This manual applies to ALL GRADUATE PROGRAMS at the Polytechnic University of Puerto Rico that require a thesis degree completion.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. How to Use this Manual</td>
<td>5</td>
</tr>
<tr>
<td>3. Organization of this Manual</td>
<td>5</td>
</tr>
<tr>
<td>4. Sections of the Thesis</td>
<td>5</td>
</tr>
<tr>
<td>5. General Format Requirements</td>
<td>6</td>
</tr>
<tr>
<td>5.1 Reprographic Processes</td>
<td>6</td>
</tr>
<tr>
<td>5.2 Corrections</td>
<td>7</td>
</tr>
<tr>
<td>5.3 Type: Size, Fonts and Style</td>
<td>4</td>
</tr>
<tr>
<td>5.4 Margins</td>
<td>8</td>
</tr>
<tr>
<td>5.5 Page Numbers</td>
<td>8</td>
</tr>
<tr>
<td>5.6 Spacing</td>
<td>8</td>
</tr>
<tr>
<td>5.7 Footnotes</td>
<td>9</td>
</tr>
<tr>
<td>6. Preliminary Pages</td>
<td>9</td>
</tr>
<tr>
<td>6.1 Title/Signature Page (required)</td>
<td>10</td>
</tr>
<tr>
<td>6.2 Copyright Page (optional)</td>
<td>11</td>
</tr>
<tr>
<td>6.3 Abstract</td>
<td>11</td>
</tr>
<tr>
<td>6.4 Table of Contents (required)</td>
<td>12</td>
</tr>
<tr>
<td>7. Text</td>
<td>13</td>
</tr>
<tr>
<td>7.1 Tables and Figures</td>
<td>14</td>
</tr>
<tr>
<td>8. Bibliography</td>
<td>15</td>
</tr>
<tr>
<td>9. Paper</td>
<td>16</td>
</tr>
<tr>
<td>10. Color</td>
<td>16</td>
</tr>
<tr>
<td>11. Photographs</td>
<td>16</td>
</tr>
<tr>
<td>12. Supplementary Files</td>
<td>16</td>
</tr>
<tr>
<td>13. ProQuest UMI Submission</td>
<td>17</td>
</tr>
</tbody>
</table>

**Appendices**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. EXAMPLES OF THE FORMATS REQUIRED FOR THE DIFFERENT PAGES</td>
<td>19</td>
</tr>
<tr>
<td>B. RECOMMENDED REFERENCES</td>
<td>32</td>
</tr>
<tr>
<td>C. LIST OF GRADUATE DEGREES AWARDED BY THE POLYTECHNIC UNIVERSITY OF</td>
<td>33</td>
</tr>
<tr>
<td>PUERTO RICO</td>
<td></td>
</tr>
<tr>
<td>D. GRADUATE SCHOOL THESIS AND DESIGN PROJECT CONTINUOUS ENROLLMENT</td>
<td>34</td>
</tr>
<tr>
<td>POLICY</td>
<td></td>
</tr>
<tr>
<td>E. UMI MANUSCRIPT FOR SUBMISSION GUIDELINE</td>
<td>46</td>
</tr>
<tr>
<td>F. PUBLISHING AGREEMENT</td>
<td>50</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>1. Preliminary Sections of a Thesis</td>
<td>6</td>
</tr>
</tbody>
</table>

iii
1. Introduction

The purpose of a thesis is to contribute knowledge to the field of study by means of research. The process includes defining a topic, selecting a supervisor, assembling a Graduate Committee, having the topic approved, writing and submitting a proposal, executing the research, and presenting the findings. This is a complex process requiring substantial amount of work and effort.

English language is recommended for the thesis, although students may choose to write the document in Spanish. However, the Title/Signature Page and the Abstract must be written in English (Refer to Title/Signature Page section).

- Graduate School Approval

A thesis is a professional document and should meet professional standards in content and appearance. The Graduate School has established guidelines to ensure uniformity in style and format. Thus, the thesis document must meet these standards to be approved.

- Student Responsibility

It is the student’s responsibility to read and fulfill the requirements presented here and to submit a document of the highest quality. The Graduate School personnel are not responsible for editing the content or grammar of the thesis document. Correct grammar, punctuation, and spelling always should be used, and these aspects are the responsibility of the student. If the student deems necessary the Graduate School could refer the student to professionals that provide professional services in these areas. Proofreading is responsibility of the student and his or her supervisor.

- Graduate School Requirements

The student must have the Graduate Program Coordinator’s approval for the Thesis or Thesis extension enrollment. The student and the Thesis Committee must verify the Graduate School

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1 The Graduate Committee approves the plan of research, provides advice, periodically assesses progress and accomplishments, and approves the final work performed by the student.
Calendar for important dates and deadlines. The student has to comply with Graduate School Thesis and Design Project Continuous Enrollment Policy (Appendix D).

- **Selecting your Committee**

  The student should choose the Committee Chairperson when thesis work begins. The Chairperson must be qualified to serve as a Chairperson according to the Polytechnic University of Puerto Rico Graduate School policy for graduate faculty membership. Members of a dissertation committee must also be approved under this policy. In conjunction with the Committee Chairperson, the Candidate assembles a thesis committee and secures the necessary signatures on the approval form (GS 1 Form). A committee consists of a Chairperson and two Committee Members. If the student plans to have a non-PUPR faculty member serve on the committee, the Chairperson must receive the Graduate Program Coordinator approval and then request approval from the Graduates School Deanship.

  Choosing a committee and supervisor is a crucial step in the process of preparing the thesis. A good supervisor can be a very useful asset in helping to direct the student through the thesis-writing as well as to guide and support the student’s ideas. A good supervisor will have time to listen and respond thoughtfully. An advisory committee needs to be chosen as well; it’s best to pick people who are familiar with the thesis topic.

- **Faculty Thesis Supervisors: Your First and Second Readers**

  Who can supervise a thesis? The student is responsible for securing two readers. Your thesis supervisor (first reader, supervisor or Chairperson) must be a member of the PUPR Graduate School faculty. Usually, your supervisor should be a professor with whom you have previously worked. The second reader is usually a faculty member, but may in some cases be an expert in your field outside of the university. Approval for non-faculty readers should always be obtained the student’s specific department before making any commitments. A successful student-supervisor match is one of the most important elements for a successful thesis.
• How does a student get a thesis supervisor?

The student should approach prospective supervising professors after completing the Core and Specialization Courses. Provide an abstract of the project, as this will greatly increase the chances of getting a positive answer from the professor in question. Check with the department’s Coordinator about deadlines for designating the thesis supervisor, presentations, etc.

What are the first steps to take with a thesis supervisor? Come to a clear, explicit agreement about the following things:

- the topic and the limits of the research, as worked out in the abstract
- a schedule for regular meetings or communications with the supervisor
- a timeline for completing outlines, bibliographies, drafts, revisions, etc.

The student should raise these points in the first meeting and confirm them in writing or email. Get momentum going quickly on the project, for two reasons: to develop the thesis project itself, and to develop the working relationship with the supervisor.

• The Second Reader

Consult the first reader about possible second readers, and then work out a feedback schedule with the second reader. Although the student may only meet a couple of times with the second, it is nonetheless important that he/she arrives at an explicit agreement of mutual expectations. Leave plenty of time to follow the second reader’s suggestions on the final draft. The second reader is not obligated to approve your thesis just because the first reader has approved it.

• Meetings with the thesis supervisor

Some supervisors will want to have weekly, bi-weekly, or monthly conferences. It is to the student’s benefit to start with a regular schedule of appointments, and to keep them.

• What if problems develop between student and supervisor?
If the student suspects that there are serious problems in the supervisor-student relationship, the student should act sooner rather than later. Go to your Graduate Program Coordinator for advice on how to proceed and or to the Graduated School Deanship.

- The Thesis Supervisor

The thesis supervisor is the student’s primary source of feedback for the thesis document. The most common complaint from thesis students is that they don’t get enough feedback and are not sure where they stand in the research. The Graduate School office has recommended that the thesis student enter into an explicit agreement with the supervisor on the following points:

- the topic and the limits of the research, as worked out in an abstract
- the times for regular meetings or communications
- a timeline for completing outlines, bibliographies, drafts, revisions
- advice on choosing a second reader for the thesis

- The First and Second Readers

Second readers often offer general advice on content rather than detailed editorial comments on style. Consequently, the student may want to present an early draft rather than waiting to judge the final draft. The first and second readers should not feel obligated to approve a thesis that clearly seems inadequate. Last minute dilemmas can be avoided only by early intervention.

Note: Once the thesis is completed, the student should provide a copy to each reader.

- Final Submission

The student should submit a draft copy of the thesis for format review at least two weeks before submitting the final copy.

- Deadlines

The deadlines for submitting the thesis can be found on the Office of Graduate Affairs and in www.pupr.edu/gs website. It is the student’s responsibility to know those dates. Students should remember to apply for graduation before or on the application deadline.
2. **How to Use this Manual**

This manual is designed to help the student in the process of submitting the thesis to the Graduate School. Guidelines in the manual provide a list of the basic rules for proper preparation of the document. The manual also contains additional guidelines as to form and style, as well as examples to clarify the rules. The student should read the entire manual before starting the preparation of the thesis document. This manual should also be kept as a quick reference while developing the thesis. **Rules in this manual take precedence over rules found in generic style manuals or other institutional guidelines.**

3. **Organization of this Manual**

Specific rules for the form and style of a thesis is contained in the sections that follow. Sample pages are provided in Appendix A.

4. **Sections of the Thesis**

The document shall consist of three sections:

- **Preliminary Sections**: these sections include the Title/Signature Page, Table of Contents and List of Tables among others. A complete list of the sections considered Preliminaries is presented in Table 1. Some of the Preliminary sections are optional.

- **Text**: this is the main body of the report and should include all the necessary sections agreed by the student and his/her Graduate Committee.

- **Reference materials**: this section includes the Appendices and Bibliography. Appendices are optional. **However, a Bibliography is required for all thesis.**

Specifications for each of the above parts are explained in the sections that follow the general document format requirements. In addition, samples are presented in Appendix A at the end of this manual.

<table>
<thead>
<tr>
<th>Table 1. Preliminary Sections of a Thesis/Project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section</strong></td>
</tr>
</tbody>
</table>

5
5. **General Format Requirements**

This section addresses the Graduate School requirements for the layout of the thesis document and also the format. Each topic contains a bullet list with the general requirements for the particular area.

### 5.1 Reprographic Processes

- Maintain clear.

- Begin each new chapter on a new page.

- Continue the text to the bottom of the page unless it is the end of a chapter.

- Do not leave widow/orphan lines or headings. A widow is defined as a single line of text from a paragraph “hanging alone” at the beginning or end of a page. Include at least two lines of text at the beginning or end of a paragraph at the top or bottom of the page.

- Do not split references in the bibliography; always complete an entry on a single page.

- Do not split captions in the lists of tables and figures. Complete each on the same page.

### 5.2 Corrections

- Corrections must be made by retyping or reprinting the entire page.

- Strikeovers corrections are not allowed.

- Once the student submits the thesis document through ProQuest/UMI, the Graduate School personnel will verify the format of the document.
• If corrections are required, the student will receive an email listing the necessary corrections.

The student is responsible of reviewing and modifying the document requested and submitting it to the ProQuest/UMI again and for reviewing also for the format of the thesis again.

5.3 Type: Size, Fonts and Style

• For consistency, a 12-point font must be used for the following:
  
  Preliminary pages
  Text (main body of the thesis project)
  Table and figure captions
  Chapter titles
  Page numbers
  Appendix titles
  Bibliography

• The font must be easy to read. Acceptable fonts are Times New Roman, Arial or Courier. This will ensure that the correct standards are followed. A font size of 12 characters per inch is required.

• Do not vary fonts in the main text of the thesis.

• Use standard numerals (1, 2, 3) in text and pagination.

• Do not use script, italic or other typefaces for numerals (except in equations).

• Full justification is required for the entire document content.

5.4 Margins

• The margins for the entire document each page (including Preliminaries, Text, Appendices, Reference Materials, Tables and Charts) must be set to:

MARGINS INCHES
• The left edge margin must be larger (1½ inches).

• Margins must be uniform throughout the whole thesis document.

5.5 Page Numbers

• Page numbers must be aligned on the bottom center of the page at ½" from the edge of the paper (Use the page numbering margin default).

• Every sheet must be counted for purposes of numbering pages.

• Every page must have a page number printed on it, except the Title/Signature Page and Copyright Page.

• All pages must be paginated consecutively.

5.6 Spacing

• The text of the thesis document must be double-spaced. This includes the Acknowledgments and Abstract Pages.

• No large spaces or gaps are allowed in the text.

• Single spacing is required for the Title of the Thesis when it takes more than one line (except in the Abstract page).

• Single spacing is required for footnotes, captions and identification text related to tables, figures, graphs, or other illustrative materials. Single spacing is also required for bibliographic entries, and for all block quotations.

• Single spacing is permitted within but not between items in lists, multi-line captions, and within appendices, if done in a consistent manner throughout the manuscript.

• Between Chapter Number and Chapter Title, double space is required. Similarly, between
Chapter Title and text double space is required. However, if the Chapter Title takes more than one line, single spacing is required for it.

5.7 Footnotes

- The only Footnotes purpose admitted is for explication.
- Historic content, must be integrate in the Thesis and not like a footnote.
- Definitions or Terms can’t be written like footnotes, it is recommended to create a Glossary, Terms or Definition page.

6. Preliminary Sections

The following sections discuss more in detail the requirements for the Preliminary Section Pages. In general:

- For master’s thesis a Title/Signature Page, Abstract Page, and Table of Contents are mandatory. A List of Tables, List of Figures, and List of Symbols or Abbreviations are required when appropriate.²
- The preliminary sections must be arranged in the order listed in Table 1.
- The pages must be numbered in lowercase Roman numerals starting with the Acknowledgments Page (refer to Appendix A) and ending in the last page of Section two of the thesis (before Chapter 1). The Title/Signature Page is considered page i, but must not be numbered.

6.1 Title/Signature Page (required)

- The Title/Signature Page is considered page i, but must not be numbered. Each line of the Title/Signature Page must be centered, except for the signatures information. The title, University’s name, and its location, are all to be typed in capital letters.
- The Title/Signature Page must be written in English.

² When tables, figures, symbols or abbreviations are included in the thesis text.
• Single spacing is required for the Title of your thesis when it takes more than one line.

• Word substitutes must be used for items such as formulas and symbols. When having any questions about the use or presentation of scientific terms, please check with the Graduate Committee Chair.

• The student must use the full legal name as it appears on his/her academic records in the Graduate School at the time of graduation.

• The student must correctly designate the degree that he/she will be receiving. A list of the graduate degrees awarded at Polytechnic University of Puerto Rico is included in Appendix C.

• The year listed on the Title/Signature Page must be the actual year of degree conferral, not the year of the final presentation or the year when the manuscript is submitted.

• The Title/Signature Page must be signed in black or blue **waterproof** on the same archival quality paper as the rest of the manuscript. **However, the document must be signed in the same color ink and the same pen. To avoid confusion with the type of ink, it is recommended that the student shows the pen to the person who checks the format of the Thesis before obtaining the signature of the members.**

• The Signature area must read, "Approved as to style and content:" and then provide enough signature lines for all members of the Committee, indicating "Chairperson" or "Member" following each name. A sample of a traditional Title/Signature Page is provided in Appendix A.

• The submitted Thesis must have the Signature page in blank but the signed page must be uploaded like a compulsory supplementary file and be deliver to the Graduate School Deanship.
• Do not use professional certifications or administrative titles for anyone. Only academic degrees are permitted.

• Each Committee Member must sign above his or her typed name.

• If corrections are required on this page, a new Signature Page must be produced.

  6.2 Copyright Page (optional)

• A copyright is optional for a master’s thesis.

• In order to include a Copyright page, the student must pay the applicable fee when submitting the electronic thesis to ProQuest/UMI.

• If the student does not select the Copyright option (pay applicable fee) this page must not be part of the thesis document.

• The copyright page, when used, is the second page of the manuscript and is counted as page ii, but it is never numbered.

  6.3 Abstract

• The heading on the Abstract Page must be written in CAPITAL LETTERS except for the line of the Thesis director.

• The language for the Abstract page is English.

• If the student selects Spanish language to write the thesis document, he/she must include the Abstract in English and it will be optional to write it in Spanish and include this additional Abstract page in the thesis document.

• The heading on the Abstract Page must be included the items shown on the example section.

• The abstract must not exceed 150 words.

• The abstract is a brief summary of the contents of the document.

• The abstract is required for all theses.
6.4 Table of Contents (required)

- The basic rule is—as with the rest of the document—to strive for consistency. Use double space between new levels of subheading. The page is titled "Table of Contents".

- For the Table of Contents, do not mix organizational schemes: if beginning with decimal headings, use decimal headings throughout. **When listing subordinate headings for one chapter, they must be listed for all the chapters where they appear.**

- Do not list the Title/Signature Page, Copyright Page, Dedication or Table of Contents pages in the Table of Contents.

- The page numbers for the following pages should all be in lower-case Roman numerals: the Acknowledgments, Abstract, List of Tables, List of Figures and List of Abbreviations.

- **List all chapter divisions.** All subdivisions must be indented. Also, subordinate of those subdivisions must be indented.

- When used, the Introduction is the first page of the body of the text and is numbered as page 1. It is listed in the Table of Contents one double space below the word Chapter and aligned with the title of Chapter 1.

- **Be sure that the headings in the text match in punctuation, word for word, letter for letter, the headings listed in the Table of Contents, List of Tables, and List of Figures.** **Capitalization must match exactly.**

- Each chapter must have a title in the text and in the Table of Contents. The title of a chapter or appendix is always listed in all capital letters and bold (**ALL CAPS**). Do not underline.

- Chapters must be numbered using Arabic (1, 2, 3) numerals. Do not spell out numbers (ONE, TWO is not acceptable). The **numbering system and form must be consistent in both the Table of Contents and the text.**

- If the Chapter title takes more than one line, single space should be used between lines.
• Do not use underlining in the Table of Contents except for titles of books.

• Use dot leaders (...) to connect headings to page numbers. Be sure to use page numbers accurately. If titles cover more than one line, text must not run into the page number. It should continue on the next line and must be indented. Also, double spacing must be used. Dot leaders must follow the end of the title.

• All Appendices must have a title. Do not designate an Appendix "A" unless there is an Appendix "B". List Appendix titles, with page numbers. See an example in Appendix A of this manual.

7. Text

• The body of the document must follow a consistent format throughout.

• Chapters must follow a consistent format and match the subheading, numbering sequence and format presented in the Table of Contents. The style or format must not change at any point in the text.

• Every Chapter must have an introduction paragraph before the first subheading.

• Writing in first person is not allowed.

• Subheadings must match the scheme presented in the Table of Contents and must not change or combine styles or formats at any point in the text.

• Every subheading must introduce a paragraph.

• A 0.5" tab is required for every new paragraph. (Every new paragraph must has an indentation. It is recommended use the Tab key).

• Equations must be numbered to the right margin using parenthesis and in sequential order.

For example:

\[ y = mx + b \]  \( (1) \)

(Do not use leveled numbering such as 2.1 or 3.1 for sequential order).
• When using references in the text, these must include last name and year within parentheses. For example: (Chaffin, 1991).

7.1 Tables and Figures

• Tables are labeled at the top center. The format and styles must remain consistent throughout the thesis.

  Example for these caption: Figure 1. Title of the Figure; Table 1. Title of the Table (with dot “.”).

• Figures, Graphics, Pictures, are labeled at the bottom center. The format and styles must remain consistent throughout the thesis document.

• If the title of the table or figure requires two lines, use single space. If the table continues in another page, the table's title must not be repeated.

• Within a table or figure, a different font from the rest of the document may be used, as long as it is large enough to be clearly readable when the image is photocopied or reproduced.

• Margins for Tables and Figures must be the same as for the rest of the document. All text and images must fit within the 6" x 9" area.

• Tables and figures must be numbered in a consistent manner, using Arabic numerals (1, 2, 3). The numbering of tables must be consistent with what is listed in the List of Tables or List of Figures. They must be numbered sequentially throughout the document (1, 2, 3).

• Every Table and Figure presented on the document must be mentioned in the text.

• All table captions must be placed in a consistent location. While figure captions do not need to be placed in the same location as table captions, all figure captions must be placed in a consistent location (relative to each other). Use Title Case Style.

• All Figures and Tables must be in portrait orientation and can’t oversize the margins.
• Be sure that every writing procedure mentioned in these sections and subsections is performed carefully, and in an uniform and consistent manner.

8. Bibliography

• A Bibliography is required. The list of sources must be comprehensive, that is, it must include all sources of cited material and other works consulted even if not formally cited within the main text.

• For Bibliographies, single spacing of reference entries with a single space in between each is required (refer to Appendix A).

• If a Bibliography text takes more than one line to cite it, these additional lines must be indented.

• For Bibliography, the Graduate School requires the APA style.

9. Paper

Although not required by the Graduate School, the student may want to keep a hardcopy of the thesis document. Final materials must meet the highest standards of permanence, legibility, uniformity, and reproducibility. The following items are recommendations that the student may follow for the printout of the document:

• Paper should be archival quality, size 8 1/2" x 11", white and acid-free. Paper cotton content should be a minimum of 25%.

• Cotton content percent should be shown on the piece of paper (watermarked).

• Do not use paper with pre-printed margin lines (often called Thesis Paper) or paper with holes for ring binders. Do not use easy-erase paper for any copies of the manuscript.

• Before printing the document, the student should double-check the margins; printer paper is not always exactly the same size as the archival paper, even if the paper is listed as the same size.
10. Color

Native digital manuscripts will appear in color when viewed electronically. Microfilm and print reproductions will NOT preserve color; colors will appear in shades of gray and may compromise legibility of figures, illustrations, photographs, and graphics. Data and information that is color-coded or based on color shading may not be interpretable. For best results, have color photographs reprinted in black and white by a professional lab.

11. Photographs

- Photographs in the thesis are to be handled according to the same procedures as for figures (reference to section 7.1 Tables and Figures).
- List and caption all photographs as figures unless they will be included in a separate List of Photographs.

12. Supplementary Files

The following items are considered supplementary files and should be submitted as so:

- Signature Page
- Abstract Page in English language if the document is in Spanish.
- Oversize materials - Fold maps and other material larger than 8 ½" x 11" to manuscript size, or roll and place in a mailing.
- Multimedia files and formats - Acceptable with external or internal links.
  - Video – could be submitted with any of the following formats: Apple Quick Time (.mov); Microsoft Audio Video Interleaved (.avi); MPEG (.mgp)
  - Audio – could be submitted with any of the following formats: AIF (.aif); CD-DA; CD-ROM/XA; MIDI (.midi); MPEG-2; SND (.snd); WAV (.wav)
  - Images – could be submitted with any of the following formats: GIF (.gif); JPEG (.jpeg); TIFF (.tif)
13. ProQuest UMI Submission

Once the content of the thesis is completed, the student should go to www.ETDadmin.com/pupr web site and create an account for the submission of the thesis. It is recommended the student uses the Polytechnic University of PR email account. Although electronic submission is used, the Graduate School Administrative Coordinator should check the format of the document. The following picture shows the submission steps after creating an account and completing the Submission form:

Students must create an account to register as New User and complete the form provided. They shall then receive a confirmation email with the account information. Students are encouraged to use their email as username. This way it will be easier to remember.

1. Publishing Options
   • Traditional Publishing or
   • Open Access
   • Once the students are finished with this section, they will be prompted to accept the publication agreement and then, the students’ information will appear automatically.

2. Dissertation/Thesis Details
   • Fill all the blanks and use formatting abstract option. This must be filled in English.
   • After this step a new menu will appear, and the students will be prompted to accept.

3. Search the thesis file. Use the PDF Conversion tool. Once the conversion is completed (this usually takes 10-20 minutes), the students will receive an email indicating that there is a file ready and a link. The students can use this link. This link will take the students to another page where they will be prompted to accept.

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3 Refer to Appendix E for UMI Manuscript for Submission Guideline.
• Conversion History – the archive link will be seen and it should be saved somewhere in the computer.
  ▪ Supplementary files – if there are other digital materials that need to be included as part of the students' thesis such as Drawings, Media, Zips, etc., they can be accommodated here. There will be 10 MB available for each file. A total of 100 MB will be available including the thesis file.
  ▪ If the thesis file alone is as large as 100 MB and still supplementary files need to be included:
    ✓ An email should be sent with three (3) files: Signature Page, Abstract and Note explaining that the document will be sent to ProQuest in DVD or CD. This requires the administrator’s authorization.
    ▪ The Signature Page is required to be submitted as a supplementary file.
 4. Copyright service, request a $65 fee. If not paid, this page must not be included from the thesis document.
 5. Service to Order Copies has an extra fee, these pages are printed.
 6. This new service and method is free for a Traditional Publishing.

• In this step, the student has a last chance to review the information provided.

The UMI Publishing Agreement is shown in Appendix F. This is the form that student has to fill once create the account.
APPENDIX A

EXAMPLES OF THE FORMAT REQUIRED FOR THE DIFFERENT PAGES

The following pages present examples of the formats required for the thesis document. A summary of the pagination format is presented below. The purpose of the border in the next pages is to show an example of a page inside a normal page.

<table>
<thead>
<tr>
<th>Page Description</th>
<th>Pagination Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title/Signature Page</td>
<td>Page i (lowercase Roman) but not numbered</td>
</tr>
<tr>
<td>Copyright Page</td>
<td>Page ii (lowercase Roman) but not numbered (optional and has a fee)</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>Optional. If used, this is the first page that is actually numbered using lowercase Roman numerals (i.e., iii). From this page on, until the last page of the document (including appendices), all pages must be numbered. The only difference is that the Preliminary pages are numbered using lowercase Roman numerals and the rest of the document is numbered using Arabic numerals.</td>
</tr>
<tr>
<td>Abstract Page</td>
<td>Required, and numbered in lowercase Roman numerals.</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>Required, and numbered in lowercase Roman numerals.</td>
</tr>
<tr>
<td>List of Tables</td>
<td>When appropriate, and numbered in lowercase Roman numerals.</td>
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<tr>
<td>List of Figures</td>
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<tr>
<td>Definitions, Glossary, or List of Terms Page</td>
<td>Optional. If use numbered in lowercase Roman numerals.</td>
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</tr>
<tr>
<td>Appendices</td>
<td>When appropriate, and numbered in ordinal numbers.</td>
</tr>
<tr>
<td>Bibliography</td>
<td>Required, and numbered in ordinal numbers.</td>
</tr>
</tbody>
</table>
TITLE OF THE THESIS IN SINGLE SPACE IF REQUIRES TWO (2) OR MORE WRITING LINES

By

Name Last Name

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science

In

Manufacturing Engineering

POLYTECHNIC UNIVERSITY OF PUERTO RICO
SAN JUAN, PUERTO RICO

2018

Approved as to style and content:

____________________________
Name1 Last Name1, Ph.D.
Chairperson, Graduate Committee

____________________________
Name2 Last Name2, M.S.C.E.
Member, Graduate Committee

____________________________
Name3 Last Name3, Ph.D.
Member, Graduate Committee

____________________________
Name4 Last Name4, Ph.D.
Dean Graduate School
ACKNOWLEDGMENTS

Example: I would like to thank my supervisor, Dr. Name1 Last Name1 for his unconditional support through all the different stages of the master program. Dr. Last Name1 has helped me to become a more educated person not only in the academic field but also in the professional field.
ABSTRACT

TITLE OF THESIS IN DOUBLE SPACE AND ALL CAPS

GRADUATION YEAR

NAME OF STUDENT WITH LAST NAMES, B.S.I.E, UNIVERSITY NAME

AND CAMPUS IF APPLIES

M.S.M.E., POLYTECHNIC UNIVERSITY OF PUERTO RICO

Directed by: Prof. Name1 Last Name1

In this section the student should describe his/her graduate work and summarize the most important achievements of it. The Abstract consists of approximately two pages, no more than 150 words. Remember, in the Name of Student Line, you have to put your undergraduate program and the University that you obtain the Bachelor Degree. If the name of the university does not fit in that line, you will have to put it, in the next line of writing to double space. Only in this page, if the title of this document has two (2) lines or more, the same should be written in double space.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgments</th>
<th>iii</th>
</tr>
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<tbody>
<tr>
<td>Abstract</td>
<td>iv</td>
</tr>
<tr>
<td>List of Tables</td>
<td>vi</td>
</tr>
<tr>
<td>List of Figures</td>
<td>vii</td>
</tr>
</tbody>
</table>

## Chapter

1. Development of the Problem ........................................................................ 1
   1.1 Background .......................................................................................... 2
   1.2 Significance of the Study ................................................................. 6
   1.3 Document Organization ........................................................................ 7

2. Review of Relevant Literature .................................................................... 8
   2.1 Mechanical Models ............................................................................. 19
   2.2 Electromyography Studies ................................................................. 20
   2.3 Psychophysical Measures .................................................................... 21

3. Experiment 1 ............................................................................................. 33
   3.1 Introduction ......................................................................................... 33
   3.2 Objectives ............................................................................................ 35
   3.3 Methodology ......................................................................................... 36
   3.4 Data Reduction ..................................................................................... 47
   3.5 Analysis Techniques ............................................................................ 49
   3.6 Results .................................................................................................. 52
     3.6.1 Musculoskeletal Discomfort Values .............................................. 52
   3.7 Discussion ............................................................................................. 62

4. Conclusion .................................................................................................. 97

## Appendices

A. Three-Dimensional Kinematics .................................................................. 99
B. Experimental Design: Experiment 1 .......................................................... 100
C. Computer Code for the Angles Calculations .......................................... 115
D. Musculoskeletal Discomfort Questionnaire ............................................. 123

## Bibliography ............................................................................................... 124
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Upper Arm Muscles and Their Principal Actions</td>
<td>11</td>
</tr>
<tr>
<td>2. Duty Cycles</td>
<td>42</td>
</tr>
<tr>
<td>3. Descriptive Statistics for Experiment 1</td>
<td>50</td>
</tr>
<tr>
<td>4. Descriptive Statistics</td>
<td>52</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure Description</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>1. Shoulder Girdle</td>
<td>7</td>
</tr>
<tr>
<td>2. Articulations of the Shoulder</td>
<td>11</td>
</tr>
<tr>
<td>3. Ranges of Motion of the Arm and Shoulder</td>
<td>15</td>
</tr>
<tr>
<td>4. Experimental Layout</td>
<td>49</td>
</tr>
</tbody>
</table>
CHAPTER 2

REVIEW OF RELEVANT LITERATURE

This chapter reviews literature and past research concerning the shoulder griddle capacity and limitations under working conditions. It intends to present the fundamental information needed to understand the research. A discussion of shoulder muscle fatigue is presented with an emphasis on three of the most common techniques to evaluate fatigue. These techniques are biomechanical models, electromyography studies and psychophysical measures.

2.1 Summary of Shoulder Functional Anatomy

The shoulder girdle or pectoral girdle (Figure 1) is the body site where the arms articulate with the trunk. It consists of the scapula and the clavicle. The clavicle articulates with the sternum, being the only direct connection between the shoulder girdle and the axial skeleton (i.e., skull, thorax and vertebral column). Skeletal muscles support and position the scapula, which has no direct connections with the thoracic cage. Ideally, the construction of a biomechanical model of the shoulder complex and the upper arm may help to determine the levels that can be tolerated by a human being without developing musculoskeletal disorders. The model may be used to predict muscle forces given worker’s anthropometry and posture. Early attempts to construct biomechanical shoulder models have often been restricted to two-dimensional models of the shoulder, where either a few muscles have been modeled or the model has been restricted to certain motions patterns. Examples of these attempts are the work of DeLuca and Forres (1973), Walker (1978), Arborelius (1986) and Dul (1988). Attempts to develop a three-dimensional model of the shoulder has been made but a final validated model has not been produced. This is probably due to the fact that the shoulder complex is a three-joint structure difficult to model.
3.5 Analysis Techniques

In this section, the number of factors and the levels of each factor are defined. For the experiment, three factors were considered. These factors were: cycle duration (4 levels), box location (5 levels) and box width (3 levels).

Four cameras, recording at a frequency of 100 Hz were used to capture a view of the subject while performing a repetitive task. The cameras were positioned to obtain a superior, right side sagittal, and posterior views of the subject. This setup permitted all the markers to be viewed by at least two cameras all the time.

Figure 5 represents a description of the sorting task. The job was divided into cycles that had the same time length. Each cycle consisted of a work and rest period. The subject performed the sorting task using a fixed technique. That is, the subject sorted to process continued until a model that contained all predictors was obtained. The best regression model was selected based on the maximum adjusted R2 value.
3.6 Results

Descriptive statistics for the anthropometric, workspace and kinematics variables studied in the experiment are presented in Table 4. In addition the statistic for discomfort are included. All value represent the results after the completion of the sorting task (i.e., after 30 minutes). Inspection of Table 4 indicates that the mean value for discomfort was between moderate (i.e., 4) strong (i.e., 5) rates although the maximum rate was obtained at the very strong measure.

Table 4. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable (units)</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Maximum/Minium</th>
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<tr>
<td>Age (yrs)</td>
<td>20.2</td>
<td>3.4</td>
<td>32/37</td>
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<tr>
<td>Height (cm)</td>
<td>171.7</td>
<td>6.8</td>
<td>193-152.4</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.1</td>
<td>4.3</td>
<td>92.9/46.2</td>
</tr>
<tr>
<td>Forward functional reach (cm)</td>
<td>65.9</td>
<td>3.9</td>
<td>72.7/57.9</td>
</tr>
<tr>
<td>Mid_shoulder height (cm)</td>
<td>59.3</td>
<td>3.7</td>
<td>.04/2.7</td>
</tr>
<tr>
<td>Discomfort scale</td>
<td>4.6</td>
<td>0.6</td>
<td>6/3</td>
</tr>
</tbody>
</table>

3.6.1 Musculoskeletal Discomfort Values

Percentages of localized musculoskeletal discomfort after 20 and 30 minutes varied in a similar way (Figures 8 and 9). Localized musculoskeletal discomfort values revealed that discomfort represents the 43% and 42% of the overall upper extremity discomfort after 20 and 30 minutes, respectively. Nevertheless, test of hypothesis to examine the difference between discomfort proportions after sorting for twenty and thirty minutes was not statistically significant (p > 0.05). Therefore, it can be concluded that sorting time was not critical in this task.
APPENDIX A

THREE-DIMENSIONAL KINEMATICS

Calculation of angles between the RCS and the body segment coordinate system.

Lateral Bending Angle ($\alpha$) Flexion Angle ($\beta$)
BIBLIOGRAPHY


APPENDIX B

RECOMMENDED REFERENCES


### APPENDIX C

**LIST OF GRADUATE DEGREES AWARDED BY THE POLYTECHNIC UNIVERSITY OF PUERTO RICO**

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<th>Program</th>
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<td>Master of Science in Civil Engineering</td>
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<tr>
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<td>Manufacturing Competitiveness</td>
<td>M.S.M.C.</td>
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<tr>
<td>Electrical Engineering</td>
<td>M.S.E.E.</td>
<td>Master of Science in Electrical Engineering</td>
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<td>Computer Engineering</td>
<td>M.S.Cp.E.</td>
<td>Master of Science in Computer Engineering</td>
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<td>M.S.C.S.</td>
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<tr>
<td>Landscape Architecture</td>
<td>M.L.A.</td>
<td>Master of Landscape Architecture</td>
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APPENDIX D

GRADUATE SCHOOL THESIS AND DESIGN PROJECT CONTINUOUS ENROLLMENT POLICY

Resumen sobre la Política Institucional en relación a los cursos de Tesis y Proyecto

UNIVERSIDAD POLITÉCNICA DE PUERTO RICO
Decanato Escuela Graduada

Trasfondo

- La política actual fue establecida en el año 2000
  - Dos programas de maestría
  - Menos de 10 estudiantes en etapa de tesis/proyecto
- Estadística tiempo a graduación está entre los 6 y 7 años
  - En el trimestre FA-08 se establece cambio de formato para los cursos de proyecto
  - Efectivo FA-10 se establece la nueva política en los cursos de Tesis y Proyectos
Política para los Cursos de Proyecto

1. **Matrícula en cursos de Proyecto:**
   El estudiante de maestría necesita firma del Coordinador en la hoja de matrícula para poder matricular los cursos de Proyecto o Extensión de Proyecto

2. **Matrícula Continuada (Continuous Enrollment Policy):**
   Una vez el estudiante comienza en el proceso de proyecto debe matricularse trimestralmente hasta terminar su investigación (no aplica en verano)
Política para los Cursos de Proyecto

3. Mínimo de trimestres de estudio:
   –Se requiere por lo menos 1 trimestre de estudios
   –Esto quiere decir, un trimestre en el curso de proyecto de diseño
   –Las extensiones son opcionales

4. Máximo de cursos de extensión:
   El número máximo de extensiones es de 2 consecutivas

¿Qué calificaciones se obtienen en los cursos de Proyecto o Extensión de Proyecto?

- S = Satisfactorio; estudiante está progresando en la investigación
- NS = No Satisfactorio; estudiante no ha hecho nada de su investigación
- P = Pasó; estudiante completó su investigación
- NP = No Pasó; estudiante presentó su investigación y fracasó
¿Qué sucede si el estudiante no cumple con la política de Matrícula Continuada?

- Deberá matricular el curso de Proyecto de 3 créditos nuevamente

<table>
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¿Qué sucede si el estudiante no termina el trabajo de proyecto y agotó el máximo de cursos de Extensión permitidos?

- Deberá matricular el curso de Proyecto de 3 créditos nuevamente

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¿Qué sucede si el estudiante no aprobó el proyecto y agotó el máximo de cursos de Extensión permitidos?

- Deberá matricular el curso de Proyecto de 3 créditos nuevamente y el curso de Extensión en el cual fracasó. Ejemplo:

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- Deberá matricular el curso de Proyecto de 3 créditos nuevamente

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**CURSOS DE TESIS**
Política para los Cursos de Tesis

1. Matrícula en cursos de Tesis:
   El estudiante de maestría necesita firma del Coordinador en la hoja de matrícula para poder matricular los cursos de Tesis o Extensión de Tesis

2. Matrícula Continuada (Continuous Enrollment Policy):
   Una vez el estudiante comienza en el proceso de tesis debe matricularse trimestralmente hasta terminar su investigación (no aplica en verano)

Política para los Cursos de Tesis

3. Mínimo de trimestres de estudio:
   – Se requiere por lo menos 2 trimestres de estudios
   – Esto quiere decir, un trimestre en el curso de tesis y un segundo trimestre en Extensión de Tesis
   – Cursos de extensión adicionales al primero son opcionales

4. Máximo de cursos de extensión:
   El número máximo de extensiones es de 5 consecutivas
¿Qué calificaciones se obtienen en los cursos de Tesis o Extensión de Tesis?

- S = Satisfactorio; estudiante está progresando en la investigación
- NS = No Satisfactorio; estudiante no ha hecho nada de su investigación
- P = Pasó; estudiante completó su investigación
- NP = No Pasó; estudiante presentó su investigación y fracasó

LOS QUÉ SUCIDE...
¿Qué sucede si el estudiante no cumple con la política de Matrícula Continuada?

- Deberá matricular el curso de Tesis de 6 créditos nuevamente

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¿Qué sucede si el estudiante no termina el trabajo de tesis y agotó el máximo de cursos de Extensión permitidos?

- Deberá matricular el curso de Tesis de 6 créditos nuevamente

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<tr>
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</tbody>
</table>
¿Qué sucede si el estudiante no aprobó la tesis y agotó el máximo de cursos de Extensión permitidos?

- Deberá matricular el curso de Tesis de 6 créditos nuevamente y el curso de Extensión en el cual fracasó. Ejemplo:

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<tr>
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<td>Calificación: P</td>
</tr>
</tbody>
</table>

¿Qué sucede si el estudiante ya tenía más cursos de extensión de los permitidos por la nueva política?

- El estudiante debe mantenerse activo a través de la política de Matrícula Continuada
- Si no cumple con la política de Matrícula Continuada:
  - Deberá matricular el curso de Tesis de 6 créditos nuevamente
  - A partir de ese momento, le aplicará el número máximo de extensiones (o sea 5 consecutivas)
¿Qué sucede si el estudiante ya tenía más cursos de extensión de los permitidos por la nueva política?

- El estudiante debe mantenerse activo a través de la política de Matrícula Continuada
- Si no cumple con la política de Matrícula Continuada:
  - Deberá matricular el curso de Proyecto de 3 créditos nuevamente
  - A partir de ese momento, le aplicará el número máximo de extensiones (o sea 2 consecutivas)

Resumen

*Cambios de más impacto en la política:*
- Establece el concepto de Matrícula Continuada
- Establece el mínimo de cursos de extensión
- Establece el máximo de cursos de extensión
- Mejora la retención en la etapa final de la maestría
Informacion de Apoyo

- Página web de la Escuela Graduada
  - www.pupr.edu/gs/

- Sección de la página web de la Escuela Graduada donde aparece la información relacionada a los requisitos de tesis y proyectos
  - www.pupr.edu/gs/deanship.asp
APPENDIX E

UMI MANUSCRIPT FOR SUBMISSION GUIDELINE

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<td>*Verdana</td>
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|                                                                 | 0446 | 0525 |
|                                                                 | 0441 | 0540 |
|                                                                 | 0444 | 0540 |
|                                                                 | 0445 | 0541 |
|                                                                 | 0680 | 0727 |
|                                                                 | 0745 | 0728 |
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|                                                                 | 0457 | 0523 |
|                                                                 | 0530 | 0533 |
|                                                                 | 0527 | 0533 |
|                                                                 | 0461 | 0534 |
|                                                                 | 0519 | 0534 |
|                                                                 | 0714 | 0534 |
|                                                                 | 0533 | 0535 |
|                                                                 | 0545 | 0536 |
|                                                                 | 0747 | 0537 |
### Humanities

#### History
- African history 0331
- American history 0337
- Ancient history 0579
- Asian history 0332
- Black history 0338
- Canadian history 0334
- European history 0335
- History 0578
- History of Oceania 0504
- Latin American history 0336
- Medieval history 0581
- Middle Eastern history 0333
- Modern history 0582
- Russian history 0724
- Science history 0585
- World history 0506

#### Language & Literature
- African literature 0316
- American literature 0591
- Ancient languages 0289
- Asian literature 0305
- Canadian literature 0352
- Caribbean literature 0360
- Classical literature 0294
- Comparative literature 0295
- English literature 0593
- French Canadian literature 0355
- German literature 0311
- Icelandic & Scandinavian literature 0362
- Language 0679
- Latin American literature 0312
- Linguistics 0280
- Literature 0401
- Literature of Oceania 0356
- Medieval literature 0297
- Middle Eastern literature 0315
- Modern language 0291
- Modern literature 0290
- Rhetoric 0681
- Romance literature 0313
- Slavic literature 0314

#### Philosophy and Religion
- Aesthetics 0650
- Biblical studies 0521
- Canon law 0375
- Clerical studies 0319
- Comparative religion 0618
- Divinity 0375
- Epistemology 0393
- Ethics 0394
- Logic 0395
- Metaphysics 0396
- Pastoral counseling 0397
- Philosophy 0432
- Philosophy of Religion 0322
- Philosophy of science 0402
- Religion 0313
- Religious history 0320
- Spirituality 0647
- Theology 0469

### Law and Legal Studies
- Alternative dispute resolution 0649
- Environmental law 0439
- Intellectual property 0513
- International law 0616
- Law 0399
- Legal studies 0553
- Patent law 0562

### Social Sciences
- Archaeology 0324
- Area planning and development 0341
- Biographies 0304
- Criminology 0627
- Cultural anthropology 0326
- Demography 0938
- Economic history 0509
- Economic theory 0511
- Economics 0501
- Economics, Commerce-Business 0505
- Economics, Labor 0510
- Folklore 0358
- Forensic anthropology 0339
- Geography 0366
- Individual & family studies 0628
- International relations 0601
- Labor relations 0629
- Military history 0722
- Military studies 0750
- Organization theory 0635
- Organizational behavior 0703
- Physical anthropology 0327
- Political Science 0613
- Public administration 0617
- Public policy 0630
- Recreation and tourism 0814
- Social research 0344
- Social structure 0700
- Social work 0452
- Sociology 0636
- Sociology 0626
- Transportation planning 0709
- Urban planning 0999

### Interdisciplinary
- Alternative energy 0363
- Artificial intelligence 0800
- Climate change 0404
- Energy 0791
- Museum studies 0730
- Nanoscience 0563
- Nanotechnology 0652
- Neurosciences 0317
- Peace studies 0560
- Sustainability 0640
- Systems science 0790
# Behavioral, Natural, and Physical Sciences

### AGRICULTURE
- Agricultural economics 0503
- Agricultural education 0517
- Agricultural engineering 0539
- Agriculture 0473
- Agronomy 0282
- Animal sciences 0475
- Aquatic sciences 0792
- Horticulture 0471
- Plant sciences 0479
- Soil sciences 0481

### ARCHITECTURE
- Architecture 0729
- Architectural engineering 0462
- Landscape architecture 0190

### BEHAVIORAL SCIENCES
- Behavioral psychology 0384
- Behavioral sciences 0602
- Clinical psychology 0622
- Cognitive psychology 0633
- Counseling psychology 0603
- Developmental psychology 0620
- Experimental psychology 0623
- Occupational psychology 0624
- Personality psychology 0625
- Psychophysiology 0589
- Psychology 0349
- Psychology 0231
- Quantitative psychology 0632
- Social psychology 0451

### BIOLOGICAL SCIENCES
- Biochemistry 0487
- Bioinformatics 0175
- Biology 0106
- Biomechanics 0648
- Biophysics 0786
- Biostatistics 0088
- Cellular biology 0379
- Developmental biology 0758
- Endocrinology 0409
- Evolution & development 0612
- Genetics 0369
- Histology 0414
- Limnology 0793
- Microbiology 0410
- Molecular biology 0107
- Morphology 0287
- Neurobiology 0412
- Parasitology 0718
- Physiology 0719
- Plant biology 0309
- Systematic biology 0423
- Virology 0720

### ECOSYSTEM SCIENCES
- Ecology 0329
- Macroecology 0420
- Paleocology 0426

### ENGINEERING
- Aerospace engineering 0538
- Automotive engineering 0540
- Biomedical engineering 0541
- Chemical engineering 0542
- Civil engineering 0543
- Computer engineering 0464
- Computer science 0984
- Electrical engineering 0544
- Engineering 0537
- Geological engineering 0466
- Geophysical engineering 0467
- Geotechnics 0428
- Industrial engineering 0546
- Mechanical engineering 0548
- Mining engineering 0551
- Naval engineering 0468
- Nuclear engineering 0552
- Ocean engineering 0547
- Operations research 0796
- Petroleum engineering 0765
- Robotics 0771

### ENVIRONMENTAL SCIENCES
- Conservation biology 0409
- Cultural resources management 0436
- Environmental economics 0438
- Environmental education 0442
- Environmental engineering 0775
- Environmental geology 0407
- Environmental health 0470
- Environmental justice 0619
- Environmental management 0474
- Environmental philosophy 0392
- Environmental science 0768
- Environmental studies 0477
- Forestry 0478
- Land use planning 0536
- Natural resource management 0528
- Range management 0777
- Urban forestry 0281
- Water resources management 0595
- Wildlife conservation 0284
- Wildlife management 0286
- Wood sciences 0746

### GEOSCIENCES
- Astronomy 0367
- Atmospheric chemistry 0371
- Atmospheric sciences 0725
- Biogeochimistry 0425
- Biological oceanography 0416
- Chemical oceanography 0403
- Continental dynamics 0406
- Geobiology 0493
- Geochronology 0996
- Geographical information science 0370
- Geology 0372
- Geosciences 0466
- Geophysics 0373
- Hydrologic sciences 0388
- Marine geology 0536
- Meteorology 0557
- Paleoclimatology 0653
- Paleontology 0418
- Petroleum geology 0583
- Petrology 0584
- Physical geography 0368
- Physical oceanography 0415
- Planetary science 0590
- Plate tectonics 0592
- Remote sensing 0799
- Sedimentary geology 0594

### HEALTH AND MEDICAL SCIENCES
- Aging 0493
- Alternative medicine 0496
- Audiology 0300
- Dentistry 0567
- Epidemiology 0766
- Gerontology 0351
- Health care management 0769
- Health sciences 0566
- Immunology 0982
- Kinesiology 0575
- Medical ethics 0497
- Medical imaging 0574
- Medicine 0564
- Mental health 0347
- Nursing 0369
- Nutrition 0570
- Occupational health 0354
- Occupational therapy 0498
- Ophthalmology 0381
- Osteopathic medicine 0499
- Pathology 0571
- Pharmaceutical sciences 0572
- Pharmacology 0419
- Physical therapy 0382
- Public health 0573
- Public health education 0500
- Speech therapy 0460
- Surgery 0576
- Toxicology 0383
- Veterinary medicine 0778
**MATHEMATICAL AND PHYSICAL SCIENCES**

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