



UNIVERSITATEA BABEȘ-BOLYAI
BABEȘ-BOLYAI TUDOMÁNYEGYETEM
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TRADITIO ET EXCELLENTIA



FACULTY OF CHEMISTRY AND CHEMICAL ENGINEERING
DOCTORAL SCHOOL OF CHEMICAL ENGINEERING

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Guidelines for writing a doctoral thesis in the field of Chemical Engineering

1. Preamble

With a view to institutional standardization and collaboration with other similar doctoral schools, the Doctoral School of Chemical Engineering (DSCE) develops guidelines for writing the doctoral thesis according to the particularities of the Chemical Engineering field, specifying elements such as: the formal structure of the thesis, elements of content, the minimum number of pages, references to bibliographical references, formal requirements of editing and writing. The author and the title of the thesis as well as the supervisor(s) of the thesis shall be indicated on the cover page. The Guidelines for writing a doctoral thesis are an integral part of the DSCE Regulation.

The doctoral thesis is the result of the scientific research activity of the doctoral candidate together with the supervisor and supported by the members of the guidance committee. The doctoral thesis must reflect (1) knowledge of the field in which it is written and (2) the original contributions resulting from the doctoral candidate's research.

In writing the *doctoral thesis*, the candidate shall bear in mind that the thesis is addressed to specialists in the field and, therefore, general descriptions should be avoided. The thesis shall also reflect the essence of the author's training in the chosen field of research, the creative and inventive spirit, the ability to critically analyse information from the specialised literature. The text of the doctoral thesis shall be written in the past tense and in the third person. Spelling and grammatical errors are not allowed.

2. Structure of the doctoral thesis

The doctoral thesis must prove the advanced scientific knowledge of the doctoral field, contain elements of originality in the development or resolution of the research topic, and their ways of scientific validation. The doctoral thesis represents the "*Final report on the completion and valorisation of the scientific research project*" and is drawn up in accordance with the requirements established in agreement with the scientific supervisor, according to the specificities of the unit where the research has been carried out.

The doctoral thesis must be seen as a particularly important document in which the findings obtained are understood and accepted by the scientific supervisor, the department's staff and the guidance committee in which it shall be defended, by the referees who draw up the "*Preliminary analysis report*", by the committee of specialists who shall make the final assessment, usually referred to as the "Doctoral Committee".

The doctoral thesis must be structured according to the following chapters

- ⇒ cover page and title page;
- ⇒ table of contents;
- ⇒ list of abbreviations and symbols;
- ⇒ introduction;
- ⇒ the content developing the candidate's personal contributions;
- ⇒ conclusions and perspectives;
- ⇒ bibliography;
- ⇒ appendices (optional);
- ⇒ curriculum vitae of the doctoral candidate (optional) and list of the doctoral candidate's published works during the doctoral research period.

Cover page

The cover page shall provide essential information about the thesis as follows: the university/faculty/doctoral school where the doctoral studies took place; the name and surname of the doctoral candidate; the name and surname of the scientific supervisor; the city and the year of the public defence.

Sub-cover

The sub-cover repeats the information offered on the cover. It is recommended to complete it with the title of the thesis, the members of the *Doctoral Committee*, the date of the public defence, and the destination of the copy.

Content of the doctoral thesis

The table of contents should provide an overview of the document and allow for the easy identification of chapters and sub-chapters. Therefore, the table of contents is organised in three columns: the number of the chapter or sub-chapter, the name of the chapter or sub-chapter, and the page on which it is found. The table of contents must cover the whole work, i.e.: the introduction, the contents, the conclusions, the appendices, the bibliographical references.

The chapter and sub-chapter numbering plan shall highlight the importance and links between the different parts of the work. The recommended numbering plan is, therefore, decimal because the rank of the number naturally indicates the level of detail.

It is very important to look for meaningful headings for chapters, sub-chapters, paragraphs, which represent an idea of development, avoiding multiplication of subdivisions.

Although the table of contents is edited at the beginning of the doctoral thesis, it is drafted in final form at the end of the research on the basis of an initial plan.

List of abbreviations and symbols

This list contains symbols, abbreviations, notations commonly used in the doctoral thesis. They are written in alphabetical order, starting with the Latin alphabet, small letters, then the corresponding capital letters, continuing with the Greek alphabet, small letters and then the corresponding capital letters. It is recommended to follow the symbols used in the literature and in the relevant standards. The list shall be written in two columns: the first column shall contain the symbol or the abbreviation, and the second column shall contain the explanation, the name of the symbol and, possibly, the unit of measurement.

The introduction of the doctoral thesis

The purpose of the introduction is to place the research in a temporal, historical, geographical and professional context. That is why the chapter should therefore contain the following:

- ⊙ a justification of the approach to the research topic;
- ⊙ the importance and topicality of the research topic;
- ⊙ the research topic's place in the international, national and regional concerns of the research team;
- ⊙ the objectives proposed for resolution in the research;
- ⊙ a summary presentation of the research method and research methodology;
- ⊙ the doctoral candidate's contributions, the originality and value of the findings obtained, their applicability, how they can be used for further research;
- ⊙ comments on the degree to which the proposed problems have been solved, the degree to which the objectives have been achieved, problems that have not been solved, new problems that have arisen during the research, new research directions that have resulted;
- ⊙ ways of exploiting the findings (application, patenting);
- ⊙ how to disseminate the findings obtained (scientific communications, journal articles). A statistical, quantitative and qualitative presentation (e.g. indicating the impact factor of the journal, how the work is presented at conferences, etc.) of the means of dissemination shall be provided.
- ⊙ how the results have been or will be applied in future periods.

At the end of the introduction, which can be developed in 4-6 pages, acknowledgements can be given to the institutions and individuals who, directly or indirectly, have contributed to the completion of the thesis by providing facilities for experimentation, professional

discussions, suggestions and comments made during the training period. Attention should be paid to the correct naming of the institution, title and functions of the persons, and they should be arranged according to importance, according to contribution.

The content of the doctoral thesis

Starting from the statement that the *doctoral thesis* must demonstrate advanced scientific knowledge of the doctoral field, contain elements of originality in the development or solution of the research topic, as well as ways of scientific validating them, for all these reasons, the thesis must contain:

- a) the theoretical part;
 - b) the original contributions part.
- a) The *theoretical part* shall represent approximately 20-30% of the thesis and shall be structured in 1-2 chapters. This part is a synthesis of the analysis of existing solutions, known from the literature or from other sources of documentation accessed during the training period or even before this stage. The presentation shall be made at principle level using diagrams, mathematical relations, graphs, photographs. The use of bibliographical references is necessary both to respect the rules of research ethics and to demonstrate the quality of the documentation carried out. The general part should highlight the importance and topicality of the topic and enable it to be placed in the context of international/national/regional concerns. This part should emphasise that the topic fits the concerns of the research team where the doctoral candidate has worked, whether this team belongs to the institution where the doctoral candidate works or is coordinated by the scientific supervisor. At the end of this part, the objectives of the doctoral thesis are presented.
- b) The *part of original contributions* shall represent approximately 70-80 % of the total number of pages of the doctoral thesis and shall be structured in several chapters. Depending on the specifics and objectives of the thesis, it is recommended that the first chapter of the original contributions part should contain information on:
- the design of modern, highly performant systems to solve the proposed problem, to achieve the objectives established. In this respect, it is recommended to use technical-economic performance indicators, as well as environmental impact indicators with the help of which the improvement of the technologies/systems analysed will be examined;
 - the development of new methods, new algorithms for the management or control of technical systems, of technological processes in the field of chemical engineering or process engineering, which underpin the proposed solutions to the proposed problem, or which underpin the methods and algorithms used to achieve the objectives established;
 - computerisation or monitoring of technical processes or systems;
 - introduction or extension of modern information technology elements to existing or new technological processes;
 - development of new methods and algorithms for monitoring the equipment, the technological processes and the working environment with a view to improving their technical, economic and environmental performance, increasing their service life, their reliability, their safety, with the purpose of diagnosing their components;
 - adaptation of existing solutions in one field of activity to a technological process or technical system in another field of activity;
 - description of the reagents, equipment and experimental methods needed to achieve the proposed objectives.

The following chapters of this part shall describe the results obtained by applying the proposed methods and discussions, as well as some brief partial conclusions. These chapters shall confirm the correctness of the proposed hypotheses/solutions and show a consistency between the results obtained by several methods.

It is recommended that the experimental verification be done on small-scale physical models, on real physical models, on real installations, under industrial conditions, as far as possible where the results are to be applied.

Experimental results shall be presented in the form of tables with numerical values, graphs, diagrams, histograms, oscillograms or other types of records, photographs, video recordings, etc.

The experimental part may be carried out in conjunction with numerical simulations or, in cases where industrial-scale systems are evaluated, may be replaced by numerical modelling. The experimental or simulation results, obtained from the experimental study, are compared with the theoretical results, explaining any discrepancies, and when these discrepancies are unacceptable, appropriate corrections shall be made to the method or calculation algorithm that was adopted. It is highly recommended to highlight the original contributions of the doctoral thesis by comparison with current systems/technologies/knowledge representing the current state of knowledge. In this respect, the use of appropriate numerical indicators of the techno-economic and environmental performance of the systems/technologies evaluated is recommended.

The elaboration of this part should highlight the experimental skills of the doctoral candidate.

Conclusions and perspectives

This part of the work is a clear and coherent summary of the doctoral thesis, of the technical, economic, environmental and impact advantages and disadvantages, the original contributions of the research work, the extent to which the original objectives have been achieved, the directions in which the research should be continued, the remaining unresolved issues.

This part is numbered as a separate chapter and will be developed over 5-6 pages.

It is recommended that this chapter should contain two distinct parts: a part of conclusions on personal contributions and a part devoted to emerging perspectives. The conclusions should be concrete and be reflected in the *part of original contributions* of the thesis. To this end, for each conclusion the chapter number and paragraph number where it has been developed shall be mentioned in brackets. It is recommended to explicitly group the conclusions into the following categories: theoretical contributions; applicative contributions; software contributions; contributions to the experimental part; contributions to physical modelling, equipment.

Bibliography

The bibliography is a selective list of references dealing with the same topic and which have been used or consulted for the elaboration of the *doctoral thesis*. A new page is used to edit the bibliography list, even if the last page of the *doctoral thesis* is only partially used. The list must contain 150-200 representative works, from the following categories: books, articles in specialised journals, papers presented at scientific events, patents, research contracts, doctoral theses, university courses, standards, company catalogues, web pages. The bibliographical list must also include the work produced by the doctoral candidate.

Each reference must contain the name of the author(s), the title of the article/paper/document, the place of publication (name of journal, publisher), the year of publication, the pages.

The order of writing in the bibliographic list is either alphabetical (according to the author's name) or in order of appearance in the text, where the number in the text must correspond to the same number in the bibliographic list. In the reference list written in alphabetical order, if an author is cited more than once in succession, the works will be subclassified in chronological order.

If an information source is an online one, it is recommended to indicate the article number, the DOI and/or the website address, as well as the date when it was accessed (e.g.: Centea O., “Guide to writing scientific articles”, <http://www.mct.ro>, accessed 15 January 2019).

In the case of company documentation, standards, regulations that do not have a declared author, or web pages, it is recommended that the space for the author(s) be replaced by three characters “***”, (e.g.: ***, “Guide to writing scientific articles”, <http://www.amcsit.ro>, accessed 15 January 2019).

It is recommended that, in the bibliographic list, for the articles co-authored by the doctoral student, his/her name be written in bold font.

Examples:

Scientific article

Murthy M. S., **Popescu A. B.**, Harish B. R., Rajanadam K. S., Ajoy K. Y., titlul articolului, *Chemical Engineering Science*, **1994**, 49, 2198- 2213.

book

Jackman L. J., **Popescu A. B.**, “Applications of Nuclear Magnetic Resonance Spectroscopy in Organic Chemistry”, Pergamon Press, Inc., New York, **1959**, chapter 4, pp. 15-20.

Appendices

Sometimes, in order to give more fluency to the content of the doctoral thesis, it is recommended that some tables, graphs, drawings, photographs, computer programs are presented at the end of the thesis in one or more appendices.

***Curriculum vitae* of the doctoral candidate (optional) and list of the doctoral candidate’s published works during the doctoral research period**

The doctoral thesis may be completed with a short CV of the doctoral candidate. It is recommended to publish a list of research outputs containing the articles authored or co-authored by the doctoral candidate, the journal impact factor (according to the website: web of knowledge) and the quartile of the journal (according to the website: Scimagojr.com), as well as the participation in national/international scientific events with oral or poster communications.

3. Recommendations on the editing and writing of the doctoral thesis

Titles, subtitles. It is recommended that short titles be used to summarise the content, and that they be written in characters that make them stand out from the rest of the text. Sometimes it is good to use titles/subtitles similar to the name of the problems to be solved, the name of the objectives.

There should be no text between the title and subtitle. There should also be more spaces between the subtitle and the previous text, usually twice the space between lines.

Figures. Tables. Most doctoral theses contain tables, figures (graphs, diagrams, photographs or illustrations). Their arrangement on the page, as an aesthetic element of the thesis, is left to the doctoral candidate, with the caveat that they attract the evaluator’s attention and contribute to the formation of the opinion on the thesis. Direct or indirect references or cross-references to each table/figure should be made in the text of the thesis. Some remarks:

- the figure/table number is preceded by the abbreviation “Fig.” or “Table”; numbering is done by a format of successive Arabic numerals throughout the thesis or numerical combinations with the chapter number (e.g. 1, 2,... etc., or 1.1, 1.2,..., 2.1, 2.2..., etc.);
- the meaning of the figure/caption is given by an explanatory title, which must be edited in smaller or italic letters and be on the same page as the figure/caption;
- the figure/caption should appear on the same page as the reference in the text or after the reference;

- a balance of text-illustration-mathematical relationships on a page should be ensured;
- the orientation of the figure should be towards the top of the page;
- the meaning of the variables in the axes and their units of measurement should be mentioned;
- standard scales should be used for graphical representation; for complicated graphs an explanatory legend should be used;
- in tables, the purpose of each column and line should be indicated; the units of measurement for the variables used and the parameters specified should be indicated as well.

Mathematical relations. The mathematical relations necessary for the development of new methods, new algorithms for the management or control of technical systems, technological processes, for the development of methods and algorithms for the monitoring of technological processes, the working environment, etc., are established based on the basic theorems and laws in the field concerned, or by analogy with other processes, other phenomena.

To this end, simplifying hypotheses are formulated, while the solutions obtained, including the hypotheses, are verified by means of units of measurement, by comparison with other results, by applying other methods, by numerical simulation or on physical models on a small or full scale. Each result obtained should be commented on and compared with similar results in the literature and in practice, with references to the literature.

In the case of demonstrations, the most important steps should be listed, mentioning the calculations that are made for each step, but in such a way that the demonstration can be easily followed.

For a doctoral thesis there are no strict rules for writing mathematical relations, but it is recommended that they follow the general rules. Thus, the mathematical relations in the text are edited with the relation editor, on a separate line and numbered for reference. Formulas should be centred or left-aligned, and their sequence number is written in brackets, aligned on the right-hand side of the page. Equation numbering can be sequential throughout the thesis or combined with the chapter number (e.g. 1, 2, etc., or 1.1., 1.2.,..., 2.1., 2.2..., etc.).

Bibliographic references. The citation of information sources in the doctoral thesis is an obligation arising from research ethics, from professional ethics. In a technical, engineering doctoral thesis, the method of citation consists of placing the position of the work in the bibliographic list in square brackets [n], e.g. “text [125]”. If the bibliographic list is written in alphabetical order of the first author, the reference in the text can be in the following form: “text (Popescu I. et al, 1992)”.

Writing rules

- diminutive and augmentative prefixes of units of measurement are always written in small letters: milli, centi, deci, deca, hecto, kilo, respectively m, c, d, da, h, k, except e.g.: mega, M; giga, G; tera, T;
- no full stop after the abbreviated units;
- it is recommended to use the units of measurement of the international system (IS). Measurements that are not expressed in the international system should be converted to IS, even in the text. For example, ‘specific heat of 0.2 kcal/(kg 0C), i.e. $4.18 \times 0.2 = 0.836$ kJ/(kg 0C)’, which in the formula appears as 0.836.103 or 836 [J/(kg 0C)]; also ‘power of 10 hp, i.e. $0.736 \times 10 = 7.36$ kW’, which in the mathematical expression will appear as 7.36.103 W, may appear in the text.
- the meanings of all the quantities appearing in a formula must be explained either before writing the relation, or afterwards, or partly before, partly after. Care should be taken to ensure that for each quantity the meaning and value are written only once;
- no abbreviation of words in the text: figure instead of figure, tab instead of table;
- in the text, numbers from 0 to 9 are usually written with letters and numbers greater than 10 are written with figures, except for table and figure numbers which are always written

- with figures. E.g. “X is twice the size and 11 times the size of Y and Z respectively”;
- writing abbreviations without full stops between letters: FAO, CITT, SNCFR;
- names of days, months, cardinal points, numbers (hundreds, thousands) are written in small letters (in Romanian), but in Capital letters in English (for names of days, months, cardinal points).
- punctuation marks: after a sentence, a phrase or a mathematical relation, a punctuation mark must be placed (full stop, comma, semicolon, colon);
- the word following a formula after which a full stop has been placed must begin with a capital letter; if no full stop has been placed, it must begin with a small letter;
- if the phrase following a formula has a closely related meaning, it should be written from the beginning of the next line, otherwise start with a new paragraph;
- words of Latin origin (e.g. *versus* or abbreviated *vs.*) are written in *italics*.

4. Summary of doctoral thesis

The summary of the doctoral thesis serves to disseminate the results to a large number of specialists in order to signal the appearance of the thesis, to know the opinion of other researchers in the field, as well as to include these findings in library files, on web pages. The abstract also serves to announce to the scientific community the date and place of the public presentation of the doctoral thesis and to invite interested specialists to participate in this scientific event.

The summary is printed on paper, but in a limited number of copies (about 15-20) and electronically in PDF format. The number of pages for the paper abstract should not exceed 30-35.

The same information is kept on the cover and the subcover, with the specification that it is the thesis summary.

Depending on the space available, the summary will contain the following types of information:

- the list of symbols and abbreviations found in the summary;
- the table of contents of the summary, in order to give the reader an overview of the thesis as well, it is advisable to indicate both the page in the summary and the page in the thesis;
- the introduction, which can be reproduced in full, as it gives an overview of the thesis;
- a brief presentation of the chapters of the thesis, but developing the chapters in the part of original contributions;
- the conclusions of the thesis;
- a synthesis of the bibliography;
- optionally, a short CV (one page) highlighting studies, specialisations, professional activity, scientific activity and list of published works in the field of the thesis.

Front cover template

Babes-Bolyai University of Cluj-Napoca
Faculty of Chemistry and Chemical Engineering
Doctoral School of Chemical Engineering

Eng. First name Last name

DOCTORAL THESIS

Scientific supervisor:
Professor Eng. First name Last name, PhD

City
Year

Subcover template

Babes-Bolyai University of Cluj-Napoca
Faculty of Chemistry and Chemical Engineering
Doctoral School of Chemical Engineering

Eng. First name Last name

DOCTORAL THESIS

Thesis Defence Commission:
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Scientific supervisor: Professor Eng. First name Last name, PhD, University...
Specialist members: Professor Eng. First name Last name, PhD, University...
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Date of thesis defence: DD.MM.YYYY

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