NANOENGINEERING
GRADUATE STUDENT HANDBOOK

DEPARTMENT OF NANOENGINEERING

JOINT SCHOOL OF NANOSCIENCE AND NANOENGINEERING
of
NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY
2907 E Gate City Blvd
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Notices

This handbook is prepared for Graduate Students in Nanoengineering at North Carolina A&T State University (NCA&TSU). It is designed to supplement the existing policies of the Graduate College and is intended to be a guide. The Nanoengineering Graduate Program periodically revises this handbook and information contained herein is also proofed for accuracy. However, students are asked to consult their academic advisor or graduate coordinator or department chair as well as appropriate University offices for current information and policy.

It is each student's responsibility to be knowledgeable of the published academic regulations and requirements set forth in the Graduate Catalog, its revisions, University policies and regulations, and specific requirements of the academic program (http://www.ncat.edu/tgc/graduate-catalog). The student is also responsible for compliance with announcements published by the Department, Graduate College, Registrar, Provost and other University offices. Lack of knowledge of regulations and requirements does not excuse the student from complying with academic regulations and meeting the requirements.

Important changes may occur without notice. The Department attempts to maintain an accurate Graduate Student Handbook at all times; however, errors may occur inadvertently. The Department reserves the right to correct such errors when they are found without further notice. Presence of errors will not affect the application of rules and requirements of the student.

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1.0 Objective

The objective of the Nanoengineering Graduate Program at North Carolina A&T State University (the University) is to provide advanced-level study in distinct areas of specialization. The Master of Science in Nanoengineering degree program is a research degree, which prepares students with a strong background in engineering or applied science who seek specialized training for industrial or government positions in fields that utilize nanotechnology. The Doctoral degree in Nanoengineering is designed for students with a strong academic track record who seek advanced-level education and training to pursue careers in academia, industrial or government organizations that utilize nanotechnology.

The degrees offered are:
Master of Science (M.S.) in Nanoengineering
Doctor of Philosophy (Ph.D.) in Nanoengineering

2.0 Master of Science in Nanoengineering

2.1 Program Description

The Master of Science in Nanoengineering (MSNE) degree program is a research degree, featuring coursework involving engineering at the nanoscale. Students will have the opportunity to work in one or more of the following research areas: nanomaterials/nanomanufacturing, nanodevices/nanoelectronics, nanobiology/nanomedicine, nanoenergy/environmental nanotechnology, and computational nanotechnology. Two program options are available to students - (i) thesis option and (ii) project option.

2.2 Admission

The Master of Science in Nanoengineering Program is open to students with a Bachelor's Degree in engineering, applied science or in a closely related field from recognized institutions. Applicants may be admitted to the MSNE Program unconditionally or conditionally.

2.2.1 Unconditional Admission

An applicant may be given unconditional admission to the MSNE Program if the applicant possesses a Bachelor of Science in engineering or in a closely related field from an accredited institution with an overall GPA of 3.0 or better on a 4.0 scale. Additionally, the applicant needs to include (a) GRE score; (b) current curriculum vitae; (c) statement of purpose; and (d) three professional recommendation letters in application materials. Two of the three recommendation letters must be from faculty members of an accredited higher education institution.

Good academic standing is a requirement for eligibility for departmental financial assistance.

2.2.2 Conditional Admission

An applicant may be granted conditional admission if the applicant falls under one of the following situations:

a. The applicant has a Bachelor's degree in engineering, applied science or in a closely related field with a GPA of less than 3.0 but has a major GPA of at least 3.0 in the last four semesters of undergraduate study.
b. The applicant has a Bachelor's degree in applied science or in a closely

related field with a GPA of 3.0 or better on a 4.0 scale but is deficient in key fundamental engineering courses.

c. The applicant has a Bachelor's degree in non-engineering or non-applied science field but is exposed to substantial and relevant engineering, science and mathematics content and a GPA of 3.0 or higher.

2.2.3 Change of Admission Status

The status of conditionally admitted students will be changed to unconditional status when both of the following two conditions are satisfied.

a. All course deficiencies have been completed with a Grade of "B" or better ("B-" is not equivalent to a "B") and
b. A minimum of 3.0 GPA is attained in courses taken at the University for graduate credits at the end of a semester in which the 9th credit hour is completed.

It is the student's responsibility to apply for a change in admission status.

2.2.4 International Students

All international applicants, except those from countries exempted, must provide proof of English language proficiency by obtaining acceptable scores on the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) or Pearson Test of English (PTE). The official TOEFL score (at least 80 or higher internet-based score), or IELTS score (6.0 or higher) or PTE academic score (53 or higher) should be submitted directly from the testing agency to the Graduate College of the University. TOEFL, IELTS, and PTE scores are reportable for a period of two years from the date of the exam. If the scores are older than two years, the student must re-take the exam.

2.3 Program Policies and Requirements

2.3.1 Transfer of Credits

The University is not obligated to accept any courses for transfer credit. However, the student may transfer up to 40% of the required credit hours from a degree program to the Nanoengineering Graduate Program, subjecting to approval by the advisor and graduate coordinator (or department chair). The credits may be transferred from another graduate program at the University or from another accredited/approved university. Transfer credits can be only applied to satisfy the domain course requirements (not core courses). Courses for transfer must be graduate-level courses relevant to the Nanoengineering graduate degree being sought based on an evaluation of the course description. Any course for transfer must have been earned at a regionally accredited university, or otherwise approved, with a grade of "B" or better ("B-" is not equivalent to a "B"). Courses that have been graded on a Pass/Fail or Satisfactory/Unsatisfactory basis will not be accepted for transfer. For other conditions, please refer to the Graduate Catalog of the University.

2.3.2 Time Limitation

The MSNE program must be completed within six (6) consecutive calendar years. Work that is not completed by this time limit is subject to cancellation, revision, or a special examination. In the event that the graduate study is interrupted by military duties, the time limit shall be extended for the length of time the student has been on active duty provided the candidate resumes graduate study no later than one year after the release from military service. A student may petition for an extension of the time limit under extenuating circumstances, for example, a long term illness.

2.3.3 Academic Advisor and Thesis Committee

All thesis-option M.S. students must select an academic advisor during their first semester of enrollment and form a thesis committee by the end of the first year. Failure to find an Academic Advisor and start working on M.S. thesis by the end of third semester will result in termination from the MSNE program.

The thesis committee shall consist of at least three faculty members with the academic advisor serving as the chair. The academic advisor and the majority of the committee members must be primary faculty members of Nanoengineering graduate program. The members of the committee must be approved by the graduate coordinator or department chair. The Graduate College verifies the eligibility of faculty to serve on the thesis committee. The committee assists the student to define the thesis topic and reviews the quality of the student's work. The committee also conducts the oral defense of the student's thesis work.

All project-option M.S. students must select an academic advisor by the end of the first year of enrollment. Failure to find an Academic Advisor by the end of the third semester will result in termination from the MSNE program.

2.3.4 Plan of Graduate Study

All graduate students are required to file a Plan of Graduate Study by the end of the second semester after admission to a program of study. A student’s Plan of Graduate Study must be approved by the advisor and graduate coordinator (or department chair) and submitted to the Graduate College. Failure to submit the Plan of Graduate Study prevents the student from enrolling in classes for their third semester. The Plan of Graduate Study is established in consultation with the advisor and approved by the graduate coordinator or department chair. The Plan of Graduate Study is based on the requirements of the Nanoengineering Graduate Program but may be structured to meet the specific needs of the student. The Plan of Graduate Study may be amended at any time before the student applies for graduation with the approval of the advisor and graduate coordinator (or department chair). Responsibility for meeting all academic requirements rests with the student. This Plan of Graduate Study serves as a contract between the student and the University towards the fulfillment of the degree requirements.

2.3.5 Degree Requirements

MSNE degree requires fulfillment of 30 credit hours, which includes course work, seminar and successful completion of thesis or project work.

2.3.6 Course Work Requirements

The coursework requirements include Nanoengineering core courses and specialty domain courses per the discretion of the student and the academic advisor. There are two options are available to MSNE students: (1) thesis option, and (2) project option (Table 1).

Table 1: Comparison of MSNE Program Option and Course Requirements

Program Options	Credit Hours	Core Courses	Domain Courses	Thesis	Project
Thesis	30	15	9	6	-
Project	30	15	12	-	3

Core Courses: 15 credit hours: NANO 701, 702, 703, 704, 705
Domain Courses: 9 (for thesis) or 12 (for project) credit hours from
NANO 700-899 excluding 792, 796-799, 851-854;
NAN 600-699 (consortium-Nanoscience/UNCG) excluding 621, 622, 628;
Or any other courses approved by the student's advisor and graduate coordinator (or department chair)

Thesis Option: This option is intended for students with strong research interests who desire to pursue further graduate studies or seek to work in research institutions. Students in the Thesis Option must complete the following requirements:

a. 24 credit hours of course work with letter grades.
b. 6 credit hours of Master's Thesis (NANO 797). A research topic must be chosen in conjunction with the advisor culminating in the preparation of a scholarly thesis.
c. Attend all JSNN/Nanoengineering seminars

An oral thesis defense/examination and a written thesis document are required. A student in the Thesis Option must pass the oral examination/thesis defense scheduled by the thesis committee. The thesis defense is scheduled after the thesis has been reviewed and approved by each member of the thesis committee. The defense is held at a public meeting. However, the deliberation following the public meeting is open only to the thesis committee members. At the deliberation, the committee will determine if the student passes or fails the oral defense, or to redo the oral defense at another date. An approved thesis must be submitted to the Graduate College by the deadline given in the academic calendar.

Project Option: This option is intended for students who have substantial industrial engineering experience. Students in the Project Option must complete the following requirements:

a. 27 credit hours of course work with letter grades.
b. 3 credit hours of Masters Project (NANO 796). A written project report must be approved by the advisor and an oral project presentation is suggested.
c. Attend all JSNN/Nanoengineering seminars

2.3.7 Application for Graduation and Graduation Clearance

Students must be in good academic standing and meet all requirements as specified in the Plan of Graduate Study with an overall Grade Point Average (GPA) of 3.00 or higher. Students must be enrolled in the semester in which they apply for graduation. Students intending to graduate must apply for graduation by the posted deadline and comply with all Graduate College requirements.

3. Doctor of Philosophy in Nanoengineering

3.1 Program Description

The Ph.D. program in Nanoengineering features coursework, laboratory rotations and extensive dissertation research involving engineering at the nanoscale. It is designed for a student with a strong academic track record who seeks advanced-level education and training to pursue a career in academia, industry, or government organizations that utilize nanotechnology. The Ph.D. student has the opportunity to work in one or more of the following research areas: nanomaterials/nanomanufacturing, nanodevices/nanoelectronics, nanobiology/nanomedicine, nanoenergy/environmental nanotechnology, and computational nanotechnology. The Ph.D. student studies under the guidance of an academic advisor and a dissertation committee. The academic advisor supervises the student for creating the Plan of Graduate Study, selecting a dissertation topic, and setting and meeting the degree goals.

The Ph.D. student is trained for the ability to undertake original research and independent work at the highest level. The Ph.D. degree is not granted simply upon the completion of required course work but rather upon the demonstration of comprehensive understanding and knowledge of their nanoengineering discipline and the contribution/creation of novel high quality research to their field. The student must demonstrate independent research abilities by generating conference presentations, journal articles and/or other form of peer-reviewed publications; and ultimately report the culmination of their research results by writing a dissertation on an original topic.

To continue in the program a Ph.D. student will maintain an average "B" grade in the four core courses: NANO701, NANO702, NANO703, and NANO704. The student will pass a preliminary examination to demonstrate their preparation to conduct dissertation research, followed by a successful proposal of a dissertation topic and research plan. After their research in concluded the Ph.D. candidate will complete an oral defense of their dissertation. The student achieves Ph.D. candidacy upon completion of all course work requirements and passing the candidacy exam.

3.2 Admission

3.2.1 Unconditional Admission

An applicant must meet either of the following requirements to get admission.

a. The applicant has a Master degree in engineering, or a closely related field with a minimum 3.0 GPA on a 4.0 scale and an acceptable GRE score
b. The applicant has a Bachelor degree in engineering or a closely related field with a minimum 3.5 GPA on a 4.0 scale and an acceptable GRE score
c. The applicant has an MSNE degree and an acceptable GRE score

Additionally, an applicant must include statement of purpose, current curriculum vitae and three professional recommendation letters in application materials. Two of the three recommendation letters must be from faculty members of an accredited higher education institution.

International Students: All international applicants, except those from countries exempted, must provide proof of English language proficiency by obtaining acceptable scores on the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS) or Pearson Test of English (PTE). The official TOEFL score (at least 80 or higher internet-based score), or IELTS score (6.0 or higher) or PTE academic score (53 or higher) should be submitted directly from the testing agency to the Graduate College of the University. TOEFL, IELTS or PTE score is reportable for a period of two years from the date of the exam. If the score is older than two years, the student must re-take the exam.

3.2.2 Conditional Admission

An applicant may be granted conditional admission if the applicant falls under one of the following situations:

a. The applicant has a Master's degree in applied science or in a closely related field with a 3.0 GPA or better on a 4.0 scale but is deficient in key fundamental engineering courses.

b. The applicant has a Master's degree in non-engineering or non-applied science field but owns a closely-related undergraduate degree with a substantial and relevant engineering, science and mathematics content and a GPA of 3.0 or higher.

3.2.3 Change of Admission Status

The status of conditionally admitted students will be changed to unconditional status when both of the following two conditions are satisfied.

a. All course deficiencies have been completed with a Grade of “B” or better (“B-” is not equivalent to a “B”) and

b. A minimum of 3.0 GPA is attained in courses taken at the University for graduate credits at the end of a semester in which the 9th credit hour is completed.

It is the student’s responsibility to apply for a change of admission status.

Applicant who does not meet the Ph.D. admission requirements will be recommended to apply for and will be considered for admission in MSNE, provided the student satisfies the MSNE requirements. Please refer to section 2.2 for MSNE admission eligibility.

3.3 Program Policies and Requirements

3.3.1 Time Limit

Students are allowed a maximum of 5 calendar years from their initial enrollment in the Nanoengineering Ph.D. program to earn their Ph.D. candidacy, and a maximum of 10 calendar years to complete all degree requirements. Once candidacy is achieved, the dissertation must be completed in 5 years. Work that is not completed in this time limit is subject to cancellation, revision, or special examination. In the event that the Ph.D. study is interrupted for military duties, the time limit shall be extended for the length of time the student has been on active duty provided the candidate resumes graduate study no later than one year after the release from military service. A student may petition for an extension of the time limit under extenuating circumstances, for example, a long term illness.

3.3.2 Transfer of Credits

The University is not obligated to accept any courses for transfer of credit. However, the student may transfer up to 40% of the required credit hours from a degree program to the Nanoengineering Ph.D. Program, subjecting to approval by advisor and graduate coordinator (or department chair). The credits may be transferred from another graduate program at the University or from another accredited/approved university. Transferred courses must be graduate-level courses relevant to the Nanoengineering Ph.D. degree being sought based on evaluation of the course description. The course for transfer of credit must have been earned at a regionally accredited university, or otherwise approved, with a grade of “B” or better (“B-” is not equivalent to a “B”). Courses that have been graded on a Pass/Fail or Satisfactory/Unsatisfactory basis will not be accepted for transfer. For other conditions, please refer to the Graduate Catalog of the University.

- For students without a MSNE degree, the transfer credits can only be applied to satisfy the Nanoengineering domain course requirements that does not include the required three 800 level courses (9 credits). Such students also cannot apply the transfer credits to any Nanoengineering core courses.
- For students with an MSNE degree, they may transfer up to 24 relevant credit hours from their MSNE degree to Nanoengineering Ph.D. program, subjecting approval from their advisor and graduate coordinator (or department chair).

3.3.3 Degree Requirements

The Nanoengineering Ph.D. program requires 60 credit hours of coursework, lab rotations and extensive research (Table 2).

Table 2: Course requirements for the Ph.D. Degree

Credit Hours	Core Courses	Lab Rotations	Domain Courses	Supervised Research	Dissertation Research
60	15	3	18	6	18

Core Courses: 15 credit hours: NANO 701, 702, 703, 704, 705

Lab Rotations: 3 credit hours from NANO 851-855, NAN 611 (Consortium course -Nanoscience/UNCG)

Domain Courses: 18 credit hours
a) 9 credit hours from:
NANO 800-899 excluding 851-854;
NAN 700-799 (Consortium- Nanoscience/UNCG) excluding 799;
Or any 800 level courses approved by the student’s advisor and graduate coordinator (or department chair)
b) Select additional credit hours to meet the total credit hour requirement from:
NANO 700-899 excluding 792, 796-799, 851-854;
NAN 600-799 (Consortium -Nanoscience/UNCG) excluding 621, 622, 628, 799;
Or any graduate level course approved by the student’s advisor and graduate coordinator (or department chair)
c) 6 credit hours for Doctoral Supervised Research (NANO 994)
d) 18 credit hours of Doctoral Dissertation (NANO 997).

Other requirements (no credit hours):
Average “B” grade for core courses
Satisfy teaching requirement – at least 1 semester

Pass Preliminary Examination
Pass Candidacy Examination
Pass Dissertation Defense
Attend all JSNN/Nanoengineering seminars

3.3.4 Dissertation Advisor and Dissertation Committee

The Ph.D. student must select an academic advisor by the end of their second semester of enrollment. The student's dissertation committee must be formed by the end of the second year before the candidacy exam. Failure to find an Academic Advisor and start working on Ph.D. dissertation by the end of fourth semester will result in termination from the Nanoengineering Ph.D. program.

The dissertation committee shall consist of at least four members who are affiliated with the Nanoengineering graduate program with the academic advisor serving as the chair. The academic advisor and the majority of the committee members must be a primary faculty member of Nanoengineering graduate program. The dissertation committee is selected by the student in consultation with the advisor. The members of the committee must be approved by the graduate coordinator (or department chair). The Graduate College verifies the eligibility of faculty to serve on the dissertation committee and also appoints an additional external member for the committee as Graduate College Faculty Representative. The Graduate College Faculty Representative serves on the dissertation committee with all the rights and responsibilities of any other member. In addition, the Graduate College Faculty Representative also represents the Graduate College to (a) protect the interest of the University by ensuring that the dissertation meets the highest academic standard; (b) provide assurance that appropriate procedure is followed; and (c) provide an "outside" point of view by sharing expertise with a new perspective or theoretical vantage that might not otherwise be available. The academic advisor and dissertation committee direct the student in establishing a Plan of Graduate Study, plan dissertation topic, and provide guidance during the student's dissertation research. The committee also conducts the student's candidacy exam and the final oral defense of dissertation.

3.3.5 Plan of Graduate Study

All Ph.D. students are required to file a Plan of Graduate Study by the end of the second semester after admission to the Nanoengineering Graduate Program. Failure to submit the Plan of Graduate Study prevents the student from enrolling in classes for their third semester. The Plan of Graduate Study is based on the requirements of Nanoengineering Ph.D. Program but may be structured to meet specific needs of the student. The Plan of Graduate Study needs to be established by the student working with the advisor, approved by graduate coordinator (or department chair), and submitted to the Graduate College. The Plan of Graduate Study may be amended at any time before the student applies for graduation with the approval of the advisor and graduate coordinator (or department chair). Responsibility for meeting all academic requirements rests with the student. This Plan of Graduate Study serves as a contract between the student and the University towards the fulfillment of the Ph.D. degree requirements.

3.3.6 Teaching Requirement

A doctoral student is required to serve as a teaching assistant or a lab instructor for at least one semester to earn the Ph.D. degree. Tasks may include NanoBus outreach program, course/lab planning, classroom/lab teaching, lecture/lab preparation, student evaluation, and grading. The faculty mentor of the student observes and provides feedback to the student and evaluate the student's performance. The student needs to provide documentation signed by the teaching mentor to prove satisfactory completion of this requirement.

3.3.7 Doctoral Supervised Research (NANO 994)

NANO 994 is a research course conducted on a Nanoengineering topic and supervised under mentorship of a Nanoengineering graduate faculty. This course is intended to expose doctoral student to different research dimensions such as literature search and information gathering, examination of existing knowledge, identifying research questions, research design, critical thinking, analytical and systematic enquiry, and problem solving. It is not intended to serve as part of the dissertation topic of the doctoral student and not to occur in one semester with multiple sections of NANO 994.

3.3.8 Preliminary and Candidacy Examinations

All students in the Nanoengineering Ph.D. program are required to pass two exams to advance to Ph.D. Candidacy. Doctoral candidacy status indicates that the Nanoengineering Ph.D. program believes the student is capable of conducting dissertation research with a high probability of success. A Ph.D. candidate is a student that has completed all requirements of the Ph.D. program except for the defense of their dissertation.

The two exams are completed in order and as follows: Literature Review (Preliminary Exam) and Ph.D. Dissertation Proposal (Candidacy Exam). The objective of these exams is to assess that the student has sufficient knowledge base to conduct Ph.D. research, is capable of processing and communicating research in written form, and is able to formulate a novel research plan and produce a research proposal based on the scientific and/or engineering method(s), respectively.

3.3.8.1 Literature Review Exam (Preliminary Exam)

This examination will be administered to the enrolled student by an examining committee of the department.

a) Eligibility to sit for the examination is that the student earns an average B grade in their NANO 701, 702, 703 and 704 courses.
b) Students may only take the Preliminary Exam twice. After the second failure, the student will be dismissed from the program.
c) The three-faculty member Review Committee will be established by the student and composed of at least two primary Nanoengineering faculty members including the student's academic advisor/major professor. The committee must be convened and approve the topic in advance of the Preliminary Exam.

(1) Literature Review Guidelines

The Preliminary Exam tests a Ph.D. student's ability to prepare and present a comprehensive overview of a topic based on existing journal literature. The Preliminary Exam is based on a written review paper appropriate to the student's field of study in the style of a peer-reviewed journal article. It should be a comprehensive discussion of the literature, scientific theory, problems or theoretical deficiencies, and possible areas of research related to nanotechnology. The topic and format of the review paper should be decided by the student in collaboration with the student's academic advisor.

The Preliminary Exam will conclude with the delivery of a publication-worthy review paper and a short seminar on the topic, which will culminate with a closed review with the Review Committee and a preliminary overview of the student's research project. This exam should occur by the end of the first year and MUST occur by the end of the Ph.D. student's third semester.

(2) Evaluation Criteria

The student's Review Committee will evaluate the student's review paper and/or presentation based on the completeness and accuracy of the review, demonstration of understanding of the material, quality of responses/answers to questions, and overall quality of the review paper and/or presentation. The student will earn a "Pass", or "Fail" based on the cumulative committee assessment. A student will receive a "Fail" grade, when the Review Committee assesses that the student did not demonstrate a sufficient capability to conduct background literature research and did not demonstrate the independence to learn a new topic based on prior art.

Students may only take the preliminary examination twice by the end of the third semester. Failure to "Pass" the Preliminary Exam results in a failure to qualify and the student will be dismissed from the Nanoengineering Ph.D. program.

A Ph.D. student who does not pass the Preliminary Exam DOES NOT qualify for candidacy and will exit the Ph.D. program. The student will be given the option to enter the Nanoengineering Master program.

3.3.8.2 Dissertation Research Proposal (Candidacy Exam)

The Ph.D. Research Proposal is a written and oral exam that will advance the student to candidacy in the Nanoengineering Ph.D. Program. The format for this examination is consistent with the highest standards and in accordance to the University Graduate Catalog. The proposal must be defended no later than the end of the student's fourth semester (**Note:** only under valid circumstances will extensions be granted by the approval from the student's dissertation committee in consultation with the student's advisor).

(1) Candidacy Exam Date and Guidelines

The student is suggested to write a detailed research proposal in the format of an NIH, NSF, or similar grant proposal (See Appendix G: Nanoengineering a Dissertation Proposal). The proposed project should be within Nanoengineering scope and should have input from the student's dissertation advisor. The student's dissertation committee must receive a complete written dissertation proposal at least one week prior to the date of the Candidacy Examination.

Important Dates to Remember

- On or before **March 1** - PRIOR to submitting copies of proposal to Dissertation Committee members by the student, the student's advisor must approve the student's proposal. The student's advisor should give back the "final" proposal no later than **March 31.** Keep in mind the advisor is formally allowed 10 business days to return written work – plan appropriately.

- On or before **April 15** - AFTER the advisor has approved the student's proposal, it is given to other dissertation committee members for their comments. Dissertation committee members should receive their "final" advisor-approved proposal copy no later than **April 15**. Each committee member will return written comments to the student within 10 business days of receiving the proposal.
  (Please note that the comments may not be extensive – and may just simply state, "this proposal is defendable".)
  All dissertation committee members must either sign-off on the proposal as defendable or alternatively ask for significant revisions. The final proposal must be approved via email from all committee members before the defense is scheduled (though a provisional date can be reserved ahead of the approval).
- **Before May 1** - The proposal defense date is scheduled to take place by the end of the spring semester.
  Students are responsible for reserving a room and scheduling a time when all committee members are available to meet for a two-hour block of time.

(2) Candidacy Exam Evaluation Criteria
Evaluation of the student's proposal occurs in a closed-door defense of the proposal in front of the Dissertation Committee. At the defense, the student will present an overview of the proposal orally. Since all the dissertation committee members will have read the proposal prior to the defense, the oral presentation should be around 30 minutes long. Afterwards, the student should be challenged on the content of the proposal, and asked to answer a series of questions related to the proposal material, which can include background information or techniques related to the proposal. At the end of the defense, the student will be asked to briefly leave the room and the committee will discuss the proposal defense. When the committee members reach a decision, the student will be asked to return to the room for result.

The Dissertation Committee evaluates the student's performance and makes a decision to "Full Pass", "Conditional Pass" or "Fail". At this point the committee can discuss more candidly with the student for their critiques and suggestions on the projects merit, scope, and research plan.

(3) Result of Candidacy Exam
Students will receive either, (1) a "Full Pass" (no other action is required on the part of the student) or (2) a "Conditional Pass" (additional action is required on the part of the student), or (3) a "Fail".

Conditional passes are given if the committee finds there is an area that still needs to be addressed by the student. For example, if a student is deficient in a specific area that the committee feels important for the student's success in the Ph.D. program, they may require the student review and be re-tested on that area. Re-writing a section of the grant proposal to clarify/correct a point that wasn't clear in the original version is another common condition that can be assigned to students receiving a "conditional pass".

In the case of a fail, the committee has the option of allowing a re-examination. If this course of action is taken, the student must be re-examined within four months on those aspects of the defense indicated by the committee as not satisfactory. Re-examination can only occur once.

In the case of a fail and re-examination does not occur, the student DOES NOT qualify for candidacy and will exit the Ph.D. program. The committee may recommend that the student be given the option to enroll in the Nanoengineering Master program.

3.3.8.3 Application for Re-examination

To continue pursuit of Ph.D. candidacy after failing a Nanoengineering Preliminary or Candidacy exam, a written request from the student must be delivered to the advisor and examination committee no later than 2 weeks after the student's receipt of the exam result.

Upon review, at the examination committee's discretion, a written recommendation containing specific conditional requirements of the student will be presented to the Nanoengineering graduate coordinator (or department chair) and must receive approval.

3.3.9 Doctoral Dissertation (NANO 997)

The student may not register for doctoral dissertation credits (NANO 997) before finishing all other course requirements or passing Preliminary Examination. No more than 18 dissertation credit hours will be counted toward the total credit hours requirement for the Ph.D. degree.

3.3.10 Final Dissertation Defense

Oral Dissertation Defense will be conducted by the student's dissertation committee and scheduled after a complete dissertation is reviewed and approved by each member of the dissertation committee. The examination may not be held earlier than six months after proposal defense. The student's academic/dissertation advisor schedules the oral dissertation defense and informs the Graduate College before the examination to request a graduate faculty representative from the Graduate College. The oral defense is generally open to the public unless there is confidential information. The committee deliberation is open only to the dissertation committee members. Upon deliberation, the dissertation committee will determine if the student pass the oral defense. If the student fails, with sufficient consideration, the student's dissertation committee may permit one re-examination. At least one full semester must elapse before the re-examination. Failure on the second attempt will result in dismiss from the Nanoengineering Ph.D. program.

3.3.11 Submission of Dissertation

The dissertation submission must follow the guidelines set by Graduate College of the University. It is the responsibility of the student to check with the Graduate College for the current Dissertation format and submission guidelines. Upon passing the Oral Dissertation Defense, the Ph.D. student must have the final dissertation approved by each member of the dissertation committee. The approved dissertation must be submitted to the Graduate College by the deadline given in the academic calendar of the University.

3.3.12 Application for Graduation and Graduation Clearance

Students must be in good academic standing and meet all requirements as specified on the Plan of Graduate Study with an overall Grade Point Average of 3.00 or higher. Students must be enrolled in the semester in which they apply for graduation. Students intending to graduate must apply for graduation by the posted deadline and comply with all the requirements for the Ph.D. degree.

Appendix A: Student's Responsibilities

It is the student's responsibility to know the University policies and regulations:

a. Each student is responsible for the timely completion of their academic program, for maintaining good academic standing, and for meeting all other degree requirements.
b. Full-time students are given stipends or assistantships to work/conduct research in labs. Students are expected to fulfil the required obligations including working for 20 hours/week.
c. First year student with financial support are required to work 20 hours/week for department-assigned research or service.
d. Full-time students who get stipends or assistantships (20 hours/week) cannot work outside of JSNN.
e. It is each student's responsibility to be knowledgeable of the published academic regulations and requirements set forth in the Student Handbook, Graduate Catalog, its revisions, University policies and regulations, and specific requirements of the academic program.
f. Each student is also responsible for compliance with announcements published by the Department, JSNN, Graduate College, Office of Registrar, Office of Provost and other University offices. Lack of knowledge of regulations and requirements does not excuse the student from complying with academic regulations and meeting the requirements.
g. Students are expected to assume academic and financial responsibility for the courses in which they enroll.
h. Students need to consult with their advisor regarding all the questions and concerns, including but not limited to the Plan of Graduate Study, working hours, research direction, request for lab and equipment access, responsible conduct of research (http://www.nsf.gov/bfa/dias/policy/rcr.jsp), academic integrity, ethics etc.
i. Responsible Conduct of Research (RCR): According to NSF, "The responsible and ethical conduct of research (RCR) is critical for excellence, as well as public trust, in science and engineering. Consequently, education in RCR is considered essential in the preparation of future scientists and engineers." If students are involved in NSF or NIH funded research, they should use online resources provided by Division of Research and Economic Development (DORED) to successfully complete RCR training.
j. All lab spaces in the Joint School of Nanoscience and Nanoengineering are shared. Students should follow general and specific lab safety guidelines to ensure a clean and safe working environment for all researchers, students, faculty and staff.
k. All students are required to attend JSNN and departmental seminars and meetings.
l. All students are required to have knowledge of and observe all regulations pertaining to campus life and student behavior. Each student is expected to participate in campus and community life in a manner that will positively reflect upon the student and the University. All students are expected to abide by the Student Handbook.
m. Email is the official form of communication at the University; students are responsible for checking their ncat.edu email regularly. Students are expected to also maintain their contact information current including mailing address and telephone number with the Office of the Registrar.

Appendix B: Academic Eligibility

Good Academic Standing: To maintain good academic standing and to meet the requirements for graduation, a student must demonstrate acceptable performance in course work after being admitted to the Nanoengineering graduate program. This requires a minimum cumulative Grade Point Average (GPA) of 3.00 or higher in all graduate course work. A student without good academic standing will not be eligible for departmental funding.

Furthermore, good academic standing requires satisfactory progress in the corresponding graduate program. The student's advisor or advisory committee may render judgments as to whether satisfactory progress is being made toward the degree, taking into account all aspects of academic performance and promise, not necessarily course work alone. The department may recommend termination of a student's graduate status at any time if the student is not making satisfactory progress toward the degree. Examples of unsatisfactory progress may include, but not limit to, inadequate GPA, inadequate research and/or research skills, failure to obtain satisfactory grades in required courses, or failing the preliminary, candidacy, or final oral defense examination.

Academic Warning: Any student who has attempted 18 or fewer credit hours and has less than a 3.0 overall GPA will be given an academic warning. Students on academic warning may not enroll in more than 9 semester credit hours.

Academic Probation: Any student who has attempted more than 18 credit hours and has less than a 3.0 overall GPA will be placed on academic probation for the subsequent regular (non-summer) semester. A student on academic probation will be required to improve their overall GPA to 3.0 or higher by the end of the probationary semester. Students on academic probation may not enroll in more than 9 semester credit hours.

Dismissal: A student on probation who fails to improve their overall GPA to 3.0 or higher by the end of the probationary period may be dismissed.

Departments may also recommend dismissal of a student at any time if a student:

a. is conditionally admitted and fails to meet the conditions of their admission;
b. is not making satisfactory progress toward the degree, for example, inadequate progress on research projects, failure to obtain satisfactory grades in required courses, or failing the candidacy, comprehensive, or final oral examination;
c. receives an "F" grade on two attempts in a required course;
d. fails to maintain continuous registration without an approved leave of absence;
e. fails to complete program requirements in the maximum allowed time for the degree;
f. cannot find an academic advisor by the time as designated in the graduate student handbook;
g. is guilty of ethical misconduct or violates the University's Student Handbook.

Readmission after Academic Dismissal: A student who is dismissed for academic reasons will be eligible to submit a new application after one academic year and may be admitted only upon the recommendation of the graduate coordinator or department chair with approval from the Dean of the Graduate College. While on academic dismissal, students are not eligible to take courses.

Appendix C: Nanoengineering Courses

C.1 Nanoengineering Graduate Course Listings

Nanoengineering Core Courses (Masters and Doctoral)
NANO 701 - Simulation and Modeling Methods in Nanoscience and Nanoengineering
NANO 702 - Fundamentals of Nanoengineering: Physical Principles
NANO 703 - Fundamentals of Nanoengineering: Chemical-Biochemical Principles
NANO 704 - Fundamentals of Nanomaterials
NANO 705 – Nano Safety

Masters Courses (also open to Doctoral Students)
NANO 711 - Introduction to Nanoprocessing
NANO 721 - Nanobioelectronics
NANO 731 - Introduction to Nanomodeling and Applications
NANO 741 - Colloidal and Molecular Self-Assembly
NANO 761 - Introduction to Nanoenergy
NANO 785 - Special Topics in Nanoengineering

Masters Courses (on Pass/Fail or Satisfactory/Unsatisfactory basis)
NANO 794 - Masters Supervised Research
NANO 796 - Master's Project
NANO 797 - Master's Thesis
NANO 799 - Continuation of Master's Thesis

Doctoral Courses (Open to Masters Students, which prior instructor approval)
NANO 811 - Polymeric Materials Engineering
NANO 812 - Process Modeling in Composites
NANO 821 - Advanced Nanosystems
NANO 823 - Compound Semiconductor and Nanostructure Devices
NANO 825 - Thin Film Technology for Device Fabrication
NANO 827 - Solid State Devices
NANO 831 - Advanced Nanomodeling and Applications
NANO 841 - Intermolecular and Surface Forces
NANO 861 - Advanced Nano Energy Systems
NANO 885 - Special Topics Nanoengineering

Doctoral Laboratory Rotations
NANO 851 - Computational Nanoscale Modeling Laboratory
NANO 852 - Nanoelectronics Laboratory
NANO 853 - Nano-Bio Electronics Laboratory
NANO 854 - Nanomaterials Laboratory

Doctoral Courses (on Pass/Fail or Satisfactory/Unsatisfactory basis)
NANO 994 - Doctoral Supervised Research
NANO 997 - Doctoral Dissertation

NANO 999 - Continuation of Dissertation

C.2 Course Descriptions

NANO 701 - Simulation and Modeling Methods in Nanoscience and Nanoengineering
This course covers first principles quantum based methods, classical atomistic simulation methods interatomic potentials, modeling of bulk nanostructure metals, carbon nanotubes, soft matter and multiscale modeling techniques.
Prerequisite: None.
Credits: 3 (3-0)

NANO 702 - Fundamentals of Nanoengineering: Physical Principles
This course is an introduction to physical principles involved at the nanoscale due to quantum size effects, and energy band structure engineering for nanoelectronic devices.
Prerequisite: None.
Credits: 3 (3-0)

NANO 703 - Fundamentals of Nanoengineering: Chemical-Biochemical Principles
This course covers chemical and bio-chemical principles involved in design, synthesis, assembly, and performance of nanomaterials and devices. Also studied are the structure and function of biomolecules and their specific roles in nano-biomolecular interactions and signaling pathways, as well as application of chemical biological detection methods at the micro and nanoscales.
Prerequisite: None.
Credits: 3 (3-0)

NANO 704 - Fundamentals of Nanomaterials
The course introduces fundamentals of nanomaterials, brings in knowledge on frontiers of the rapidly developing interdisciplinary field of nanomaterials and help to develop skills to understand and communicate in the field of nano-engineering.
Prerequisite: None.
Credits: 3 (3-0)

NANO 705 – Nano Safety
This is an interdisciplinary course that explores the safety, environmental, and ethical issues surrounding the manufacture, distribution, use, and disposal of nanomaterials. Students will read and discuss the established principles of nano safety along with new material as it arises from the primary literature. The pedagogy utilized in this course fosters student critical thinking about the interaction of nanomaterials with the biological world.
Prerequisite: None.
Credits: 3 (3-0)

NANO 711 - Introduction to Nanoprocessing
This course introduces students to the field of nanoprocessing including basic fabrication and processing techniques to construct nanostructures and nanomaterials through both "bottom up" and "top down" strategies. Basic nanostructure characterization techniques are integrated as a start.
Prerequisite: None.

Credits: 3 (3-0)

NANO 721 - Nanobioelectronics
This course introduces the emerging areas where biology, medicine, nanofabrication and electronics coverage. The course addresses fundamental concepts and current applications of biofabrication and bioelectronic devices such as biosensors, DNA electronics, protein based devices, analytical electrochemistry, biomolecular electronics, single molecule physics, BioNano machines, and biofuel cells. A special emphasis is placed on problem-based learning targeting current issues in nanobioelectronics.
Prerequisite: NANO 702 or NANO 703 or consent of instructor.
Credits: 3 (3-0)

NANO 731 - Introduction to Nanomodeling and Applications
This graduate level course provides an introduction to nanomodeling and applications for students with background in engineering, physical, mathematical, and biological sciences focusing on atomistic and molecular dynamics modeling.
Prerequisite: NANO 701 or consent of instructor.
Credits: 3 (3-0)

NANO 741 - Colloidal and Molecular Self-Assembly
This course offers an introduction to self-assembly in soft matter and the associated thermodynamic and chemical principles. Topics are covered from a materials-oriented perspective and include colloidal crystals, liquid crystals, surfactants and micelles, polymers and block copolymers, and biomolecule assembly.
Prerequisite: None.
Credits: 3 (3-0)

NANO 761 - Introduction of Nano Energy
This course is a 3-credit comprehensive course of nanomaterials and devices for energy application. The course will introduce emerging energy technologies and the fundamentals required to design such a great technology at nanoscale and will cover the description of basic energy principle, nanoarchitectured energy material and its device concept used in all forms of energy harvesting, conversion and storage.
Prerequisite: None.
Credits: 3 (3-0)

NANO 785 - Special Topics in Nanoengineering
This course is designed to allow the introduction of potential new courses on a trial basis or special content courses on a once only basis at the Master's level. The topic of the course and title are determined prior to registration.
Prerequisite: Consent of the instructor.
Credits: 3 (3-0)

NANO 794 - Masters Supervised Research
This course is supervised research under the mentorship of a faculty member. It is not intended to serve as the project nor thesis topic of the master's student.

Prerequisite: Master's level standing.
Credits: 3 (3-0)

NANO 796 - Master's Project
The student will conduct advanced research of interest to the student and the instructor. A written proposal which outlines the nature of the project must be submitted for approval. This course is only available to project option students.
Prerequisite: Master's level standing with project option.
Credits: 3 (3-0)

NANO 797 - Master's Thesis
Master of Science thesis research will be conducted under the supervision of the thesis committee chairperson leading to the completion of the Master's thesis. This course is available only to thesis option students and can be repeated.
Prerequisite: Master's level standing with thesis option.
Credits: 3 (3-0)

NANO 799 - Continuation of Master's Thesis
This is a continuation of NANO 797. This course is for master's students who have completed all required credit hour requirements.
Prerequisite: Completion of all Thesis Credits.
Credits: 1 (1-0)

NANO 811 - Polymeric Materials Engineering
This course introduces polymer fundamentals, synthesis, structure and properties, and processing with an emphasis on applying basic knowledge in nanoengineering applications.
Prerequisite: None.
Credits: 3 (3-0)

NANO 812 - Process Modeling in Composites
This course provides an overview of composites, composite manufacturing processes followed by transport equations, constitutive laws and their characterization in composite processing. Process modeling applications to specific composite manufacturing processes involving short fibers, continuous and woven fibers for processing with thermoplastic and reactive thermoset resin systems are discussed. Transport issues in the processing of polymer nanocomposites are briefly discussed.
Prerequisites: NANO 701 or consent of instructor.
Credits: 3 (3-0)

NANO 821 - Advanced Nanosystems
This course is designed to teach advanced nanosystems, which are a result of hierarchical assembly and integration of diverse and heterogeneous components including materials, molecules and components at the nanoscale. This course discusses the fundamental concepts and current trends in such advanced nanosystems with examples from nanoelectronic/photonic devices, organic-inorganic assemblies, biomimetic devices, bio-nano machines, biofuel cells etc. A special emphasis is placed on problem-based learning targeting current issues in nanosystem integration.

Prerequisites: NANO 721 or consent of instructor.
Credits: 3 (3-0)

NANO 823 - Compound Semiconductor and Nanostructure Devices
This course covers physics of compound semiconductors, application of Schrodinger equation to nanoscale structures; heteroepitaxy layered and self-assembled nanostructures. The course also discusses strain and bandgap engineering, materials and device options for advanced optoelectronic devices at the nanoscale.
Prerequisites: NANO 702 or consent of instructor.
Credits: 3 (3-0)

NANO 825 - Thin Film Technology for Device Fabrication
The course provides a fundamental understanding of the thin film deposition techniques and epitaxial growth of semiconductor materials. High vacuum technology and application of the deposition processes to the fabrication of heterostructure devices are also covered.
Prerequisites: NANO 702 or consent of instructor.
Credits: 3 (3-0)

NANO 827 - Solid State Devices
This course deals with p-n junction and Schottky barrier diodes, bipolar junction and field effect transistors, heterostructure devices (e.g., heterojunction bipolar transistors and solar cells), and device modeling and simulation.
Prerequisites: NANO 702 or consent of instructor
Credits: 3(3-0)

NANO 831 - Advanced Nanomodeling and Applications
This graduate level course is an advanced level treatment of atomistic and molecular modeling at nanoscale with a focus on the principles and background theory of the modeling methods and applications of relevance to crystalline, amorphous, ceramic, cementitious, and bio systems.
Prerequisites: NANO 731 or consent of the instructor.
Credits: 3 (3-0)

NANO 841 - Intermolecular and Surface Forces
This course covers the theory and principles of forces between molecules, particles, and surfaces typically relevant at micrometer and nanometer length scales. Topics include: detailed treatment of dispersion, polar, and electrostatic interactions; solvation, hydration and steric forces; adhesion and surface tension; and relevance to real material systems.
Prerequisite: Basic courses in thermodynamics recommended.
Credits: 3 (3-0)

NANO 851 - Computational Nanoscale Modeling Laboratory
This is a laboratory rotation course to expose and educate the students on computational modeling analysis, and enabling technologies available for nanoscale modeling.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 852 - Nanoelectronics Laboratory
This is a laboratory rotation course to expose and educate the students on the equipment and tools available in the nanoelectronics laboratory.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 853 - Nano-Bio Electronics Laboratory
This is a laboratory rotation course to expose and educate the students on the equipment and tools available in the nano-bio electronics laboratory.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. Program.
Credits: 1 (0-1)

NANO 854 - Nanomaterials Laboratory
This is a laboratory rotation course to expose and educate the students on the equipment and tools available in the nanomaterials laboratory.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 855: Advanced Nano Laboratory
NANO-855 is a 1-credit practical and more hand-on oriented laboratory course of energy storage material and device. The laboratory course will provide hands-on experiences with the specific topics regarding advanced nanomaterials such as battery anode and cathode material for energy storage application. Student will learn how to design and synthesize energy storage material for battery and how to assemble its device and finally how to evaluate batter performance.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 861: Advanced Nano Energy System
NANO-861 is a 3-credit advanced and more practical oriented course of energy storage material and system. The course will be specifically touching on what are the advanced nanomaterials on energy storage application, how to design the material and how to fabricate its device through state-of-the-art equipment. Furthermore, the course will provide how to elucidate the failure mechanism using a nanoscale fundamental analysis.
Prerequisite: None.
Credits: 3 (3-0)

NANO 885 - Special Topics Nanoengineering
This course is designed to allow the introduction of potential new courses on a trial basis or special content courses on a once only basis at the doctoral level. The topic of the course and title are determined prior to registration.
Prerequisite: Consent of the instructor.
Credits: 3 (3-0)

NANO 994 - Doctoral Supervised Research

This is supervised research under the mentorship of a member of the graduate faculty. It is not intended to serve as the dissertation topic of the doctoral student. The student receives a Pass/Fail and no letter grade is given upon completion.
Prerequisite: Doctoral level standing.
Credits: 3 (3-0)

NANO 997 - Doctoral Dissertation
This represents the supervised research leading to the dissertation for the doctoral student. The student receives a Pass/Fail grade only after the completion of the final Ph.D. oral defense.
Prerequisite: Passed NANO 995 and consent of the advisor..
Credits: 3 (3-0)

NANO 999 - Continuation of Dissertation
This course is for doctoral students who have completed all required dissertation credit hours. This can be repeated by the students as required. The student receives a Pass/Fail and no letter grade given upon completion.
Prerequisite: Completion of all dissertation credits in nanoengineering.
Credits: 1 (1-0)

Appendix D: Graduate Faculty and Staff in Nanoengineering

D.1 Nanoengineering Graduate Faculty Profiles

Jeffrey R. Alston **Assistant Professor**
B.S. University of La Verne (La Verne, CA); Ph.D., Nanoscale Science, University of North Carolina at Charlotte (Charlotte, NC)

Shyam Aravamudhan **Associate Professor**
B.S., University of Madras (Chennai, India); M.S. and Ph.D, Electrical Engineering, University of South Florida (Tampa, FL)

Kristen Dellinger **Assistant Professor**
B.Sc., Chemical Engineering, Queen's University (Kington, Canada); M.Sc., Chemical Engineering, Queen's University (Kington, Canada); Ph.D. Biomedical Engineering, McGill University (Montreal, Canada)

Joseph L. Graves, Jr. **Professor**
A.B., Biology, Oberlin College (Oberlin, OH); Ph.D., Environmental, Evolutionary, and Systematic Biology, Wayne State University (Detroit, MI)

Shanthi Iyer **Professor**
B.S. and M.S., Physics, Delhi University (Delhi, India); Ph.D., Physics, Indian Institute of Technology (Delhi, India)

Ajit D. Kelkar **Professor and Chair**
B.S., Mechanical Engineering, Pune University (Pune, India); M.S., Mechanical Engineering, South Dakota State University (Brookings, SD); Ph.D., Mechanical Engineering, Old Dominion University (Norfolk, VA)

Ram V. Mohan **Professor**
B.S., University of Madras (Chennai, India); M.S., Mechanical Engineering, West Virginia University (Morganton, WV); M.S., Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign (Urbana, IL); Ph.D., Mechanical Engineering, University of Minnesota, (Minneapolis, MN)

Reza Zadegan **Assistant Professor**
B.S., Biology-Cytology and Microbiology, Kharazmi University (Tehran, Iran); M.S., Cell & Molecular Biology (with emphasis on Bioelectronics), Shiraz University (Shiraz, Iran); PhD. Nanoscience, Aarhus University (Aarhus, Denmark)

Lifeng Zhang **Associate Professor**
B.S., Polymer Materials Science and Engineering, Xi'an Jiaotong University (Xi'an, China); M.S., Polymer Materials Science and Engineering, Beijing Institute of Technology (Beijing, China); Ph.D., Fiber and Polymer Science and Engineering, University of California at Davis (Davis, CA)

D.2 Faculty and Staff Directory

Faculty	**Office**	**Phone**	**Email**
Shyam Aravamudhan	208G	336-285-2856	saravamu@ncat.edu
Jeffrey Alston	106L	336-285-2861	jralston1@ncat.edu
Kristen Dellinger	106G	336-285-2868	kdellinger@ncat.edu
Joseph Graves	204D	336-285-2858	gravesj@ncat.edu
Shanthi Iyer	106I	336-285-3710	iyer@ncat.edu
Ajit Kelkar (Chair)	208C	336-285-2864	kelkar@ncat.edu
Ram Mohan	208E	336-285-2867	rvmohan@ncat.edu
Reza Zadegan	106F	336-285-2857	rzadegan@ncat.edu
Lifeng Zhang	208I	336-285-2875	lzhang@ncat.edu

Staff	**Office**	**Phone**	**Email**
Karen Courtney	208B	285-4458	kcourtne@ncat.edu
Jerri Price (Dean's Executive Assistant)	204A	285-2801	jlpri22@uncg.edu

Appendix E: Compliance with the Americans with Disabilities Act

The University is committed to complying with the Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973 by providing equal access to the programs, services and benefits to qualified students with disabilities. All reasonable efforts will be made to accommodate the needs of students with documented disabilities. If you have a disability that requires an accommodation during the semester, please REGISTER with the Office of Veterans and Disability Service (OVDSS) located on campus in Murphy Hall (334-7765). Make sure that you notify OVDSS of any disability accommodation requests prior to the start of classes or within the first two weeks of classes. Please note that accommodations and modifications cannot be performed retroactively!

Appendix F: Graduate Forms

Some relevant forms are listed here. Electronic versions (PDF) and additional forms may be found online http://www.ncat.edu/tgc/continuing/forms/index.html or by contacting the Graduate Coordinator of the Nanoengineering Graduate Program.

a. Plan of Graduate Study
b. Report of Doctoral Preliminary Examination
c. Thesis/Dissertation Submission Components
d. Report of Thesis/Dissertation Committee Composition
e. Results of Thesis/Dissertation Final Oral Defense
f. Final Degree Clearance

Appendix G: Nanoengineering a Dissertation Proposal

A. GENERAL SUGGESTIONS

Timing

These guidelines are based on timelines faculty use when preparing their own research grant proposals. Good writing takes time – and a well-written grant (especially one that contains preliminary data and well thought out experiments) typically takes months of hard work to complete. This assignment is NOT the one you should procrastinate on – and try to complete at the last minute. The best proposals evolve over time and require numerous revisions. Try not to get frustrated and eventually you will be astonished by what you can accomplish if you take your time and pace yourself appropriately!

It is NOT appropriate to halt all dissertation research activities and work exclusively on this assignment during the spring semester. In fact, the more preliminary data you collect before you defend your proposal, the more convincing your proposed research will sound to your committee.

(Note: Although this is a general rule of grant writing – the faculty understand that the second year students might not have generated large amounts of data yet).

Motivation

The proposal should state why the scientific problem is interesting and important, how the research will be approached, and why the student investigator is well poised to work on this problem. It is also useful to know the proposal's potential audience. Your committee members will have different areas of expertise – thus, make sure you are very clear and concise with your prose. Remember that your proposal will be judged by both experts in the discipline (especially your thesis advisor), as well as generalists in the field (other members of your exam committee). The following steps are provided to help the proposal writer understand the steps that go into preparing a proposal and to share some advice that others have found useful.

1. Step 1 - Before You Write

Getting Started

Before you start writing the proposal, make sure you have done your homework: research the field, choose an excellent idea to pursue. For example, the summer after your 2nd semester in the Ph.D. program (May – Aug.) may be spent reading the literature, talking with your advisor and members of your lab, and formulating a series of questions that you can experimentally address as part of your Ph.D. dissertation project.

Consider the reviewers of your proposal (committee members for candidacy exam) to be "informed strangers." You must include enough detail to convince them your hypothesis is sound and important, your aims are logical and feasible, you understand potential problems, and you can properly analyze the data. Begin by focusing on the big picture. <u>A good proposal begins with a clear idea of the goals and objectives of the project.</u> In addition, a good project begins with a sense of why it will be a significant improvement over current practice.

Before You Begin

- How well do I know the field and its literature?
- Did I check the literature to make sure the project I'm considering has not been done before, or has been done but its methods judged inadequate?
- Did I brainstorm ideas with colleagues and mentors?
- Am I giving myself plenty of time to write the proposal? Good writing takes time & practice.

Developing the Hypothesis

- Most reviewers feel that a good grant application is driven by a strong hypothesis. The hypothesis is the foundation of your application. Make sure it's solid. It must be important to the field, and you must have a means of testing it.
- Provide a rationale for the hypothesis. Make sure it's based on current scientific literature. Consider alternative hypotheses. Your research plan will explain why you choose the one you select.
- A good hypothesis should increase understanding of the topic of your grant.
- Your proposal should be driven by one or more hypotheses, not by advances in technology (i.e. it should not be a method in search of a problem). Also, avoid proposing a "fishing expedition" that lacks solid scientific basis.
- It is recommended by many reviewers that you state your hypothesis clearly as part of your research plan at the beginning of your proposal.

2. Step 2 - Writing the Proposal Narrative

Good writing takes TIME and PRACTICE. Do not think that your first draft will be perfect (and please do NOT give your first draft to your thesis advisor expecting she/he will say it is ready to defend….

As a general rule - faculty should never be given papers that are still in rough draft form.

You will need to write, edit, write, edit, write ….. and edit some more before your proposal is ready for your advisor to review. This is the normal process of proposal writing. Don't forget that a good proposal is always readable, well-organized, grammatically correct, and understandable (there is NO excuse for a grant that is not proofread). Your project description must contain specifics including details of experiments and/or applications. The narrative should be specific about the proposed activities. Careful writing should allow you to describe, in the limited space available, enough about your project to give the reviewers a clear idea of exactly what you plan to do and why your plan is a good one.

General Writing Tips

- Try to use the active rather to the passive voice. For example, write "I/We will develop a cell line," not "A cell line will be developed."
- Keep related ideas and information together, e.g. put clauses and phrases as close as possible to - preferably right after, the words they modify.
- Simplify and breakup long, involved sentences and paragraphs. In general,

use short simple sentences; they are much easier on the reader. Your goal is communication, not literature.

- Edit out redundant words and phrases. Edit and proofread thoroughly. Look carefully for typographical and grammatical mistakes, omitted information, and errors in figures and tables. Sloppy work will definitely suffer in review. Reviewers feel that if the application is sloppy or disorganized, the applicant's research may be as well.
- Don't be afraid to ask for help! For many students this will be their first grant proposal – so if you feel you are not making any progress – and are suffering from writers block or need some direction – ask for help well before the deadlines for submission arrive!
- Write for a period of time (1-3 hours) and then put it down for a while and do something else. Not many writers can sit at a computer for 12 hours a day and continue to write clear, concise thoughts. This is not an assignment you should start thinking about in March – you should begin getting your thoughts on paper at the start of semester to give yourself enough time to revise your text/ figures before the deadline arrive.
- Remember, although you will be working on this assignment - you are also still expected to work on your research – it is not appropriate (nor necessary) to take a month off to work on your proposal – doing a little at time, over the course of the semester will create a much better end product. Time management is important for this assignment – plan ahead.

B. RESEARCH PROPOSAL FORMAT (based on an NSF- style proposal)

1. Proposal Margin and Spacing Requirements

The proposal must be clear, readily legible, and conform to the following:

a) Use one of the legible typefaces such as:
   - Arial at a font size of 12 points or larger
   - Times New Roman at a font size of 12 points or larger

   A font size of less than 12 points, but not less than 10 points may be used for mathematical formulas or equations, figure, table or diagram captions and when using a Symbol font to insert Greek letters or special characters.

b) No more than 6 lines of text within a vertical space of 1 inch

c) Margins, in all directions, should be at least ONE inch

2. Page Formatting

Please use only a standard, single-column format for the text.

While line spacing (single-spaced, double-spaced, etc.) is at the discretion of the student, established page limits should be followed. Brevity will assist graders in dealing with proposals. Therefore, your research proposal is suggested to be 15 pages maximum. Visual materials, including charts, graphs, maps, photographs and other pictorial presentations are included in the 15 pages (reference lists are NOT included in the 15 pages). Students are cautioned that the "project description" must be self-contained and that URLs that provide information related to the proposal should not be used because 1) the information could circumvent page limitations; 2) the graders are under no obligation to view the sites; and 3) the sites could be altered or abolished between the time of submission and the time of review.

The guidelines specified above establish the minimum type size requirements; however, students are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the proposal. Small type size makes it difficult for committee members to read the proposal; consequently, the use of small type not in compliance with the above guidelines may be grounds for the committee members to return the proposal without review. Adherence to type size and line spacing requirements also is necessary to ensure that no student will have an unfair advantage, by using smaller type or line spacing to provide more text in the proposal.

C. SUGGESTED SECTIONS OF AN NSF STYLE PROPOSAL

There is no magic formula for writing a successful grant proposal – however, you can do things that will hurt your chances of writing an excellent application. Throughout your scientific career you will write dozens (if not hundreds) of research applications and over time, you will develop your own writing style. Below are general guidelines based on a 15-page proposal.

1. Title

The title of the project must be brief, scientifically or technically valid, intelligible to a scientifically or technically literate reader

2. Abstract (Summary) (~250 words 0.5 page)

This is a summary of your ENTIRE proposal – and should be written LAST. Make sure that your proposal has a good abstract that succinctly states what the problem is, why it is important, and how it will be solved. In real life - many reviewers will refer to the abstract before they write a review of your proposal - so it is important that this summary is clear and well-written as it will influence the way reviewers approach your proposal. In your abstract you should: state the problem and long-term goals, specific aims of the current project, describe the methodologies proposed and the significance of the work.

3. Hypothesis statement or goals – should be clear and well written (1-3 sentences)

4. Specific Aims (typically 2-4 specific aims; 1-2 pages)

- Your specific aims are the objectives of your research project and what you want to accomplish. The project aims should be driven by the hypothesis you set out to test. Make sure they are highly focused.
- Begin this section by stating the general purpose or major objectives of your research. Be sure all objectives relate directly to the hypothesis you

are setting out to test. If you have more than one hypothesis, state specific aims for each one. Keep in mind your research methods will relate directly to the aims you have described.

- State alternatives to your hypothesis and explain why you choose the one (or more) you have selected.
- Choose objectives that can be easily assessed by the review committee. Do not confuse specific aims with long-term goals.

5. Background & Significance (2-3 pages; keep it brief)

This part helps the reviewer to understand the problem being addressed. Avoid jargon that only experts will appreciate. Show your understanding of the important issues in the discipline. Present knowledge gap to be addressed and shows the uniqueness of your approach.

Review the relevant literature objectively – but this is not a 'review article' – be careful of making this section too long. Restrict yourself to using materials needed for YOUR grant topic. State how your research is innovative, how your proposal looks at a topic from a fresh point of view or develops or improves technology. Show how the hypothesis and research will increase knowledge in the field. Justify your proposal with background information about the research field that lead to the research you are proposing. The literature references are very important because it shows reviewers you understand the field and have a balanced and adequate knowledge of it. Use this opportunity to reveal that you are aware of <u>gaps or discrepancies in the field</u>. Identify the next logical stage of research your current application will address.

6. Preliminary Data (2-3 pages; length will depend on how your research is going):

- Preliminary data should support the hypothesis to be tested and the feasibility of the project.
- Explain how the preliminary results are valid and how early studies will be expanded in scope or size.
- Make sure you interpret results critically. Showing alternative meanings indicates that you've thought the problem through and will be able to meet future challenges.
- Preliminary data may consist of your own publications, publications of others (evidence from the literature – make sure you cite this work properly), unpublished data from your own laboratory or from others, or some combination of these.
- Include manuscripts submitted for publication (if you have any). Make sure it's clear which data are yours and which are reported by others.
- Summary of data collected – NOT all the data you have collected

7. Research Design and Methods (6-8 pages approximately ½ your total proposal length is a good guide for length of this section)

Overview: Describe the experimental design and procedures in detail and give a rationale for their use. Organize this section so each experiment or set of experiments corresponds to one of your specific aims and is stated in the same order. Even holding to this structure, the experiments still must follow a logical sequence. They must have a clear direction or priority, i.e., the experiments should follow from one another and have a clear starting or finishing point.

Approach

- State why you chose your approach(es) as opposed to others.
- If you are choosing a nonstandard approach, explain why it is more advantageous than a conventional one. Ask yourself whether the innovative procedures are feasible and within your competence.
- Spell it out in detail. While you may assume reviewers are experts in the field and familiar with current methodology, they will not make the same assumption about you. It is not sufficient to state, "We will synthesize a variety of nanoparticles using standard in synthesis techniques." Reviewers want to know which particles, methods, and techniques; the rationale for using the particular system; and exactly how the techniques will be used. Details show you understand and can handle the research. If your methods are innovative, show how you have changed existing, proven methods while avoiding technical problems. Also, describe why the new methods are advantageous to the research you propose to do.

Results

- Describe how you will evaluate success in achieving your aims. Show you are aware of the limits to - and value of - the kinds of results you can expect based on current knowledge of the subject. State the conditions under which the data would support or contradict the hypothesis and the limits you will observe in interpreting the results. Show reviewers you will be able to interpret your results by revealing your understanding of the complexities of the subject.
- Call attention to potential difficulties you may encounter with each approach. Reviewers will be aware of possible problems; convince them you can handle such circumstances. Propose alternatives that would circumvent potential limitations
- Describe your proposed statistical methods for analyzing the data you plan to collect. Define the criteria for evaluating the success or failure of a specific test.

Figures

- Include supporting data. Where appropriate, include well-designed tables and figures. Use titles that are accurate and informative. Label the axes and include legends. Reviewers will look for discrepancies between your data and text.
- All figures, diagrams, charts, photos (etc.) are included as part of the 15-page limit (except the references & acknowledgements). Thus, make sure each figure has a purpose and is well thought out – a well designed figure can be critical to a grant proposal – a poorly designed figure is not

only confusing but it wastes important space.

8. Conclusion/Summary (0.5 page)

A conclusion summarizing why this research needs to be done, how it will advance the field, why you're excited to do this... end on a high note. This is your chance to remind the reviewer about why they should be so keen on your proposal.

9. References (unlimited pages)

Pertinent literature referenced within the project description. It is strongly suggested that students use a reference manager like Endnote *FREE to JSNN students* (as you do your background reading you will create a reference library that you will use during your study at JSNN – typing out a reference sheet by hand is NOT something you should do). The references should be in proper citation format (use an appropriate journal format that your advisor suggests.)