North Carolina A&T State University

GRADUATE STUDENT HANDBOOK

M.S. and Ph.D. Programs
in
Industrial Engineering

DEPARTMENT
OF
INDUSTRIAL & SYSTEMS ENGINEERING
419 McNair Hall

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This document is to serve only as a guide and is subject to change.

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1. Introduction

The Department of Industrial and Systems Engineering (ISE) at North Carolina A&T State University (NC A&T) offers graduate programs with specialization areas in Human-Machine Systems Engineering, Manufacturing and Service Enterprise Engineering, and Operations Research/Systems Analysis. Masters degrees are offered in all specialization areas and the Ph.D. is offered in all areas except for Operations Research/Systems Analysis.

The faculty of the Department of Industrial and Systems Engineering has the responsibi lity of administering the M.S. and Ph.D. programs including admission of students, cour se requirements, administering comprehensive examinations, and supervising graduate student research and dissertation/thesis work. The program is administered by the Gra duate Program Committee, within the department, under these requirements and guidel ines. A graduate student must assume full responsibility for current knowledge of the p olicies, procedures, and regulations of the School of Graduate School (refer to the Grad uate Programs Catalog) and the program requirements and guidelines. For assistance, the student should see his or her major professor, or the Graduate Program Coordinato r.

The administrative staff of the academic programs of the ISE Department includes:

Department Chairperson:	Dr. Paul Stanfield 408 McNair Hall 336-334-7780 ext. 533 stanfiel@ncat.edu
Graduate Program Coordinator:	Dr. Eui H. Park 401 McNair Hall 336-334-7780 ext. 520 park@ncat.edu
Administrative Assistant:	Ms. Elizabeth Brooks 419 McNair Hall 336-334-7780 ext. 526 ebrooks@ncat.edu

2. Purpose of the Graduate Handbook

The Graduate Handbook provides detailed requirements for all of the graduate degrees offered by the Department of Industrial and Systems Engineering (ISE) as well as descriptions of the procedures to be followed in completing the requirements of each degree program. Each graduate student should read and conform to the policy contained in this handbook. Additional information concerning Graduate School

requirements may be found in the 2007-2008 Graduate Programs Catalog from North Carolina A&T State University (NC A&T). If there is any doubt regarding the interpretation of any regulation or requirement in this handbook, or if there are questions about the graduate program involving matters not covered in this manual please consult the ISE Graduate Program Coordinator, Dr. Eui H. Park, or the ISE Graduate Student Program Administrative Assistant, Mrs. Elizabeth Brooks.

This handbook includes the requirements, policies, and procedures adopted by the ISE faculty for successful completion of graduate degrees. The requirements set forth herein apply only to graduate programs in Industrial Engineering. Further requirements have been established by NC A&T's School of Graduate Studies, and ISE graduate students must meet the requirements of both the Graduate School and ISE Department for successful degree completion. While Graduate School requirements may be mentioned occasionally in this document, the student should consult the Graduate Programs Catalog for a complete description of those requirements.

The requirements, policies, and procedures set forth herein apply to students joining the ISE Gradate Program in or after in Spring Semester of 2008. Graduate students joining the ISE program prior to the Spring Semester of 2008 should consult the appropriate prior ISE Graduate Handbook for requirements for completion of their graduate programs. It is the responsibility of each graduate student in ISE to understand and adhere to all applicable policies, procedures, and requirements included in the Graduate Programs Catalog.

The provisions of this handbook do not constitute a contract, expressed or implied, between any applicant or student and the ISE Department or North Carolina A&T State University. The University and the Department reserve the right to change any of the provisions, schedules, programs, courses, rules, regulations, or fees whenever university or departmental authorities deem it expedient to do so.

3. Administration of the ISE Graduate Programs

All requirements, policies, and procedures for the ISE Graduate Program are approved by the ISE faculty at faculty meetings where a quorum must be present. Recommendations regarding the operation of the graduate program are reviewed by the Graduate Program Committee (GPC) and, if approved, are forwarded to the ISE faculty for their consideration. The GPC is also charged with the responsibility for resolving conflicts that may arise regarding policy or procedural issues. The GPC is chaired by the ISE Graduate Program Coordinator. In addition to chairing the GPC, the Coordinator is responsible for supervising implementation of requirements, policies, and procedures adopted by the ISE faculty. The ISE Graduate Program Coordinator and members of the GPC are appointed by the ISE Department Chairperson.

The program administrative staff member who maintains all files for the graduate program is the source of information on the graduate program including, but not limited to, forms for carrying out graduate program and graduate school requirements,

application for admission and financial aid, and other routine paperwork relating to the graduate program.

4. Admission to Master of Science Program in Industrial Engineering (MSIE)

To apply for admission to the MSIE program, please download application forms from the website of the School of Graduate Studies (www.ncat.edu/~gradsch). The application and supporting materials must be submitted to the School of Graduate Studies. The Department will process applications within approximately 20 days of receipt from the School of Graduate Studies.

Applicants with their highest degree from non-English speaking countries must complete the Test of English as a Foreign Language (TOEFL) exam and obtain a minimum written score of 550, a computer score of 213, or an internet score of 79.

5. Admission to Doctor of Philosophy Program in Industrial Engineering

To apply for admission to the Ph.D. program in Industrial Engineering, please download application forms from the website of the School of Graduate Studies (www.ncat.edu/~gradsch). The application and supporting materials must be submitted to the School of Graduate Studies. The Department will process applications within approximately 20 days of receipt from the School of Graduate Studies.

To be considered for admission to the Ph.D. in Industrial Engineering an applicant must satisfy the following requirements:

1. At least one degree in engineering.
2. A Bachelor of Science degree in Industrial Engineering from an EAC-ABET accredited program with a cumulative Credit Point Average of 3.5 or above on a 4-point scale.

OR

A Master of Science degree in a discipline related to Industrial Engineering, from a college or university recognized by a regional or general accrediting agency, with a cumulative Grade Point Average of 3.3 or above on a 4-point scale.

3. Complete the Graduate Record Exam (GRE) Aptitude Exam.
4. Applicants with their highest degree from non-English speaking countries must complete a TOEFL exam and obtain a minimum of written score of 550, a computer score of 213, or an internet score of 79.

6. MSIE Program Requirements

6.1 Program Options

The Department offers three options in the M.S. degree: thesis option, project option, and course only option.

Thesis Option
This option consists of twenty-four (24) credit hours of course work and six (6) hours of thesis. An original research topic must be chosen in conjunction with the student's advisor culminating in the preparation of a scholarly thesis. The student's committee members must approve the thesis topic at a proposal defense. A written thesis report and a final oral thesis defense are also required. This option is intended for students with strong research interests who may desire to pursue further graduate studies.

Project Option
This option consists of thirty (30) credit hours of courses and three (3) hours of project. The student's committee members must approve the project topic at a proposal defense. A written project report and a final oral defense are required.

Course Only Option:
This option consists of thirty three (33) credit hours of courses and one (1) credit hour of comprehensive examination.

6.2 Graduation Requirements

Admission Status
Students must apply for and secure "unconditional" admission status before they commence project or thesis work.

Credit Hour Requirements
The student must have completed the following credit hour requirements:

(i) Project Option: 30 credit hours of course work and 3 credit hours of project
(ii) Thesis Option: 24 credit hours of course work and 6 credit hours of thesis
(iii) Course Option: 33 credit hours of course work and 1 credit hours of M.S. comprehensive exam

700-Level/800-Level Course Requirements
The student is strongly encouraged to meet the following 700-level/800-level course requirements: *Project Option*: 12 credit hours; *Thesis Option*: 9 credit hours; *Course Option*: 12 credit hours. The student's advisor and the Graduate Program Committee must approve any exception. INEN 792, INEN793, INEN 794, INEN 796, and INEN 797 cannot be counted toward completion of the 700-level/800-level course requirements.

Seminar Course
The student must register and attend the INEN 792 course during two semesters of his/her graduate study. This course does not count towards credit hour requirements.

Assistantship Course
Students employed as a teaching assistant or research assistant should enroll in INEN793: Supervised Teaching or INEN794: Supervised Research. These courses do not count towards credit hour requirements.

Table 1: MSIE Program Requirements

Requirement Category	Credits			HMSE	MSEE	ORSA
	Thesis	Project	Course			
Background Courses*	-			GEEN 162/163 MATH 132 INEN 270 INEN 371 INEN 372 INEN 600	GEEN 162/163 MATH 132 INEN 270 INEN 325 INEN415 INEN 600	GEEN 162/163 MATH 132 INEN 270 INEN 330 INEN 415 INEN 600
Core	12			INEN 625; INEN 665; INEN 675; INEN 655		
Specialty Core (take at least 3)	9			INEN 648 INEN 664 INEN 721 INEN 735 INEN 821 (reqd.)	INEN 628 INEN 653 INEN 658 INEN 731 INEN 831 INEN 833 INEN 853	INEN 615 INEN 658 INEN 721 INEN 742 INEN 841 INEN 843 INEN 844
Seminar	-			INEN792 (Seminar) in two semesters		
Electives (with consent of Advisor)	3	9	12	Any other INEN6xx, 7xx, 8xx course; Graduate level Psychology courses	Any other INEN6xx, 7xx, 8xx course; Up to 6 Cr. of graduate-level courses	Any other INEN6xx, 7xx, 8xx course
Thesis/ Project/ Exam	6	3	1	INEN797 (Thesis), INEN796 (Project), INEN791 (Course option, MS Comprehensive Exam)		
TOTAL	**30**	**33**	**34**			

Other Graduation Requirements

The other requirements include background courses* (for conditional admission), core courses, special core courses and free electives. These are listed in the Table 1. The requirements depend on the student's chosen specialization, which is discussed in Section 6.4.

* These are the minimum background requirements that will be checked for students meeting the admission criteria. These do not count towards the M.S. credit requirements. Background courses may include minimal acceptable grades.

6.3 *Academic Advisor, Major Professor, and Ph.D. Committee*

All students enrolled in the graduate program must have an academic advisor. Upon admission to the program, the **Graduate Program Coordinator** will act as the student's advisor on a temporary basis. Ph.D. students **must** choose a major professor by the end of the second semester. Thereafter, the major professor will also serve as the Academic Advisor. The major professor must be a graduate faculty as designated by the School of Graduate Studies.

The Ph.D. committee will consist of a major professor and three committee members, and the major professor will act as the chair of the committee. Students may select a non-ISE faculty for his/her committee, but he/she can not have more than one outside member. If a student would like to have a non-ISE faculty member as a major advisor, he/she must select another ISE faculty member as a co-advisor. Any outside member for his/her committee must be approved in advance by the department Graduate Program Committee.

6.4 Specializations

There are three (3) specializations available to M.S. graduate students: Human-Machine Systems Engineering (HMSE), Manufacturing and Service Enterprise Engineering (MSEE**)**, and Operations Research and Systems Analysis (ORSA). **The requirements for each specialization are shown in Table 1.**

Human-Machine Systems Engineering (HMSE)

This area of specialization is concerned with human-computer interface (HCI) and cognitive systems engineering. The HMSE research and educational programs are a combination of social sciences and engineering. There is a strong emphasis on quantitative methods and computer modeling.

Manufacturing and Service Enterprise Engineering (MSEE**)**

This area focuses on the design and improvement of manufacturing, service, and supply chain enterprises. MSEE focuses on engineering complex organizational and logistics systems, a growing need in a global economy. It requires process understanding as well as application of technical skills. Required technical skills include the use of quantitative and computational models and tools. The MSEE specialization area provides the student with flexibility to choose courses in preparation for technical, managerial or academic careers. Graduates of the program will become leaders in such diverse areas as advanced manufacturing, health systems, finance and banking, military operations, and retail/distribution.

Operations Research And Systems Analysis (ORSA)

This area of specialization is concerned with optimization tools and information systems. Students learn to analyze and propose solutions for general and specific optimization problems. Students may develop abilities in design of information systems. (M.S. only)

6.5 Critical Steps

The following are the critical steps in the progression toward a Master's degree in Industrial Engineering:

1. Application for Admission: Obtain and complete the application for admission and return forms to the School of Graduate Studies. The School of Graduate Studies will forward the completed application package to the Graduate Program Coordinator who will review it along with the Graduate Program Committee.

2. Initial Contact: All students enrolling for the first semester of graduate study in the IE Department must consult with the Graduate Program Coordinator who serves as the temporary advisor for all graduate students prior to the selection of their permanent advisor. This selection normally takes place in the first semester after the student's academic and research interests are better defined.

3. Plan of Study: Prior to pre-enrollment for the second semester or the 10th credit hour (whichever comes first), the student is required to select and confer with an Advisor, who should provide overall guidance and may also suggest specific details to tailor course work in support of the student's educational objective. The purpose of the Plan of Study is to ensure that the courses planned and completed will adequately prepare the student with the proper background necessary to successfully complete all the requirements of the program. Any change(s) needed to the Plan of Study must be approved by the Advisor and the committee members, and an amended Plan of Study must be filed.

4. Selection of Advising Committee: Once an Advisor is selected, the student must confer with him/her for assistance in the formation of a project/thesis committee. Once established, the committee as a whole is responsible for recommending any changes in its composition. The committee shall consist of an Advisor and two or three additional faculty members with research interests related to the field of study of the student. A student may choose no more than one member from a department outside the ISE Department.

5. Complete Course work: Students are **required to complete the course work** as listed in their **approved** Plan of Study. Also, students who are admitted as provisional students must complete all background courses during the first academic year.

6. Propose, Complete and Defend Thesis/Project Work: Students are urged to complete a project/thesis proposal defense before completion of 18 graduate course credit hours. The project/thesis must be completed and project/thesis **final defense** successfully completed before the advisory committee, and a report must be prepared to the satisfaction of the committee.

7. Time between Proposal Defense and Final Defense: The time between proposal defense and final defense should **be no less than 90 days**.

8. Graduation: Students **must apply for graduation** in accordance with the deadlines established by the School of Graduate Studies.

6.6 Project /Thesis Requirements

The steps in completing project/thesis requirements are given below:

1. With the consent and advice of his/her advisor, the student selects a tentative project/thesis topic. See Appendix E for detailed guidelines for selection of a thesis topic.

2. In consultation with the advisor, the student selects committee members. See Appendix F for guidelines on changing the composition of a committee, if it becomes necessary.

3. The student prepares a typed project/thesis proposal outlining the proposed work. Thesis proposals are expected to review the state-of-the-art, and should clearly indicate that a substantial literature search has been completed. A thesis proposal will not be considered complete without a list of relevant reviewed references.

4. The advisor approves the proposal and copies are submitted to the committee members at least one week before the proposal defense.

5. A proposal meeting is held. The student presents his/her proposal (less than about 20 minutes for projects, 40 minutes for thesis) and answers questions. The committee decides if the topic is suitable and makes suggestions on scope, solution, etc. If the decision is favorable, the committee becomes the project/thesis committee. The student must submit a Project/Thesis Proposal Notification Form according to the instructions stated on the form.

6. The advisor directs the project/thesis research and initial writing. Other committee members are also available for guidance and advice. The advisor may schedule a committee meeting for progress review when research is well underway.

7. The advisor approves initial typed draft of project/thesis.

8. The student must schedule an oral examination with the individual committee members. Copies of the project/thesis must be submitted to the committee members at least one week prior to the scheduled oral examination date.

9. The committee members will read the draft and submit suggestions for changes and/or additions to the student.

10. In consultation with the advisor, the student makes the changes and/or additions and types the final draft.

11. The oral examination begins with a presentation by the student of the project/thesis work (30 - 35 minutes), followed by questions by the advisor and committee members.

12. The student leaves the room, the committee decides on a pass, fail, or retest, and the student is informed. It is the policy of this department that students who do not perform well on the oral examination will not pass. The committee will have

the option of failing these students or requiring a retest. In the case of a retest, the student must again appear for an oral examination no sooner than two weeks following the original examination. This procedure may be repeated at the option of the committee.

13. Bound copies of the project/thesis report will be supplied to each committee member and the ISE department. A copy for the department must be hard-bound. For thesis, three copies must be deposited with the Dean of Graduate Studies. Please consult with the School of Graduate Studies for details. Project reports need not be submitted to the School of Graduate Studies.

7. Ph.D. Program Requirements

7.1 Expected Timetable

We expect students to be able to complete the various requirements according to the schedule indicated below. Please note that this is shown for full-time students only. Part-time students may take a longer time to complete each of the requirements.

	With M.S. in IE	Without M.S. in IE
Qualifying Exam	1st or 2nd semester	3rd or 4th semester
Preliminary Exam	3rd or 4th semester	5th or 6th semester
Other Requirements (Course credits, Supervised Teaching /Supervised Research, Statistics, Seminar)	5th semester	6th or 7th semester
Final Dissertation Exam	6th semester	7th or 8th semester

7.2 Graduation Requirements

Please note that options are available to students with a background in Computer Science (M.S. in CS) or Civil Engineering (M.S. in CE). The requirements for this differ in the Qualifying Exam format.

1. Credit Requirement: A total of 75 credits after the B.S. degree, of which 18 credits are toward dissertation work, and 57 credits are toward course work. Of the 57 credits of course work, up to 24 credits of Industrial Engineering-related course work at the MS-level may be applied towards the 57 course credit requirements.

2. Supervised Teaching/Supervised Research Requirement: Students must complete 3 credits of either supervised teaching or supervised research. Students can meet this requirement by either teaching an undergraduate course in the department (Supervised Teaching) or completing a semester-long research effort at a research laboratory in industry or government (Supervised Research). Registering for and completing either the INEN993 or INEN994

course as a part of a Graduate Teaching Assistant or Graduate Research Assistant assignment does not count towards this requirement.

3. Seminar Requirement: Students must register and complete Graduate Seminar (INEN992) (1 credit) in at least two semesters.

4. Statistics Requirement: Students must complete a specified Ph.D.-level (INEN821) statistics class.

5. Course Credits: At least 24 of course credits (including the Statistics requirement), will be at the 8xx level. Of this, at least 9 credits will be from a specified list of courses in the area of specialization chosen by the student (HMSE, MSE, or PSE).

6. Qualifying Exam: Students must pass a 6 hour in-class written exam (1 credit) that will cover the 12 subject areas of industrial engineering at the B.S. in Industrial Engineering (senior) level. Students must pass this exam in no more than two attempts. Please see Appendix G, *Preparing for Ph.D. Qualifying Exam Preparation Guide*, for details. Please note that the exam format is slightly different for the options for Computer Science or Civil Engineering backgrounds.

7. Preliminary Exam: Students must pass a written exam in the area of specialization. The written exam will be in a take-home format (7 days), and will be given typically in the 5^{th} or 6^{th} week of the Spring and Fall semesters. This exam will be prepared and administered by the student's Ph.D. Committee. Please see Appendix H, Ph.D. Preliminary Exam Preparation Guide, for details.

8. Oral Proposal Defense: The student must present a proposal of dissertation research to the student's Ph.D. committee. The student will be permitted to proceed to this part of the Preliminary Exam only if he/she passes the Written Exam. The student must prepare and submit the Dissertation Proposal to the committee at least one week before the proposal defense date. The Dissertation Proposal Defense will be scheduled by the department and will be open to all students and faculty. The Ph.D. Committee will decide the outcome of the defense and inform the student within one day.

   If the student fails the Dissertation Proposal Defense, the committee will give the student one more attempt. The date and time of the exam will be determined by the Committee, but must be done within the same semester, unless the committee determines that the student should take one or more courses before he/she attempts the Dissertation Proposal Defense again. A representative from the School of Graduate Studies shall serve as an observer during the oral portion of dissertation proposal. The student and/or the advisor shall notify the School of Graduate Studies at least two weeks in advance on the time and place of the dissertation proposal. Students must pass this two-part exam in no more than two attempts.

8. Supervised Teaching/Supervised Research Requirement: Please see Appendix I for details.

9. Final Dissertation Exam: Students must prepare a written dissertation and defend it in the presence of the student's Ph.D. committee.

The above requirements are summarized in the Table 2.

7.3 Academic Advisor, Major Professor, and Ph.D. Committee

All students enrolled in the graduate program must have an academic advisor. Upon admission to the program, the **Graduate Program Coordinator** will act as the student's advisor on a temporary basis. Ph.D. students **must** choose a major professor by the end of the second semester. Thereafter, the major professor will also serve as the Academic Advisor. The major professor must be a graduate faculty as designated by the School of Graduate Studies.

Table 2: Ph.D. in Industrial Engineering Program

Requirement Category	Credits	HMSE	MSEE
Specialty Core (take at least 3)	9	INEN 721 INEN812 INEN813 INEN814	INEN852 INEN833 INEN853
Quantitative Requirement	3	INEN821	INEN841
Intermediate-level Courses	24		
Supervised Teaching/ Research	3	INEN993 or INEN994	
Seminar Requirement	2	INEN992	
Electives (with consent of Advisor)	12	Courses at the 700-level or 800-level	
Qualifying Exam	1	INEN991	
Preliminary Exam	3	INEN995	
Dissertation	18	INEN997	
TOTAL	75		

The Ph.D. committee will consist of a major professor and three committee members, and the major professor will act as the chair of the committee. Students may select a non-ISE faculty for his/her committee, but he/she can not have more than one outside member. If a student would like to have a non-ISE faculty member as a major advisor, he/she must select another ISE faculty member as a co-advisor. Any outside member for his/her committee must be approved in advance by the department Graduate Program Committee.

7.4 Specializations

There are two areas of specialization available to Ph.D. students: Human-Machine Systems Engineering (HMSE), and Manufacturing and Service Enterprise Engineering (MSEE**)**. **The requirements for each specialization are shown in Table 2.**

7.5 Critical Steps

The following are the critical steps in progression toward a Ph.D. degree in Industrial Engineering:

1. Application for Admission: Obtain and complete the application for admission and return forms to the School of Graduate Studies. The School of Graduate Studies will forward the completed application package to the Graduate Program Coordinator who will review it with the assistance of the Graduate Program Committee.

2. Initial Contact: All students enrolling for the first semester of graduate study in the ISE Department must consult with the Graduate Program Coordinator who serves as the temporary advisor for all graduate students prior to the selection of their major professor. This selection must take place no later than the end of the second semester after the student's academic and research interests are better defined.

3. Plan of Study: Prior to pre-enrollment for the second semester or the 10th credit hour (whichever comes first), the student is required to select and confer with an Advisor who should provide overall guidance and may also suggest specific details to tailor course work in support of the student's educational objective. The purpose of the Plan of Study is to ensure that the courses planned and completed will adequately prepare the student with the proper background necessary to successfully complete all the requirements of the program. Any change(s) needed to the Plan of Study must be approved by the Advisor and the committee members, and an amended Plan of Study must be filed.

4. Selection of Ph.D. Committee: Once an Advisor is selected, the student must confer with him/her for assistance in the formation of a Dissertation Committee. Once established, the committee as a whole is responsible for recommending any changes in its composition. The committee shall consist of an Advisor and three additional faculty members with research interests related to the field of study of the student. A student may choose no more than one member from a department or organization outside the ISE Department.
5. Complete Qualifying Exam: Register for the INEN991 course, take the Qualifying Exam and pass the exam. See section 5.2(f) for details about the exam.

6. Complete Preliminary Exam: Register for the INEN995 course, take and pass the Preliminary Exam. See section 7.2 for details about the exam.

7. Complete Course Work and Other requirements: The student is **required to complete the course work** as listed in his/her **approved** Plan of Study.

8. Complete Oral Proposal Defense: See section 7.2 for details about the exam.

9. Complete and Defend Dissertation Research: The dissertation must be completed and project/thesis **final defense** successfully completed before the advisory committee, and a report must be prepared to the satisfaction of the committee. The time between **proposal defense** and **final defense** should **be no less than 180 days**.

10. Graduation: Students **must apply for graduation** in accordance with the deadlines established by the School of Graduate Studies.

7.6 Dissertation Research Requirements

The steps in completing dissertation requirements are given below:

1. With the consent and advice of his/her advisor, the student selects a tentative research topic. See Appendix E for detailed guidelines for selection of a dissertation topic.

2. In consultation with the advisor, the student selects committee members. See Appendix F for guidelines on changing the composition of a committee, if it becomes necessary.

3. The student prepares a typed dissertation proposal outlining the proposed work. Dissertation proposals are expected to review the state-of-the-art, and should clearly indicate that a substantial literature search has been completed. A dissertation proposal will not be considered complete without a list of relevant, reviewed references.

4. The advisor approves the proposal and copies are submitted to the committee members.

5. A proposal meeting is held. The student presents his/her proposal (less than 45 minutes) and answers questions. The committee decides if the topic is or is not suitable and makes suggestions on scope, solutions, etc. If the decision is favorable, the committee becomes the dissertation committee. The student must submit a Dissertation Proposal Notification Form according to the instructions stated on the form.

6. The advisor directs the project/thesis research and initial writing. Other committee members are also available for guidance and advice. The advisor may schedule a committee meeting for progress review when research is well underway.

7. The advisor approves initial typed draft of dissertation.

8. The student submits copies to the committee members. The student must schedule the oral examination with the individual committee members. Copies of the dissertation must be submitted to the committee members at least two weeks prior to the scheduled oral examination date.

9. The committee members will read the draft and submit suggestions for changes and/or additions to the student.

10. In consultation with the advisor, the student makes the changes and/or additions and has the final draft typed.

11. The oral examination begins with a presentation by the student (60 minutes) of the dissertation work, followed by questions by the advisor and committee members.

12. The student leaves the room, the committee decides on a pass, fail, or retest, and the student is informed. It is the policy of this department that students who do not perform well on the oral examination will not pass. The committee will have the option of failing these students or requiring a retest. In the case of a retest, the student must again appear for an oral examination no sooner than two weeks following the original examination. This procedure may be repeated at the option of the committee.

13. Bound copies of the dissertation report will be supplied to each committee member and the ISE department. The copy for the department must be hard bound. As specified in the Graduate School Bulletin, three copies must be deposited with the Dean of Graduate Studies. Please consult with the School of Graduate studies for details.

8. Financial Support

There are financial supports for African-American students interested in the Ph.D. programs through three types of fellowships: the McNair Fellowship, Title III, and the Sloan Foundation Fellowship. The Department of Industrial and System Engineering has available a limited number of assistantships. Applications for all assistantships must be submitted to the Graduate Program Coordinator by November 1st for the Spring semester and May 1st for the Fall semester. Available funds will be allocated first to the students who submit applications before these deadlines. Questions concerning these assistantships should be directed to the Graduate Program Coordinator.

Students should not depend on assistance from North Carolina A&T State University in making their financial plans. Assistantships are customarily awarded to students only after they have been on campus for at least a semester and are then dependent strictly on availability of funds.

9. Graduate School Requirements

The following procedures are at the direction of the School of Graduate Studies. Students must conform to these guidelines.

Changes in Requirements

Generally, a student is permitted to graduate according to the requirements specified either in the catalog current during the year of his/her first application for candidacy or in the catalog current in his/her application for graduation. **If more than six(6) years pass between the student's application for candidacy and his/her application for graduation, the university reserves the right to require the student to satisfy the regulations in effect at the time of his/her application for graduation.**

Schedule of Deadlines

The School of Graduate Studies provides schedules of specific dates for completing various requirements for a degree program. These notices are not sent to individuals automatically but may be found in the calendar of the School of Graduate Studies, available upon request. The student is required to be familiar with these dates.

Course Levels

At the university, three-digit numbers are used to designate all course offerings. The three digits indicate the classification level of the course. Courses numbered 600 through 699 are open to seniors and to graduate students. Courses numbered 700 through 999 are open to graduate students only.

Transfer of Credit

Up to six semester hours of course work may be transferred from another university if it was not part of any prior undergraduate degree requirement and if, in the opinion of the advisor, the content adequately replaces current graduate offerings in the student's curriculum. Course work being considered for transfer credit should be at a level comparable to our 700- or 800- level courses.

Time Limitation

The graduate program **must be completed within six (6) consecutive calendar years.** Programs remaining incomplete **after this time interval are subject to cancellation**, revision, or special examination for outdated work. In the event that studies are interrupted for duty in the armed services, the time limit shall be extended for the length of time the student was on active duty providing the **student resumes graduate** work no later than **one year following** release from military service.

Concurrent Registration in Other Institutions

A student registered in a degree program in the School of Graduation Studies may not enroll concurrently in another graduate school except upon permission, **secured in advance**, from the Dean of the School of Graduate Studies.

Application for Graduation

A **candidate for** graduation **must file an application for graduation at least thirty (30) days prior to the close of the session in which he/she expects to complete the requirements for the degree**. The application forms are available from the School of Graduate Studies. The student's advisor must approve the application before it is sent to the School of Graduate Studies. A copy of the completed application should be filed with the Department of Industrial Engineering. Failure to meet the deadline may result in graduation delay for the candidate.

Grade Point Average (GPA)

A graduate student is expected to maintain a GPA of 3.00 or above in: (i) each registered semester, and (ii) overall cumulative grade at North Carolina A&T State University. A graduate student who fails to meet these standards will be reviewed by the Graduate Program Committee. Substandard performance will be considered grounds for terminating a student's program. Any student failing to show satisfactory progress toward a graduate degree may be terminated at the discretion of the Graduate Program Committee.

Course load

A student using **any resource of the University** must be **registered** for at least **three credit hours or 0 credit hours during the semester of the thesis/project**. **No** assistantship can be provided for a **non-registered student.** A normal maximum load for a graduate student is 9 hours per semester and 3 hours for each summer session. A half-time graduate teaching or research assistant (20 hours/week) cannot take more than 10 hours during regular semesters and 3 hours during summer session. A maximum load the quarter-time assistant (10 hours/week) may take 13 semester hours.

Appendix A: Industrial Engineering Laboratories

In conjunction with the departmental focus on systems engineering and information systems, departmental instructional laboratories are integrated using information technology into a single "virtual enterprise." The enterprise system allows all laboratories to use common database(s) and similarly functioning application programs as if they were separate operations within a single manufacturing or service supply chain. Instructional laboratories are located in adjacent rooms in Graham Hall serving at the Engineering, Manufacturing, Assembly/Packaging, and Distribution departments of the virtual enterprise.

Active Learning in the Virtual Enterprise Laboratories

Curriculum integration of the Virtual Enterprise is achieved through the ALIVE (Active learning in the Virtual Enterprise) system. The ALIVE system provides the equivalent of many short intern experiences in different parts of the same company. It provides a practical and consistent means of developing systems engineering, information technology, and business skills in engineering students.

Product, Process, and Facility Design Systems Laboratory (202 Graham)

This laboratory allows the student to participate in activities associated with the "Engineering Department". These functions include solid modeling and rapid prototyping for product design; process planning and robotics/vision for process design, and layout and material handling for facility design. The laboratory is equipped to teach concurrent engineering methods and includes a training area with 14 high speed computers. Additional equipment includes a Feedback Serpent SCARA Robot, Cognex Camera and Vision System, Z-Corp rapid prototype 3D printer, and computers with Access to AutoCAD, SolidWorks, and facility planning software.

Manufacturing Processes and Systems Laboratory (200 Graham)

This laboratory offers a broad educational opportunity for manufacturing processes including machining, casting, fabrication, and plastics molding and extrusion. Hands-on learning and experimentation is stressed with machines available for use with manual and automatic control. Computer-based quality control tools are available to study product quality and perform parametric analysis. Major equipment in this laboratory includes Amatrol Plastics Manufacturing System for Blow Molding, Extrusion Molding, and Injection Molding, Articulated Arm CMM, Mitutoyo Computer SPC Metrology System, EMCO Compact 5 CNC lathe, EMCO Unimat PC DCC lathe, Jet bandsaw, and ZYCO Laser Telemetric System. Several high speed PCs are connected to the virtual enterprise and are able to run CNC code generating software.

Automated Assembly and Packaging Systems Laboratory (201 Graham)

This laboratory houses a flexible manufacturing cell capable of producing a variety of small milled and assembled parts. The cell consists of an Automatic Storage and Retrieval System, an Adept Viper robot, an EMCO CNC mill, an Adept Cobra robot and vision system, and a Flexible Conveyor System. The operations of the cell are integrated using a Visual Basic program interfaced to an Allen-Bradley PLC and Microsoft SQL

Server. Additionally, the laboratory has a number of Allen-Bradley Programmable Logic Controllers with table top simulators and programming software. Also housed in this laboratory are computer and software to develop industrial man-machine interfaces that can connect to manufacturing information systems.

Logistics and Distribution Systems Laboratory (204 Graham)
This laboratory allows focus on distribution and service systems. The laboratory contains Virtual Enterprise servers and a computer network designed to solve complex optimization/simulation problems. Equipment in this laboratory includes fixed and portable bar-code readers, network controllers, bar coding software, printers, high speed PCs connected to the virtual enterprise, and radio frequency tags and data communications hardware. Additionally, the laboratory contains equipment to test human performance and work methods. This equipment includes traditional anthropometry tools, programmable treadmill, heart rate monitors, an automatic blood pressure cuff, dexterity tests, and stopwatches.

Information Technology Systems Laboratory (416 McNair)
This laboratory is intended for students to work with a variety of information technology tools useful in industrial and systems engineering. Software available includes Microsoft SQL Server and Access databases, Visual C++, VisualBasic and Java rapid application development, Microsoft Office Applications, BLOCPLAN (Plant Layout), LINGO (Math Programming), AutoCAD, Visio, ProModel, and ARENA (simulation). Several high speed PC's are available.

Departmental laboratories devoted to research include:

Human-Machine Systems Engineering Laboratory (HMSEL)
(221-222 Edward B. Fort Interdisciplinary Research Center) For virtual tour: http://gandalf.ncat.edu/ihms

1. **Cognitive Systems Engineering and Simulation Laboratory**
   This laboratory is for the study of human cognition and the use of their properties to design, analyze, and validate behaviors of engineered systems. These include the performance of humans when interacting with engineered systems; adjustment and adaptation of human and artifact behaviors in changing task environments; and, the understanding of command and control and the underlying mitigating factors in diagnosing human-systems failures under various organizational designs. Research in CSE is focused on developing empirical models of analytical simulation, collaborative sensemaking, engineered work domains, human error and safety, computational modeling, workload, and application of evolutionary algorithms to simulate human cognitive processes.

2. **Human Systems Integration Laboratory (HSIL)**
   This laboratory provides facilities for experimental and analytical testing and evaluation of human capabilities and performance in system designs. We design prototypes and use simulated environments to demonstrate human System

integration principles. HSIL has state-of-the art usability laboratory, audio and speech intelligibility booth, iViewXTM head and eye tracking with gaze analysis capability, diving simulators, human signal acquisition systems (EEG, EMG, etc.), and virtual JACKTM Simulator for work envelop and anthropometric compatibility design. Typical research efforts include, workload, application of Living Systems theory to adaptive HCI, acoustic influence operations, using human neurophysiological data to classify workload under stress and to understand semantic information processing, and display design.

3. **Decision Support System and Simulation Laboratory (DS^3L)**
   The laboratory is concerned with decision support system development and information display and visualization modeling. Some equipment include, Rapid Prototyping software, Microsaint, assorted personal computers, custom design and a variety of development software for simulation and information display and visualization.

4. **Perception and Visual Cognition Laboratory (PVCL)**
   This laboratory is involved with modeling and simulation of visual cognition and perception and how they affect human performance in automated systems. The existing equipment includes ISCAN eye perception laboratory equipment with all its accessories.

5. **Human Judgment and Decision Making (J/DM) Laboratory**
   This laboratory was founded to investigate judgment and decision making in complex dynamic environments. The work in this laboratory involves situations in which individuals make efforts to understand the environment in order to make sense out of situations, and execute multiple decisions in context over time while interacting with complex automated systems. The laboratory seeks to develop models and prototypes that would help us understand human interaction with complex systems, and predict and support human judgment and decision making behavior.

Appendix B: Industrial Engineering Faculty

Name/Title	Education	Contact Info	Primary Research Interests	Secondary Research Track
Dr. Lauren Davis, Assistant Professor	North Carolina State University (Ph.D. 2005)	lbdavis@ncat.edu (336) 334-7780 x518	**Management Systems:** Supply Chain Optimization, Optimization Models for Supply Chain Information Sharing & Negotiation, Applied or Stochastic Processes	Operations Research
Dr. Salil Desai, Assistant Professor	University of Pittsburgh (Ph.D. 2004)	sdesai@ncat.edu (336) 334-7780 x530	**Production Systems**: Nano and Micro Fabrication Technology, Finite Element, CFD and Multiphysics modeling, Design for X, and CAD/CAM.	Management Systems
Mr. Joseph Hong, Adj. Assistant Professor	North Carolina A&T State University (MS 2001)	jhong@ncat.edu (336) 334-7780 x469	**Management Systems:** Database Design and Analysis, and E-Commerce	Production Systems
Dr. Xiaochun Jiang, Assistant Professor	Clemson University (Ph.D. 2001)	xjiang@ncat.edu (336) 334-7780 x522	**Human-Machine Systems:** Human Computer Interaction, Visual, Auditory and Haptic Display, Multivariate Statistics, Modeling Humans in Quality Control and Process Systems	Management Systems
Dr. Daniel Mountjoy, Assistant Professor	North Carolina State University (Ph.D. 2001)	mountjoy@ncat.edu (336) 334-7780 x529	**Human-Machine Systems:** Information Visualization, Human Performance, Human-Computer Interaction.	Production Systems
Dr. Celestine Ntuen, Distinguished University Professor	West Virginia University (Ph.D. 1984)	Ntuen@ncat.edu (336) 334-7780 x531	**Human-Machine Systems:** Human-Computer Interaction, Wargames, Cognitive Systems Engineering, and System Simulation	Management Systems
Mr. Steve Oneyear, Adj. Associate Professor	University of Wisconsin (MS 1973)	sjoneyea@ncat.edu (336) 334-7780 x528	**Production Systems:** Computer Integrated Design and Manufacturing, Production Systems Design and Analysis, and Quality Assurance	Management Systems

Dr. Eui Park, Professor	Mississippi State University (Ph.D. 1983)	park@ncat.edu (336) 334-7780 x520	**Human-Machine Systems Engineering**: Production Systems Design and Analysis, Manufacturing Automation, Simulation, and Quality Assurance	Production Systems
Dr. Qu Xiuli, Assistant Professor	Purdue University (Ph.D. 2006)		**Management Systems:** Applied Operations Research, Healthcare Engineering, Multi-Objective Optimization, Supply Chain Optimization	Operations Research
Dr. Bala Ram, Professor	State University of N York At Buffalo (Ph.D. 1983)	ram@ncat.edu (336) 334-7780 x516	**Production Systems:** Manufacturing Engineering, Materials Handling, Industrial Simulation, Applied Operations Research and Information Systems.	Management Systems
Dr. Funda Samanlioglu, Assistant Professor	Clemson University (Ph.D. 2005)	fsamanli@ncat.edu (336) 334-7780 x527	**Management Systems:** Applied Operations Research, Multi-Objective Optimization, Evolutionary Algorithms, Interactive Decision Making, Combinatorial Optimization, Transportation Scheduling	Production Systems
Dr. Younho Seong, Assistant Professor	State University of New York At Buffalo (Ph.D. 2002)	yseong@ncat.edu (336) 334-7780 x532	**Human-Machine Systems:** Human- machine interaction, Human judgment an d policy analysis, Cognitive Engineering.	Production Systems
Dr. Paul Stanfield, Associate Professor & Chairperson	North Carolina State University (Ph.D. 1995)	stanfiel@ncat.edu (336) 334-7780 x533	**Management Systems:** Production System Modeling, Supply Chain Systems, Remanufacturing, Military Logistics, Enterprise Information Systems, and Stochastic Scheduling.	Production Systems

Dr. Silvanus Udoka, Associate Professor	Oklahoma State University (Ph.D. 1989)	udoka@ncat.edu (336) 334-7780 x521	**Production Systems:** Immersive 3-D Environments for interactive visualization, visual depiction and applications; Robotics, Automation and Integrated Manufacturing Systems Engineering; Six Sigma and Lean Enterprises.	Management Systems

Appendix C : Course Descriptions

I. Course Relationships

Most of the undergraduate and graduate courses offered in the Department of Industrial and Systems Engineering are presented below as sets of courses in various subject areas.

General:
Preparatory: INEN600
Integration: INEN289, INEN389, INEN485, INEN489, INEN495

Human-Machine Systems Engineering:
Human-System Interaction:
INEN255, INEN370, INEN665, INEN721, INEN735, INEN813, INEN814
Human Factors Engineering
INEN255, INEN370, INEN648, INEN664, INEN812
General/Statistics:
INEN270, INEN375, INEN716, INEN821, INEN844

Management Systems Engineering:
Economic Analysis: INEN260, INEN262, INEN731
Organizational Issues in Engineering:
INEN633, INEN658, INEN734, INEN831, INEN832
Quality Control: INEN325, INEN618
Service Sector Engineering: INEN831, INEN833
General/Analytical Operations Research: INEN330, INEN335, INEN841, INEN843

Production Systems Engineering:
Production Control: INEN355, INEN749
Facility Design: INEN365, INEN635, INEN854
Production Process: INEN246, INEN346, INEN424, INEN624, INEN852
Robotics and Automation: INEN632, INEN851
Informational Technology for Manufacturing: INEN745, INEN853
General/Computers: INEN280, INEN625
General/Simulation: INEN415, INEN615, INEN822

II. Background Courses

See the Undergraduate Handbook for the list and course descriptions of undergraduate courses that may be assigned as background courses.

III. Advanced Undergraduate and Graduate Courses

INEN-600. Survey of Industrial Engineering Topics **Credit 3 (3-0)**
This course will introduce topics in the following areas of Industrial Engineering: Engineering Economy, Linear Programming, Production Control, Methods Engineering, and Statistical Process Control. Prerequisite: Senior/Graduate Standing.

INEN-615. Industrial Simulation **Credit 3 (3-0)**
This course addresses discrete-event simulation languages. One general purpose simulation language is taught in depth. The use of simulation in design and improvement of production and service systems is emphasized. Term papers and projects will be required. Prerequisite: Consent of Instructor.

INEN-618. Total Quality Improvement **Credit 3 (3-0)**
This course provides a systematic engineering approach to understanding the philosophy and application of Total Quality Improvement (TQI). It also introduces students to Continuous Improvement (C) techniques used by management as a means of improving engineering processes in order to become and remain competitive in the global marketplace. The C1 techniques and concepts this course includes a strategic planning, benchmarking, ISO 9000, teamwork, customer satisfaction, employee involvement, quality tools, and business process reengineering. Design projects are required. Prerequisite: Senior/Graduate Standing.

INEN-624. Computer-Integrated Design / Manufacture **Credit 3 (2-2)**
This course addresses Computer-based tools and techniques for integrated product and process design. Topics include numerical computer-aided design and process planning, group technology, numerical control, computer numerical control, and direct numerical control, rapid response technologies, integrated manufacturing planning, execution, and control and computer-integrated manufacturing. Design projects are required. Prerequisite: Senior/Graduate Standing.

INEN-625. Information Systems **Credit 3 (3-0)**
This course introduces the planning, design, implementation and evaluation of industrial information systems. Analysis and design techniques, organization of data, current software tools, client-server architectures, and current database technologies are presented. The role of information systems in global manufacturing, distribution, and services is addressed. Design projects are required. Prerequisite: Senior/Graduate Standing.

INEN 628. Six Sigma Quality **Credit 3(2-2)**
This course covers the current Six Sigma body of knowledge for process engineering and improvement as well as Lean concepts and tools. Topics covered include problem identification and implementation of improved operations and processes. This course prepares students to take the Six Sigma Certification Exam. A project is required. Prerequisite: Consent of Instructor.

INEN-632. Robotic Systems and Applications Credit 3 (2-2)
This course addresses design, analysis, implementation and operation of robotics in production systems. End effectors, vision systems, sensors, stability and control off-line programming, and simulation of robotic systems are covered. Methods for planning robotic work areas are emphasized. Design projects are required. Prerequisite: Senior/Graduate Standing.

INEN-633. Engineering Law and Ethics Credit 3 (2-2)
This course introduces engineers to law and ethics. Topics include contract law and practices, product liability, intellectual property and patent law, research and development contracts, environmental law, interstate commerce regulations, labor law, workers' compensation, safety regulations, ethical issues involving conflict of interest, and confidentiality. Prerequisite: Senior/Graduate Standing.

INEN-635. Materials Handling Systems Design Credit 3 (2-2)
This course focuses on the design and analysis of materials handling and flow in manufacturing facilities. Principles, functions, equipment and theoretical approaches in materials handling are discussed. Tools for the automation of materials handling are introduced. Design projects are required. Prerequisite: Senior/Graduate Standing.

INEN-648. Biomechanics Credit 3 (3-0)
This course covers human biomechanical and physiological behavior during work. Quantitative methods using engineering mechanics principles and computer simulation are emphasized. Prerequisite: Senior/Graduate Standing.

INEN-653. Engineering Entrepreneurship Credit 3 (2-2)
This course focuses on innovation and entrepreneurial skills development oriented toward an engineering enterprise. The course covers key entrepreneurial areas of intellectual property; evaluation of market viability of new product ideas; shaping product ideas into the right products or services for the right markets; developing strategies for product positioning, marketing and operations; acquiring the resources needed to start a new venture; and leadership roles for the founders of engineering ventures. A project is required. Prerequisite: Consent of Instructor.

INEN-655. Production Planning & Scheduling Credits 3 (3-0)
This course focuses on the design, control and underlying behavior of manufacturing and service systems with emphasis on quantitative and information technology methods. Topics covered in this course include demand forecasting, inventory management, aggregate planning, operations scheduling, Material Requirements Planning and Manufacturing Resource Planning, Just-in-Time, Theory of Constraints and Supply Chain Management. Projects will be required. Prerequisite: Senior/Graduate Standing

INEN-658. Project Management Credit 3 (3-0)

This course addresses project proposal preparation, resource and cost estimation, project planning, organizing and controlling, network diagrams, and computerized project planning systems. Prerequisite: Senior/Graduate Standing.

INEN-664. Systems Safety Engineering and Risk Analysis Credit 3 (3-0)
This course presents the principles and methods of system safety management and risk analysis. Quantitative and qualitative methods and their applications in safety and risk analysis of human-machine systems are emphasized.

INEN-665. Human Machine Systems Credit 3 (2-2)
This course emphasizes the application of perceptual, cognitive, and physical ergonomics principles to the design of human-machine systems. Topics covered include physiological limitations, cognitive and perceptual issues, task complexity and the demands on physical/cognitive resources, human-machine system integration, usability and evaluation methods. Design projects are required. Prerequisites: Senior/Graduate Standing in ISE or Consent of Instructor.

INEN-675. Design and Analysis of Experiments Credit 3 (3-0)
This course addresses various experimental designs, to analyze data for research projects, process improvements, human factors studies, and surveys. Designs covered include Latin Squares, complete and incomplete block designs, one, two, and three variable factorials, fractional factorials, nested designs, and 2k designs. Suitable laboratory apparatus will be set up to study the effect of design parameters on selected response. Statistical software will be utilized to analyze results. Parametric statistics such as analysis of variance (ANOVA) are introduced. Prerequisite: Senior/Graduate Standing.

INEN-685. Selected Topics in Industrial Engineering Variable Credit (1-3)
Selected engineering topics of interest to students and faculty. The topics will be selected before the beginning of the course and will be pertinent to the programs of the students enrolled. Prerequisite: Senior/Graduate Standing.

INEN-694. Special Projects Variable Credit (1-3)
Study arranged on a special engineering topic of interest to student and faculty member, who will act as advisor. Topics may be analytical and/or experimental and encourage independent study. Prerequisite: Consent of the instructor. M.S. and Ph.D. Students Only

IV. M.S. and Ph.D. Level Courses

INEN-721. Systems Engineering Models Credit 3 (3-0)
This course presents an overview of modern quantitative and computational techniques for system modeling, design and control. Topics include fuzzy set theory, neural network, control theory, optimization search methods, Petri-nets, and knowledge-based systems. Prerequisite: Graduate Standing.

INEN-731. Engineering Cost Control **Credit 3 (3-0)**
This course is designed to emphasize the use of cost data by engineers in support of the financial management function. Cost functions, cost behavior, cash control, budgeting, and cash flow analysis are discussed.

INEN 734. Engineering Organization **Credit 3 (3-0)**
This course presents theories of organizational structures, motivation, leadership, delegation, incentives and rewards systems, teams, strategic planning, and personnel evaluation. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-735. Human-Computer Interface **Credit 3 (3-0)**
This course provides a fundamental coverage of topics in human-computer interface (HCI). The primary emphasis is on the impact of human characteristics and the use of information processing models for HCI-design, usability evaluation, virtual reality, and multimedia systems. Prerequisite: Graduate Standing.

INEN-742. Linear and Integer Programming **Credit 3 (3-0)**
This course addresses solution techniques for linear and integer programming problems. Topics addressed include initial basic feasible solutions, large scale linear programs, column generations, scaling, Dantzig-Wolfe decomposition, Interior point methods, integer programming models, and branch and bound approaches for solving integer programming models. Prerequisites: Consent of Instructor.

INEN-745. Advanced Computer-Integrated Production Systems **Credit 3 (3-0)**
This course addresses the principles relating to integration issues for an automated manufacturing enterprise. Topics include control architectures, communication networks and standards for graphical information interchange. Current research areas will be discussed. Design projects are required. Prerequisites: INEN-624 and INEN-635.

INEN-812. Advanced Ergonomics **Credit 3 (3-0)**
This course covers quantitative and qualitative analysis of human motions in space and time. Sample topics include human physiology, anthropometry, human figure modeling, and human performance for a set of task requirements and specifications. Design projects are required. Prerequisite: Graduate Standing.

INEN-813. Cognitive Systems Engineering **Credit 3 (3-0)**
This course examines the principles, theories, and applications of the cognitive basis of system design. Topics include models of human and machine information processing, mental models, human error, human-centered design, abstraction hierarchy, ecological interface, cognitive task analysis, multi-flow models, activity-behavior models, and theories of complexity in human-machine systems. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-814. Advanced Topics in Human-Machine Systems **Credit 3 (3-0)**

This course examines advanced topics in human-machine systems. Topics covered include supervisory control, human aspects of fixed and programmable automation, theories and models of complex systems, collaborative work support systems, human attention and cognitive control of dynamic actions, and tele-operations. Applications include supervisory control in transportation, process, space operations, waste and hazardous handling, manufacturing, and other applications of automated systems. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-821. Multivariate Statistics for Engineers Credit 3 (3-0)
This course focuses on methods for statistical analysis of multivariate data. Topics include: dimensionality, multidimensional classification and clustering, unstructured multi-response sampling, analysis of covariance structures, such as principal components, factor analysis and canonical correlation analysis, and multivariate normal distribution and analysis of multivariate means. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-822. Advanced Systems Simulation Credit 3 (3-0)
This course discusses advanced statistical issues in the design of simulation experiments: variance reduction, regeneration methods, performance optimization and run sampling. Continuous simulation models are introduced. High fidelity simulation software and high-level architecture for constructing large simulation models is introduced. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-831. Service Sector Engineering Credit 3 (3-0)
This course focuses on the application of modeling and analysis of enterprises in the service sector of an economy. Topics include the role of the service sector in an economy, special characteristics of service operations, structuring the service enterprise, facility design for services, service quality, quantitative models for managing services. Applications in the financial services, health care, and other sectors will be emphasized. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-832. Information Technology Management Credit 3 (3-0)
This course focuses on productivity measurement and improvement of information technology and information system services. Other topics covered include the planning and control of human resources and budgets, as well as the planning of innovation, entrepreneurship and research and development, and the forecasting and justification of technology. Prerequisites: Consent of Instructor.

INEN-833. Supply Chain Systems Engineering Credit 3 (3-0)
This course addresses the analysis and design of logistics and supply chain systems. Topics covered include: logistics and supply chain characterization, site location, mode selection, distribution planning, vehicle routing, demand management, replenishment management, geographic information systems and real-time logistics control issues. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-841. Linear and Nonlinear Optimization Credit 3 (3-0)

This course addresses solution techniques for linear and integer programming problems, and nonlinear optimization. Topics addressed include initial basic feasible solutions, large- scale linear programs, column generation, scaling, Dantzig-Wolfe decomposition, interior point methods, integer programming models, branch and bound approaches, unconstrained multivariate optimization, and penalty methods. Applications to engineering and economic systems are discussed. Prerequisite: Consent of Instructor.

INEN-843. Queuing Theory **Credit 3 (3-0)**
This course presents stochastic models and solution techniques for such models. Specific topics include elements of queuing systems, measures of performance, arrival processes, steady state analysis, stationary arrivals, controlling service processes, priority queues, and queuing networks. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-844. Reliability and Maintenance **Credit 3 (3-0)**
This course reviews the statistical concepts and methods underlying procedures used in reliability engineering. Topics include the nature of reliability and maintenance, life failure and repair distributions, life test strategies, and complex system reliability including: series/parallel/ standby components with preventive maintenance philosophy. Analytical models are emphasized. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-851. Integrated Manufacturing Control Systems **Credit 3 (3-0)**
This course provides an advanced study of systems used for manufacturing execution and shop floor control. Traditional control and adaptive control algorithms and applications for manufacturing are explored. Integrated control system functions include scheduling, execution planning, supervisory control, human machine interface, process control, quality control, and information acquisition. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-852. Integrated Product and Process Design **Credit 3 (3-0)**
This course provides an integrated approach to the design and manufacture of a new product. Topics include product requirements, concept generation and selection, design, product optimization, tolerances, prototype development, design for manufacturability and assembly, process optimization, and quality function deployment. Prerequisite: Graduate Standing.

INEN-853. Enterprise Integration **Credit 3 (3-0)**
This course is directed toward development and contribution to the advancement of a unified framework for conceptualizing, designing, modeling, and operating advanced integrated manufacturing systems. It builds upon emerging developments in computer and communications technologies and conceptual breakthroughs regarding the nature and behavior of integrated enterprises. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-854. Inventory and Warehouse Systems **Credit 3 (3-0)**

This course investigates the integration of inventory and warehouse systems. Quantitative models for inventory and warehouse layout/location are developed and solved. Computational tools and equipment in inventory and warehouse systems are reviewed. Application of supply chain and information technology concepts to strategic inventory and warehouse system integration is addressed. Prerequisite: Graduate Standing.

INEN 861. Nano-/Micro- and Bio-Manufacturing Credit 3 (3-0)
This course addresses the translation of fundamental nano-and biotechnology concepts to practical industrial applications. Topics include the design, prototyping and development of nano/micro- and bio-manufacturing techniques. Supporting infrastructure, measurement tools, characterization devices, and positioning systems needed for nano/micro- and bio-manufacturing are discussed. Current state-of-the-art research areas are discussed. Prerequisites: Graduate Standing and Consent of Instructor.

INEN-885. Advanced Special Topics in Industrial Engineering Credit 3 (3-0)
The course will address a current body of knowledge in Industrial Engineering with a research orientation. Term papers and projects will be required. Prerequisites: Graduate Standing and Consent of Instructor.

V. M.S. Level Pass/Fail Courses

INEN791 Masters Comprehensive Exam Credit 1(1-0)
This course will guide the student to take the M.S. Comprehensive Exam. The examination will be administered towards the end of the semester. Pass/Fail evaluation only, no letter grade will be given. Prerequisite: Graduate Standing.

INEN-792. Industrial Engineering Master's Seminar Credit 1 (1-0)
This course introduces contemporary industrial engineering topics via talks by individuals from industry, government, and academe. Prerequisites: Graduate Standing in ISE.

INEN-793. Master's Supervised Teaching Credit 3 (3-0)
This course provides students with the experience of assisting in instruction and evaluation of lecture and laboratory components of industrial engineering courses. Prerequisites: Graduate Standing in ISE

INEN-794. Master's Supervised Research Credit 3 (3-0)
This course provides students with the experience of assisting in all aspects of planning and completing research projects. Prerequisites: Graduate Standing in ISE.

INEN-796. Master's Project Credit 3 (3-0)

This course provides the student an opportunity to complete a comprehensive industrial engineering project of their choice under the supervision of a faculty advisor. A project is an application of industrial engineering methods and techniques to a specific problem. Students are required to complete a project proposal and a final defense in accordance with departmental guidelines. Prerequisites: Graduate Standing in ISE

INEN-797. Master's Thesis Variable **Credit 1-6**
This course provides the student an opportunity to complete a piece of original research, of their choice, in industrial engineering, under the supervision of a faculty advisor. Students are required to complete a thesis proposal and a final defense in accordance with departmental guidelines. Prerequisites: Graduate Standing in ISE

INEN-799. Continuation of Master's Project / Thesis **Credits 1 (1-0)**
This course will enable master's students who have completed all required coursework and all project/thesis credits, to complete their project/thesis work. Prerequisites: Graduate Standing in ISE.

VI. Ph.D. Level Pass/Fail Courses

INEN-991. Doctoral Qualifying Examination **Credit 1 (1-0)**
This course will guide student to take the departmental Qualifying Examination. The examination will be administered towards the end of the semester. Pass/Fail evaluation only, no letter grade will be given. Prerequisite: Doctoral Standing in ISE.

INEN 992. Doctoral Seminar in Industrial Engineering **Credit 1 (1-0)**
The course will present potential dissertation topics and research work-in-progress by faculty members and doctoral students, and talks by eminent practitioners and researchers on classical and contemporary topics in Industrial Engineering. Pass/Fail evaluation only, no letter grade will be given. Prerequisite: Doctoral Standing in ISE.

INEN-993. Doctoral Supervised Teaching in IE **Credit 3 (3-0)**
This course will introduce the student to teaching courses under the guidance of a faculty member. This course will give the student experience in course planning, lecture preparation, classroom teaching, and student evaluation. Pass/Fail evaluation only; no letter grade will be given. Prerequisite: Doctoral Standing in ISE.

INEN-994. Doctoral Supervised **Credit 3 (3-0)**
This is supervised research under the direction of a member of the Graduate Faculty. This research should lead to the identification of a dissertation topic. Pass/Fail evaluation only; no letter grade will be given. Prerequisite: Doctoral Standing in ISE.

INEN-995. Doctoral Preliminary **Credit 3 (3-0)**
This course is for doctoral students who are preparing to take a written examination in their area of specialization. In this course dissertation supervisors will guide their students towards completing the Preliminary Exam. Pass/Fail evaluation only; no letter grade will be given. Prerequisites: Doctoral Standing in ISE and INEN 991.

INEN-997. Dissertation Variable **Credit 1-6**
This course provides the student an opportunity to complete a significant piece of original research, of their choice, in industrial engineering, under the supervision of a faculty advisor. Students are required to complete a dissertation proposal and a final defense in accordance with departmental guidelines. Prerequisites: Doctoral Standing in ISE and INEN 995.

INEN-999. Continuation of Dissertation **Credit 1 (1-1)**
This course will enable doctoral students who have completed all required coursework and all dissertation credits, to complete their dissertation research. Prerequisites: Doctoral Standing in ISE.

Appendix D: Guidelines for Students Seeking a Project/Thesis/Dissertation Topic

1. First consider the area of Industrial Engineering in which you find most interesting: Manufacturing Systems, Ergonomics, Production Control, Operations Research, Engineering Economy, Quality Control and all of the other courses you have taken, are taking, or will take, offer possibilities for these. So to find a topic you will find interesting to work on, first pick the area you like most.

2. Check the appropriate technical journals. Try to pick a specific subject matter in the area, such as scheduling in Production Control, and look through the journal articles published on this subject. Often, authors point out unanswered questions in their articles. Such questions can become the basis for your research. Seek the assistance of faculty for any of these steps.

3. After completing the above process (both steps), visit with the professor who normally teaches courses in your area of interest. Take with you a list of literature reviewed, as well as any ideas you may have come across for possible topics. Sometimes, he/she will have a topic in mind for a thesis, and is waiting for a graduate student to express an interest. But you can't count on this! You have the responsibility of identifying a topic, and the professors can provide advice while you are determining a topic. During this process, keep the following in mind:
   a) you must find the topic;
   b) no faculty is required to direct your thesis; it is solely the decision of the faculty to serve as advisor based on his/her research interests and prior commitments;
   c) you are responsible for your project/thesis and its progress; faculty will not (and should not) do your research, will not write your thesis, take the responsibility for your mistakes, nor is he/she responsible for seeing that you finish by your personal deadline;
   d) the date of completion is a function of how many hours you work on your thesis, the quality of work you put in, and how well your research progresses; research has unknowns, and that is why it is research, and your advisor cannot determine how long it will take you to finish.

4. Ph.D. students should consider topics related to their M.S. thesis work, if appropriate.

Appendix E: Guidelines for Change of Project/Thesis/Dissertation Committee

This situation should normally not arise. However, these guidelines are stated in the event of such an unlikely situation.

A student who wants to change his/her project/thesis advisor and/or the composition of his/her committee should follow the following guidelines:

1. Changes in Committee:
   Once established, the committee shall be responsible for recommending changes in its composition. A student may petition the committee providing reasons and justification for any desired changes in its composition. When necessary, the student may be required to appear in person before the committee to make arguments in favor of their position. The committee shall do everything necessary to ensure that the student's concern is heard fairly; when necessary, individual committee (faculty) members may be excused from the proceedings to avoid possible conflict of interest. The Advisor will communicate the committee's decision to the student in a timely manner. If the change of committee members is permitted, the student can seek a replacement member. In the event the Advisor is involved in the dispute, a member of the committee will be appointed to make this decision, to avert any conflict of interest.

2. Solicitation of individual faculty members as replacements in the Committee:
   It shall be the duty of all IE faculty members prior to committing to a solicitation by student to serve as either the Advisor or committee member, to ensure that the solicitation is for the formation of a new committee. In cases where the solicitations are for replacement of committee personnel, the faculty member should verify and ensure that the case has been properly channeled through student's Advisor and other committee members, and a decision has been made for replacement before engaging in any significant dialogue with the student.

   If a replacement is sought for the Advisor, a new research topic which is in line with the new advisor's research interests and expertise may be required. In the event that the student desires to maintain the same topic, it shall be his/her responsibility to convince the committee that a change of Advisor is justifiable.

3. Requirements for the student in the event of a change:
   If a change is approved by the student's committee, and replacement is made, the student will be required to present his/her project/thesis proposal for the approval of the new committee (even if a proposal defense has been done before).

   For the sake of professional courtesy and to ensure a smooth transition, each faculty member who is contacted by a student to serve as a replacement in the committee should confer with the student's current Advisor and/or colleague to be replaced and ensure that there are no conflicts of interest issues.

Appendix F: Ph.D. Qualifying Exam Preparation Guide

1. Format of Exam:
   The exam will be of 6 hours duration, split into 2 separate sessions of 3 hours each. There will be 3 questions from each subject area, and the student is to answer 2 out of 3. There will be 18 questions per session, and the student will have to answer a total of 12 allowing about 15 minutes per question. There will be no multiple-choice questions. The exam format will be as follows:

   Part I: Human Factors & ORSA: Information Systems, Optimization, Statistics, Simulation, Ergonomics, Safety.*

   Part II: Engineering Management & Production Systems: Facilities Design*, Manufacturing Processes*, Production Systems, Engineering Economy, Quality Control, Work Measurement.

   Subject Substitutes for Computer Science (CS) and Civil Engineering (CE) background students are as follows:

Major	Substitutes
CS	Any two IE subject areas can be substituted by the following two Computer Science subject areas: • Advanced Operating Systems (see COMP 650), Advanced Analysis of Algorithms (see COMP 685), and • Second area (to be decided by student in advance) from the following: Artificial Intelligence (COMP 695), Formal Methods (COMP 681), Software Specifications, Analysis & Design (COMP 710), Software Project Management (COMP 712), and Advanced Artificial Intelligence (COMP 740).
CE	Three IE subject areas (Ergonomics, Safety, and Manufacturing Processes) can be substituted by the following three Civil Engineering subject areas: **- Water Resources Engineering** • Water Resources Systems Analysis [CIEN 762] • Water Resources Systems Engineering [CIEN 785] • Geospatial Information Technologies for Water Resources Manage [CIEN 785] • Open Channel Flow [CIEN 664] • Advanced Hydrology [CIEN 785] • Stream Water Quality Modeling [CIEN 614] • Groundwater/Sub-Surface Hydrology [CIEN 668] **- Environmental Engineering** • Environmental Systems Analysis [CIEN 785] • Modeling and Simulation of Environmental Systems [CIEN 785] • Stream Water Quality Modeling [CIEN 614] • Solid Waste Management [CIEN 616]

	• Hazardous Waste Management [CIEN 710] • Systems Approach in Waste Management [CIEN 712] **- Transportation Engineering** • Traffic Engineering [CIEN 656] • Geometric Design [CIEN 650] • Analysis and Design of Transportation Systems [CIEN 754] • Transportation Planning (Techniques and Methodologies) [CIEN 652] • Discrete Choice Theory and Model [CIEN 785] • Transportation System Operation and Control [CIEN 756] • Advanced Traffic Engineering [CIEN 785] • Advanced Theory of Traffic Flow [CIEN 785]

2. What student may bring to the exam:
   Students may bring books, calculator, and other materials. Access to computers will not be permitted.

3. Exam Evaluation
   The qualifying exam (QE) consists of 12 subject areas, each of which will be graded. The 9 best areas will be selected and serve as the basis for evaluation. The following describes the criteria for a passing score.
   Passing Score Criteria: A score is considered passing if both of the following are satisfied.
   a. The average of the 9 best subject areas is at least 70%.
   b. None of the 9 best subject area scores is below 50%.

   Any other score is considered non-passing. There are three post-conditions for non-passing scores: (a) the student qualifies for a "Deficiency Test"; (b) the student may retake the exam during the next semester; and (c) the student may not retake the exam, and is dismissed.

   Deficiency Test: A student may take a Deficiency Test (DT) if no more than 6 subject area scores are below 50% (or equivalently, no more than 3 of the best 9 is below 50%). DT will be given during the first week of the subsequent semester. The format of the DT is similar to the QE with the following changes: (a) it covers only the subject areas identified as deficient (at most, three) and (b) the duration is 30 minutes per subject area. The best scores in each subject area will then be used to determine if the student has passed the exam according to the *Passing Score Criteria*.

   Retaking the Exam: If more than 6 subject area scores are below 50% (or equivalently, more than 3 of the best 9 are below 50%), then the student must retake the exam within two semesters of the first attempt. No more than one retake is allowed.

Dismissal: If the student does not pass the exam on the second attempt, (that is, the student does not pass the retake), then the student will be dismissed from the doctoral program.

4. Number of Attempts:
   Students can attempt the exam two times at most.

5. Exam Date:
   The Exam will be given on the Friday immediately before Thanksgiving Day in each Fall semester, and on the Friday after Good Friday in each Spring semester.

6. Preparing for the Exam:
   You may plan to sit in on the courses that address the topics to be covered in the exam. Develop your study resources as you progress in your preparation and plan to take the resources you are familiar with to the exam. During the semester in which you take the exam you MUST register for the INEN991 course. A set of materials for preparation will be available to students. This is entitled “Ph.D. Qualifying Exam Preparation Materials” and is available from the department. In addition, a booklet entitled “Ph.D. Qualifying Sample Exam” and is available from the department. Please be aware that the preparation materials and the sample exam should be used only to get an understanding of the format of the exam and the approximate level of complexity. Planned preparation for the exam is vital to your success in the exam.

Ph.D. Qualifying Exam Examples: Five Sample Cases

Fall 2006				Spring 2007				Fall 2007				Spring 2008			
	Evaluation				Evaluation				Evaluation				Evaluation		
Action	Avg	No. in best 9 Courses<50	Outcome	Action	Avg	No. in best 9 Courses<50	Outcome	Action	Avg	No. in best 9 Courses<50	Outcome	Action	Avg	No. in best 9 Courses<50	Outcome
Take QE	71	2	Must take DT in 2 courses	Take DT	74	0	Passed QE								
Take QE	75	0	Passed QE												
Take QE	55	4	Must Retake QE	Retake QE	54	0	Passed QE								
Take QE	53	3	Must take DT in 3 courses	Take DT	54	1	Must Retake QE	Retake QE	53	3	Must take DT in 3 courses	Take DT	57	1	Dismissal from PhD program
Take QE	60	2	Must take DT in 2 courses	Take DT	61	1	Must Retake QE	Retake QE	67	0	Passed QE				

7. Topics List for subject areas:

Part I

Information Systems
- Information System Architectures
- System Design and Implementation
- Analysis and Design Techniques
- Data Modeling
- Database Systems
- Structured Query Language
- Common Application Tools

Optimization
- Dynamic Programming
- Linear Programming
- Markov Chains
- Multiple Criteria and Nonlinear Programming Models
- Poisson Process
- Queuing Models and their Applications
- Simplex Algorithm
- Transportation Problem

Statistics
- Calculus-based Probability Calculations
- Conditional Probability
- Confidence Intervals
- Data Presentation and Analysis
- Discrete and Continuous Probability Distributions
- Estimation
- Frequency Distributions
- Hypothesis Testing
- Joint Distributions
- Probability Concepts and Axioms Of Probability
- Random Variables
- Regression Analysis
- Sampling Distributions

Simulation
- Monte Carlo and Discrete Event Simulation
- Random Variable Generation
- Simulation Language Constructs
- Use of Simulation Modeling in Design and Improvement of Systems

Ergonomics
- Anthropometry
- Biomechanics and Manual Material Handling
- Concepts of Psychomotor Work Capabilities
- Design of Hand Tools
- Energy Measures

Environmental Stressors
Human Error
Human-Machine Trade-Offs
Mental Information Processing
Psychological Measures
Work Station Design

Safety*

Methods of Investigating and Analyzing Accidents
Occupational Safety and Health Act
Relationship between System Safety, Risk and Human Performance
System Failures and Risk in Human-Machine Systems

Part II

Facilities Design*

Automated Storage and Retrieval Systems
Concepts of Distance Metrics
Determination of System Capacities
Evaluation of Layouts
Location Analysis
Material Flow Analysis
Material Handling Technology and Equipment Selection
Relationship Charts
Systematic Layout Plans
Warehousing

Manufacturing Processes*

Basic Jig, Fixture and Gage Design
Machining Formulas
Material Removal and Joining
Material Removal Rates
Metal Casting, Forming, Shaping

Production Systems

Aggregate Production Planning
Demand Forecasting
Group Technology
Inventory Control
Job Scheduling
Just-In-Time Manufacturing
Line Balancing
Process Planning

Engineering Economy

Breakeven Analysis
Cash Flows
Concept of Time Value of Money
Depreciation and Depletion Methods
Effect of Income Taxes and Inflation on Economy Studies

Methods of Evaluating Alternatives Based on Present Worth, Annual Worth, Rate of Return, Payback Period and Cost Benefit Analysis
Replacement Analysis

Quality Control

Attributes and Variable Sampling Plans
ISO 9000
Process Capability
Quality Auditing
Quality Function Deployment
Quality Philosophies
Statistical Control Charts

Work Measurement

Determination of Time Standards using Time Study
Documentation and Improvement
Job Evaluation
Learning Curves
Methods Analysis
Predetermined Times Standards
Productivity Measures
Time and Motion Study
Work Sampling

Notes:
1. Subject areas marked with "*" are not required for HCI option.
2. Topic lists for Computer Science subject areas for the HCI option will be provided under this option prior to the exam.

Appendix G: Ph.D. Preliminary Exam Preparation Guide

1. Prerequisites to register for the Preliminary Exam (INEN995):
   In order to register for the Preliminary Exam, the student must have completed the following:
   (i) Qualifying Exam
   (ii) Any course work the student's Ph.D. Committee feels must be completed in preparation for the written part of this exam.
   (iii) Must have formed a Ph.D. Committee as reflected in their current Plan of Study.

   In addition, the student's Dissertation Advisor must ensure that the student is well-prepared to begin writing a dissertation proposal.

2. Format of Exam:
   This exam has one part,
   (i) Written Exam in area of specialization (HMSE, MSE, or PSE) to be given by the student's PhD Committee

3. Written Exam:
   The Written Exam will consist of in-depth questions in subject areas related to the student's chosen specialization. The student's Dissertation Advisor and the other Committee members will convene a meeting early in the semester in which the student registers for the Preliminary Exam to plan for the Written Exam. Each committee member will prepare and grade questions in one area for the exam. The student will be given one week to complete the exam. The PhD Committee will decide whether the student passed or failed the written exam, and inform the student within two weeks. The Ph.D. committee typically schedules the Written Exam in the second month of the semester (Fall Break and Spring Break periods are suggested).

   If the student fails the Written Exam, the committee will give the student one more attempt in the form of a fresh exam. The date and time of the exam will be determined by the Committee, but must be done within the same semester, unless the committee determines that the student should take one or more courses before he/she retakes the exam.

5. Passing the Preliminary Exam:
   In order to pass the Preliminary Exam, the student must pass the Written Exam.

6. Preparing for the Exam:
   In preparation for the Written Exam the student must complete course work related to the student's specialization. The student should get guidance from their Dissertation Advisor to understand if they are ready to prepare a Dissertation Proposal.

Appendix H: Supervised Teaching and Supervised Research for Ph.D. Program Credit

All PhD students are required to take either Supervised Teaching or Supervised Research for credit during one semester. *Please note that this is different from the requirement that all Graduate Teaching and Research Assistants must register for Supervised Teaching or Supervised Research in semesters in which they receive financial support.* Students who wish to pursue an academic career after PhD are advised to register for and complete Supervised Teaching, and students who anticipate pursuing a career in research are advised to register for and complete Supervised Research. The following are the guidelines for initiation and grade evaluation for these two courses.

Steps	Supervised Research	Supervised Teaching
Planning	• Complete Qualifying Exam • Talk to Dissertation Advisor about possible research agencies • Work out details of a minimum of one-semester research effort at the agency site, with the agency	• Complete Qualifying Exam • Talk to Dissertation Advisor about possible courses to teach • Work out details of course to be taught with the Graduate Program Coordinator
Registering	• Get a letter of approval from Dissertation Advisor about the research experience, including the name of the agency supervisor and the research planned • Register for INEN993 in the semester in which the research experience assignment will be completed	• Get a letter of approval from Dissertation Advisor about the teaching assignment, including the name of a faculty supervisor assigned for course; as far as possible the Dissertation Advisor will also serve as the faculty supervisor • Register for INEN993 in the semester in which the teaching assignment will be completed
Tasks	• Complete a review of INEN994 overview slide set • Work on research tasks • Provide monthly progress reports to your Dissertation Supervisor • Prepare and submit final report of research work to Dissertation Advisor and agency supervisor	• Complete a review of INEN993 overview slide set • Prepare a course outline • Teach class and submit grades for students
Evaluation	• Dissertation Advisor and supervisor at agency will jointly evaluate the performance; monthly progress reports and	• Two faculty selected by chair will evaluate teaching performance and provide input to student and faculty

	final report will be used • Dissertation Advisor will assign course grade	supervisor • Student Opinion form summary will be provided to student and faculty supervisor • Faculty Supervisor will assign course grade

Appendix I: Guidelines for Qualifying Research Experience Requirement for Ph.D. Students

This requirement is for students who are admitted into the program without an appropriate research experience at the MS degree level.

1. Identification of requirement:
   Students will be identified as being subject to this requirement at the time of admission or when they commence the program, by the Graduate Program Committee. The student will also be assigned a faculty member to supervise the completion of this requirement.

1. The requirement:
   The student must complete research proposal, resembling a M.S. thesis proposal, under the supervision of the assigned faculty member, and the proposal must include the following elements
   - introduction to the research
   - literature survey
   - research methodology or approach
   - preliminary results
   - expected results from research

   The student is required to register for INEN796 (Master's Project) in the second semester of this one and one-half semester effort.

3. Time line and approval:
   The student must complete the work in the second semester of their enrollment in the PhD program. Specifically, the student must submit their work by the end of Spring Break for those entering the PhD program in Fall, the end of first session of Summer for those entering in Spring, and Fall Break for those entering in Summer. The research proposal must be submitted to the Graduate Program Committee for approval. Continuation in the PhD program will be contingent on approval of this report by the Graduate Program Committee.

Appendix J: List of Required Forms

These forms are available at the departmental website. Download the forms you need. Complete your information. Print the completed form. Get appropriate signatures and return to the Graduate Program Secretary.

1. Specialization Form
2. Change of Status
3. Ph.D. Course Waivers
4. Plan of Study (M.S.)
5. Plan of Study (Ph.D.)
6. Proposal Notification
7. Application for Graduation
8. Final Clearance Checklist
9. Thesis/Dissertation Cover Sheet
10. Thesis Exam Report Form