A GUIDE TO THE INDEPENDENT STUDY
FOR THE MASTER'S DEGREE
AFIT/ENP

March 2004

CONTENTS:

ATTACHMENTS:

I. THE INDEPENDENT STUDY

The term "Independent Study" represents the totality of effort required for the master's research project. The major objective of this study is learning how to attack and solve a major technological problem in a controlled environment. In large measure, this is self-learning with some direction from a thesis advisor. In the process of problem solution, the student learns in depth those subjects related to the chosen thesis area. The student is required to define the problem, plan a method of attack, perform the work required for its solution, and analyze and report on the results of the work.

The nature of the study has been well expressed in the following excerpt from a statement by the Graduate Committee of the American Society for Engineering Education:

"It is only at the doctorate level that there is justification for the requirement that a thesis shall comprise an original contribution to knowledge as evidence of expertness acquired. In respect to the thesis for a master's degree, the time conventionally assigned is limited and the student is usually inexperienced in research. It should be clear, therefore, that the objectives of the master's thesis are not necessarily the same as those of the doctorate. **A COMMONLY ACCEPTED PRINCIPLE IN THE CURRICULUM LEADING TO A MASTER'S DEGREE IN ENGINEERING IS THAT THE MASTER'S THESIS IS TO BE PRIMARILY CONSIDERED AS A CONTRIBUTION TO THE TRAINING OF THE CANDIDATE RATHER THAN A CONTRIBUTION TO KNOWLEDGE**."

These views generally are also those of the AFIT Faculty.

II. SELECTION OF A THESIS TOPIC

Selection of a thesis topic may proceed in several ways. In rare cases, as a result of prior experience or interest, the student may propose a topic of his or her own choosing. In this case, the Department needs to be informed as soon as possible in order for the student to obtain tentative approval. Final Departmental approval will depend on the appropriateness of the subject matter, as well as upon the student's ability to locate a faculty member who possesses sufficient background and interest in the proposed area to act as the student's advisor.

Normally, topics will be chosen from those proposed by AFIT faculty members and scientists from other Air Force organizations either during scheduled Department of Engineering Physics Seminars or posted in a binder of thesis topics kept in the Engineering Physics office under the "department clock." Most students will select a topic via this route. Before selecting, the student should make sure of the exact nature of the problem and the conditions under which he or she will be working. This is best done by discussing the topic one-on-one with the faculty member. Generally, topics will have the sponsorship of some Air Force or DOD organization. In some cases, for topics sponsored by one of the AFMC laboratories, the student may be located in that laboratory for a period of cooperative research. Co-op assignments to laboratories not located at Wright-Patterson AFB will be arranged on an individual basis. Students selecting topics primarily proposed by an AFIT faculty member will usually work entirely within AFIT and directly with that faculty member. In such cases, the sponsoring DOD organization will be kept abreast of the thesis progress by the student, and may or may not be directly involved in an advisory capacity. In all cases, a member of the AFIT faculty will be assigned to the student's committee to serve as a point of contact for administrative matters.

The schedule for topic selection, as well as other benchmarks in completing the theses, are given on Attachment I for all GAP, GNE, GM, GMS, GES and GEO students. Although topics can be selected as early as the first quarter, students must select thesis topics before the end of the third quarter. Selection is accomplished by submitting to the class advisor a list of three proposed topics in order of preference. Although second and third choices are required, in many cases, students will have resolved conflicts among themselves before submitting their request; if not, conflicts will be resolved by the Department. Final assignment of topics and advisors will be made by the Department for the students before the beginning of the fourth quarter.

III. STUDENT/ADVISOR RELATIONSHIP

The student and his or her advisor form a team. It is the advisor who will serve as the primary source of guidance and information in carrying out the thesis project. The advisor is a resource who should be used well, but not overused. When problems are encountered by the student, they should be analyzed and possible approaches formulated for resolution before the advisor is consulted. This is a guided independent study. The prime responsibility for completing it lies with the student, not the advisor. The advisor is there to help the student through those difficult periods and point him or her in the right direction, not as a person who will direct the student on a day-to-day, step-by-step basis. Each advisor has his or her own methods of providing guidance,

just as each instructor has different classroom techniques. It is imperative that the student fully understand what the advisor expects.

For a student working in a laboratory outside of AFIT, the laboratory scientist will normally be the primary source of advice concerning the research problem. The AFIT thesis advisor will, in this case, monitor the progress in a general sense and assist in grading the final report. Monthly progress reports on the work should be submitted by the student. In addition, since the student remains under AFIT control for administrative and academic matters, it will usually be necessary to consult the AFIT advisor from time to time on questions in these areas. It is particularly important that the student become acquainted with the laboratory environment where he or she will be working. Such acquaintance will foster a smooth liaison among all involved parties. Also, the student should ensure that the working relationship and the division of authority between the faculty advisor and the laboratory advisor is clearly understood, and that regularly scheduled reporting procedures are established with the AFIT thesis advisor.

Questions concerning leave, duty hours, and other administrative matters should be coordinated with your AFIT thesis advisor. Several matters of this nature are covered in Attachment II.

IV. THESIS COMMITTEE

A thesis committee will be formed in a cooperative effort between the advisor and the student. This committee will usually consist of three members, one of which is the thesis advisor and at least two of which are full-time faculty. The other members may be chosen from full-time faculty, adjunct faculty or other persons such as Air Force laboratory or program office scientists and engineers. Details of the interaction between the student and his or her committee should be established at the beginning of the thesis effort by consultation with the faculty advisor. During the final quarter, the committee will judge the results of the independent study. The final grade will be determined principally by the thesis advisor with the advice and consent of the committee.

V. THE PROSPECTUS

A written prospectus will usually be required by the thesis advisor. The specific details and form required in the prospectus should be obtained from the thesis advisor; however, generally there should be enough information presented to enable the committee members to judge the student's knowledge of the topic and the suitability of the proposed approach to a solution of the problem presented by the topic.

VI. THE MS THESIS - WHAT IT IS

The thesis, a written document, is an interpretive report on the independent study that has been completed by a candidate for a degree. The thesis and the oral presentation supporting it are a significant measure of the level of competence a student has attained as a candidate for a degree. They provide insight into the candidate's knowledge and understanding of a special field of study, originality and independence in approaching a problem, skill in planning and conducting

such work, and ability in communicating ideas - the candidate's and others' - by words and figures.

The preparation and execution of a thesis are valuable parts of a professional education. The thesis offers a practical opportunity for the young scientist or engineer to demonstrate his or her ability to make progress on one's own initiative in the solution of a problem he or she has never seen before.

VII. PREPARATION OF THE THESIS

The preparation of the thesis should begin as early as possible; some sections can often be prepared early in the fifth quarter. The details of the thesis and the degree to which the thesis advisor will interact with the student in its preparation should be established in that quarter. Generally, this preparation proceeds in three steps: Rough draft, Grading Copy, and Final Thesis.

a. **Rough Draft**: After initial discussion with the advisor, a rough draft of the thesis is prepared. This may be done over an extended period of time and parts of the draft will often be discussed with the advisor. This draft may vary from a sketchy outline to an essentially complete, but rough, report; i.e., whatever is required to achieve an understanding between the student and his advisor regarding content, style and organization of the thesis.
b. **Grading Copy**: This is the student's first complete presentation of the written thesis to the faculty for approval. It consequently represents the student's **best** effort as far as technical content and literary style are concerned. Although formatting of the **grading copy** is not required to be precise; that is, written corrections can be made, margins are not critical, drawings/graphs do not have to be in final form, etc, in this day of the word processor, the grading copy is generally well laid out and complete. The important point that must be kept in mind is that the **grading copy must be in a form that enables the committee to make a fair assessment of its technical and literary content**. The grading copy is to be submitted in triplicate to the advisor no later than the date given on the attached schedule. It is then read by all committee members who will suggest changes and corrections. The copies will be returned to the student no later than Friday of the fifth week of the sixth quarter.
c. **Final Thesis**: This is the final version handed in by the student. It is in completed, "camera ready" form; i.e., it includes all suggested changes from the committee, contains final graphs and drawings, is devoid of typographical errors, has proper margins, uses an acceptable font, is on proper weight paper, etc. The final thesis (original) and four Xerox copies, each containing Standard Form 298, plus three extra copies of Standard Form 298, and a computer disk containing an electronic copy of the thesis, are to be submitted to the departmental administrative assistant no later than Monday of the tenth week of the sixth quarter. (Note: **The original should not be punched or bound**, copies should be bound in the imprinted AFIT covers available at the bookstore.) Ms. Jordan will check the submission to assure that all copies and forms are present as well as to asertain whether the quality of the final document will be acceptable to DTIC for reproduction. She will then pass the copies to the thesis advisor for a final check of the technical quality and assignment of a grade.

There are many documents governing the preparation of the formal report on the independent study. Two important publications are Theses and Dissertations, ENOI 50-2, and Style Guide for Theses and Dissertations by AFIT/LA. These documents will either be distributed to each student during the thesis seminar or, if not, they are available from the Physics Department secretary. Another very useful reference is the book, Theses in Science and Engineering by R. Davis, a former AFIT faculty member, which is available for use in the Library and for purchase in the AFIT Bookstore.

VIII. ORAL PRESENTATION

During the quarter following the full-time thesis quarter, each student is required to give an oral presentation and defense of his or her independent study. This oral presentation will be given on a day devoted to thesis presentations scheduled early in the sixth quarter. All thesis presentations will be scheduled on this one day at a seminar attended by the members of the thesis committees, other AFIT faculty, personnel from the laboratories with whom the student has been associated during the thesis period, and interested students. The allotted speaking time is generally 15-20 minutes per student. The oral presentation requires that the work be carefully reviewed, that a clear statement of the problem be selected, that only the salient features of apparatus, procedures, and results be discussed, and most importantly, that the analysis and conclusions be clear and definite. These features should then be organized so that the presentation will be smooth and orderly. **Note: The thesis advisor should be consulted prior to the oral presentation** as to the general quality of the grading copy of the thesis, as well as to possible areas that might be re-examined by the student prior to the presentation. At some time following this thesis presentation seminar, the student will meet with his or her committee to defend the work presented in the thesis. Although another presentation is not normally a part of the defense, circumstances such as the absence of a key member on the day of the thesis presentation seminar, might argue for a short review of the thesis presentation. The student should check with his or her advisor for guidance on this matter.

Generally, some of the drawings and graphs found in the thesis may have to be redone for oral presentation since these drawings contain too much detail or the printing on them is too small for clear projection. One of the best presentation aids is the thermofax transparency used as a viewgraph. These transparencies can be made directly from the thesis paper. Thermofax transparencies are available at the desk in the AFIT Library. In addition to the projection methods described above, the student should consider the different possibilities carefully, and then choose the one which best suits the purpose. The student should bear in mind that what may be large and clear at the front of the room may appear small and confusing to the audience at the rear of the room.

The Thesis Committee will evaluate the presentation and defense on the basis of the statement of the problem, the description of the method and important apparatus, analysis of data, conclusions drawn, overall clarity of presentation, and understanding shown in answering questions. In almost every case, additional changes will be necessitated by discussion during the oral presentation. Evaluation of the presentation and defense is included in the thesis grade. Within a day after the oral presentation, recommended changes and revisions of the thesis will be provided to the student by all committee members. After receiving these changes and revisions,

the student prepares the final copy of the thesis, which is due on Monday of the ninth week of the sixth quarter.

IX. GRADING POLICIES

The grade for the independent study is determined by the thesis advisor with input from the other members of the thesis committee. This grade is based on all of the student's work under PHYS, NENG, OENG, or METG 799, including the grading copy of the thesis as well as the oral presentation and defense. Work required of the student after the oral presentation generally will involve only modifications of the grading copy. Such required modifications can have only incremental effects on the final grade. Normally, only in the event that the work is not of graduate quality will major modifications of the thesis be required.

NOTE WELL: THESIS GRADES WILL BE FORMALLY ASSIGNED ONLY AFTER SUBMISSION OF THE FINAL, COMPLETED THESIS.

Some factors which are considered in the determination of the grade for XXXX 799 are:

1. Independence displayed
2. The effort and perseverance displayed
3. Judgment used in planning and carrying out the work
4. Knowledge gained as a result of the work
5. Clarity and completeness of the written report - the thesis itself
6. Clarity and completeness of the oral presentation

Department of Physics Standards for Thesis Grading :

(1) The **"B" grades (B, B+)** are given for a good, solid result. The "B" grades indicate the level of result one would expect from a Master of Science candidate. Such an effort is characterized by some or all of the following:

a. Some creative contribution or thinking by the student in addition to the guidance and direction given by the thesis advisor. Specifically, the advisor does not have to specify every step, but rather some steps are proposed by the student.
b. A level of effort appropriate to the time available. (Full-time research students do not show up at 10:00 a.m. and disappear at 3:00 p.m. with little or no evidence of progress or work done elsewhere.)
c. The student produces experimental measurements, calculations, or analyses which are consistently correct or which need only minor modification to be correct.
d. The grading copy of the thesis is readable and intelligible to the committee on the first reading, and it reports research in an accurate manner. Minor style, organization and grammatical changes may be recommended by the committee, but on the whole the grading copy meets the above criteria.

(2) The **"A" grades (A-, A)** are reserved for true excellence. "A"-graded independent studies are characterized by most or all of the following most or all, not one!):

a. After initial guidance and direction by the committee, the student takes over and, under the continued approval of the committee, takes primary direction of the research. (The student typically suggests the next step, analyzes what it means, and suggests further steps.) Furthermore, that direction and those results are the best possible in the judgment of the committee.
b. The level of effort and level of knowledge acheived is outstanding.
c. The results are significant and often publishable. They are often noted by the sponsoring agency as being an outstanding contribution to their mission.
d. The grading copy of the thesis is succinct, accurate, and above all, smoothly written, indicating an excellent understanding of the thesis problem and the results obtained.

(3) **Other grades (C, C+, B-)** are given for studies which, it taken alone (without any compensating course work), would not merit the award of the Master of Science Degree. Such theses are characterized by some or all of the following:

a. The student need continued strong guidance by the advisor on what step to perform next, and even then has a great difficulty in carrying out the step or in analyzing its significance.
b. The level of effort is inadequate.
c. The student has great difficulty in carrying out measurements or calculations to a correct end point, even after continued corrections and help from the advisor. The student has great difficulty in interpreting the meaning of his or her efforts, even in the final days of research.
d. The grading copy needs complete, sometimes total, reorganization. The use of the English language shows deficiencies and the author's meanings are obscure.

(4) **The failing grades (D and F)** are given for an unacceptable independent study. In the past (rare), "D or F" thesis grades have been given for the following reasons:

a. The effort is at best marginal. The student rarely showed up and when he or she did, had empty hands or a half-page of calculations or analysis hastily prepared. No equipment was ever hooked up; no computer code ever written.
b. The student was unable to turn in a thesis of any kind, or if one was turned in, it bordered on nonsense or glittering generalities about science and the problems at hand.

(5) **The grade of "I" (Incomplete):** Sometimes, through no fault of the student--sickness, family emergencies, non-delivery or failure of experimental apparatus, continued non-availability of computer time--a student is unable to complete the project in the scheduled time. In such cases, a grade of "I" may be awarded and the student given an additional specified time to complete. In very rare cases, this additional time may extend beyond scheduled graduation. Unfortunately, the Department's experience is that students who leave AFIT with "I" on the thesis are more likely not to complete, than to complete, the thesis. Students who receive an "I" do successfully complete the thesis are not given a grade penalty for the initial incomplete. The "I" grade, however, will not be awarded solely for the purpose of grade improvement.

X. THESIS DISTRIBUTION:

The final thesis and the copies of the thesis are distributed as follows:

1 DTIC Copy, unbound in blue cover w/SF 298 in back of document + 1 extra copy of SF 298
1 Library Copy, unbound (25% rag) w/SF 298 in back of document
1 Department Copy, unbound (25% rag) w/SF 298 in back of document
1 Sponsor Copy, bound in blue cover w/SF 298 in back of document (must be reflected on 298)
1 Advisor Copy bound in blue cover w/SF 298 in back of document
1 extra copy of SF 298

TOTAL: 1 original + 4 copies w/SF 298 + 2 extra copies of SF 298

** *Doctoral Students See ENR for Dissertation Distribution* **

ATTACHMENT I

SUMMARY OF IMPORTANT DATES (GM, GNE, GAP, GEO, GMS)

Presentation of Topics to Students
First, Second, Quarters

Final Selection of Topics by Students
Fifth Week of Third Quarter

Student Begins Work of Independent Study
Not later than Fourth Quarter

Student Submits Prospectus
Not Later Than Ninth Week of Fourth Quarter

Student Begins Full-Time Thesis Work
Fifth Quarter

Student Submits Progress Reports and Portions of Draft
As Required by Advisor

Student Submits Final Draft Copy to Advisor and Committee
Not Later Than **Monday, Second Week, Sixth Quarter**

(THERE WILL BE A GRADE PENALTY FOR LATE SUBMISSION UNLESS PRIOR APPROVAL HAS BEEN GRANTED BY THE DEPARTMENT HEAD)

Oral Presentation
As Scheduled

Thesis Advisor Returns Final Draft Copy
Not Later Than **Friday, Fifth Week, Sixth Quarter**

Students Submit Completed Thesis (with Abstracts and Distribution Lists)
Monday, Ninth Week, Sixth Quarter

Department Submits Grades for XXXX 799
Friday, Tenth Week, Sixth Quarter

ATTACHMENT II

ADMINISTRATIVE MATTERS

As stated earlier in Section III, questions concerning leave, TDY travel, flight scheduling and other administrative matters which may arise must be coordinated with the AFIT thesis advisor or faculty advisor unless otherwise directed. Students sometimes have questions regarding the conditions under which they are to operate during the period of full-time thesis work. The guiding principle behind our policies is that, to the fullest extent possible, working conditions should be equivalent to those encountered by R and D officers in the Air Force as they go about their daily business.

a. **Duty Hours:** The student is expected to spend at least eight hours of solid effort, five days per week. How these hours are appointed should be negotiated between student and advisor. For some, it may make more sense to work in the evenings to take advantage of computer availability. For others, availability of experimental apparatus may dictate hours. In any event, the thesis advisor needs to be aware of the student's schedule and have a reasonable expectation of being able to get in touch with him or her if necessary.
b. **Duty Station:** The student's work area should be coordinated with the thesis advisor, just as the work schedule should be. The Physics Department will cooperate with the student in finding a suitable work area. If, for some reason, it is advisable to work at home, this is acceptable as long as the thesis advisor concurs. It is very important, however, that the Department, through the thesis advisor, be able to get in touch with the student if necessary. Thus, the student is expected to follow the agreed upon schedule and be present at the work areas agreed upon.
c. **Uniform:** In view of the fact that the student officer is on duty during the thesis quarter, it goes without saying that the proper uniform should be worn while working "on campus" during duty hours. If the thesis work is being done elsewhere, let common sense prevail, guided by the general principle outlined above.
d. **Leave:** The Department of Engineering Physics has the following leave policy for students working on their Independent Study. During the Summer Short Term, students will spend one week on a field trip, **up to two weeks on leave**, and any remaining time working on the thesis project. During the eleven weeks (first week through examination week) of the Fall Quarter, no leave will be taken except for emergencies. In all cases, leave plans must be coordinated with your thesis advisor during the period of Independent Study.

ATTACHMENT III

DEPARTMENTAL THESIS INFORMATION FORM

FROM: AFIT/ENP

SUBJECT: Theses/Dissertation and Future Assignments

TO: Graduating Students

The following information is requested for our files. Please return to ENP (Educational Technician, Rm 134) ASAP **(at least 3 weeks before graduation)**. Thank you for your cooperation.

LAST NAME: FIRST: MI:

RANK: SSAN:

MS CLASS/YEAR: GAP GM GEO GNE GE GSO DS (Check one)

ED CODE: BRANCH OF SERVICE:

THESIS

TITLE:

THESIS DESIGNATOR: (example: AFIT/GNE/89D-04) ADVISOR:

ADVISOR's DEPT:

CLASSIFICATION: FACILITY USED:

DISTRIBUTION: Unlimited Classified NOT TO DTIC

Distribution Statement:

LAB SPONSOR (DOD organization sponsoring this research)

Complete Address (Office Symbol and Base):

POC Name and Phone:

NEW ASSIGNMENT

Organization (Office Symbol/Address and Base):

DSN Phone # Duty Title:

PERSONAL DATA PRIVACY ACT OF 1974 (5 U.S.C. 552a)