore presented for the prospective PhD/MSc student, PhD holders, the supervisor, and the university administration to serve as a reference point in times when issues regarding elements of PhD dissertation/thesis reports become stalemated or deadlocked. Copious examples have been provided where necessary, with specific reference to physics subject/students as example, though PhD/MSc students from other disciplines will also find it useful.

In a technical sense, the book falls within the realm of research methodology for which many books have been written to address the issue. However, almost all such books have been targeted at education and the social sciences, and their authors are generally non scientists. Regrettably, the typical approach of such books have been based on assumptions about the capacity of the students to undertake the task of thesis-reporting

while the authors are generally inclined to provide scanty treatment of the standard principles of research methodology as they relate to PhD, while leaving out the nitty-grity and down-to-earth treatment of issues such as, what literature reviews entail, how they are carried out, the style, the language, content, the meaning of a thesis, its structure, amongst others.The analyses of simple concepts such as aim, objective, methodology, amongst others, are either not given proper contexts, elaborated upon or a proposed methodology for their development provided.

This is where this book distinguished itself, by emphasizing on such concepts and their analysis and avoiding the standard presentations in textbooks which are full of assumptions. It presents structural elements of proposals and thesis reports in an analytical, probing and contexual manner, providing guidance for preparations for postgraduate admissions, post-admission, coursework, proposal development and thesis-reporting within the contexts of Nigerian universities and those outside its borders.

Many books have been written on dissertation-writing but very few of such books are written for the scientific audience that emphasize their peculiarities, in particular which provide details on subjects such as Physics and the mathematical sciences' theses. In addition, most of the literatures that provide guidance on thesis-writing in science generally exist as guides on websites of many universities and these were generously consulted. Similarly, PhD theses which are freely available

online from Europe, America and India were consulted in writing this book. Such websites from the UK, US, Germany, Switzerland, France, Kenya and India, amongst others, were consulted extensively for the purpose of writing this book. There are relatively few universities in Nigeria, however, that have such thesis guides on their websites, compared to those in Europe and America. The book covers the most important components of a PhD dissertation-report from title to appendix and discusses relevant terminologies and concepts found in each chapter from preliminary pages, to conclusion. Throughout the book, wherever it is necessary to be specific due to peculiarities of the disciplinary-dependent nature and structure of theses, physics has been used as a typical example. Every important term which will aid understanding such as analysis, abstract, table, figure, reference, theory, and other necessary details have been presented and explained. The presentation is such that after the author had presented his views and ideas about each concept, they are then followed by a review of existing literature on each in order to complement the presentation or where possible establish a consensus, outright disagreement or demonstrate open-endedness of the concept so that the student or reader has a definite knowledge of the standard position on each concept or topic concerning dissertation. This is done wherever it is found necessary.

An additional feature of the book is the use of schematics which summarize all fundamental concepts for easy remembrance and understanding. Many examples of typical discussions of concepts were provided by reference to theses

and literatures, among others, in order to provide a broad perspective on the issue. The book is based on the conventional five-chapter (Introduction, Literature Review, Methodology, Results and Discussion and Conclusion and Recommendations) thesis system. It is intended to serve as a rallying point for the resolution of the meanings, standards, depth and capabilities and all issues related to PhD training with emphasis on dissertation report-writing and the characteristic features of its holder. It more than meets the needs of Master degree students in science. The book is based on the experience of the author as a former Postgraduate/Seminar Coordinator, his experience in teaching Research Methods course to postgraduate students, postgraduate supervision in general and educational administration at the college of education and university levels.

The book was written bearing in mind the areas of difficulty experienced by students, hence the need to elaborate on those areas. There are boxes which provide specific and detailed examples on selected concepts/topics wherever necessary in order to distinguish them from the main text and for emphasis. The reader is therefore expected to study the structure, order and general systematics of these boxed examples. The book has eight chapters which are logically arranged.

Chapter One is a general introduction to postgraduate programmes, from preparation for postgraduate studies, the admission process, to coursework. Others are the processing of postgraduate issues, the role of the supervisor and that of the student, definitions of preliminary sections of a thesis report

including abstracts, title page and proposal development, amongst others. Also, a distinction between a thesis and dissertation was made. It is the longest chapter because of its contents and relevance.

Chapter Two deals with the beginning chapter of a thesis report or structure, that is “introduction”.’’. Important elements that make up this section include terms such as objective, aim, problem statement, justification and significance, all of which were properly discussed. Information on the systematics and strategic development of the section has been provided.

Chapter Three deals with typical literature review section in a thesis and elaborated on the important considerations of the components of the section. The components may include the method of citation, results and their discussion, methodology and the general principle of sequencing of arrangements and presentation for cogency, systemization, and logicality, amongst others.

Chapter Four is methodology or experimental design or materials and methods, as it has been variously described in theses. The section emphasizes the need to develop a good research design, provides a detailed but succinct experimental description, including that of instrument or software used. It emphasizes the need for validity of methodology to the subject of investigation, objectives and research questions.

Chapter Five deals with results and their discussion. The importance of the use of tables, figures, their presentation

formats and requirements for proper and compact presentation of results was emphasized, side by side with their integration with relevant literature that which matched the data obtained.

Chapter six deals with the concepts of summary, conclusion and recommendation. The difference between summary and conclusion were presented succinctly and the necessary elements which constitute each were elaborated upon by emphasizing on the contexts in which each is used. A systematic procedure for developing the summary and conclusion was proposed. Similarly, the contents and meanings of recommendation were elaborated upon, particularly, within the contexts of experimental design and data obtained for the purpose of validity. It also deals with the compilation of the reference list. Reference was distinguished from bibliography and the matching of in-text citations with the reference list was emphasized, including the sequence of the details.

Chapter Seven deals with specific and general considerations such as seminar presentation strategy, External Defence structure and publications in a nutshell. The concept of "original contributions" and the meaning and context in which the appendix section is used, amongst others, were all discussed at length.

Chapter Eight deals with publications in detail, journals, books, grants and conferences, amongst others. It is an elaboration of the formal issue of publications earlier presented. Local contexts have been provided and presented in an informal way so the general reader can benefit and appreciate the issue,

with Nigeria used as a specific example. The meanings of these concepts have been properly distinguished and analyzed.

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22nd September, 2020.

CHAPTER ONE

INTRODUCTION TO POSTGRADUATE STUDIES

1.1 Introduction

Postgraduate students get involved in postgraduate programmes under the assumption that it is a continuation of undergraduate studies in terms of structure, course content, administration and level of preparedness. However, this is further from the truth, as they soon find out. Postgraduate studies though dependent on undergraduate achievements are totally different in structure and require special preparations which vary within a country and outside it.

Postgraduate studies (unless otherwise specified, refers to MSc/PhD) are meant for those who have completed their undergraduate programmes and for training highest level manpower as vested in the universities' philosophies and tuned to national objectives.The conditions governing postgraduate studies are generally the same in terms of duration and requirements for admission globally, among others. These can be found in the various prospectuses of the relevant institutions online these days. The most important requirements for postgraduate studies are normally reflected in the application forms where referees are expected to certify that the "candidate has the capacity for independent study",i.e., the candidate can

proceed with his/her programme with little or no guidance or input from any one, including his/her supervisor, ,apart from other necessary requirements. This is the most obscured and de-emphasized point by postgraduate students. Ironically however, it is the most fundamental qualification that the prospective student needs to have as an asset. Unfortunately, most referees normally commit themselves to endorsement without actually knowing whether the candidate has the capacity in terms of intellectual preparedness, emotional stability, motivation and requisite skills as a result of various forms of pressure.

Another important question to which the referee has to respond to is the question of the ability of the prospective student to communicate effectively, oral presentation or written English by the student, which is another fundamental requirement for a successful postgraduate programme. Again, one finds referees endorsing that the candidate has fluency in both written and spoken English, whereas it is to the contrary. These qualities standout prominently as requirements for postgraduate studies during admissions. They are assumed by the university authorities at the time of admission and are the basis for the success or failure of the postgraduate programme chosen by the applicant. This is the reason for the emphasis by university authorities in recent times for credits in 'O' level English, because postgraduate studies have to do with writing, putting down your thoughts and findings in a standardized language format. Other items that may be present in the application forms may include, team-work spirit, emotional

stability, meticulousness and dedication, all of which are no less important and could become relevant during the various phases of the programme and thus test the capacity of the would-be postgraduate to withstand each of these qualities. On a general note, postgraduate studies can be either extensive in scope or narrow in its investigations (microscopic to macroscopic details) requiring the student to study literatures extensively with a capacity for analytical, deductive and accurate determination of variables and understanding.

1.2 Understanding postgraduate studies

A key fact a prospective postgraduate student should know is that postgraduate programmes have become too competitive locally in Nigeria, almost rivalling the undergraduate programmes. Enrolment is almost 50% of undergraduate admissions in some departments/fields. This has caused serious strain, pressure and burden on the supervisors and on an already overstretched resource. In addition, there are lots of political and other ancillary considerations involved in postgraduate programmes, both at the university and departmental levels by all actors which the student should be very wary of in order to avoid being caught in the middle. Poor social and interpersonal relations sometimes characterize the social structure of the supervisory cadre and lecturers resulting from conflict of interests, jealousy and competition or other mundane affairs which would certainly be a trap for the student who finds him/herself in this group. This, to some extent, is true even for those who study overseas. Visiting the department and having

a discussion with prospective supervisors, Heads of Department Head of Departments (HODs) and students would be a wise thing to do before applying for admissions for those planning to study in Nigeria; whereas those who intend to study overseas could visit the websites of their choice universities and contact the appropriate supervisors where such information are on line. It should be understandable that every supervisor would certainly want the best student for him/herself in terms of the students' intellectual ability and skills as defined by the capacity to use software programs these days. One should, ttherefore, make him/herself marketable and attractive in terms of academic achievements and the promise of demonstrable potentials as a postgraduate student.

1.2.1 Upsurge in postgraduate admissions

The upsurge in postgraduate admissions as a result of the preponderant applications universities receive has exposed a lot of inadequacies and incompetence on the part of many would-be and postgraduate students due to their poor preparations, unreasonable and erroneous assumptions.The unemployment situation in the country, revival of the Federal Scholarship Scheme, amongst others, and funding by the TETFUND (Tertiary Education Trust Fund) have further spurred this avalanche in applications, such that those who have the means proceed for postgraduate studies after graduation. While for those already employed and teaching in Polytechnics and Colleges of Education, stringent measures tightening the noose on promotions and advancement in the system by the National Commission for Colleges of Education

(NCCE) and the National Board for Technical Education (NBTE) on those without higher degrees, have also contributted to the deluge of applications. This is apart from those seeking to enhance their economic well-being through better jobs due to the poor economic situation in the country.

A major crisis faced by supervisors is the inability of postgraduate students to write or develop an acceptable proposal for presentation and implementation at the postgraduate (M.Sc./Ph.D.) level. This may sometimes slow down the progress of their work and lead to the termination of the programme, or its abandonment altogether by the postgraduate student.Where supervisors insist on the right thing to be done, they are blamed for over-stay of the students, or rather accused of "holding them" (i.e., delaying them), to use the phrase often used by the students;whereas it could be that some supervisors are simply cautious of approving a substandard work for their reputation's sake and of which if allowed the student will not be able to implement the proposal successfully. Other supervisors may harbour sinister motives as well. When supervisors succumb to such characteristic pressures and blackmails, probably due to collusion of interested parties, one finds the typical postgraduate with questionable MSc or PhD degrees which they cannot defend. Therefore, some departments have made in-house aarrangements to improve the situation by introducing research methodology courses alongside the core ones. However, they still lack the main elements that would make them successful

since they are based on traditional presentations which are ladden with assumptions about the students ability and preparedness. In any case, the students have always taken the course with levity.

The major deficiencies observed by supervisors is the errorneous impression students hold about postgraduate studies, particularly, the intellectual and skill requirements. Typical proposals written by postgraduate students exhibit some or all of the following features: smack of shallow depth of literature survey and understanding, poor grammar, lack of knowledge about the structure of typical proposals or PhD dissertation reports and the meanings of its elements, lack of/improper consultation of previous works and experts, sheer laziness to do the work and lack of funding, among others.

1.2.2 Seeking for postgraduate admission

Certain factors should be considered by the prospective postgraduate students before or when applying for admission within or outside the country. Consider for example the choice of university in terms of the available postgraduate programmes, teaching facilities, available experts (Professors and PhD holders), rate of graduation of postgraduate students and most importantly, the profiles of the relevant experts. The last parameter, quality is very important as the prospective postgraduate will eventually have to work with one or a combination of these personalities as lecturers and supervisors. Knowing something not only about their academic profiles but their character patterns will be equally helpful, particularly

within the country. For example, one may consider the one who graduates students most timely amongst them, juxtaposed with the quality of his/her research and why? There could be both positive and negative reasons.The prospective postgraduate could do this by travelling to these institutions, to the departments in order to obtain relevant data and preferrably discuss with some of the lecturers, supervisors and their current students before applying within the country. This would provide the necessary information needed to plan postgraduate programmes based on reality and expectations on the ground and which, in all probability,would help in easing his/her stay during the programme and facillitate timely graduation.The general consideration for choice of university would have to be influenced by the academic reputation of the university in terms of facilities for research, water, electricity and availability of internet connection, among other vital components like security and stability in the system. Surely those wishing to study overseas could check their choice university's website and search the curriculum vitae of the prospective supervisor (s) among other details where such are available or can be requested. The greatest problem and dificiency in most of our universities in Nigeria is ill–preparedness for postgraduate work, in terms of facilities and expertise. However, based on globalization through internet connections, one should be able to overcome the problem of facility by sending samples overseas for analysis at a fee in the case of material scientists, for example. Although there is the additional problem of the universities being "bottom heavy", that is more lecturers

without doctorate degrees and below the rank of professors (this is fast-changing, what with the TETFUND fellowships being awarded). Ironically, this group forms the nucleus of the lecturing workforce. NUC (National Universities Commission) estimates 60% of university lecturers have no doctorate degrees [1].These two principal factors, amongst others, are the crucial reasons for the protracted ASUU (Academic Staff Union of Universities) strikes over the years and which may likely continue.

1.2.3 Preparation for postgraduate studies

When a prospective postgraduate student is set for admission into a designated programme it is important to consider the following: look for money, not only for school fees but for textbooks, specialized programs (software), fees for carrying out characterisations (analysing samples) and for presenting the research at seminars, amongst others. There is also the fundamental requirement or rather assumption that a revision of previous undergraduate notes in the area had been undertaken. The course content of the postgraduate programme will generally be based on undergraduate lectures, depending on the field of expertise, except where one wishes to change area of specialization. However, it will be widened and deepened in terms of treatment. There is no alternative to meeting this challenge other than buying textbooks. There is need to begin to gather appropriate information about relevant software (programs) used in the field in order to analyze the data. There is a need for writing and publication skills or experience in journal article-publishing or seminar presentations as these will

enhance success and performance at the postgraduate level and make it attractive and essential in the eyes of the lecturers. Previous academic credentials would also be helpful, that is, grades, though they will not necessarily be the sole consideration for admission, but would certainly help in the success of the programme. Should you find youself wanting in these, enhance your skills and academic achievements by studying hard and making necessary preparations before the postgraduate programme begins.

1.2.4 The coursework

Once admitted into the programme of your choice and department, settle down for work. It is assumed in this presentation that the admission is full-time and thus you would be available at all times. There are two components to your stay for the duration of the postgraduate programme: coursework and research. Depending on the univeristy, it may be either of them. Let us look at the coursework in detail.

Coursework is generally based on previous undergraduate work with expanded content. M.Sc. could be by coursework or, research (or project), separately (separately in overseas) or together. In Nigeria M.Sc. is generally by coursework and research; thus, students spend comparatively longer times than some of their foreign counterparts who undertake the separate option. But PhD is generally by research, both in Nigeria and outside, though coursework has begun in some universities in Nigeria. There may also be new courses and it is necessary to know the relevant courses and their statuses, together with the

credits reguired for graduation. Attending lectures regularly is necessary, for lecturers may seem indifferent but keenly observe students that take their studies seriously and this could influence their opinions about those who behave to the contrary. The relevant textbooks, either as prescribed by the lecturer or as established by you must be purchased. Depending on how you gauge the lecturer's notes, if they are given at all; you may not have to buy textbooks, only for reference purposes. Because this is postgraduate studies and the need to broaden and deepen knowledge cannot be overemphasized, you would need to buy the books nevertheless. Attend lectures and do assignments or tests regularly, as may be scheduled and administered. Desist from unnecessary travellings without notifying the lecturers or the university. Per chance, during the lectures it is possible that you begin to get interested in some topics and have an idea of the kind of research you would want to undertake after having completed the coursework and passed successfully. Be matured, gentlemanly, respectful, hardworking and committed student, an embodiment of what the referee said you were. However, some departments rarely look at those comments in the application forms during the admission process, neither do they use them to assess the students' progress or worthiness at any point due to various pressures, among others, but these are very important in seeking admissions into foreign universities. It is assumed that you have passed all the prescribed courses successfully and are about to embark on research.

1.2.5 Processing postgraduate issues

Many students are disappointed with the length of time it takes to obtain their results after external defence in Nigeria. Thus, they resort to blaming the supervisors/postgraduate coordinator for the delay. However, this is due to ignorance of postgraduate administration process which varies from university to university within and outside the country. So, it is necessary to understand the applicable postgraduate issue–processing steps for your institution. The current presentation is that of a typical Nigerian university. Postgraduate administration and processing of results are structured around the following in a typical university set-up: Postgraduate Co-ordinator (departmental), HOD (departmental), Postgraduate Committee (departmental/school or faculty), supervisors, lecturers, Deans, Postgraduate School (as per university postgraduate committee) and finally the Senate-where results are approved (ratified) and subsequently released. All of these individiuals/bodies play one role or the other with regard to postgraduate issues. In between these, there are the office clerks, secretaries and typists, all of whom are supposed to work in harmony and sequentially from the course lecturers to the university Senate in a network on a particular issue. Any person or group that failed to do his or her job at any stage in the system due to default, error of judgement, commission/ommission, would inevitably cause a delay in the processing of the results or issues related to the particular candidate. Meetings are held generally once in every month in most universities to consider such cases, except in extraordinary situations which rarely arise. So once a month is missed, for

whatever reason, the postgraduate student would have to wait for another month.

The students'self-discipline, respect for all manner of staff, particularly, at the departmental level, will greatly help matters under these circumstances. Moreover, periodic checks at the department to find out about progress of the thesis/report/issue will help in resolving many potential problems. Most importantly, the researcher is expected to follow the stipulated guidelines for writing thesis with special attention to details, including binding prescriptions. If for any reason the study will be discontinued, inform the administration with appropriate documentation through the head of department to the Dean, Postgraduate Schoool.

In recent times, supervisors are being assigned more students than officially required due to exigencies of the situation, amongst others. They are conducting their own research for promotions, lecturing, doing administrative work in committees, etc. Therefore, if there is any complaint, be patient, choose your words carefully when talking to supervisors and other members of staff, be decent in your words and respectful and approach the appropriate staff at the right time and place. Note their moods. Distinguish yourself by sheer hard work, honesty, transparency, dedication and quality work which will potentially result in publications in high-impact journals for the supervisors and be rest assured that they would be competing over you.

Take your time to do an interesting and original work which can catapult you through several promotions if you are in the academic ladder. Do not be in a hurry to get a PhD through dubious or substandard work; for a PhD can be a burden and a joke if you do not merit it, or even if you do. Remember that you may come back for a PhD degree, or you would certainly need a reference for one thing or the other from your supervisors and lecturers in the future, so be wary and forward-looking as you are not done yet.

1.3 The supervisor or advisor

A supervisor (Britain and Nigeria) or advisor (US) for a thesis or dissertation is one who has been officially assigned to oversee the work of the thesis, advises as appropriate in terms of amendment or approval of the work which is normally in coordination with a team or committee of advisors in which he/she is the chair. Before admission for a PhD, a proposal in the relevant field is necessary based on which the relevant expert (s) in the field is (are) sought and assigned to the student. The relationship between the student and supervisor gradually evolves into an intimate one due to the very nature of the job and thus allows the supervisor to understand the student better in terms of intellectual capacity, competence, emotional stability, independence, amongst other attributes necessary for a PhD work. In the case of MSc. Thesis, a proposal is usually not necessary or required. Vacancy for PhD depends strongly on available experts. The ideal academic supervisor/advisor for

a thesis or PhD dissertation is one that has enormous background expertise in the designated area of investigation [2]. This however, is often difficult to achieve in most cases and thus the student has to do with an advisor that has peripheral or no knowledge of the entire field of investigation. There are various reasons for this in different universities but whatever the circumstances the supervisor should be able to carry out the work based on his research experience as a PhD holder or professor in the department.

In the case where a non-expert is the advisor for the student, the researcher should consult with other relevant subject experts even if their contribution may be limited to literature review [2], and he/she has to work much harder and show extraordinary level of independence.

The researcher should ensure that he/she obtains feedback from the supervisor [7] at every reasonable step over details of various sections of the thesis outline, schematics, experimental set up, necessary contacts, facilities or other aspects of the thesis. Similarly, the researcher should show the supervisor in piece meal the thesis periodically for review, rather than the whole, particularly near the end of the programme in order not to put the supervisor in an awkward position. This would help the researcher develop a systematic buildup of material with a clear scientific writing style, logic and continuity [7]. Whenever in doubt, do not hesitate to ask the supervisor because it is better than doing the wrong thing without consultation which may

lead to more expenses or waste of time or both on the part of the researcher and probably delay the date of graduation.

In the following sections we discuss the various sections of a typical dissertation which form the “front matter”. The order presented here may differ from one university to another depending on stipulated formats and therefore only serves as an example.

1.4 The title page

The first page in a thesis or PhD dissertation is the title page and normally contains information such as the title of the thesis, author's name and registration number and a statement such as a "dissertation submitted to the postgraduate school…(followed by the full name of the university, including town and country) in partial fulfillment for the award of Doctor of Philosophy degree in…(Physics)", for example. This is followed by a line which contains the name of the department and university, with the date making the last line. In some dissertations the copy right symbol© may be provided. An example is provided in box 1-1.

Ex.1-1. Studies of the microstructural, structural and electrical (dielectric and piezoelectric) damage of neutron irradiated $(Ba_{1-x}Ca_x)(Zr_{0.03}Ti_{0.97})O_3$, (x = 0.00, 0.03, 0.04, 0.05 and 0.10) perovskite ceramic.

1.4.1 The research topic

The issue of title of a Ph.D. research paper belongs to what is called the "front matter". The Front matter is the preliminary material (text) that comes before Chapter One (Introduction) and generally include the title, dedication, abstract, declaration and acknowledgements pages. The table of contents is also part and parcel of the "front matter". There is need to elaborate on the intricacies of obtaining or selecting a research topic.

Where can I get a research topic? This is one pertinent question that begins to border a typical PhD/MSc student once his coursework is about to be over or is over, where it is applicable. The anxiety to get a valid, workable or researchable topic is necessary owing to what the consequences of doing otherwise would lead to. There are many considerations for obtaining a research topic as much as there are many sources for obtaining it. Here, the most important of these will be discussed. Depending on the university in which the researcher is carrying out his work, the postgraduate course may be under some form of sponsorship, fellowship or grant. In such a case, the financial and facility aspects of the research topic consideration can be neglected. Otherwise, these two are the most crucial and can bring a research project to a standstill and may lead to the termination of the programme and subsequent frustration.

Also, another factor which is relevant particularly for the PhD researcher is the availability of experts in the area, looking at it from a wide and a narrow context of the research area. For

the PhD student to be competent enough to choose a research topic (a highly non recommendable action in the view of the author) all by himself, the researcher needs a relatively appreciable knowledge of the field, if there are some topics that are likable to him or her or for which he or she is excited about. Similarly, the intellectual capacity of the student and the ability to work independently, normal requirements for postgraduates, would be highly necessary if not instrumental to the success or failure of the research. In any case, considering the various factors that may be evaluated in a typical research, it is highly recommended that the research topic be provided by the supervisor who already has experience and research problems to be addressed expectedly. This should be the case particularly when the student is enrolled in a Master degree programme rather than a PhD, in which case it would be assumed that he already had research experience. Except of course if he/she decides that a change of course is necessary from the field in which he/she previously specialized, in which case the guidance of the supervisor would be instructive too.

There are many sources of research topics other than from the supervisor. These may include news (media-radio/Television), workshops, conferences, journals, discussions with experts and the internet. However, the topics obtained through these channels must also be discussed with the supervisor in order to evaluate their researchability, validity, amongst other necessary considerations for executable research. Journals are the best and most important resources for PhD or thesis research generally. This is because the research

problems pertaining to a particular topic are found in them together with other relevant information. The topic must not only be topical but be researchable in terms of yielding to scientific process of investigation and most importantly can be concluded within a specific time frame and budget. It must be based on real problems as much as possible. All postgraduate programmes have specific lifetimes during which the programmes must terminate. The experience of the supervisor should enable him/her determine whether the proposed work can be concluded within the time frame of three to four years (PhD) or within three years or less (Master degree).

Choosing a topic that can be concluded within the programme duration is critical and as such students must discuss this and view it from a researchable and practical perspective within a very wide context, including facilities, available experts, financing, materials and ability. There are restrictions on the validity of the length of topic and its appropriateness. These must be properly trashed out by the supervisor at seminars and in consultation with available guidelines and peers.

A thesis title can be seen as an advertorial and a domineering banner amongst the various signposts in a thesis. Various opinions exist regarding the title [3] such as whether it should be broad and generic or narrow and detailed. There is good justification for either and it is considered as a matter of taste and consultation with the supervisor [3]. It is expedient that a title informs about the problem studied and the type of

method used to unravel it [3]. A title should not be bogus or claim what is not inside or treated in the thesis in order to deceive the reader since it undermines or misrepresents the actual work done. A match is necessary between a title and the actual work carried out and defined by its contents. A title should not be too long.

The title of a thesis must reflect in an accurate manner the contents of the work, be brief and informative [4, 8]. It should prepare the reader on the topic researched and the nature of the study carried out [5]. As much as possible, interest, competence and relevance of the topic must be considered while choosing a title or topic; the researcher must be realistic [6].

1.4.2 Declaration page

As a necessary requirement, thesis carry the declaration page in which the author is expected to declare that the work is original, has never been presented elsewhere for a degree or diploma or equivalent qualifications using the same title. It is also essential to declare that all works of others have been appropriately cited and documented. This is in order to give credit to authors whose works have been cited and avoid plagiarism. It is no more than a few lines containing the list of supervisors in official order and followed by the name, signature and date of the candidate. An example is given in box 1-2.

Ex.1-2 This is to certify that the work reported in this thesis is in the Department of Physics, Faculty of Science,…(name of university) under the supervision of Professor…(name) The work of other investigators in the area covered in this thesis is duly acknowledged and referred to appropriately. No part of this thesis was submitted anywhere for a degree or diploma.

1.4.3 Certification page

The certification page details the title of the thesis and states categorically that the work is in fulfillment of the requirements of graduation of the named university and the relevant degree (Ph.D./M.Sc.) to be awarded; in addition to the statement that it is awarded for its literary presentation and contribution to scientific knowledge. Depending on the university, the thesis/dissertation is followed immediately by a sequential order of the list of the supervisory committee members' names, the Head of Department and Dean of Postgraduate School. Other universities may require different authorizing officers apart from the supervisory cadre. All of these will sign and date their signatures. An example is given in box 1-3.

Ex.1-3. This Thesis titled … by …. meets the regulations governing the award of the Degree of Master of Science in Solid State Physics of …(name of university) and it is approved for its contribution to scientific knowledge and literary presentation.

…… …….

Prof. …(name) Date

Chairman, Supervisory Committee

…… …….

Dr.…(name) Date

Member, Supervisory Committee

……..	…….
Dr.…(name)	Date
Head of Physics Department	
…….	Date
Prof. …(name)	
Dean, Postgraduate School	

1.4.4 Dedication page

When a particular piece of work is carried out in written form or constructed, the author may want to dedicate the piece of work to his parents, wife, children, historic personality, teacher, mentor or even God. This is part of the preliminary pages in a thesis or dissertation and is not necessary or compulsory but a formality. It normally does not exceed few lines and is called the dedication page. An example is provided in box 1-4.

Ex.1-4 This work is dedicated to …(name) in recognition of their hard work, contribution and sacrifice toward the development and sustenance of …..(specify).

1.4.5 Acknowledgement

Acknowledging the contributions to your thesis/dissertation by others is an essential requirement of dissertations. Some researchers exhibit the attitude of denying supervisors/supervisory team members recognition in their thesis or undermine the reporting of their contributions due to various actions or inactions of the members of the supervisory committee that might have characterized the period of the work. Refrain from sending hidden messages to advisors, colleagues, the university, department or country as these may have negative implications in the future [3]. All those entitled to be recognized should be obliged despite whatever must have happened during the work or their level of importance in the hierarchy of departmental staff. Being positive about your supervisors, even where they do not contribute anything at all may help greatly in the future. Similarly, do not spend many pages acknowledging individuals who are not essential or instrumental in any way to your work while devoting barely few lines only to undermine the supervisor's contribution. This will speak volumes of your intentions and would be reflective of an embattled supervisory team [3]. Similarly, any publications resulting from the work supervised by the supervisory committee must reflect their correct names in the right order as authors of the work. As the principal investigator your name should therefore be the first on the list of authors.

Acknowledgement is an optional [7] and informal component of dissertations and thus the advisor, colleagues and family members may be mentioned without overdoing it. It is

necessary that all those mentioned should have made contributions to the research [4, 8] work whose nature it is essential to describe briefly [8]. In some thesis formats should be followed by a list of published articles, "in press" or "submitted" as a product of the thesis [8]. The recommended practice is to keep personal aspects such as family and friends to a minimum [2]. An example is given in box 1-5.

Ex.1-5 I 'm greatly indebted to my supervisors, Prof…(name) for providing me with some of the

expensive materials needed, including theoretical grounding for this research and all the friendly atmosphere in which we worked; and to …(name) for his relentless concern and logistical and technical advice. I'm deeply appreciative of the advice and assistance by the technical team of Physics Workshop, in particular … for construction of my design.

The Head of Department of Physics, …(name) saved me from the incessant power outages of NEPA by sparing the departmental generator entirely for my use when almost all hope was lost and my work was at a standstill. Sir, I say a million thanks. I must thank my colleague and friend, …(name), who gave me series of fruitful advice with regard to the design of my system. To my other colleagues, …(names), I say thank you for upholding the "es spirit de corps" throughout the course. As to my colleague at work, …(name), I'm grateful for the construction of some of the apparatus and the drawings. I, m also grateful to the

authorities…(name of institution) for their sponsorship of the course.

1.4.6 Definition of terms

In a typical thesis, sometimes acronyms (abbreviations), short for a string of words representing names of particular agencies, industries, process or technique, are usually applied generously throughout the thesis in order to avoid repetition of the same phrase over and over again using some few letters, which may or may not necessarily correspond with the beginning of the letters of the words they represent. In such cases if acronyms are used throughout the thesis, it is expected that their full meanings be fully spelt out the first time they are used while the abbreviations (acronym) follow immediately in brackets, that is if the word the acronym represents is (are) not a standard acronym that is well known such as United Nations (UN) and UNESCO (United Nations Cultural and Scientific Organization). The List of acronyms is listed in the preliminary pages with their full meanings, word for word. The definitions and terms in particular must pertain to those used within the research in special contexts [9] which may be unclear to readers due to their technicality or otherwise, so long as they are not in standard usage.

Abbreviations are listed alphabetically along with their full meanings and deployed only when necessary due to the nature of the dissertation [4]. It should be noted that where very few

abbreviations are used which are not characteristic of the thesis, they should be explained the first time they appeared without the need for a dedicated list or need to explain the abbreviations again in the future.

1.5 Abstract

As the word implies, it is an extraction of specially selected statements, results, data and generally information from a piece of document which may vary in length from few paragraphs to one or two pages, depending on the purpose and extent of work. The purpose of an abstract is to give a snapshot of the essential message of the document in question (project, thesis, report, etc.) in a compact form without unnecessary details. This is especially important where one does not have the time to go through the whole document due to time constraints or bulky nature of the document. Abstracts can be for research purposes, implementation for policy or general guidance and information. Abstracts are very useful for researchers who may be working on a particular project in which they have to go through many documents. They offer researchers a quick overview of the contents of the document without the researcher having to belabour himself/herself by reading through the entire document. This is especially the case if the abstract follows the general acceptable structure: that is, the purpose or why the work was carried out, how it was done, the result obtained and the conclusion(inference) from the work.

This is the case for thesis writing where the work involved is either survey, construction, theoretical or experimental in the general case. However, abstracts may also be for opinion survey or other general purposes. Whatever is the case, the same principles apply. Abstracts can be descriptive or informative. The most important thing is for the researcher to decide which elements of the document (information, description, data, etc.)

are the most significant or provide essential information to the reader of the document as it applies to the subject matter presented in the document. Abstracts must be based wholly on the work done and the result achieved and not the literature reviews or external data. An example is given below in box 1-6.

Ex.1-6 Three species of starches from "Dioscorea rotundata*"* (D.R.) namely, "Giwa" (G)*, "*Lagos" (L) and "Sule" (S), *were* investigated and characterized by X-ray diffraction, EDX/XRF/PIXE/ESEM and their proximate composition and material properties determined. Estimated relative crystallinities are (%) ~ 21.25±0.01, 21.25±0.02, and 21.00±0.01%, respectively for G, L and S. The element K was found in highest concentration in S and G at 0.13±0.007 and 0.10 ±0.009 wt%. The starches have grains which are generally uniform/oval-oblong in shape and belong to the C-type crystal structure. The patterns were fitted and refined using GSAS II suite of programs yielding weighted agreement factors ("Rwp*")* of 1.61, 2.32 and 2.50%, respectively, for G,S and L. The samples were indexed as orthorhombic cells. The results show that the starches can be safely stored due to the relatively low moisture content. The physical properties of some of the species may be suitable for application in the starch industry…

1.5.1 Developing the Abstract

The components of an abstract have been described and identified above but how is an abstract developed? There are various ways of deducing an abstract from a document depending on the nature of the research carried out. For the purpose of this book, the methods used in developing the abstract have been described as the Fundamental and Deductive methods. Depending on the nature of the research work (i.e. theoretical, review, survey, construction or experimental) there would be slight variations in the contents, not necessarily the structure of the abstracts in order to reflect the intrinsic differences among them.

1.5.2 Fundamental method

In this method the researcher looks critically at the various subsections of his/her work (problem statement, objective, methodology, results and conclusion) and summarizes the essential points, arguments, data and information to reflect the "why", "how", "result", or "conclusion" components which define an abstract and condenses them into a single, well-articulated (linked) paragraph that is maximally informative. In this manner one may develop two or more versions of the abstract and decide on which is maximally informative (and relevant) and has the least wordings-economy of words within the scientific context. Abstracts are typically required to be no more than 200-250/300 words in journal publications but may be up to a page and a half in theses. It is therefore essential for researchers to have adequate capacity to do an informative and cogent summary by appropriate choice of words and important

information. Abstracts are also generally required to be typed in a single-spaced paragraph. There should be no references cited (unless otherwise acceptable) in the body of the abstract or any discussions. Only descriptive, quantitative and deductive information is required.

How does one arrive at the required 200-250/300 words? This is very simple. If you open an MS Word document in your Windows computer it displays the word count for the document. By selecting different sections (copying) of the document earmarked for developing summary and pasting it in a new page, one could successively develop the abstract by sequential editing while at the same time observing the change in the word count until desired number is reached. You must have the capacity to select antonyms and synonyms and ability to deploy appropriate technical register for the subject to make it water-tight and maximally informative yet with a minimum number of words. Abstracts are usually written at the beginning of the document before the Introduction. Some databases keep document abstracts for easy and fast access to published works.

1.5.3 Deductive method

This method is only recommended for persons who have acquired some experience in research or have a reasonable understanding of their research work. Here, the researcher does not have to summarize section by section of the thesis, rather all that is needed is to assess and evaluate the different subsections (or sections) to determine what are the essential pieces of information that are necessary to reflect the import of

the document. This can be done simply by jotting down some points from the different sections (after evaluating their worth and import) and then merging them in a paragraph. The paragraph may be rewritten, depending on the experience of the researcher to ensure flow, cogency and that it reflects the work in total. This is normally a faster method and it indicates that the researcher appreciates the objectives of his/her work and the problem to be solved.

Some examples of different elements which constitute abstracts have been provided in Fig.1-1 for study and analyses. The methodologies may include techniques used such as XRD (X-ray diffraction), SEM (Scanning Electron Microscopy), amongst others. In each of these cases the parameters measured could be density, ferroelectric and dielectric properties, amongst others. A correct and full abstract must possess those components which define it. Try to train yourself on writing abstracts by developing them from different documents with which you are familiar with their contents. Note that you may not necessarily be able to develop abstracts properly and appropriately at the first summary, you may have to do it again and again before it becomes satisfactory. However, with experience, this will reduce to once with time.

Another fact that should be noted is the issue of appropriate language for abstracts. By default, and general convention, most abstracts are written in the past tense. This appears to be based on the fact that the work had already been carried out and it is simply being reported and thus should be in reported

speech, in third person singular as is generally applicable to academic report-writing anyway. However, one does observe sometimes abstracts that are written in the present tense. This may be a requirement of formatting procedure required by the various postgraduate schools and some universities. There does not seem therefore any strong rule or opinion regarding these.

Abstracts are also normally "blocked or justified", that is, in Microsoft Word format and single-spaced, unless otherwise stated. This makes it stand out from the body of the document. Abstracts do not generally contain reference to work or discussion, only statement of fact is reported without discussion. They have been described as a high-level summary of the constituents of the thesis [3] since they provide the methods, achievements and limitations, even as they remain self-contained with no reference to articles, figures and equations [3]. Although abstracts are best written last, it is good to have an initial draft as the work progresses which should be reviewed and made up-to-date before External Defence. Abstracts are expected to reflect the context and key findings of the thesis such that its aim, approach and outcomes are properly expanded and apparent [10]. In some thesis, abstracts could be followed by key words or phrases which highlight the most important issues in the thesis [10]. PhD dissertation abstracts typically contain up to three hundred and fifty words (350) and are best written after the complete dissertation has been written [2, 8]. Abstracts allow readers to get an idea of what has been written without having to read through the whole dissertation. From a broad perspective they should include [2] aim and

objectives, the relevant boundaries (that is context and content of the discussion), the methodology, results or findings, conclusions and recommendations (such as solution to the problem raised in the research questions which are related to the specific objectives.).

Abstract is a concise summary of the thesis or dissertation [4] but distinct from introduction. It is often published separately from the thesis it summarizes with an emphasis on conclusion but without the need to include supporting evidence (citation) [7]. Abstracts assist readers in making decisions on whether to continue reading the thesis or not. A good abstract must therefore be accurate in capturing the overall view of the work and should be written within the limit of a paragraph, though it can extend beyond that if absolutely necessary [2, 11]. Equations, graphics (journal articles now accept what is called "graphical abstracts*",* where some of the results of the work are embedded within the abstract statement) and citations are not allowed, although citations can also be allowed if absolutely necessary, in which case they must be fully cited within the abstract (that is all the usual details of references are provided). Thesis abstracts may include summary of introduction, statement of the problem, background of the study, research question (hypothesis) and methods (procedures) [5]. Abstract should not be more than two pages long [12] in a thesis.

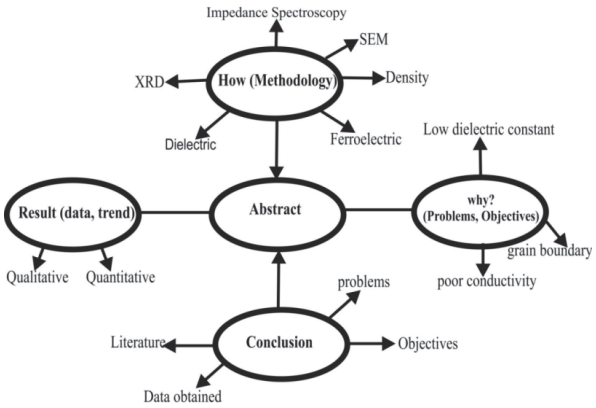


Fig1-1. Schematic of attributes of an abstract (problem, methodology, result and conclusion) in the order in which the components constitute the abstract and the details of each component. The methodology involves techniques used (e.g., XRD, X-ray diffraction, SEM (Scanning Electron Microscopy). The parameters to be measured could be density, ferroelectric and dielectric properties, amongst others.

1.6 Table of contents

This imply chapters and their headings or titles and their starting and ending page numbers which expand out into an extensive list with subheadings of the contents within each chapter. The table of contents includes the preliminary pages which were discussed earlier on, such as title, dedication, certification, declaration and others. It is a list of all the contents of the thesis including the appendix.

One of the most important aspect of the table of contents is the breaking down of each chapter into subtitles (subtopics) which reflect all the necessary components needed to understand the concepts under discussion in the relevant chapter. These are developed systematically considering the theoretical requirements necessary to understand the work and may reach three to four levels as deemed adequate by the researcher and should be rich enough to treat a material at some reasonable depth rather than three to four lines only. Otherwise they could be merged into an appropriate subtopic.

The subtopics are developed by looking at the main title of the thesis and dividing it into subdivisions until all the relevant concepts have been exhausted. These are then reassessed for appropriateness to ensure they are unique, not overlapping, adequate and relevant to the understanding of the thesis and prioritized. Each of these is further developed fully into rich subtopics either at the third or if absolutely necessary at the fourth levels. The titles given to these subtitles must be relevant and adequate to capture the necessary information to be given.

Note that the order of i-xii, in the table of contents page may change in some formats as it is not a rigid criterion. A typical table is shown in box 1-7.

Ex.1-7 Title Page----------i

Dedication----------ii

Declaration----------iii

Certification----------iv

Acknowledgement----------..v

Abstract----------vi

Table of Contents----------vii-ix

List of Figures----------x-xi

List of Plates……xii

CHAPTER ONE

Introduction

1.0 General Introduction…… 1-2

1.1 Classification of Solids……..…2-3

1.2 The band Model of Substances…… 3-4

1.3 Ionic Crystals and Lattice Defects…….4

1.3.1The ionic Bond……4-6

1.6.1 List of tables / figures

This section lists all the captions of tables/figures and their numbers according to the chapters in which they appear and their page numbers. This listing is carried out in two principal ways: figure, title and page numbers, or simply a title which indicate figures/tables while at the bottom the figures are numbered with their titles and pages. Sometimes there is list of plates. These are usually pictures of scenes, persons or things. A typical example is depicted in box 1-8(a&b).

Ex.1-8a List of tables

Ex.1-8b List of Figures **Page**

.

1.7 The Research proposal

A research proposal is the first step towards executing a research project, M.Sc. or Ph.D. which eventually culminates in a thesis or dissertation. The development of a proposal is one of the highest intellectual activities required at the postgraduate level and is a measure of the student's capacity for intellectual profusion, articulation, vision, acuity of intellect, deduction, comprehension and organization. It needs the mustering of one's overall intelligence. A student may be academically proficient in coursework but poor in research work. Many factors have to be considered and carried out before attempting

to draw up a proposal. There are various formats depending on the institution, department and purpose. These have been discussed below. The following is a sequence of a typical proposal structure, although it is not rigid or necessarily in the order indicated. There are various formats depending on institution and purpose and thee have been discussed below.

It is important to consider the design or format, that is the blueprint for the whole work which consists of the contents and their logical sequence. The contents can be fully developed by extensive study of the relevant literatures in the field. Copious notes should be made on the relevant themes in the subject matter, that is, the chosen topic can be obtained from journals (for results, problems, applications), textbooks (for grounding in theory, method and technique), monographs, edited books, reports, internet resources, etc. Ensure that all documents consulted and referenced are relevant and current, and as close as possible to the research topic. General literature which is incidental on the topic is good for background. A typical proposal consists generally of three sections or chapters "Introduction, Literature Review and Methodology", with no table of contents, unless otherwise instructed. It can be assumed that where a good work is carried out in these sections, one does not have to repeat it again when it comes to thesis/dissertation-reporting, except for some few fine-tunings and updating here and there. The full discussion of the fundamental elements that make up this chapter will come at the appropriate chapters devoted to them. Here, we simply mention some of them in

passing. However, we shall elaborate on the concepts of expected outcome, budget, time-table, programme schedule or time-line or table of activities (as they have been variously described) which are particular to this section, i.e., proposals. Typical thesis structures hovers around five chapters, though some departments/institutions may require up to seven or more chapters in order to emphasize certain key concepts or sections and provide in-depth analysis. The following are therefore typical proposal components:

- introduction
- literature review
- methodology
- objectives
- justification or significance
- expected outcome
- conclusion
- budget
- table of activities/time-line or programme schedule.

Here, the explanation of expected outcome, budget and table of activities (programme or time-line) are provided. Since it is a proposal one is expected to hypothesize on the results which he/she expects and can be discerned from the literature review, objectives and research questions. Because it is hypothetical, the final version may reveal something different altogether which should not be surprising at all. The budget is the projected expenditure of the work in terms of material requirements and services, amongst others. The time-line of the project represents the series of activities that define the various

processes of acquisition of data needed with their time-lines designated in table form and w\covers the whole period of the research. This gives an idea of the time required to complete the job, and at the same time forces the researcher to be time–conscious. It is a guide. Typical examples of these components (expected outcome, budget and time-line) are shown in box 1-9.

Ex.1-9 Budget 1.

DESCRIPTION OF ITEM	**TOT AL**
1.0 Expenses	(₦)
1.1 …	3,000,000.00
1.2 …	3,000,000,00
1.3 …	1,000,000.00
1.4 …	1,000,000.00
2.0 Equipment	**8,000,000.00**
2.1 Potentiostat/Galvanostat	2,000,000.00
2.2 Crucibles (platinum, zirconium	500,000,000.00
2.3 Pelletizing machine	300,000.00
2.4 HP Impedance Analyzer Analyser	2,000,000.00
2.5 X-ray Diffractometer	3,000,000.00
2.6 Dual DTA/TGA Thermal Analyzer	500,000.00
2.7 Pestle and mortar	30,000.00
2.8 Electrodes	20,000.00
2.9 Microwave Oven (Reactor for research)	1,000,000.00
2.10 Variac (8 to 10 Amps, 250 Hz)	200,000.00
2.11 Temperature controller	30,000.00
2.12 Thermocouple	20,000.00
Sub Total	**9,600,000.00**
3.0 Supplies/Consumables	
3.1 Deionized/distilled water/chemicals	**11,000,000.00**

4.0 Data Collection & Analysis	
4.1 Research Assistants	1,000,000.00
4.2 Research Informants	1,000,000.00
4.3 Collection Instruments	1,000,000.00
4.4 Data Analysis	1,000,000.00
4.5 Technical Assistants	1,000,000.00
Sub Total	**5,000,000.00**
5.0 Travels	
5.1 International	4,000,000.00
5.2 Local	1,000,000.00
Sub Total	**5,000,000.00**
6.0 Dissemination	
6.1 Publication in Journal	1,000,000.00
6.2 Conferences/Workshops	4,000,000.00
Sub Total	**5,000,000.00**
7.0 Miscellaneous	
… **…**	
7.1 …	500,000.00
7.2…	5,900,000.00
GRAND TOTAL	**50,000,000.00**

Expected outcome 1.

It is expected that a lead-free piezoelectric ceramic with highly promising properties suitable for different applications in diverse fields such as radiation environments will be produced. It is expected that this material would be able to withstand neutron radiation within the context of the fluences used in this study…

Intended Outcome 2.

Students and researchers will be able to purchase analytical grade chemicals at reasonable costs and have their samples characterised with ease, with the guarantee of a reliable data. It will similarly, expose them to relevant techniques of materials characterisation, their physical basis and introduce them to relevant program modules for data analysis...

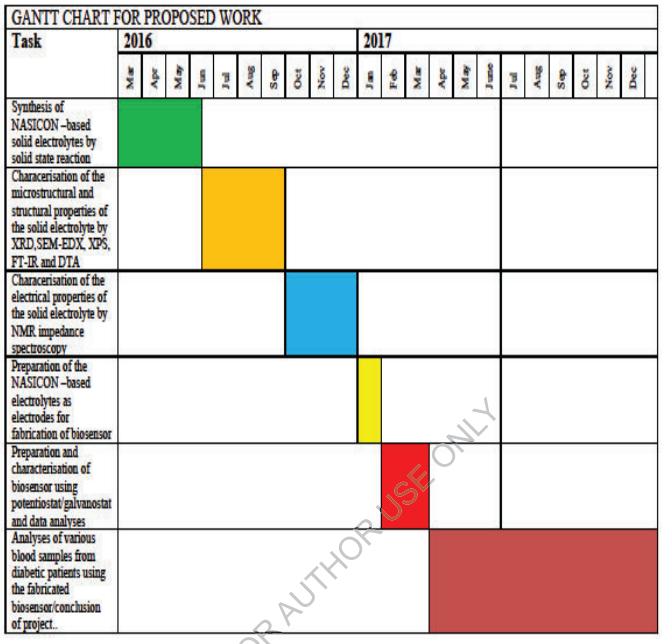
Budget 2.

S/No.	Item/Activities	$(US dollars)
1	Survey of relevant research facilities' locations for materials characterisation in Nigeria for database.	1,226.99
2	Survey of relevant experts in Nigeria in the field of materials characterisation and data analysis for database.	1,226.99
3	Browsing on the internet to purchase ebooks on materials characterisation.	613.50
4	Browsing on the internet to obtain relevant information on materials characterisation instrumentation and vendors.	184.00
5	Obtaining information on relevant program modules for data analysis, through websearch, discussion and travelling.	184.00
6	Gathering information on conferences, workshops, getting posts to the website from volunteers, partners/collaborators. *	245.00
7	Obtaining details of profiles of volunteer international experts in designated fields of	245.00

	materials science (phone nos., affiliations, publications, emails. etc.) for database.	
8	Seeking volunteers/collaborating and partnering institutions to post their latest instruments or program modules on the website by browsing, amongst others.	245.00
9	Development of a professional website relevant to all the diverse services, with interactive capability, multimedia and linked to social networking websites such as Facebook, and Twitter, amongst others.	797.55
10	Payment for hosting the website for a year.	245.00
11	Renting an office accommodation for a year and furnishing it with computers, printers, scanners, phone, tables, chairs and a mini library, amongst others.	4,294.48
12	Production of database of suppliers of analytical grade chemicals in Nigeria.	470.25
	Total	**9,977.76**

GANTT for activities for proposed research

GANTT CHART FOR PROPOSED WORK



A research proposal is therefore a prelude to a full thesis report. It may be for academic purpose or to obtain a grant from an institution interested in the research or purely administrative purposes. Research proposal is the first step towards producing a thesis and has some similar features or characteristics with a thesis/dissertation although limited in scope. A proposal may also take another format/structure as presented below [13]:

- introduction
- review of literature
- identification of knowledge gap
- statement of the problem
- objective and limitation
- hypothesis
- method/source of data
- importance and contribution of the study to knowledge.

Hypothesis is an intelligent scientific guess about the cause or reasons of the existence of certain observation which needs further explanation and has to be subjected to a test. All other terms or items on the list have been explained fully at the appropriate sections/chapters.; it justifies and effectively plans for a research project while at the same time demonstrates the research's contribution to existing knowledge or how it can solve a problem [5] within a given period of time. Yet another format/structure. A thesis/dissertation proposal explains the "why", "how", "what", "when" and sometimes "where" of the

research [5]. Yet another format/structure which is more detailed is [5]:

- title
- abstract
- introduction/ background
- problem statement
- purpose/aims/ rationale
- review of literature
- methodology
- significance/implications
- overview of chapters
- work plan and
- bibliography or references

In this format, the purpose, aim and rationale are technically the same and have been treated at the appropriate sections. These are sometimes described as motive for the work. All of them mean the same thing, aim. Whereas work plan is the same as time-line of activities earlier discussed. That is how the work has been planned. Here a list of activities which will be undertaken within the period and ideally how they will be approached, that is, the design, is necessary. The overview of chapters refers to a brief description of the highlights of each chapter/section as the case may be, as presented in the preface to this book. These differing formats clearly demonstrate how varied proposal structures could be in terms of requirement of

details of presentation in the various sections. It should be noted that generally sections (1.0, 1.1, 2.0, 2.1 to 3.0, 3.1) are used instead of chapters to represent different sections of the proposal (Introduction, Literature Review and Methodology, respectively, amongst others) with their subsections. However, other university/departmental formats represent the sections by chapters. The structure depends on the purpose, requirements and institutional format which emphasize different sections or aspects. Essentially, all the different formats are the same in that one is expected to discuss those aspects not emphasized in the others within the text since they are subsumed. So, follow the appropriate guidelines provided by the advisor/ department.

A research proposal may also be considered as a road map through the whole research architecture whose forms change due to various reasons, with the document changing in synchrony [2]. All the while, the advisor is kept fully informed of these. A research proposal can also be considered a demonstration of the fact that the researcher had thought through the objectives, sources of primary and secondary data and the specific methodology to be adopted [2]. Ultimately, a research proposal crystallizes into a thesis/dissertation.

1.8 Definition of a thesis

The culmination of a research proposal is into a formal thesis or dissertation. A thesis is defined by its structure and consists of sections, subsections and the transition points between them [14]. The sections must be clear and follow a logical order which should be apparent to the reader of the thesis [14]. There should be clear continuity in direction and not simply a series of statements in paragraphs without the requisite links [14].

By convention a thesis is divided into three parts:1) preliminary 2) main text and 3) method (see earlier discussion). The preliminary section deals with the title, dedication, certification, acknowledgement, among others. The main body starts from Introduction (Chapter One) to Summary/Conclusion and References while the end matter is the appendix. A thesis is considered as a monographic piece of work that is self-contained and solely written by a PhD candidate [3]. It defines a certain problem, revises existing approaches to the problem, identifies gaps through critical analysis using hypothesis to the problem and proposes a solution [3]. A thesis also provides detailed justification, literature studies, theoretical analyses, experimental design, and method of collection of data and implements data analysis together with delimitation of conclusions and limitations and future directions [3].

A thesis must exhibit a style of writing which reflects the choice made by the researcher of words and sentence structures which characteristically should be clear, exact and organic [14]. The thesis is generally referred to as a dissertation when it is a

PhD work but can also be called thesis. Both have been used interchangeably in this book but where emphasis is needed, they have been discriminated.

Dissertations project a writing style that is of the third person singular (passive voice) [15]. It is advisable that each chapter begins with an introduction and ends with a conclusion of the chapter [2]. In turn the conclusion should also end with an introduction to the next chapter, and so on. These alternations are like links which hold the chain of the chapters together in a seamless fashion while at the same time smoothening out the turning points [2].

Some authors have warned on over reliance on the passive voice (verb) construction because it can result in a dumb document compared to active voice which generally captures the reader's attention [7, 5]. Passive voice can be used to describe research design, experimental details and to preserve coherence from section to section [5]. The use of active/passive voice is debatable among scientists, science publishers and amongst different universities [3]. A thesis is a demonstration of comprehension, importance and the capacity to synthesize and evaluate the multifaceted component parts of the presentation on the part of the PhD prospective.

A thesis is thus a fundamental insight (idea) and proposition advanced about a subject (topic) which is demonstrated by the essay [14]. Its characteristics should therefore be such that the concept of the thesis is true but arguable with other alternatives possible [14]. It should also be limited in scope, arguable in a

short essay and with available evidence adduced which are stated in a simple form and cast sharply [14]. A Master or PhD dissertation thesis must be seen to have motive, evidence, analysis, structure and style [14, 16]. The motive factor can refer to reasons given at the beginning of the thesis on the chosen topic for being argued, why it is not so obvious to others and why others might hold a different thesis [14].

The evidence is in reference to all the facts, examples, supporting literatures and details the researcher adduces to support and uphold the thesis which is expected to be adequate and be of the right type (that, is relevant) [14]. It therefore, be accurate and adequately concrete [14].

On the other hand, analysis is the dismembering of the various components of the research which led to the acquisition of data and their subsequent interpretations [14]. It measures how the various parts of the thesis are related to each other, the whole and the elicitation of the implications which may not be clearly apparent from a shallow perspective [14].

1.8.1 Definition of a PhD dissertation

A PhD dissertation or thesis is a formal document [2] written based on specified guidelines whose contents are carefully selected and structured to be in consonance with a defined standard. It must demonstrate knowledge, originality [11] and understanding beyond the undergraduate level and its scope and depth must be beyond what is taught in the class [2].

Although there are no hard or specific rules, a PhD dissertation by research would usually contain 12,000 to 15,000 words [2], without the inclusion of appendices and references. However, some would recommend a maximum of 200 pages (in LaTeX DIN A4 format) for physics dissertations [8]. A PhD degree report in physics, for example, is normally a single piece of work or at most three pieces of work on a related thematic area which makes a significant contribution to knowledge [15]. This may include, for example work that has been published with the student as the Principal Investigator [15]. It must be distinguishable from an M.Sc. degree in physics thesis by research, which is a demonstration of research training at the frontiers of knowledge and a reflection of evidence of originality in method or interpretation of the data [15, 17].Therefore, a PhD dissertation in Physics must not be unnecessarily voluminous or lengthy in nature; it is the quality that is important. Differences in standards and requirements of departments and universities means that some may require or accept up to 70,000 words for a PhD dissertation (excluding appendices, footnotes, tables and bibliography) [15, 8]. The important principle is that the dissertation must be succinct in

presentation by jettisoning all unnecessary material that has no bearing or apparent contribution to the main thesis. The researcher has to be judgmental about including or not to include certain items. A lengthy dissertation is therefore an indication of poor effort at concentrating on essentials; whereas an M.Sc. physics thesis by research comparatively, may require from 50-80 pages of text, in addition to essential tables and diagrams [15]. A PhD dissertation must be a self-directed type of study where the majority of the input comes from the researcher [4] while the supervisor (advisor) provides guidance and materials support, among others. The supervisor must not take blame because it is the sole work of the student. The researcher must therefore take control and be in charge of his work. However, it is the responsibility of a Master's degree student to achieve progress in his study and produce high quality work [17].

The letters PhD or sometimes Ph.D. (for, example, in north America) is an abbreviation for Doctor of Philosophy, that is, doctoral degree, from the Latin Philosophiae. It is awarded for demonstrating the ability to carry out independent research (original) work within a defined academic standard [3]. It can be measured in terms of the advanced study of a particular subject area for three to four years, and by making at least one discovery or at least one contribution to knowledge. Further, a written and defended thesis in a "viva"(External Defence," (i.e., Oral Defence) within the context of literature is necessary and the candidate would have had a discussion with examiners who are experts in the field [3]. In most universities a PhD must also

demonstrate novelty whereas for others a demonstration of originality through the exercise of independent critical power can be a replacement for absence of discovery of new facts [3].

1.8.2 Writing style and the depth factor in a PhD

There is the heated debate on the question of how deep and broad a PhD dissertation should be, a highly passionate debate which often engulf academics at seminar presentations by postgraduate students. The argument is that since the novelty aspect of a PhD is achieved in a narrow field and the award of a PhD is testimony of ability to carry out research to a certain standard, the depth factor should take precedence over breadth in a PhD [3]. A PhD is expected to guarantee the candidate to become a lecturer in a university in Nigeria or UK for example. However, European countries may require the breadth factor which is obtained through postdoctoral studies before being able to teach in the universities [3].

In a physics thesis for PhD dissertation, the writing style should be that obtainable in scientific journals of high Impact Factor or repute, such as that of the Institute of Physics, London and Review of Modern Physics, among others [15] (this is only for illustrative purposes no implied advertisement). More pieces of advice on structure and presentation of PhD dissertation in Physics can be found elsewhere [8]. It is highly recommended to use LaTeX software for writing physics thesis in particular, the sections/subsections (1.1, 1.11, etc.) due to its excellent capability in handling scientific texts, graphics and formulae [8].

There are acceptable research codes which a PhD thesis must follow which are elaborated at PhD education workshops, research methodology courses or by being an active laboratory

member or by taking part in research projects [3]. Fundamental litmus test for a PhD is that the entire thesis must be "own account", with no cutting and pasting, copied artworks, figures or tables [3]. A thesis should introduce other researchers or future PhD candidates to the area or field of study [3] and its items should therefore have good self-contained quality to a large extent [3]. The reader of a thesis (PhD or Master) should have a fairly general knowledge equivalent to undergraduate level in the field concerned. Beyond this level or where things are important for the understanding, an overview of the most fundamental issues must be provided together with references for further reading to enhance understanding [3].

The tone of the grammar and style in a PhD dissertation are limited within the framework of university formats, such as margin size, font (type/size), printing on one side or double-spaced line for the purpose of comments and questions by examiners or reviewers [3]. The tone of the thesis should also be neutral, factual and analytical [3]. Similarly, a PhD researcher should be aware of ethical issues surrounding his/her work, even though this is a specialized area with its rules and procedures [3], particularly in the biological sciences.

1.9 Page-numbering

Numbering of the pages of theses/dissertations should be such that those that come before the introduction are indicated in Roman (i, ii, iii…) numerals while the page numbers of the main texts are set to Arabic numerals (1,2,3…) at the introduction page [3]. This is because the front matter of necessity has to

have an even number of pages to take care of double side printing of the thesis or it may be necessary to insert a blank page before the introduction [3]. Thus, all books must have odd page numbers and even numbers on the right and left side, respectively, when opened in the middle [3].

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CHAPTER TWO

INTRODUCTION

2.1 General introduction

Introduction is usually the first chapter (Chapter One) in most thesis formats. It is a very important chapter in that in a way it is a summary of everything carried out (thesis report) or to be carried out (proposal) except the results. As such, it must be written in a well-couched language systematically, seamlessly, logically and comprehensively. In the introductory chapter, sections such as aim, objectives, problem statement, significance and justification, scope/delimitation of the research and limited literature review are the conventional constituents, unless otherwise specified by the institution or format. All of these have been discussed in detail at the appropriate sections in this chapter. Essentially, therefore, the introduction is about background information and holistic and systematic presentation of the whole work that has been carried. From experience, and for the purpose of realistic and relevant introduction writing, it is best to do it after completion of the whole research report. What has been achieved will be clear from what has not been achieved. One can therefore re-write the introduction if it has been written before or rewrite a completely new one that is reflective of the actual work carried out. Writing introduction before actually carrying out the research will at best be a conjecture, unrealistic, inadequate and definitely subject to change as the research progresses, probably