What we will cover

- Deadlines
- Electronic Thesis & Dissertation (ETD) Process
- Formatting
- Summary

http://inside.mines.edu/Thesis-Resources
Resources for Thesis Submission

- **Thesis Writer’s Guide**
- **Sample Thesis**
- **Graduate Student Government resources** including **LaTeX template**
- **LAIS Writing Center**
- **Sample Pages**
  - **Title Page**
  - **Copyright Page**
  - **Submittal Page**
  - **Abstract**
  - **Table of Contents**
  - **List of Figures**
  - **List of Tables**
  - **Chapter Page – double-number system**
  - **Chapter Page – three-level system**
  - **References Cited**
  - **Figure Pages**
  - **Journal Page**
  - **Supplemental File Appendix**

Instruction Material

- **Thesis Writers Workshop**
  - TBA
    - **Office of Graduate Studies ETD presentation**
    - **Research Data Services presentation**
    - **Liberal Arts Writing Process Presentation**
Thesis Deadlines

http://inside.mines.edu/GS-Graduation-Information-and-Deadlines

- **Thesis Defense**
  - At least one week prior to thesis upload
  - Have to be registered the semester you defend and check-out

- **Thesis Upload Deadlines**
  - **Spring 2016 graduation**
    - Standard Check-out
      - PhDs: April 11, 2016
      - MS: April 18, 2016
  - **Fall 2016 graduation**
    - Early Check-out I:
      - May 16, 2016 – to avoid summer and fall registration
    - Early Check-out II:
      - August 31, 2016
    - Standard Check-out
      - PhDs: November 16, 2015
      - MS: November 23, 2015
## Thesis Deadlines

http://inside.mines.edu/Calendars-Deadlines

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>2015-2016</th>
<th>2016-2017</th>
<th>2017-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduation Ceremony</td>
<td>December 2015</td>
<td>December 2016</td>
<td>December 2017</td>
</tr>
<tr>
<td>Early Checkout Dates to Avoid Summer &amp; Fall Registration</td>
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<tr>
<td>Admission to Candidacy Form</td>
<td>May 1, 2015</td>
<td>May 2, 2016</td>
<td>May 1, 2017</td>
</tr>
<tr>
<td>Apply to Graduate in Trailhead - Applies to All Degrees</td>
<td>May 11, 2015</td>
<td>May 16, 2016</td>
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<tr>
<td>Checkout (summer I census day)</td>
<td>May 15, 2015</td>
<td>May 20, 2016</td>
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<tr>
<td>Early Checkout Dates to Avoid Fall Registration</td>
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<td>May 2, 2016</td>
<td>May 1, 2017</td>
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<tr>
<td>Apply to Graduate in Trailhead</td>
<td>September 2, 2015</td>
<td>August 31, 2016</td>
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<tr>
<td>Checkout (fall census day)</td>
<td>September 9, 2015</td>
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<td>Standard Checkout Dates for Fall Graduation</td>
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<td></td>
<td></td>
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<td>Admission to Candidacy Form</td>
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<td>May 2, 2016</td>
<td>May 1, 2017</td>
</tr>
<tr>
<td>Apply to Graduate in Trailhead - Applies to All Degrees (fall census day)</td>
<td>September 9, 2015</td>
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<td>November 18, 2016</td>
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<td>November 21, 2016</td>
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<td>December 11, 2015</td>
<td>December 9, 2016</td>
<td></td>
</tr>
<tr>
<td>Graduation Practice</td>
<td></td>
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<td>Academic Year</td>
<td>2015-2016</td>
<td>2016-2017</td>
<td>2017-2018</td>
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<td>Graduation Ceremony</td>
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<td>May 2017</td>
<td>May 2018</td>
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<td>Early Checkout Dates to Avoid Spring Registration</td>
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<td>November 1, 2016</td>
<td>November 1, 2017</td>
</tr>
<tr>
<td>Apply to Graduate in Trailhead - Applies to All Degrees</td>
<td>January 21, 2016</td>
<td>January 19, 2017</td>
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</tr>
<tr>
<td>Checkout (spring census day)</td>
<td>January 28, 2016</td>
<td>January 26, 2017</td>
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<td>Standard Checkout Dates for Spring Graduation</td>
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<td>Admission to Candidacy Form</td>
<td>November 2, 2015</td>
<td>November 1, 2016</td>
<td>November 1, 2017</td>
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<tr>
<td>Apply to Graduate in Trailhead - Applies to All Degrees (spring census day)</td>
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<td>PHD Checkout</td>
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<td></td>
</tr>
<tr>
<td>MASTER’S THESIS UPLOAD</td>
<td>April 18, 2016</td>
<td>April 17, 2017</td>
<td></td>
</tr>
<tr>
<td>MASTER’S THEESIS CHECKOUT</td>
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<td>May 5, 2017</td>
<td></td>
</tr>
<tr>
<td>Graduation Practice</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spring 2016 Standard Checkout Dates-Master's Thesis Students

**Degree Audit Form**
- Must be submitted the semester prior to the semester you intend to graduate.
- Forms submitted without an Advisor/Thesis Committee Request form on file will not be accepted.

**Check your Degree Evaluation**
- Check 1 to 2 weeks after you have turned in your Degree Audit form.
- If you see any No comments, you may need to submit an addendum.

**Addendum**
- Can be submitted up until 1 week before graduation.
- If you make any changes to your Degree Audit form, an addendum must be submitted.

**Apply to Graduate**
- Complete the Graduation Application by Census Day of the Semester you intend to graduate.

**Checkout Card**
- Obtain your checkout card from the Office of Graduate Studies approximately 1 week after you apply to graduate.

**Submittal Page**
- Master's thesis and PHDs only. Submit signed submittal page to the Office of Graduate Studies before uploading thesis.

**Thesis Upload**
- Master's thesis & PHDs only. Submit your thesis through ProQuest. Thesis must be reviewed & approved before checkout.

**Checkout Card**
- Completed Checkout Card must be turned in to be able to graduate.

**Statement of Work Completion**
- Required of all students. Submit this form with your completed checkout card to the Office of Graduate Studies.

**Regulated Materials**
- Master's thesis only. Submit this form with your completed checkout card and Statement of Work Completion.

**Commencement Practice**
- All graduates who are attending the commencement Ceremony Must Attend Graduation Practice.
- 4:00pm-5:00pm

**Commencement**
- 5:00pm-7:00pm
ELECTRONIC THESIS & DISSERTATION (ETD) PROCESS
What is an ETD?

- **Electronic Thesis / Dissertation**
  - Electronic submission
  - Electronic format review
  - Electronic acceptance
  - Electronic publication

- The Office of Graduate Studies (OGS) does not require print copies of your thesis.
ETD Advantages

- Increased access to research
- Additional visibility for students and universities
- ETDs available through
  - Mines’ Interlibrary Loan program (ILL)
  - ProQuest
  - Digital Collections of Colorado
    - http://digitool.library.colostate.edu/about
- Lower cost (in many cases free)
- Greener option
Cost

You Choose

- Traditional Publishing: free
- Open Access Publishing: $95.00
- Copyright: $55.00

See the ProQuest *Traditional Publishing Agreement* and the *Open Access Publishing Agreement*. Links can be found on Mines Thesis & Dissertation website.
Thesis Hard Copy Distribution

1. Mines library (archive) copy
2. Department copy
3. Student copy
   ‣ No cost to you
   ‣ Ensure that your department has your most current mailing address, because they will mail your thesis to you.
   ‣ If you do not receive a copy of your thesis, please contact your department.
Roles

- Format review
- University requirements
- Contact: Office of Graduate Studies
  - Suzanne Beach
  - Roxane Aungst

- Publishing options
- ProQuest requirements
- Contact: ProQuest
Electronic Theses/Dissertations (ETDs)

Effective September 6, 2012, the Colorado School of Mines requires all theses and dissertations to be electronically submitted through ProQuest. All students whose programs of study require a Thesis or Dissertation must comply with all Colorado School of Mines thesis requirements in order to graduate.

Overview

2. Complete the Graduation Application by Census Day for the semester you plan to graduate.
3. Submit your Thesis Defense Request Form to your department. You must defend your thesis at least one week prior to the thesis upload deadline (see deadlines listed to the right). You must be registered to defend (see "Thesis Defense" in Graduate Bulletin).
5. Make all of the corrections to your thesis required by your committee.
6. Obtain the required signatures on your Statement of Work Completion form, Regulated Material Check Out form and your Submittal Page form.
7. Submit the signed, original Submittal Page to the Office of Graduate Studies (OCS), Guggenheim Hall, Room 125. Format review will not begin until the original, signed Submittal Page is received in the OCS. If you are trying to meet an upload deadline, you must upload by the deadline AND the Office of Graduate Studies must have the submittal page by the deadline.
8. Review the ProQuest guide Preparing Your Manuscript for Submission (Including Supplemental Files) to ensure that your thesis complies with the ProQuest requirements.
10. Upload your final, committee approved, correctly formatted thesis as a PDF to the website for format review by the upload deadline. Uploads are not accepted after the deadline. Missing the deadline means you will be awarded your degree in the following semester – no exceptions. No revisions to the content of the thesis will be allowed after submission for format review.

In preparation for the thesis upload process:

- Create an account at the ProQuest ETD submission website.
Thesis Submission Procedure

1. Read the Information on the OGS Theses & Dissertation website
2. Write your thesis
3. Submit Thesis Defense Scheduling Request form to department
4. Defend your thesis
5. Make committee’s recommended revisions
6. Create ProQuest account
   ‣ Enter personal email address
   ‣ Make sure the delay (embargo agreements match)
   ‣ Check spelling of department, degree, committee and department head
   ‣ Decide on publishing agreements
   ‣ Decide whether you want to register your thesis with the Library of Congress and pay for copyrights
7. Obtain signatures on Submittal Page
8. Submit signed Submittal Page to OGS by 5:00pm on upload deadline
9. Submit thesis PDF to ProQuest online
   ‣ Submit by midnight on upload deadline
   ‣ Before you upload, check to make sure the PDF has not changed the spacing of your thesis.

10. Format review by OGS
    ‣ First review may take up to 48 hours
    ‣ OGS reviews theses quicker during non-peak submission times
      ‣ If you upload on the day of the deadline, it could take OGS longer to review your thesis.

11. Make recommended revisions—*this may take more than one time*
    ‣ Make sure to check the email that you entered in ProQuest
    ‣ Continue to check email until you receive an email that your theses has been approved.

12. Receive format approval from OGS

13. OGS will submit your thesis/dissertation for publishing
Submittal Page
https://inside.mines.edu/GS-Submittal-Page

Customize to:
- Your Name
- Your degree
- Your advisor(s)
- Your department head

This page is always page ii.

Bring this page to your defense to obtain signatures.

Submit your signed submittal page to OGS before uploading into ProQuest.

Submittal page in thesis is without signatures.
Submit your Thesis

Publishing your dissertation/thesis at Colorado School of Mines

Campus Resources & Guidelines for Colorado School of Mines

This is the place where you can come to learn how your campus can assist you with your dissertation/thesis needs - from links to the campus writing center to important information about deadlines.

- Campus Resources
  - Learn more about your institution's guidelines & resources.
- Preparing to submit your dissertation or thesis
  - Are you working toward submission of your dissertation or thesis? Obtain the information you need to ensure it's published the way you want it to look.
- Publishing Guides
  - View instructions and guides to help you prepare your manuscript.
- About ProQuest/UMI Dissertation Publishing

ProQuest®/UMI Dissertation Publishing is the world's only comprehensive service for publishing, archiving, and disseminating graduate research. By publishing with ProQuest/UMI, you ensure your dissertation or thesis gains the widest possible audience.

Ready to begin?
- Submit my dissertation/thesis
- View/revise existing submission

ETD Administrator @ Colorado School of Mines

Welcome to the Colorado School of Mines Site

ETD Administrator lets graduate students submit their completed dissertation/thesis to ProQuest Publishing.

To continue, please log in or create a new account.

Do you have an account? If not, create your account.

Login:

If you have an account, login here.

Username: 
Password: 
Forgot your password?

Login
ETD Details:

Manage this ETD:

- View ETD details
- Assign administrator
- Add notes
- Edit tags
- Save XML file
- View checklist

Decisions:
- Register decision
- View decisions

Revisions/Changes:
- Revise details
- Revise PDF
- Revise supplemental files
- Revise PQ publishing options
- Revise IR publishing options

ETD Details:

- Title:
- ID:
- Author(s):

Publishing Settings & Copyright
- Traditional Publishing [View agreement]
- Delayed Release (ProQuest): 1 year
- Allow search engine access.
- File for a new copyright - I am requesting that ProQuest/UMI file for copyright on my behalf.

Institutional Repository (IR) Publishing Options
- Include in institutional repository: Yes
- Delayed Release (IR): Do not delay release to Institutional Repository

PDF and Supplementary Files
- (7.0 MB)
- View ETD

- No supplemental files provided --

Degree/Department Information
- Year degree awarded: 2014
- Degree Awarded: Master of Science
- Year Manuscript Completed: 2014
- Department: Civil and Environmental Engineering
- Advisor/Supervisor/Committee Chair: Christopher P Higgins
- Committee Members: Robert L Siegrist, Junko M Marr

Subject Categories

Make sure to enter a non-Mines email

Delayed Release Agreements must match (this is an example of agreements not matching)

Check your department

Check your committee names
Copyrights

- Students own the copyright to their thesis.

- If you choose to register your thesis with the Library of Congress:
  - You may pay ProQuest to register your thesis.
    - For more information: [https://inside.mines.edu/Copyright](https://inside.mines.edu/Copyright)

- If you choose to copyright your thesis, the copyright page is the second page (not numbered) following the title page. Submittal page is still numbered “ii”.

Copyright Permissions

You do not need to receive permission from committee members.

You do need to receive permission from:

- 1. Article already published
  - Publisher permission
  - Co-author permission
- 2. Article accepted for publication
  - Publisher permission
  - Co-author permission
- 3. Article submitted but not yet accepted/rejected
  - Co-author permission
- 4. Future article submission
  - No permissions required
Copyright Permissions Cont.

- Emails granting copyright permission are acceptable.
- Upload copyright permissions into ProQuest or add the emails to the end of your thesis/dissertation.
Dear Student,

I'm writing you to request minor changes to your submission, "THESIS TITLE".

- Please log into ProQuest and click on the PDF in "View ETD details." You should find notations/comments made in the PDF requesting revisions.

- To submit your revised PDF, please go to the following page: View ETD (http://www.etdadmin.com/xxxxxx )

- After you UPLOAD your revised thesis, please remember to click the SUBMIT REVISION button at the bottom of the page.

Regards,

Colorado School of Mines Administrator
Dear student,

Congratulations. Your submission, 10522 has cleared all of the necessary checks and will soon be delivered to ProQuest/UMI for publishing.

Regards,
Colorado School of Mines Administrator
FORMATTING
Quick Reference Guide

**Registration Requirements**

- General
- Combined Students
- RA/TA Contracts
- International Students
- Financial Aid
- Semester of Defense/Graduation
- Leave of Absence & Potential Leave
- Reduced Registration Hour to Qualify
- Reduced Registration Hour to Register

**Grades**

- Grade Submission Deadlines
- Incomplete Grades
- Grade Changes & Appeals
- GPA
- Grades & Graduation
- Academic Standing

**Degree Requirements**

- General
- Minors
- Transfer Credit Limits
- Transfer Credits How To
- Degree Audit Form
- Degree Audit Don’ts
- Responsible Conduct of Research (RCR)
- Admission to Candidacy (gpa only)

**Thesis/Dissertation**

- Thesis Committee Requirements
- Formatting Basics
- Thesis Upload

---

**Thesis Formatting Basics**

**Sample Thesis** (view this document to see examples)

**Thesis Formatting Checklist Print Version**

**Thesis Formatting Checklist**

- **Margins**
  - 1 inch margins (top, bottom and both sides) throughout document
- **Font**
  - Color: Black
  - Type: Times, Times New Roman, Arial, Helvetica
  - Size: 10-12 point font
- **Line Spacing**
  - Double space or 1.5 spacing on all text in paragraphs
  - Exceptions:
    - Figure and Table captions are single spaced
    - Multi-line entries in the Table of Contents, List of Figures, List of Tables and References are single spaced
    - Double or 1.5 space between different entries
  - Use appropriate spacing between the text of paragraph and the Figure/Table captions to differentiate the text.
  - Make sure the you have enough space so the text on the caption does not look like it could be a part of the text in the preceding/following paragraph
- **Indenting**
  - Indent at the beginning of each new paragraph
- **Titles** (Title Page, Table of Contents, List of Figures/Tables, chapters, References, etc.)
  - Centered on page
  - All capital letters
  - Inverted pyramid
- **Copyright**
  - Students own the copyright to their thesis and you may wish to register your work with the Library of Congress.
  - For a fee, ProQuest will register your thesis at the time of submission. For more information, see the ProQuest website and the U.S. Copyright Office website.
  - If an official copyright is obtained, the copyright page is the page just after the title page.
  - The copyright page is not numbered
- **Permissions**
  - You do NOT need to receive permission from your committee
  - You do need to receive permission from:
    - Article already published
      - Publisher permission
    - Co-author permission
    - Article accepted for publication
      - Publisher permission
    - Co-author permission
    - Article submitted but not yet accepted/rejected
      - Co-author permission
Quick Reference Guide Cont.

Thesis Formatting Basics

Sample Thesis (view this document to see examples)

Thesis Formatting Checklist

Margins
- 1 inch margins (top, bottom, and both sides) throughout document

Font
- Color: Black
- Type: Times, Times New Roman, Arial, Helvetica
- Size: 10-12 point font

Line Spacing
- Double space or 1.5 spacing on all text in paragraphs
- Multi-line entries in the Table of Contents, List of Figures, List of Tables, and References are single spaced.
- Use the appropriate spacing between the text of a paragraph and the Figure/Table captions to differentiate the text.
- Make sure that you have enough space so the text on the caption does not look like it could be a part of the text in the preceding/following paragraph

Indenting
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- If an official copyright is obtained, the copyright page is the page just after the title page.
- If the copyright page is not numbered

Permissions
- You do NOT need to receive permission from your committee
- You do need to receive permission from:
  - Article already published
  - Publisher permission
  - Article accepted for publication
  - Publisher permission
  - Article submitted but not yet accepted/rejected
  - Publisher permission
  - Future article submission
  - No permissions required

Adding Permissions to thesis
- Permissions may be in the form of an email
- Permissions may be added at the end of the thesis
- Permissions may be uploaded separately in ProQuest

Page Sequence
- Title page (not numbered)
- Front matter (pages numbered with lower case Roman numerals- i, ii, iii, iv, etc.)
- Copyright page (if applicable) not numbered
- Submitted page without signatures (always numbered page ii)
- Abstract (always numbered page iii)
- Table of Contents
- List of Figures
- List of Tables
- List of Plates or Symbols (if applicable)
- Acknowledgments
- Dedication
- Content begins with chapter 1 (pages numbered with Arabic numerals: 1, 2, 3, etc.)
- Chapters
- Each new chapter begins on a new page
- References
- Bibliography (if applicable)
- Appendices (if applicable)

Table of Contents, List of Figures, List of Tables
- Double space unless multi-line item, then single space
- Text cannot overlap the last leader dot (…)

Headings and Subheadings within chapters
- Must have a paragraph of text under each heading and/or subheading
- Exceptions only for chapters that have been previously published as a journal article

Figures and Tables
- Figures must be listed in the List of Figures and Tables must be listed in List of Tables
- Must be numbered and have a brief caption describing the figure/table
- Number & Captions
  - Single spaced
  - Font size and type must match font size and type throughout thesis
  - Font color must be black
  - Flush with left margin, or centered under figure/table
  - Figure numbers & captions are placed below the figure.
  - Table numbers & captions are placed above the table.
- Numbering
  - First number = chapter number
  - Second number = number within chapter

Large Figures/Tables that (are):
- Taken up more than 50% of a page may stand alone on the page
- If figure fills the page and no room for caption, place caption alone on the preceding page
- Figures or Tables that fill more than one page (ie. continue on to a 2nd or 3rd page) will have:
  - Figure/Table number and caption on first page
  - Figure/Table number followed by continued on each subsequent page
  - Figure/Table number followed by continued on each subsequent page

- For example Figure 2.4 Continued
- Larger than 8.5 x 11 may be shrunk to fit the page, or uploaded as supplemental files

- Figures/Tables formatted wider than they are high must be in landscape mode with the page number placed at the bottom of the figure or table, on the 11" side of the page.

No Extra White Space
- Text must fill the entire page
- The figure/table does not need to directly follow the text referring to the figure/table
- If a figure/table won’t fit:
  - Add text to refer the reader to the page where the figure/table can be found and bring text from the next section up to the page with the white space
  - White space is only allowed:
    - At the end of a chapter.
Sample Thesis

THESIS TITLE CENTERED ON THE PAGE VERTICALLY & HORIZONTALLY IN ALL UPPER CASE LETTERS

Do not add a blank page after title page – no blank pages are allowed in the document

Note: No page number

by

Author’s Name

“by” is lower case
Author’s Name is 1” up from bottom of page

Table of Content Rules:
- Title is in all capital letters & centered horizontally
- Single line spacing for main-line titles and captions
- Double line (or 1.5 line) spacing between different titles (you must be consistent throughout the entire document).
- Do not list the Table of Contents in the Table of Contents page
- Page numbers are preceded by ellipses (…) and are right justified
- Text should not extend beyond the last leader dot of the ellipses for a clear line of sight of the page numbers
- Each list entry must appear exactly as it does in the text
Thesis Checklist

Upon completing your thesis/dissertation, compare the following Checklist against a final copy of your manuscript. When all items in your manuscript conform to those specified on this Checklist, provide the signed Submission Page (page ii of your thesis/dissertation) to the Office of Graduate Studies (OGS) and submit your thesis to ProQuest. Format review of your manuscript will not commence prior to receipt of a signed Submission Page in the OGS.

---

**Page Sequence**
Correct order and formatting

**Title Page**
- Matches example
- No page number
- Title is in all caps
- Title is centered vertically and horizontally on page
- Multi-lined titles appear as inverted pyramid
- Special characters in title are spelled out (section not 3)

**Submission Page**
- Matches example
- Numbered page
- Electronic copy (no signatures)
- Original submitted to OGS (with signatures)

**Page Numbering**
- Roman numeral front matter, centered, ¼ inch from bottom of page
- Arabic numeral main body and back matter, begin as page 1 on first page of Chapter I
- Consistently centered at bottom of page

**Margins**
- 1" from all edges

**Line Spacing**
- 1½ or 2 line spacing in body text
- Single line spacing for captions and multiple-line references throughout thesis
Resources

- LaTex template
  - Scroll down to Unofficial Latex Thesis Template
  - Template is maintained by the Graduate Student Government
  - Questions about the template: Contact Graduate Student Government, not OGS
- Thesis Writer’s Workshop presentations
1. Consistency matters
   - Consistent font style & size
   - All primary text is black. Colored text is only acceptable in figures and tables, but not the figure number or caption.
   - Headings and titles all have consistent font
2. No blank pages
3. Avoid excess white space on pages
4. Center page numbers at bottom of pages
5. Thesis margins should be 1 inch from all edges
6. Front matter page numbers in lower case Roman numerals
   - Title page, submittal page, table of contents, list of figures & tables, abstract
7. No signatures on submittal page included in ETD (always numbered ii)
8. Supplementary electronic materials listed in a single Appendix
9. Rotate page orientation to optimize electronic viewing of illustrations (i.e. landscape figures)
Title Page

- Title appears in all CAPITAL LETTERS
- Title is centered horizontally & vertically
- Title is in an inverted pyramid shape
- “by” is in lower case letters
- Name is 1” from bottom of page
- This page is not numbered
A thesis submitted to the Faculty and the Board of Trustees of the Colorado School of Mines in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Geophysical Engineering).

Golden, Colorado

Date ____________________

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Dr. Terence K. Young

Professor and Head

Department of Geophysics
Abstract

Statement including:

- The thesis problem
- Description of the research method or design
- A report of the major findings
- The conclusions

Title centered, in all capital letters & 1” from top of page

Page iii
List of Figures/Tables need a tab (space) between the figure number and text.
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CHAPTER 1
INTRODUCTION

Metal and mineral extraction using underground mining methods requires detailed engineering and planning to ensure the safe and economic operation of a mine. Mine planning is an iterative process and involves the evaluation of numerous options and scenarios [1]. Currently, most underground mine plans are developed using manual scheduling techniques, i.e., an engineer selects the sequence of activities that attempts to meet a desired production goal. These labor-intensive manual schedules tend to only satisfy a few constraints and may or may not be feasible in application. Mathematical modeling can incorporate a greater number of constraints while producing an optimal or near-optimal schedule in less time than a manual schedule.

This dissertation presents an underground production scheduling model, \((Z)\), which is a variation of a resource constrained project scheduling problem (RCPSP). The RCPSP consists of an objective function, resource constraints, and precedence constraints [2]. Using the RCPSP formulation as a basis, the author formulates \((Z)\) as an integer optimization model that schedules underground mining activities for a two-year time horizon. Model \((Z)\) expands upon the basic RCPSP formulation by incorporating features that provide an operationally implementable solution that better reflects the actual mining environment.

A novel approach to scheduling is evaluated with the introduction of a ventilation constraint into the production scheduling model. Additionally, the ventilation constraint is used to evaluate three estimation methods that are based on the required airflow needed to dilute diesel particulate matter below regulatory limits.

Two solution methods are used to solve \((Z)\). First, the branch-and-bound algorithm is evaluated using the commercially available software, CPLEX. The second solution method uses the academic research software, OMP Solver, which implements an unconventional
Figures & Tables must be numbered and have a descriptive caption.

- Figure & Table numbers:
  - The first number (2) = the chapter number
  - The second number (4) = the figure number *within* the chapter
  
  Example: Figure 2.4 is the 4th figure in chapter 2.

- Figure & Table captions are single spaced.
Figure 5.7 Horizontal component of the wavefield: (a) data recorded with the P-wave source and S-wave receiver transducer; (b) data recorded with the S-wave source and the laser vibrometer as the receiver.

The next paragraph begins here……

Table 1.1. Sediment gravity-flow continuum organized by increasing sediment concentration, grain size, and transport capacity (from Middleton and Hampton, 1973; Lowe, 1979; Lowe 1982.)
Figures and Tables

Don’t place figures or tables side by side

The Denver Basin, like the WIS, is an asymmetric foreland basin with a steeply-sloping western flank along the Front Range Uplift and a gradually shallowing eastern limb. It is bound to the south by the

................................. Uplift and the Las Animas Arch and to the north by the Harville Uplift and the Chadron Arch. Present

................................. 10,000 ft along the basin axis near Denver and Greeley but thin to ≤ 500 ft along the eastern border

.................................

The western margin of the Basin is defined by the Front Range Up.................................

Don’t wrap your text around figures or tables
Figures & Tables
Spacing Before and After Captions

- Spacing between Figure/Table number & caption and proceeding/preceding paragraph must be consistent throughout entire thesis.
  - Make sure to leave sufficient space between Figure/Table numbers & captions and other paragraphs to differentiate between the caption and the paragraph.
  - See examples below of a thesis with too little space between the captions and paragraphs, making it difficult to see where the caption ends and the paragraph begins.
Spacing Between Captions and Text

**Figure 3.7 Building Structural Framework with Fault and Horizon Modelling**

Unconformities are erosional or non-depositional surfaces between two packages of strata. Reflection terminations of layers above and below the unconformity surfaces are onlaps, downlaps, toplaps, and truncations as seen in Figure 3.8 (Mitchum et al. 1977). Erosional unconformities, their time equivalence, the scale of the interpretation, seismic character of the interpreted horizons, and the level of confidence in interpreting the seismic horizons (Table 4.1).

<table>
<thead>
<tr>
<th>Age of the Seismic Horizon</th>
<th>Structural Significance</th>
<th>Scale</th>
<th>Interpreted On</th>
<th>Reflection Characteristics</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late Miocene</td>
<td>Regional Post-Rift</td>
<td>Profile</td>
<td>Peak</td>
<td>Regional Unconformity</td>
<td>Medium</td>
</tr>
<tr>
<td>Base Miocene</td>
<td>Regional Post-Rift</td>
<td>Profile</td>
<td>Peak</td>
<td>Regional Unconformity</td>
<td>Medium</td>
</tr>
</tbody>
</table>

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Tables & Figures that cover more than 50% of the page may stand alone on a page.
- Stand alone figures and tables need to be centered vertically and horizontally

Figures that cover more than one page should be uploaded as supplemental files

Tables that cover more than one page must have:
- The number and full caption on the first page
- The number + continued on the following pages
  ‣ Example: Table 5.3 Continued
Tables & Figures that fill the page, but leave no space for the figure/table number and caption must have:

- The number and full caption on the preceding page
- The number and caption will be centered vertically and horizontally on the page.

Figure 5.13 S-Wave cap in the transmissive experiment: (a) The waveform simulated with the spectral element method. The solid line is the S-wave time modeled using the inverted parameters from figure 5.11. The observed cap is larger than that predicted by the group-velocity surface.
Figures & Tables that are in landscape orientation need to be oriented correctly.

- Top of Figure/Table is at the top of the page
- Page number is at the bottom of the page

Figure 5.13. S-wave cusp in the transmission experiment: (a) The wavefield simulated with the spectral element method; (b) the wavefield recorded by the laser vibrometer. The solid line is the S-wave time modeled using the inverted parameters from Figure 5.11. The observed cusp is larger than that predicted by the group-velocity surface.
Numbered Equations

- Equations must appear on separate line from other text.
- Equations must be centered on the page or indented.
- Equations that are not in running text must be numbered (see example below)

\[ \Gamma - \delta \times a = 0 \]  
(2.1)

- Equation numbers:
  - The first number (2) = the chapter number
  - The second number (4) = the figure number \textit{within} the chapter

- It is OK to split equations between pages.
Equations in Running Text

- Equations are a part of a sentence.
- Equations are not entered on a separate line.
- Equations are not numbered

Example:

If the bridge has been balanced by setting $R_1 = R_2 = R_0$, it is easy to show that $V_{out} = V_0 / 2$. 
You must have one paragraph of text under every heading or subheading.

Example:

2.2 Literature Review

2.2.1 Applications of ZnMgO

Based on the properties demonstrated in above section, ZnMgO has been integrated into various applications.

As Figure 2.6 shows, the shift of the conduction band towards the vacuum level is the main reason
Rules for Eliminating Excess White Space

› Text should fill the page

› If you have text that refers to a table or figure and the table or figure will not fit on the same page as the text or on the page immediately following the text:
   
   • Make a reference to the table or figure, indicating the page number for the table or figure.
     
     ‣ For example: …as is presented in Figure 2.1 (page 15).

   • Move text that would normally follow the table or figure to the preceding page before the table or figure.
Rules for Eliminating White Space continued

‣ New section headings at the bottom of the page:
  • Make sure the section heading + 2 lines of text will fit on the page.
    ‣ If not, then place section heading at the beginning of the next page.

‣ New paragraphs at the bottom of the page:
  • Make sure 2 lines of text will fit on the page.
    ‣ If not, then place new paragraph at the beginning of the next page.
This equation can be simplified by considering only the peak oscillator values and by substituting \((K_e + K_o)\) and \(K_o\) for \(K\) and \(M_o\), respectively. The result of this substitution yields:
\[
x_e = \frac{P_e}{(K_e - K_o) - K_e} = \frac{P_e}{K_e}
\]  
which can then be further simplified to:
\[
P_e = K_e x_e
\]  
From Equation (3.4), it can be seen that the force produced by the oscillator \((P_e)\) is equal to the amplitude of force in the specimen \((K_e x_e)\). Therefore, the force in the specimen is equal to that produced by the oscillator, irrespective of changes in the sample rigidity, \(K_e\).

3.3.3 Cantilever Bending Fatigue

To avoid any surface effects on fatigue results due to machining, all samples were polished to a 1 \(\mu\)m diamond finish on a lathe. The polishing sequence on the lathe was 180 and 320 grit alumina, 400 and 600 grit silicon carbide, and 15\(\mu\)m, 6\(\mu\)m, 3\(\mu\)m, and 1\(\mu\)m diamond suspension. After polishing on the lathe, select samples from each condition were analyzed using a non-contact white light optical profilometer to determine the final surface roughness prior to fatigue testing. The surface roughness \((R_a)\) of the large and small fatigue samples was 174 \(\pm\) 78 nm and 274 \(\pm\) 105 nm, respectively.

For the large fatigue samples, run-out is defined to be \(1.5 \times 10^5\) cycles. The endurance limit for the large fatigue samples is determined as the applied stress in which five consecutive samples run-out after dropping the applied stress by 5 MPa from a stress level where finite life is observed. For the small fatigue samples, run-out is defined as \(10^5\) cycles, and the endurance limit of the small fatigue samples is defined as the stress at which three consecutive run-out samples are observed.

The bending fatigue set-up for the SF-1-U fatigue tester is shown in Figure 3.9. The bungee cord (Figure 3.9) pulls the sample away from the fixed end during fracture to ensure integrity of the fracture surfaces for analysis. A copper sleeve (Figure 3.9a) was used to eliminate fretting between the sample and fixture during testing, which sometimes leads to premature fracture in the grips of the fixed end of the sample. Four air jets were used for cooling the large fatigue samples (Figure 3.9b). The air pressure was adjusted to ensure that the temperature of fatigue samples did not exceed 35\(^\circ\)C during testing. The sample temperatures were measured during low and high cycle fatigue testing using a non-contact infrared (IR) thermometer. The maximum surface temperature measured was 35\(^\circ\)C, which was only achieved during low cycle (< 50,000 cycles) testing of fatigue samples. Without the cooling air, however, sample surface temperatures in excess of 300\(^\circ\)C during low cycle fatigue testing were observed.

**Eliminate excess white space on this page.**

Text should continue here unless it’s the end of the chapter.
Eliminate Excess White Space

Move 2.6 subheading (page 2) + at least 2 lines of text in first paragraph to page 1 to eliminate excess white space.
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- If you cannot fit the first 2 lines of a new paragraph.
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  - If you have more than one figure or table on a page, it is not a stand alone figure or table and you may not have excess white space.
- At the end of a chapter.
3.3.2 Cantilever Bending – Universal Fatigue Testing Machines

All fatigue testing was conducted using a SF-1-U (4450 N capacity) or a SF-01-U (890 N capacity) universal fatigue tester set up for cantilever bending, both of which operate at a constant frequency of 30 Hz. All fatigue testing was conducted using fully reversed (R = -1) load control. Both the SF-1-U and SF-01-U were calibrated with uniform diameter steel bars with a uniaxial strain gauge attached. All calibration data were acquired using a Vishay System 6000 digital acquisition system. The output from the acquisition system was used to verify the R-ratio control and that applied load was within 1% of the calculated value. The internal lay-out of the SF-1-U universal fatigue tester is shown in Figure 3.8. The oscillator, pendulum housing, compensator springs, and R-ratio adjustment are all shown. The pendulum rests within the pendulum housing, but rotates about the location labeled “pendulum” in Figure 3.8.

![Pendulum diagram](image)

Figure 3.8 SF-1-U assembly showing the pendulum housing, pendulum location, compensator springs, oscillator, and the R-ratio adjustment control (color image; refer to PDF file).

Both the SF-1-U and SF-01-U fatigue testers operate in load control and can be modeled as a forced vibration with a single degree of freedom [62]. The vibration analysis is simplified because the fatigue testers operate below resonance and the differential equation used to specify the displacement is given by:

\[
M \frac{d^2x}{dt^2} + Kx = P_o \sin(\omega t)
\]  

(3.1)

where \(M\) is the mass of the pendulum, \(x\) is the displacement of mass \(M\), \(t\) is time in seconds, \(K\) is the overall spring constant which is made up of two components: \(K_o\) which is the specimen spring constant, and \(K_c\) which is the compensator spring constant. \(P_o\) is the amplitude of force produced by the oscillator, and \(\omega\) is the circular frequency of the oscillator force. The solution to Equation (3.1) is given by:

\[
x = x_o \sin(\omega t) = \frac{P_o \sin(\omega t)}{K - M \omega^2}
\]  

(3.2)

Looks good.
Figure 3.9  Bending fatigue set up for the SF-1-U: (a) front view and (b) top view with the cooling air connected (color image; refer to PDF file).

The bending fatigue set-up for the SF-01-U fatigue tester is shown in Figure 3.10. The bungee cord and copper sleeve shown in Figure 3.10 were used to maintain the integrity of the fracture surface and to eliminate fretting between the sample and fixture during testing. The overall set-up of the fixture is similar to the large fatigue sample set-up with the exception that there is no cooling air applied to the sample. Even in low cycle fatigue testing, the small fatigue sample did not heat up more than 1-2 °C above room temperature so cooling air was deemed unnecessary.

Figure 3.10  Bending fatigue set up for the SF-01-U: (a) front view and (b) top view (color image; refer to PDF file).

The temperature in the fatigue testing laboratory was maintained between 22 and 26°C. The humidity in the room was maintained below 35% relative humidity with the use of three dehumidifiers. No correlation between total fatigue life and room humidity was observed. For the majority of fatigue tests, the room humidity was below 20%.

3.3.4 Tensile Testing

Tensile testing was conducted to determine case and core tensile properties of all of the induction processed conditions. Specimens were machined according to the ASTM E8-2008 standard [63] from the as-received bars of the 1045, 4145, and 1000 alloys (Figure 3.11). To simulate the core microstructures, the tensile samples were heat treated similarly to the initial heat treatments described in Table 3.2. Then, the specimens were tempered at 176°C.
CHAPTER 2
TITLE IN ALL CAPITAL LETTERS IN AN INVERTED PYRAMID SHAPE

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Katherine xxxxx*, 1, Eric xxxxx 2, xxxxx Drewes 1, Christopher xxxxx, 1

Abstract
The objective of this study was to examine xxxxxxxxxxxxxxxx xx xxxxx to activated xxxxx. Compounds examined in this study included neutral, xxxxx as well as acidic xxxxx which may carry a negative charge and xxxxx which may carry a positive charge at the xxxxx. These xxxxx were evaluated to examine how xxxxxxxxxxxxxxx might differ for xxxxx in different states of charge. Additionally, multiple xxxxx from geographically and operationally different xxxxxxxxxxxxxxxx were studied to elicit how xxxxxxxxxxx characteristics xxxxxxxxxxx. Characterization of xxxxxxxxxxxxxxxx from 6 full scale xxxxxxxxxxxxxxxx and 3 xxxxxxxxxxxxxxxx showed no significant difference in fraction organic carbon (xxx) and xxxxx exchange capacity. xxxxxxxxxxxxxxxx experiments demonstrated that xxxxxxxxxxx of xxxxx also exhibits little variation between xxxxx. Organic carbon normalized xxxxxxxxxxxxxxxx xxxxx (xxx) were determined as a measure of xxxxxxxxxxxxxx, and were found to correlate well with xxxxxxxxxxxx partition xxxxxxxxxxxxx (xxx) for xxxxx, and xxxxxxxxxxxxxxxxxxx xxxxxxxx where log xxxxx is greater than 2. These data were xxxxxxxxxxxxxxxxxxx

*Primary author and editor.
Corresponding author. Direct correspondence to chiggins@mines.edu.
1 Department of Civil & Environmental Engineering, Colorado School of Mines, 1500 Illinois Street, Golden, Colorado 80401, USA.
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<table>
<thead>
<tr>
<th>Geographical Data Files</th>
<th>Files containing geographical location information of all survey lines. Files include raw survey data, reduced survey data showing relative location of each station with respect to a survey base station, and absolute latitude and longitude of each survey location. All files are in Microsoft Excel 2003 format. See figure 2.3 for area map show location and orientation of each survey line.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeographDescr ipt.txt</td>
<td>ASCII file containing description of data file format for all files containing geographical information included as part of these electronic supplementary files.</td>
</tr>
<tr>
<td>Line111.xls</td>
<td>Geographical survey information for line 111. See figure 2.3. See GeographDescr ipt.txt for description of data included in each page and for each column of the spreadsheet.</td>
</tr>
</tbody>
</table>
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Mines Requirements

Suzanne Beach
(303) 273–3627
sbeach@mines.edu
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Roxane Aungst
(303) 273–3608
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