

BROCK UNIVERSITY
Centre for Biotechnology

GUIDELINES FOR HONOURS THESIS PROJECTS
BTEC 4F90/4F91

(Approved, Dec 6, 2002, by the Biotechnology Program Committee.)

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Part One

1. Admission of Students to Biotechnology 4F90/4F91

1. All students registering for Biotechnology 4F90 must also register for Biotechnology 4F91 **at the same time**. No marks for Biotechnology 4F90/4F91 are submitted until the thesis and defence are completed, and corrections to the thesis are judged satisfactory by the examination committee.
2. Admission of students to the 4F90/4F91 program normally requires the achievement of an overall 70% (B) average in the Year III Biotechnology courses.

3. Year IV students who do not meet this standard may be admitted to the program at the discretion of the Director of the Biotechnology Centre and the supervising faculty member, to the extent that space and facilities permit.
4. Every faculty member has the right to refuse supervision of a specific student. However, this will be exercised only under extraordinary circumstances, and must have some defensible basis. The Director of the Biotechnology Centre will judge the defensibility of such refusals.
5. In no case shall a 4F90/4F91 student be employed or paid by his/her supervisor while enrolled in the course.
6. Faculty members will not normally supervise Biotechnology 4F90/4F91 students while sabbaticants

2. Responsibilities of the Student, the Supervisor, and the Committee

The thesis program has been instituted primarily to provide Honours students with significant experience in the investigative process. Although it is undesirable to legislate formal regulations regarding the responsibilities of supervisors and committees *vis-à-vis* students, some guidelines are appropriate.

A. Student

1. The student has the responsibility of functioning as independently as possible. This does NOT mean that the student should never consult with the supervisor about what the student is doing. Informal but fairly regular discussions with the supervisor will be very useful. The student should be prepared to discuss what he or she has done in the last few days, and tell the faculty member what he or she plans to do next and why. Students should also get into the library and read additional papers related to their research; the supervisor is not expected to provide the student with all of the relevant work in the field.
2. Biotechnology 4F90/4F91 counts as two courses towards graduation. A good rule of thumb is that students should spend as much time on each of these as on a normal course. This works out to 15-20 hours per week, divided between lab work, reading, computer work, or whatever activity is appropriate for the research.
3. Students are expected to be able to write reasonably grammatical English, free of spelling errors (it isn't fair to blame the typist). It is not the supervisory committee's responsibility to correct the student's grammar and spelling mistakes.

4. The student must write his or her own thesis. The supervisor and/or the committee may assist the student with the initial organization, and may suggest topics that should be covered. The supervisor will usually read the completed thesis and suggest further revisions. However, the supervisor does not write or re-write the thesis for the student. A student who cannot satisfactorily organize and write the thesis, even after consultations with the committee, cannot expect to receive a good mark in Biotechnology 4F90/4F91.

B. Supervisors

1. Thesis projects should be suitable for the illustration of the entire research process, from the formulation of hypotheses/identifying a research problem through to the decision-making steps and the communication of results. They should be real problems and not primarily isolated aspects or technical problems associated with the supervisor's personal research program.
2. B.Sc. projects are not the equivalent of M.Sc. studies and their principal goal is not the publication of a research paper. Consistent with the aim of the Biotechnology 4F90/4F91 program, they should be well defined and relatively limited in scope. Open-ended projects should not be encouraged and every effort should be made to avoid studies that are unlikely to yield results within the time period available.
3. Since Year IV students cannot ordinarily be expected to have the background knowledge necessary to define a research problem and establish appropriate methods to study the problem, supervisors should work closely with their students in this phase of the study. Supervisors also normally assist in the development of analytical, observational and technical skills. The supervisor normally provides the student with a selection of research papers related to the topic of study, and assists the students to understand the nature of the research they are undertaking. Most students have difficulty setting up realistic experimental schedules, so supervisors should help with this.
4. A most important part of the learning experience of 4F90/4F91 is data analysis, interpretation of results and integration of these into the current scientific thought. Since this is the ultimate reason for doing research, it is very important that students be exposed and assisted through this process by discussions with their research supervisors.
5. Since most students require assistance in the organization of their reports, a schedule has been defined which provides time for the student to prepare and submit more than one thesis draft. Supervisors should ensure that the drafts are of reasonable quality with respect to style, organization, etc., before final typing.
6. The duties of the supervisor cease with the final submission of the thesis to the Biotechnology 4F90/4F91 Coordinator. At this time the supervisor reverts to membership on the examining committee.

N.B.:

When Biotechnology 4F90/4F91 is taken during any 8 month term, no thesis investigation may be initiated before commencement of the 8 month term. Students may carry out

projects in the laboratories of faculty members for whom they have worked as summer research assistants but may not use for a thesis any data or material obtained during the tenure of such an appointment. Moreover, no Year II or Year III student may be hired as a research assistant with the understanding that he or she is then obligated to carry out a thesis project under the supervision of the faculty member concerned.

C. Committees

Committee: Each student registered for Biotechnology 4F90/4F91 will be assigned a committee that will consist of the research supervisor and one other faculty member from the department of Chemistry or Biology. The second faculty member on the committee must also be a member of the Center of Biotechnology and preferably will have some knowledge of the area in which the project is to be conducted. The faculty member that is not the project supervisor will act as chair of the committee. The function of the committee is to advise the student during the course of the research and writing of the thesis. The student may consult with members of the committee at any time, and should also seek advice from other faculty members when this is appropriate. The committee will meet with the student to hear the first and second seminars, to mark the progress report, and to mark the final thesis, final seminar and final defence as outlined in Section 4. The committee chair will be in charge of the final thesis presentation and defence, and will be responsible for collating and returning the final grades assigned to the program coordinator.

3. STARTING DATES

BTEC 4F90 and BTEC 4F91 may be started in fall (September to April cohort), winter (January to August cohort) or spring (May to December cohort). The same regulations apply whether a student starts in the fall, winter or spring with the exception of deadline dates. Deadline dates for all three cohorts are listed in section 4.

4. SCHEDULE AND DEADLINES

Schedule:

- (a) Each member of the Centre for Biotechnology is expected to participate in the BTEC 4F90/4F91 program. For each member, a list of possible student projects will be given to the undergraduate coordinator and a general meeting of all interested prospective BTEC Honours students will be held during the winter term (normally in early March). Supervisory faculty will present an overview of their proposed project areas at that meeting. (Copies of the list of topics will also be given to the Honour's program coordinators of participating departments.)

Each student participating in the BTEC Honours program will be required to make his/her arrangements with a supervisor, and to register with the

BTEC Undergraduate Coordinator no later than one week following the commencement of the term they begin their project.

Two faculty members may co-supervise a 4F90/91 project if so desired.

- (b) Each student will be required to present three seminars during the course:
- (i) The initial seminar, the planning seminar, will be scheduled during the first month of the term that 4F90/91 commences. These seminars should deal largely with the nature of the problem and the proposed design of the study. The principal goal will be to provide for a committee input with respect to the final organization of the study. A 1 to 2 page written outline should be provided to the committee at the start of the seminar. This planning seminar presentation will be no longer than 15 minutes and will be followed by a 5 to 10 minute discussion period.
 - (ii) The second seminar, the progress seminar, will be scheduled after submission of the written progress report at the start of the second 4 month term(see Section 4, Deadlines for dates and Section 5 for content. Each student should present his/her findings to date. The committee may then make recommendations as to possible further experiments, data analysis, etc.
1. The final seminar will be scheduled within a two-week period after final submission of the thesis (see section 4, Deadlines for due dates and Section 5 for content). The student will be expected to outline the problem, its background, the design of the study and results obtained and discuss the conclusions. A defence of the thesis will follow in closed session with the examining committee. The total session should not exceed 1.5 hours.
1. Each student will prepare two written reports during the course:
 1. The progress report will be handed in at the end of the first term. See section 4, Deadlines for due dates and section 5 for content requirements. The progress report is limited to 15 pages in length.
 - (ii) The final thesis will be handed in at the end of the second term. See section 4, Deadlines for due dates and section 5 for content requirements. The final thesis is limited to 50 pages in length.

Deadlines:

- (a) Under no circumstances should theses be submitted for examination without prior submission of draft(s) to the supervisor.
- (b) Submission of the first draft to the supervisor will be at least **three weeks before** the final submission date. This should allow sufficient time for revisions and final typing.
- (c) **Due Dates**
 - (i) **September – April cohort**
 - Planning seminar: Prior to September 30
 - Progress Report: December 20 by 5 pm, handed to the course coordinator
 - Progress Seminar: Friday of the first week of January
 - Final Thesis: April 1 by 5 pm, handed to course coordinator
 - Final Seminar and Defence: Scheduled day prior to April 14
 - 2. **January – August cohort**
 - Planning seminar: Prior to January 31
 - Progress Report: April 20 by 5 pm, handed to the course coordinator
 - Progress Seminar: Friday of the first week of May
 - Final Thesis: August 1 by 5 pm, handed to course coordinator
 - Final Seminar and Defence: Scheduled day prior to August 14
 - 3. **May – December cohort**
 - Planning seminar: Prior to May 31
 - Progress Report: August 20 by 5 pm, handed to the course coordinator
 - Progress Seminar: Friday of the first week of September
 - Final Thesis: December 1 by 5 pm, handed to the course coordinator
 - Final Seminar and Defence: Scheduled day prior to December 14
- (d) For all cohorts, final submission of the thesis (**two copies**) to the Honours Program Coordinator will occur **prior to 5 p.m. on the due date** or if a weekend, on the following Monday as announced by the Program Coordinator. No further revisions will be permitted. This copy is to be graded, as submitted, by the Committee. Failure to submit the thesis on the deadline date will carry the **penalty** of a reduced grade unless there are documented medical or comparable reasons justifying late submission or unless, **under rare exceptional circumstances**, the Director of

Biotechnology, in consultation with the Program Coordinator, exercises his/her discretionary powers. There are no predetermined penalties. Penalties are determined by faculty of the Departmental Committee as a whole on an individual, case-by-case basis. The final seminar and oral defence will be scheduled by the course coordinator within two weeks of the thesis submission between the last day of classes and the start of the examination period.

5. EVALUATION

- (a) **Progress Report:** Two copies of a typed progress report worth 15% of the grade for 4F91 must be submitted to the 4F90/91 co-ordinator by December 20 (for projects started in September), April 20 (for projects started in January) or August 20 (for projects started in May). If a student has two supervisors, then three progress reports must be submitted. The reports will be distributed to the supervisory committee for grading by the course co-ordinator. If any of these dates should fall on a weekend, then the deadline will be the following Monday. The progress report will only include an introduction and literature survey along with literature cited. The report is to be written in a concise manner such that a complete literature review is presented in 15 pages.

Progress Seminar: After the written report has been submitted, on the Friday of the first week in the following (2nd) term, the student will give a seminar reviewing progress to date for laboratory research worth 15% of the grade for 4F90. (First Friday of Jan for September to April cohort, first Friday of May for the January to August cohort, first Friday of September for the May to December cohort). The progress seminar is limited to 20 minutes with a 5 minute discussion to follow.

- (b) **Final Thesis: Two copies** of the thesis must be submitted for examination (see section 6 and Part 2 for details of thesis format).
1. **Final Thesis:** Final Theses must be submitted in final form on April 1 (for the September to April cohort), August 1 (for the January to August cohort) or December 1 (for the May to December cohort). Both members of the committee (the supervisor and the chair) will grade the thesis for Scientific Merit (50% of 4F90) and Library Research and Communication (50% of 4F91). These marks will be submitted before the seminars and defences, which will take place shortly following the end of classes.

- (d) **Final seminar presentations:** The final seminar presentation will be 20 minutes in length with a question period thereafter. This will be held within a two-week period after submission of the thesis. Grades worth 15% for BTEC 4F90 and 20% for BTEC 4F91 will be assigned to the seminar.
- (e) **Closed oral defences:** Closed oral defences in which the student and examining committee meet for not more than one hour will be held after the seminar presentation. Questioning by committee members will normally pertain to the thesis topic but students should anticipate questions on the theoretical basis and appropriateness of methodology used and also on the broad ramifications and significance of their topic. Grades worth 20% for BTEC 4F90 and 15% for BTEC 4F91 will be assigned to the defence.

Marks assigned to the seminar and the defence are to be registered, in writing, with the Chair of the Examination Committee immediately following termination of the final defence of the thesis and prior to any discussion. The marks assigned by individual committee members will have equal weight.

Final Mark Allocation:

4F90 is Scientific merit and laboratory performance

4F91 is Library research and communication

| | 4F90 | 4F91 |
|------------------|-------------|-------------|
| Planning seminar | 0% | 0% |
| Progress report | 0% | 15% |
| Progress seminar | 15% | 0% |
| Written thesis | 50% | 50% |
| Final seminar | 15% | 20% |
| Defence | 20% | 15% |
| | 100% | 100% |

- (f) For purposes of transmission to the Registrar, two final grades will be assigned, one for BTEC 4F90 and one for BTEC 4F91.
- (g) The mark assigned for BTEC 4F90 will reflect the laboratory performance and scientific merit of the thesis. It should be based on the material presented in the thesis and the defence of the thesis during examination.

The mark assigned for BTEC 4F91 will reflect the communicative abilities of the student and the thoroughness of the library research. This will be based in part on the thesis and in part on the seminar presentation.

- (h) The program coordinator will collate all mark assignments, weigh and calculate the average marks for each subsection and for each of the two courses. In cases of **extreme** discrepancies in assigned marks, the coordinator and Chair of the Examining Committee should attempt to arrive at some acceptable consensus.

All grades, including the individual mark assignments of committee members, must be returned to the coordinator of the course.

Prior to submission of the final grades for BTEC 4F90 and 4F91, the faculty of Centre for Biotechnology, acting as a Committee of the Whole, will review all results.

- (i) Final grades will not be transmitted to the Registrar until corrected copies of the thesis have been received by the course coordinator. Normally, three corrected copies of the thesis are submitted for binding (see section "j" below).
- (j) Disposition of theses: One copy, corrected to the satisfaction of the examining committee, is retained by the Centre for Biotechnology, bound and deposited in the Centre's collection. A second copy is the property of the supervisor and the third copy is the property of the student. The secretary of the Centre will make arrangements for additional copies to be bound if desired by the student.

6. THESIS FORMAT

A short thesis outline is available at the end of this document (see Part Two). It is suggested that all theses follow a format similar to the following:

- (a) Title Page
- (b) Acknowledgments
- (c) Abstract
- (d) Introduction and Literature Review (combined or separate sections):
concisely outline the problem, the goal of the study and the approach used
- (e) Materials and Methods
- (f) Results
- (g) Discussion
- (h) Summary and Conclusions

- (i) Literature Cited
- (j) Appendices

The final thesis should not be longer than 50 pages. At the discretion of the supervisor, additional data may be included in the appendices.

7. BUDGET AND SUPPLIES

- (a) A small budget for each student will be allocated to the supervisor, provided sufficient funds are available.
- (b) A withdrawal record sheet will be maintained for each project in Stores. All in-stock items and all purchased equipment and supplies will be recorded on this. Withdrawal from stock and all purchase orders must be authorized by the supervisor. All purchase orders must be signed by the Chair.
- (c) Students will be held accountable and responsible for all equipment and unused supplies, and these are to be returned in clean condition to the Storeroom prior to the thesis defence.
- (d) In general, the teaching laboratories will have priority in questions of equipment use.
- (e) If possible, students will be provided with individual locked cupboards for the storage of materials.
- (f) The following items constitute reasonable charges against project budgets: apparatus, glassware, chemicals, mileage costs associated with field studies, photographic and drawing supplies used by the student in thesis preparation, reasonable inter-library loan costs. Costs of thesis typing and photocopying are specifically **excluded**.

8. KEYS

There is a deposit of \$20/key with a maximum of \$50. Final grades for each student will not be transmitted to the Registrar until their university keys have been returned to the appropriate departmental storeskeeper. Exceptions will be made for students who continue to work in the same laboratory as graduate students, student assistants or research assistants.

9. APPEALS

It is recognized that under some circumstances students may wish to appeal a final grade. The Appeal Procedure as outlined in the Undergraduate Calendar is followed. Since the final grades for Biotechnology 4F90/4F91 are not awarded solely by the research supervisor, in the first instance the student must refer the matter to the Director of the Centre for Biotechnology. The Director will appoint an *ad hoc* committee to deal with the appeal.

10. GRADUATION

Students intending to graduate at the Spring Convocation must complete an “application to graduate” by March 1st. And, students intending to graduate at the Fall Convocation must complete an “application to graduate” by August 1st. These are fixed dates as outlined in the Undergraduate Calendar. These application forms are available in the Office of the Registrar and must be submitted to them by the dates listed above.

11. INTELLECTUAL PROPERTY

All students must be apprised of Brock University’s policy on Ownership of Student-created Intellectual Property. Both the student and his/her research supervisor must fill out the Intellectual Property Agreement form and return it to Research Services.

Part Two

Instructions for the Preparation and Submission of Theses for B.Sc. (Honours) Degrees

A. Scope

The thesis for B.Sc. (Honours) degrees shall be a report of research work carried out during the honours candidate's Biotechnology 4F90/4F91 project. A description of related summer work may be appended to the thesis but this description will not be considered in the evaluation of the thesis.

B. General Information

1. **Number of copies:** At least two (2) copies of the final version of the thesis must be prepared and submitted in an unbound form to the program coordinator following the schedule outlined in Section 4, Deadlines. Each copy must be adequately secured in a spring back or similar folder, but not in a folder requiring the punching of holes in the pages of the thesis.
2. **Incursion of costs:** All typing, reproduction and other costs of preparing the thesis are the responsibility of the student. The research supervisor may have expenses paid from a research account at his/her discretion. Students are **not** permitted to use departmental laser printers for printing.
3. **Approval and disposition of the thesis:** After the oral examination and approval of the thesis by the examining committee, the candidate must correct errors noted by the examiners, in each copy of the thesis, and then submit three corrected unbound copies of the thesis to the Biotechnology 4F90/4F91 Coordinator. After binding, one copy of the thesis shall remain in the Centre for Biotechnology, one copy shall be retained by the candidate's thesis supervisor and one copy shall be returned to the student. Any additional copies that the student wishes to have bound will be paid for by the student (payable when the thesis copies are submitted to the Administrative Assistant for the Biotechnology Centre). Any student that does not submit final copies of the corrected thesis by the deadline for submission of marks dictated by the Office of the Registrar will receive a grade of Incomplete. If the corrected thesis is not received within the 8 week grace period allowed by the Office of the Registrar, the interim grades will stand for both Biotechnology 4F90 and Biotechnology 4F91.
4. **Rights to lend and reproduce the thesis.** Unless there is a specific arrangement to the contrary, the university will allow the thesis to be consulted or borrowed or to be used in whole or in part in photocopied (as allowed by the copyright protection law) or microfilmed form.

C. Paper and Typing

1. A good bond paper must be used for all copies of the thesis. The size of paper must be 8.5 x 11 inches. A margin of 1.5 inches must be left on the left-hand side of all bound pages, and margins of not less than 0.5 inches on the other three sides.
2. The title page should bear the title of the thesis and the candidate's name as registered at Brock University.
3. The original copy of the thesis must be typewritten or laser printed and must be clearly legible. Other copies should be photocopied on a good photocopying machine. The main body of laser printed theses should be 12 point type, double spaced (24 point spacing).
4. All typing must be double-spaced except for quotations, footnotes, legends, tables and references, which may be single-spaced.
5. Right-hand pages only should be used and numbered. These should be numbered in one continuous sequence from the Introduction to the last typed page, in Arabic numerals from 1 onwards.
6. Plates, diagrams, tables, etc., which are not bound in with the text, but which are either loose or in an end pocket, or separately bound, should be given one separate sequence of numbering.
7. Photographs should be securely dry mounted. In no circumstances should tape be used for any purpose in a copy of the thesis.
8. Subsidiary papers and other loose material should be bound in whenever possible. If this is not possible, an adequately guarded pocket for such material should be provided at the end of the thesis. Any such loose material, and corrigenda sheets, if not bound in, should bear the candidate's name, initials, degree, date and the name of the University.
9. No interlineations, crossing out of letters or words, strikeouts or extensive erasures are permissible. Characters not available on standard typewriters may be neatly added by hand with black ink.

D. Format

A thesis should normally include the following major parts:

1. Preliminary pages:

(a) **The first page** must be a blank unnumbered sheet.

(b) **Title Page.** The form of the title page must follow the sample shown at the end of these instructions. It must state the full title of the thesis, the candidate's name in full, the degree expected, the title of the (supervisor's) department and the year of submission.

(c) **Abstract.** The abstract should be a summary of the thesis outlining the problem, methods of investigation, the main results and general conclusions. It should normally not exceed 500 words.

(d) **Acknowledgements.** This section should be a brief acknowledgement of assistance given to the candidate in his research and writing.

(e) **Table of Contents.** This should set forth all the principal topics and subdivisions of the thesis.

(f) **List of Tables.**

(g) **List of Illustrations.** This should include separate lists of all figures and plates.

(h) **List of abbreviations.**

2. Text

Conciseness and clarity of exposition are of the essence. The format appropriate to the topic should be decided in consultation with the supervisor. Normally a thesis contains at least the following sections:

I Introduction: The introduction to a thesis should normally present the purpose, methods and scope of the study together with a survey of the literature pertaining to the subject of the investigation.

II Experimental or Methods: This section should present a detailed account of all methods used in the investigation.

III Results: All results to be presented in the thesis must be given in this section together with any explanations that are necessary.

IV Discussion and Conclusions: A discussion of the results obtained in the investigation and a summary of the candidate's conclusions should be given in one final section, or may be presented in two separate sections.

Each Figure number and accompanying legend should appear on the same page as the Figure and be placed under the Figure. Figures and Tables may either appear on separate pages from or be embedded within the text.

3. Footnotes

Footnotes, where considered necessary, should be placed at the bottom of the appropriate page.

4. References (or Literature Cited)

The list of references is a very important part of a thesis and care should be given to its preparation. All references should be typed single-spaced, with double spacing between each entry. The general form of the references and the method of abbreviating names of periodicals should be the same as that used in an appropriate journal recommended by the research supervisor.

5. Appendices

Appendix pages are numbered in chronological sequence following the last page of the Reference or Literature Cited section of the thesis. Appendices should be used to present material accessory to the argument of the text. These may be of such a nature as not to form integral parts of the text, and of such extent as not to be appropriate as footnotes. Such material as extensive tables, mathematical developments, computer programs and additional experiments may well form appendices. Each topic shall form a separate Appendix, which must be identified by an upper case Roman letter. References used in Appendices will not be included in the list of References, but should appear either as footnotes or as a separate section at the end of the Appendix.

6. Last Page. The last page should be a blank, unnumbered sheet.

Additional Aspects. It is the candidate's responsibility to ensure that details not considered here are discussed and clarified with his supervisor. Check references related to writing up research results, e.g. "Writing Your Thesis", by J.M. Pratt.

(SAMPLE TITLE PAGE)

DIRECT GENE TRANSFER INTO NEWT SKELETAL MUSCLE *IN VIVO*

Jennifer Mueller

Department of Biological Sciences

A thesis submitted to the Centre for Biotechnology
in partial fulfilment of the requirements for the degree
of Bachelor of Science (Honours)

Brock University

St. Catharines, Ontario

April, 2001

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