

The 2009-2010
Department of Civil and Environmental Engineering

SENIOR THESIS GUIDE

A Compendium of dates, tips, guidelines and procedures



September, 2009

Copies of this guide can be obtained from
Undergraduate Coordinator
E-212, Engineering Quad

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INTRODUCTION

The senior thesis guide represents an effort to better inform students of what to expect when writing a thesis. The guide applies to all students who are satisfying the senior thesis requirement by signing up for CEE 478.

The senior thesis *is a full-year effort*, and students should budget their efforts accordingly. This guide is intended to help develop a schedule that will avoid the typical thesis rush at the end of the year, while at the same time providing tips on how to organize the research writing of the thesis. It also provides key dates and deadlines and certain rules and procedures governing the preparation of the final document. Failure to abide by these procedures can delay the time at which your thesis is accepted, possibly resulting in a reduction in grade and, in some instances, postponement of graduation. Procedures for obtaining extensions (for extreme circumstances) and tips on the oral presentation at the end of the year are also provided.

ARCHITECTURE AND ENGINEERING: Students in this certificate granting program (both structures focus and architecture focus) must follow the guidelines and procedures in this booklet for deadlines and submissions. These students must submit all reports and prepare the same presentations as the other CEE students. Those in the architecture focus are also responsible for meeting the requirements of the School of Architecture (SOA). They must contact the Undergraduate Administrative Assistant in Architecture to obtain the SOA guidelines and deadlines. Typically this means making final presentations in both CEE and SOA.

GEOLOGICAL ENGINEERS: Students in this certificate granting program must follow the guidelines and procedures in this booklet for deadlines and submissions. These students must submit all reports and prepare the same presentations as the other CEE students. They are also responsible for meeting the requirements of the Department of Geosciences (contact the Undergraduate Administrative Assistant in Geosciences to obtain their guidelines and deadlines). Typically this means making final presentations in both CEE and Geosciences.

COURSE LEARNING OBJECTIVES FOR CEE 478 SENIOR THESIS

The following learning objectives constitute the minimum skills that every student must acquire through the senior thesis experience. These objectives will be used, in part, to evaluate the student's work and in the assignment of a grade.

Course Learning Objectives	ABET Criterion 3
1. Integrate science and engineering principles for analysis and solution of problems in the field of civil and environmental engineering.	a
2. Combine in-depth science/engineering analysis with examination of societal issues related to the thesis topic. Gain broad knowledge about the topic of interest, and appreciate its relevance in modern society.	h, j
3. Formulate the thesis research project. Identify the critical research questions, and define the scope and objectives of the project. Design experiments, analysis, or observation plan.	e
4. Examine a range of investigative options for approaching the research questions, such as experimentation, field observation, simulation, optimization, economic analysis, or risk assessment. Defend the method chosen for approaching the research.	i
5. Know how to use information technology resources to find background information and data pertinent to the thesis topic. As needed, gain the skills to use laboratory techniques and software for data analysis and simulation.	k
6. Apply appropriate paths of inference to interpret the theory, findings, and/or data. Use these interpretations to draw conclusions with regard to the project objectives.	b
7. Behave as a responsible professional engineer with respect to planning and meeting project deadlines, regularly reviewing progress with advisors, and being responsive to feedback from advisors and peers. Become familiar with the ethical standards of technical writing with respect to giving credit: acknowledging other contributors, acknowledging funding sources, citing references.	f
8. Develop writing skills and presentation skills needed to effectively communicate the purpose, scope, and conclusions of the project.	g

IMPORTANT DATES

The following dates represent the key milestones that must be observed during the year:

Monday, November 2, 2009 **FALL TERM PROGRESS REPORT** Deadline
(two copies due)
(see the *FALL PROGRESS REPORT* for details)

Friday, January 8, 2010 **POSTER PRESENTATION**

Tuesday, January 12, 2010 **INTERIM PROGRESS REPORT** Deadline
(two copies due)
(see *THE INTERIM PROGRESS REPORT* for details)

Monday, April 12, 2010 **SENIOR THESIS** Deadline
(three copies—two bound, one unbound)
(see *TURNING IN THE THESIS* for details)

Thursday, May 6, 2010 **ORAL PRESENTATIONS**
(see *THE ORAL PRESENTATION* for details)

All reports and the thesis must be turned in to the Undergraduate Administrative Assistant in E-212 no later than 5:00 p.m. on the date indicated. Late progress reports will be penalized at a rate of one letter grade per day. A late thesis is penalized at a rate of one fifth of a letter grade per day. **DO NOT TURN REPORTS IN TO YOUR THESIS ADVISOR.** We will handle forwarding your reports to your advisor.

SENIOR THESIS FUNDS

A limited fund is provided by the Dean of the College's office for theses that require financial support for special travel needs, acquisition of data, or other special requirements. Awards are typically around \$750, but not all proposals can be funded. Early in the semester talk with your advisor if you feel you may qualify for this support. The application deadline is relatively early, implying that you must already have a good idea of what you need, why it requires additional support, and how you would use the funds in your thesis. If you would like to apply, you must submit a one- or two-page proposal, including a budget, to your advisor who must then write a letter of support and pass it on to the Departmental Representative.

THE FALL PROGRESS REPORT

The fall progress report is due the first Monday after fall break, and comprises 5 percent of your thesis grade. It is designed to serve as an initial checkpoint on your progress and provides an early opportunity for feedback.

As with all material you turn in, it will be graded by your advisor and hence you should discuss with him/her what is expected. In general, however, the fall report is expected to be five to ten pages in length, typed and neatly presented. The basic outline of the report would normally be as follows:

- Detailed problem description
- Preliminary review of the literature, including a list of cited references.
- Description of what you propose to do with the topic.
- Summary of major data requirements, if applicable. Many a thesis has undergone significant changes in emphasis due to an overly optimistic assessment of data availability. If your thesis does depend on a source of data that is not absolutely reliable (such as getting data from a company you worked for over the summer), it is a good idea to have a backup position.
- Summary of project work, if applicable. This includes, for example, conducting experiments, writing major computer programs, or statistical analysis of data.
- Schedule of tasks (attempt to estimate major milestones on a time-scale of weeks).

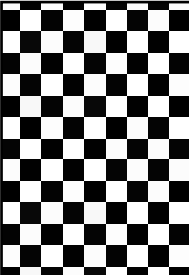
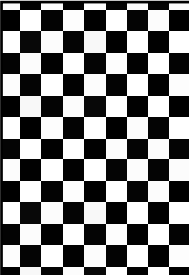
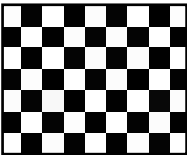
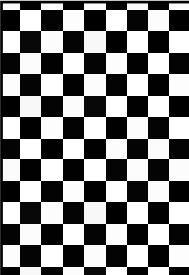
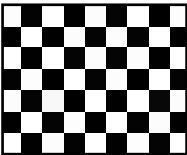
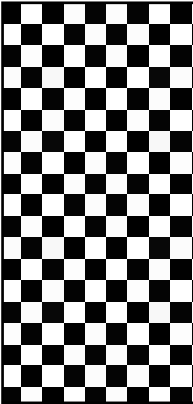
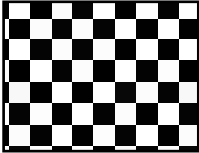
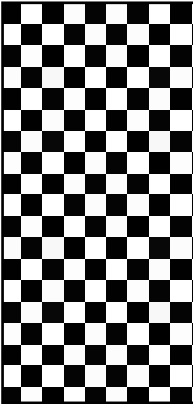
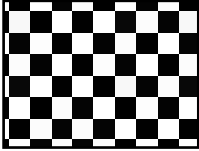
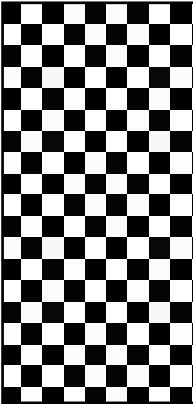
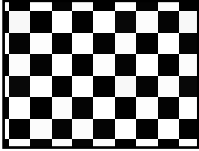
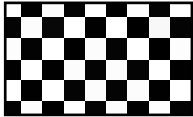
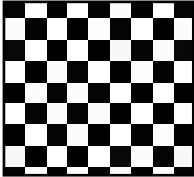
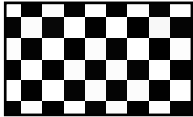
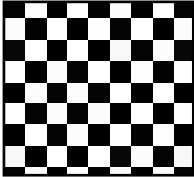
Late submissions of reports are penalized at a rate of one letter grade per day. No extensions will be given under any circumstances.

ORGANIZING YOUR TIME

One of the most common mistakes made by seniors is underestimating how much time it takes to complete certain tasks, in particular the actual writing of the thesis. It may be helpful to divide the effort into three primary tasks:

- Defining the problem and reviewing the literature
- Getting data and doing the work
- Writing the thesis

Depending on the nature of the work, each task can be viewed as requiring approximately the same amount of calendar time (the number of hours spent per day, however, can vary widely). If your research is fairly well defined (usually with the help of your advisor), then the first stage may be reduced somewhat. Naturally, the three tasks will overlap, since you may have to do additional literature review when you finally settle on a specific problem, and it is often useful to begin writing certain sections of the thesis while the actual research is in progress. An approximate time schedule is outlined on page 7.

<u>Month</u>	<u>Problem definition</u>	<u>Doing the work</u>	<u>Writing</u>
September			
October			
November			
December			
January			
February			
March			
April			

Please do not underestimate how long it takes to write the thesis. In particular, allow sufficient time for printing, copying, and binding the thesis. **UNDER NO CIRCUMSTANCES WILL EXTENSIONS BE GIVEN FOR DELAYS DUE TO BROKEN DOWN COMPUTERS OR PRINTERS.** Even though these may be beyond your immediate control, you still bear the responsibility for getting the thesis in on time. **PLAN AHEAD!**

THE INTERIM PROGRESS REPORT

The interim progress report is a summary of progress to date and counts 15 percent of the final thesis grade. Combined with the fall progress report and the poster presentation, the work you do in the fall will count a total of 25 percent of the final thesis grade. Poor progress in the fall, then, can produce as much as a two-grade reduction in your final thesis grade, regardless of the grade given on the thesis itself. Late reports are penalized at a rate of one letter grade per day. The report must be typed and neatly presented. No extensions will be given under any circumstances.

The progress report will be graded by your advisor, and hence you should talk to him/her regarding the contents of the report. The grade you are given will be based on the progress report as well as other work you have completed by January. It is not unusual, for example, to have a chapter completed in the fall covering the literature review or an initial experiment.

A suggested format for the report is as follows:

Part I: Review of the progress made to date

The review should include a refined description of your problem with a more detailed summary of exactly what you are doing. Summarize specific tasks already completed, such as the literature review, development of a mathematical model, conceptualization and/or actual design of a component/structure, software, etc. List tasks by general titles with short descriptions.

Part II: Literature review of references and sources of data

This list should include a reasonably complete bibliography covering your topic. Each bibliographic item should be annotated or described in the text explaining its importance to your project. Also include all sources of data that you have been using or plan to use in the spring.

Part III: List of tasks

This list is to be completed in the spring with an anticipated time schedule. List tasks by general titles with short descriptions (a few sentences). Included in this list should be the task of writing and rewriting the thesis (this task may be broken down into specific chapters).

Please note: the January progress report and poster presentation **MUST** include your name, your advisor's name **AND** a tentative thesis title. This thesis title will most likely be used to schedule your oral presentation in May. You may change the title, but it should be as close as possible to your actual thesis title and should adequately describe your work.

WHAT IS A THESIS?

The most frequently asked questions concern what is actually in a thesis (How much detail?, How long should it be?, Should I have a pop-up model of my bridge design inside the thesis?, etc.). This section of the guide is a strictly informal set of guidelines that a student may use to orient him/herself as to the basic components of a thesis. Since projects differ widely, it is impossible to develop a general outline that applies equally to all students. Regardless of how well you think your own research fits the following guidelines, you should talk to your advisor to determine the most appropriate style of presentation for your own work.

The essence of any scholarly work, which a thesis is supposed to be, is to establish the following:

- Definition of the problem and review of the literature
- Presentation of your particular contribution to this area
- Identification of fruitful areas of further research that others in the field may use to guide their own work

Toward these three goals, the following list of questions may prove useful for organizing both your research effort and the final writing of the thesis.

I. What are you looking at?

You must begin by defining your problem. In the introduction of the thesis, however, you want to do this in a general way that gives the reader a sense of the scope of the project and a basic understanding of your problem area. For example, you may be solving a problem of interest to a particular company, or developing a new approach to a problem that may be of interest to the research community as well.

II. Why are you looking at it?

Motivate your work. Explain to the reader why you will not simply waste his/her time on an uninteresting problem if he/she reads your thesis. Establish who will benefit from your work and why. Note that you do not have to get the whole world interested in your work. Most theses involve the application of existing techniques to particular problems, and hence the only people who will be directly interested may be others working for a particular company, engineers working on a specific project, and so on.

III. Who else looked at it?

Now that we (the readers) have a rough idea of what your problem is, you must firmly establish what the state of the art is in the area. This is particularly critical if you wish to claim that you have a better way of solving/approaching a problem than has appeared previously in the literature. For example, if you are developing a new statistical model for describing the relationship between SAT scores and academic success at Princeton, list others who have worked on the same or similar problems and briefly describe their work. If you are duplicating the approach used by others in the field, but using a different data set that is of particular interest to you, say so and describe why you have chosen this approach over others that may have been used.

IV. How are you looking at it?

At this point, you may need to review your problem again but at a much higher level of detail, introducing any mathematical notation required and describing any subtle aspects of your problem that may in fact be the central component of your research but which were too detailed to put in the introduction. Empirical research, which involves gathering data to investigate some relationship, can often be introduced by citing one or more hypotheses which you feel your research will prove (or disprove). Examples of hypotheses are:

- There is no relationship between a student's math SAT and his/her starting salary on graduation.
- The nation's independent truckers can carry freight for the same or lower cost than rail, with a higher level of service.
- Risks associated with the use of conventional fuels are greater than the risks associated with use and disposal of nuclear fuel.

After stating the relevant hypotheses, your work would consist of collecting and analyzing data to confirm or deny your hypotheses. The most interesting hypotheses are ones that run counter to prevailing public opinion, although these can be very difficult to prove.

Not all work is conducive to initial statements of hypotheses, particularly methodological theses which are aimed at better solutions to existing problems (the implicit hypothesis is that your method is better than others, but this need not be stated as such). In any event, unless your work is purely theoretical, you should describe in detail your experimental design: how you structured your data collection, problems you encountered, and how you conducted your experiments. The description should be sufficiently detailed to allow another researcher to duplicate your efforts. A key part of your description should be a clear list of major assumptions

you are making and why you are making them. It is useful at the same time to indicate which assumptions are perfectly reasonable (e.g. other researchers have used the same assumption and have obtained good results) and which are likely to affect your results but are required for time/budget reasons.

V. What are the limitations of your work?

One of the most difficult aspects of research is understanding exactly what you did and what you did not do. If you were limited by your data, explain how you think this might affect the generality of your conclusions. Discuss openly any shortcuts required due to time/budget/data availability constraints. Do not try to claim credit by stating that you feel that your method/model/bridge/pump will work in more general situations if you have done only limited testing. At the same time, do not feel you are getting off the hook by over qualifying your work (e.g. "Because of such and such restrictions, no valid conclusions can be drawn until more extensive experiments are carried out using so and so's data or equipment."). Clearly drawing the line between what you did and did not do is a central step in the scientific method since it helps define the state of the art.

VI. What are your conclusions?

In view of the limitations above, what conclusions can you draw from your research? Because your conclusions are often inextricably intertwined with the limitations of your research, both questions are often answered simultaneously. It may be useful to discuss limitations of specific aspects of your work while you are describing the work itself, but defer a discussion of how such limitations actually impact your results until later. Your section on conclusions is usually brief, and should specifically and clearly describe your contributions to the field. Frequently, researchers familiar with the field will start by reading your conclusions and, depending on your claims, and then decide to read the thesis itself. Again, do not underrate your work, but do not claim to have solved problems that are not firmly substantiated in the body of the thesis.

VII. What next?

Areas for future research. Now that you are an expert in your particular area, you should have both a narrow understanding of a well-defined problem as well as a broader understanding of the field as a whole. As such an authority, it is now your responsibility to guide others in the field who do not have the benefit of your particular experience in directions that you feel will provide the greatest good. Such recommendations are usually based on an evaluation of the major weaknesses in your own work, in which case you might recommend how others (preferably with more time and money than you enjoyed) could overcome these weaknesses. Be sure, however, to specify those weaknesses that you feel would have the greatest impact on your conclusions. Some assumptions that you may have made may be perfectly reasonable, in which case a more accurate model would not improve the final results.

FORMAT OF THE THESIS

There are certain guidelines that must be followed when preparing the copies that will be turned in. These guidelines have been developed as a response to certain legal requirements regarding copyrights as well as administrative needs for processing the thesis.

The requirements for preparing the thesis are as follows:

The front page of the thesis should include title, author, date, advisor(s), and the statement:

Submitted in partial fulfillment
of the requirements for the degree of
Bachelor of Science in Engineering
Department of Civil and Environmental Engineering
(Program name) Program
Princeton University

The second page should contain the following statements:

I hereby declare that I am the sole author of this thesis.

I authorize Princeton University to lend this thesis to other institutions or individuals for the purpose of scholarly research.

(your signature)

(your name)

I further authorize Princeton University to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

(your signature)

(your name)

Each thesis must have the title and author typed on a white label placed on the front of the thesis unless it is engraved by the binder (bound copy only).

Other requirements that must be observed when preparing the thesis:

- The thesis may be formatted one and one half spaced or double spaced, with the exception of footnotes and bibliography
- The font size should be between 10 and 12 point
- The left hand margin should be 1 1/2 inches to allow for binding; all other margins should be approximately 1 inch.
- All material in the thesis (tables, figures and exhibits) must be photo reproducible. Photographs may be included, but should be clear, glossy, and high contrast. Color graphics may be included but they should be clear when reproduced in gray-scale.

Finally, you must turn in a "Senior Thesis Information Sheet." The information you provide on this sheet must be reported to Mudd Library with the submission of your thesis. The form is included at the end of this guide. Additional forms are available in E-212.

TURNING IN THE THESIS

The following must be submitted to the **Undergraduate Coordinator in E-212 no later than 5:00 pm on Monday, April 12, 2010:**

- One (1) electronic copy of the thesis in PDF format
- One (1) unbound copy
- Two (2) bound copies

One of the bound copies will go to your advisor to keep. The other bound copy will go to the second reader, who will grade it and return it (unmarked) to the Undergraduate Program Coordinator. Once the grades are reported, you can pick up this bound copy from E-212. If you have more than one advisor, consider making an extra copy if appropriate.

ALL STUDENTS MUST DELIVER THE THESIS IN PERSON. There are several forms that must be signed before the thesis can be accepted. The thesis cannot be accepted unless it follows the guidelines described in **FORMAT OF THE THESIS** and the appropriate forms are signed. Late theses are penalized at a rate of one fifth of a letter grade per day or any part thereof. This rule is rigidly enforced, so allow plenty of time for copying and binding. Remember that many other students are trying to meet the same deadline and that copying and binding services may require more time than you think.

EXTENSIONS

Extensions for turning in the thesis will be granted only in the case of illness (or family emergencies) and only when such illness or emergency makes it impossible to complete the thesis on time. All extensions must be requested in writing and turned in to the Departmental Representative at least one week prior to the deadline for the thesis. Each request must be approved first by the student's advisor and then by the Departmental Representative. Extensions will not be granted for unexpected delays due to problems in printing, photocopying, or binding the thesis.

No extensions will be allowed for the thesis progress reports. If for some reason you must be away from campus when one of these reports is due, and then turn the report in early.

THE ORAL PRESENTATION

Capping the thesis effort is a day of oral presentations where seniors have a chance to stand up and describe their work. Attendance is required. Failure to make an oral presentation will result in a one letter grade penalty. If you have other commitments on the day of the presentation, contact the Departmental Representative at least one week in advance, and it may be possible to schedule around these commitments. In case of conflict, however, the oral presentation takes precedence. The schedule of presentations will be available on or about May 1 and will be posted or may be obtained in E-212.

The format of the presentation provides **NO MORE THAN 12 MINUTES** for describing your work, followed by 3 minutes for question and answer. As it is very easy to run over this time limit, it is important to practice your presentation ahead of time. The content of your talk should generally accomplish the following:

- Briefly explain your problem
- Describe what you did and briefly how you did it
- Summarize your most important and interesting conclusions

A good rule to follow is just to present the highlights of each aspect of your work. Do not try to impress people with how much work you did; if you did a lot of work, you will not be able to describe it all, and invariably you will simply be cut short (the time limits are rigidly enforced). A few tips on how to make your presentation are the following:

- Sound interested in your work - enthusiasm spreads.
- Emphasize the easy-to-communicate ideas that others will enjoy the most
- Do NOT read your presentation (if you want to know why, just listen to someone else reading his/her presentation - it's boring).

- Use a few overhead transparencies or 35 mm slides to help structure the presentation; keep them simple and prepare them in a manner suitable for a professional presentation (i.e. don't scribble out a few slides the night before). Also, do not photocopy pages out of your thesis. Avoid complex expressions unless they are central to your work.
- This is a formal presentation, so dress accordingly (coat and tie/dress or blouse and skirt).

GRADING

The Civil and Environmental Engineering thesis is graded by the thesis advisor, and a second faculty reader assigned by the Department. The second reader's report and grade recommendation are made available to the advisor.

The final CEE 478 senior thesis course grade is calculated as follows: Fall Progress Report, 5%; Interim Progress Report, 15%; Poster Presentation, 5%; Oral Presentation, 5%; and Main (advisor) reader, 40%; Second reader, 30%. Because CEE 478 is taken over two semesters, the grade received in CEE 478 counts as two grades in the departmental GPA.

Please note that the final thesis grade as reflected in your transcript is a two-semester evaluation (25% comes from the first semester effort).

Guide to Good Grading Practices for Faculty Advising Students in CEE 478 Senior Thesis in Civil and Environmental Engineering

A thesis with a grade of **A+** should contain original work, i.e. the project execution, analysis and interpretation, are largely the work of the student. The student devoted a large amount of time to the thesis and persevered to solve difficult problems on his/her own. The work is of high quality, with a creative approach, appropriate methods of analysis, and insightful interpretation. The background material is thoroughly researched, and includes examination of related societal issues. The thesis is complete and well written, and it is almost ready for publication (if that is the desire).

A thesis with a grade of **A- or A** should contain a large portion of original work, although some components of the work may have developed from suggestions of the advisor. The student devoted a large amount of time to the thesis and persevered to solve or overcome problems on his/her own or with the guidance of the advisor. The work is of high quality, with a creative approach, appropriate methods of analysis, and insightful interpretation. The background material is well researched, and includes examination of related societal issues. The thesis is complete and well written, and it will be ready for publication with a small amount of additional work (if that is the desire).

A thesis with a grade of **B-, B or B+** represents work from a student who worked independently but was advised extensively on the objectives and components of the project. The student worked steadily but did not solve or overcome problems on his/her own. The work is accurate but limited in scope. The conclusions derive correctly, but follow-up work would be needed to completely address the project objectives. The background material is researched and includes examination of related societal issues, but important references are missing. The thesis has all the components of a complete thesis, but is lacking in depth and originality.

A thesis with a grade of **C** represents work from a student that needed extensive help with the planning, execution and analysis of the project. The student worked sporadically and progress was seriously hindered due to lack of attention. The work is of questionable quality and would need to be repeated before definitive conclusions could be drawn. The subject has not been well researched and the thesis does not adequately examine related societal issues. The thesis is seriously lacking in scientific quality.

A thesis with a grade of **D** represents work from a student that devoted very little time and attention to the project. Large portions of the work were not completed. The work that was completed is of questionable quality and does not lead to useful conclusions. The subject has not been researched and the thesis does not examine related societal issues. The thesis is seriously lacking in virtually all aspects.

A thesis with a grade of **F** is largely incomplete and incorrect. The student worked rarely or not at all.

SENIOR THESIS INFORMATION SHEET

Please print.

Student Complete Name		
Complete Title of Thesis		
Advisor(s) Full Name (Last, First, Initial)		
Total number of pages for Microfiching/ (Exclude only blank pages)		
Total number of color pages		
Program of Study (Check One)	<input type="checkbox"/> Architecture and Engineering <input type="checkbox"/> Environmental Engineering <input type="checkbox"/> Geological Engineering <input type="checkbox"/> Structural Engineering <input type="checkbox"/> Engineering and the Liberal Arts	
<i>Date:</i>		
Special Instructions (Oversided materials, photographs, color pages, etc.):		
Signature:		