JSNN

Joint School of
Nanoscience and Nanoengineering

NANOENGINEERING
GRADUATE STUDENT HANDBOOK

DEPARTMENT OF NANOENGINEERING

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

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Notices

The Department of Nanoengineering at North Carolina A&T State University (N.C. A&T) prepared this Handbook for its graduate students in the M.S. and Ph.D. Nanoengineering programs. The Handbook supplements the existing policies of the Graduate College, and it intends to guide students through the graduate programs. The Nanoengineering Graduate Program periodically revises this Handbook and information contained herein to ensure accuracy. However, students are encouraged to consult their research advisor, the graduate coordinator, the Department Chair, and appropriate University offices for current information and policies.

Each student is responsible for knowing the published academic regulations and requirements specified in N.C. A&T Graduate Catalog, its revisions, University policies and regulations, and specific academic program requirements (http://www.ncat.edu/tgc/graduate-catalog). The student is also responsible for compliance with announcements published by the Department, the School, Graduate College, Office of the 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.

Significant changes may occur without notice. The Department attempts to maintain an accurate Graduate Student Handbook at all times; however, errors may occur inadvertently. When errors are found, the Department reserves the right to correct such errors without further notice. The 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 N.C. A&T (the University) is to provide advanced-level study in distinct areas of specialization. The Master of Science in Nanoengineering degree prepares students with a strong engineering or applied science background who seek specialized training for industrial or government positions in nanotechnology fields. The Department of Nanoengineering designed the Doctoral degree in Nanoengineering for students with a strong academic track record who seek advanced-level education and training to pursue careers in academia, industry, or government organizations that use nanoscale science, technology and engineering.

The degrees offered are:

Master of Science (M.S.) in Nanoengineering
Master of Science (M.S.) in Nanoengineering with Synthetic Biology Concentration
Doctor of Philosophy (Ph.D.) in Nanoengineering
Doctor of Philosophy (Ph.D.) in Nanoengineering with Synthetic Biology Concentration

Graduate Certificates offered are:

STEM Entrepreneurship
Advanced Materials
Micro and Nano Devices
Systems and Synthetic Biology

2.0 Master of Science in Nanoengineering

2.1 Program Description

The Master of Science (M.S.) in Nanoengineering degree program is a research-based degree. Students complete coursework in nanoengineering and conduct research in one or more of the following research areas: nanomaterials/nanomanufacturing, nanodevices/nanoelectronics, synthetic biology, environmental nanotechnology/sustainability, and computational nanotechnology. Two program options are available to students - (i) thesis option, or (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 a closely related field from recognized institutions. Applicants gain admission to the M.S. program either unconditionally or conditionally.

2.2.1 Unconditional Admission

An applicant may receive unconditional admission to the M.S. Program if he/she possesses a Bachelor of Science in engineering or a closely related field from an accredited institution and has an overall GPA of 3.0 or better on a 4.0 scale. Additionally, the applicant needs to include in the application materials the following: (a) GRE score; (b) current curriculum vitae; (c) statement of purpose; and (d) three professional recommendation letters. Two of the three recommendation letters must be from faculty members from an accredited higher education institution. Good academic standing is a requirement for eligibility to receive Departmental financial assistance.

2.2.2 Conditional Admission

An applicant may receive conditional admission if he/she 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 lastfour semesters of undergraduate study.

b. The applicant has a bachelor's degree in applied science or a closely related field with a GPA of 3.0 or better on a 4.0 scale but is deficient in foundational engineering courses.

c. The applicant has a bachelor's degree in non-engineering or non-applied science field but has demonstrated exposure to substantial and relevant engineering, science, and mathematical content with a GPA of 3.0 or better on a 4.0 scale.

2.2.3 Change of Admission Status

The status of conditionally admitted students can change to unconditional when both of the following conditions are satisfied:

a. All course deficiencies are completed with a grade of “B” or better (a “B-” is not equivalent to a “B”), and
b. Attainment of a minimum 3.0 GPA in graduate-level courses taken at the University at the end of a semester and after the student completes the 9th credit hour.

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

2.2.4 International Students

All international applicants, except those from exempted countries of origin (https://www.ncat.edu/tgc/english- countries.php), must provide proof of English language proficiency by obtaining acceptable scores onthe Test of English as a Foreign Language (TOEFL); International English Language Testing System (IELTS); or Pearson Test of English (PTE). The minimum scores to be eligible for admission are at least 80 or higher in the internet-based TOEFL, 6.0 or higher in the IELTS, or 53 or higher in the PTE. Test scores should be submitted directly from the testing agency to the university’s Graduate College. TOEFL, IELTS,or PTE scores are reportable for two years from the exam date. If the scores are older than two years, the student must retake the exam.

2.3 Program Policies and Requirements

2.3.1 Transfer 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 GraduateProgram, subject to the approval of the advisor and Graduate Coordinator (or Department Chair). The Program may accept credits transferred from another graduate program at the University or another accredited/approved university. Transfer credits can only be applied to satisfy the domain course requirements (not core courses). Transfer courses must be graduate-level courses relevant to the Nanoengineering graduate degree being sought based on an evaluation of the course description. Copies of relevant course syllabi are strongly recommended. Any transfer course must come from a regionally accredited university or otherwise approved university/college, with a gradeof “B” or better “B-” is not equivalent to a “B”). The Program will not accept courses for transfer graded on a Pass/Fail or Satisfactory/Unsatisfactory basis. For other conditions, please refer to the Graduate Catalog of the University.

2.3.2 Time Limitation

The student must complete the M.S. in Nanoengineering program within six (6) consecutive calendar years. Work not completed by this time limit is subject to cancellation, revision, or a special examination. If military duty interrupts the graduate study, the time limit shall be extended for the student's length of time 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, such as long-term illness.

2.3.3 Advisor and Thesis Committee

All thesis-option M.S. students must select an advisor during their first semester of enrollment and form a thesis committee by the end of their second semester. Failure to find an advisor and obtain an approved thesis subject by the end of their second semester will result in termination from the M.S. Nanoengineering program.

The thesis committee shall consist of at least three faculty members, with the advisor serving as the chair. The advisor and a majority of committee members must be primary faculty members of the Department of Nanoengineering. The Graduate Coordinator or Department Chair must approve the members of the committee. The Graduate College verifies the eligibility of faculty to serve on thesis committees. The committee assists the student in defining 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 advisor by the end of the second semester of enrollment. Failure to find an Advisor by the end of the second semester will result in termination from the M.S. Nanoengineering program.

2.3.4 Plan of Graduate Study

The Program requires all graduate students to file a Plan of Graduate Study before the end of the first 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 student’s specific needs. The student may amend their Plan of Graduate Study at any time before he/she applies for graduation with the approval of their advisor and Graduate Coordinator (or Department Chair). **The student is responsible for meeting all academic requirements.** The Plan of Graduate Study serves as a contract between the student and the University to fulfill the degree requirements.

2.3.5 Degree Requirements

The M.S. in Nanoengineering degree requires 30 credit hours, including coursework and the completion of a research thesis or suitable project. All students must attend the seminars and professional development workshops offered regularly at the JSNN.

2.3.6 Course Work Requirements and Program Curriculum Structure/Guide

The M.S. degree in Nanoengineering is a 30-credit hour program. The Nanoengineering M.S. curriculum structure and program requirements are given below.

Common Core Courses (9 credits): The student will take three courses that will introduce them tofundamental concepts, methods, and discoveries in different areas of Nanoengineering. These courses include:

Course No.	Course Title	Credit Hours
NANO 701	Mathematical Methods in Nanoscience and Nanoengineering	3
NANO 702	Fundamentals of Nanoengineering Physical Principles	3

NANO 703	Fundamentals of Nanoengineering Chemical – Biochemical Principles	3
NANO 704	Fundamentals of Nanomaterials	3
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biology	3

Disciplinary Foundation Courses (15 credits for the thesis option or 18 credits for the non-thesis option):
These courses build on the undergraduate degree to ensure appropriate depth of knowledge in the student's discipline. The student, with their advisor, will select the appropriate courses. These graduate-level courses will come from North Carolina A&T State University and the University of North Carolina at Greensboro in science, mathematics, and engineering. Current graduate-level course offerings from the Department of Nanoengineering at the Joint School of Nanoscience and Nanoengineering are:

Course No.	**Course Title**	**Credit Hours**
NANO 701	Mathematical Methods in Nanoscience and Nanoengineering	3
NANO 702	Fundamentals of Nanoengineering Physical Principles	3
NANO 703	Fundamentals of Nanoengineering Chemical – Biochemical Principles	3
NANO 704	Fundamentals of Nanomaterials	3
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biology	3
NANO 711	Introduction to Nanoprocessing	3
NANO 721	Nanobioelectronics	3
NANO 731	Introduction to Nanomodeling and Applications	3
NANO 741	Colloidal and Molecular Self-Assembly	3
NANO 771	Intro to Nano Thermodynamics	3
NANO 781	Intro to Synthetic Biology	3
NANO 782	Techniques in Synthetic Biology	3
NANO 784	Professional Development	3
NANO 811	Polymeric Materials Engineering	3
NANO 812	Process Modeling in Composites	3
NANO 814	Nanomechanics-Modeling and Experiments	3
NANO 821	Advanced Nanosystems	3
NANO 823	Compound Semiconductors and Nanostructured Devices	3
NANO 825	Thin Film Technology for Device Fabrication	3
NANO 827	Solid State Devices (cross listed with ECEN 802)	3
NANO 831	Advanced Nanomodeling and Applications	3
NANO 841	Intermolecular and Surface Forces	3
NANO 861	Advanced Nano Energy Systems	3
NANO 871	Advanced Nano Thermodynamics	3

NANO 881	Nano and Synthetic Biology	3
NANO 882	Adv Biomedical Nanomaterials	3
NANO 885	Special Topics in Nanoengineering	3

Option 1: Thesis Option – 6 credit hours of thesis (NANO 797), 9 credit hours of core courses, and 15 credit hours of disciplinary foundation courses.

Option 2: Non-thesis Option – 3 credit hours of the project (NANO 796), 9 credit hours of core courses, and 18 credit hours of disciplinary foundation courses.

Concentration in Synthetic Biology

M.S. students in Nanoengineering, in consultation with their research advisor, graduate program coordinator, and department chair, will be able to choose the option for a concentration in synthetic biology and follow the concentration course requirements outlined below.

Disciplinary Foundation Courses (15 credits for the thesis option or 18 credits for the non-thesis option):

These courses build on the undergraduate degree to ensure appropriate depth of knowledge in the student's discipline. The student, with their research advisor, will select the appropriate courses. These graduate-level courses will come from North Carolina A&T State University and the University of North Carolina at Greensboro in science, mathematics, and engineering. Current graduate-level course offerings from the Department of Nanoengineering at the Joint School of Nanoscience and Nanoengineering are:

Course No.	Course Title	Credit Hours
NANO 703	Fundamentals of Nanoengineering Chemical – Biochemical Principles	3
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biologu	3
NANO 721	Nanobioelectronics	3
NANO 781	Intro to Synthetic Biology	3
NANO 782	Techniques in Synthetic Biology	3
NANO 783	Evolutionary Biology for Nanoengineers	3
NANO 784	Professional Development	3
NANO 881	Nano and Synthetic Biology	3
NANO 882	Adv. Biomedical Nanomaterials	3
NAN 612	Food/Agricultural Nanotech	3
NAN 620	Immunology	3
NAN 626	Intro Stem Cell Bio and Ethics	3
NAN 630	Advances in Nano-biosensors	3
NAN 655	Biomimetics and Biomaterials	3
NAN 740	Nonlinear Waves in Biological Excitable Media	3

NAN 741	Nanoimaging	3
NAN 750	Nanomedicine	3

NOTE: The number of courses taken from the Department of Nanoscience cannot exceed the number of courses taken at N.C. A&T in any semester. For all practical purposes, the limit is one Nanoscience course per semester.

Option 1: Thesis Option – 6 credit hours of thesis (NANO 797), 9 credit hours of core courses, and 15 credit hours of disciplinary foundation courses.

Option 2: Non-thesis Option – 3 credit hours of a project (NANO 796), 9 credit hours of corecourses, and 18 credit hours of disciplinary foundation courses.

Thesis Option: The Thesis Option provides students with strong research interests and is recommended for those who desire to pursue further graduate studies or work in research institutions. Students in the Thesis Option must complete the following requirements:

a. Twenty-four (24) credit hours of course work with letter grades.
b. Six (6) credit hours of Master's Thesis (NANO 797). The student must choose a research topic in conjunction with their advisor to prepare 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 thesis committee's oral examination/thesis defense. The student can onlyschedule their thesis defense after each thesis committee member has reviewed and approved their thesis. The oral thesis defense is a public meeting. However, the deliberation following the public meeting is open only to the thesis committee members. At its deliberation, the committee will determine if the student passes or fails the oral defense or must 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: For students who have substantial industrial engineering experience, the Project Option is offered. 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 master's Project (NANO 796). The advisor must approve a written project report. The advisor may require an oral project presentation.
c. Attend all JSNN/Nanoengineering seminars.

2.4 Application for Graduation and Graduation Clearance

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

3.0 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. The Department designed the Ph.D. in Nanoengineering 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 use nanotechnology. A Ph.D. student has the opportunity to work in one or more of the following research areas: nanomaterials/nanomanufacturing, nanodevices/nanoelectronics, synthetic biology, environmental nanotechnology/sustainability, and computational nanotechnology. The Ph.D. student studies under the guidance of their research advisor and a dissertation committee. The advisor supervises the student and works with them to create the Plan of Graduate Study, selects a dissertation topic, conducts research for the dissertation, and meets degree goals.

The Program trains the Ph.D. student to undertake original research and independent work at the highest level. A student is not granted a Ph.D. degree simply upon completing required course work but upon demonstrating comprehensive understanding and knowledge of the nanoengineering discipline and creating or generating novel high-quality research in their field. The student must demonstrate independent research abilities by generating conference presentations, journal articles, and other forms 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 three core courses: NANO 701, NANO 702, NANO 703, NANO 704, NANO 705, or NANO 706. The student will pass a **Qualifying Examination** to demonstrate their preparation for dissertation research, followed by a successful **Candidacy Exam** (proposal of a dissertation topic and research plan). The student achieves Ph.D. candidacy upon completing all coursework requirements and passing the Candidacy Exam. After completing their research, the Ph.D. candidate will submit an original dissertation document to their committee and conduct an oral, public defense of their dissertation

3.2 Admission

The University Graduate College has two types of admissions for Nanoengineering: Unconditional and Conditional.

3.2.1 Unconditional Admission

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

a. The applicant has a master's 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's 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 M.S. in Nanoengineering degree and an acceptable GRE score.

Additionally, an applicant must include a 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.

3.2.2 Conditional Admission

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

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

b. The applicant has a master's degree in a non-engineering or a non-applied science field but owns a closely related undergraduate degree with 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 are completed with a grade of "B" or better "B-" is not equivalent to a "B") and,

b. Attainment of a minimum of a 3.0 GPA at the end of the semester in graduate-level courses taken at the University in which the student completes the 9th credit hour.

It is the student's responsibility to apply for a change of admission status.
Applicants who do not meet the Ph.D. admission requirements are encouraged to apply for the M.S. in the Nanoengineering program, provided the student satisfies the admissions requirements. Please refer to section 2.2 for M.S. in Nanoengineering admission eligibility.

3.2.4 International Students

All international applicants, except those from exempted countries of origin (https://www.ncat.edu/tgc/english- countries.php), must provide proof of English language proficiency by obtaining acceptable scores onthe Test of English as a Foreign Language (TOEFL); International English Language Testing System(IELTS); or Pearson Test of English (PTE). The minimum scores to be eligible for admission are at least 80 or higher on the internet-based TOEFL, 6.0 or higher in the IELTS, or 53 or higher in the PTE. Test scores should be submitted directly from the testing agency to the university's Graduate College. TOEFL, IELTS,or PTE scores are reportable for two years from the exam date. If the scores are older than two years, the student must retake the exam.

3.3 Program Policies and Requirements

3.3.1 Transfer Credit

The University is not obligated to accept any courses for transfer of credit. However, the student may request to transfer up to 40% of the required credit hours from a degree program to their Nanoengineering Ph.D. program. Their Program with the transfer credits is subject to approval by the advisor and Graduate Coordinator (or Department Chair). Transferred credits must be from another graduate program at the University or 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. Course syllabi are strongly recommended. Courses for transfer of credit must be from a regionally accredited university or otherwise approved, with a grade of "B" or better ("B-" is not equivalent to a "B"). The Program will not accept courses for transfer graded on a Pass/Fail or Satisfactory/Unsatisfactory basis. For other conditions, please refer to the Graduate Catalog of the University and the conditions below:

1. The transfer credits can only be applied to satisfy the Nanoengineering domain course requirements, including three required 800 level courses (9 credits). Students cannot use the transfer credits to substitute any Nanoengineering core courses.
2. Students with an M.S. degree may transfer up to 24 relevant credit hours from their M.S degree to the Nanoengineering Ph.D. program, subjected to their advisor and Graduate Coordinator (or Department Chair) approval.

3.3.2 Degree Requirements and Program Curriculum Structure

The Ph.D. program in Nanoengineering is a 60-credit hour program beyond the B.S. degree. The Nanoengineering Ph.D. Program offers two tracks, the Ph.D. in Nanoengineering and the Ph.D. in Nanoengineering with a concentration in Synthetic Biology. The student may transfer up to 24 transfer credits from their prior M.S. degree in Nanoscience, Nanoengineering, or other science and engineering disciplines with the approval of the Nanoengineering Graduate Coordinator and the DepartmentChairperson.

Requirements	Credit Hours
Common Core Courses	9
Individual Plan of Study Courses	18
Lab Rotations	3
Elective/Domain	6
Supervised Research	6
Dissertation Research	18
Total Number of Credits	60

Common Core Course Requirements: Students must complete nine (9) credit hours from core courses in Nanoengineering. Students who have completed an M.S. in Nanoengineering will take other domain/disciplinary courses as recommended and approved by their advisor.

Course No.	**Course Title**	**Credit Hours**
NANO 701	Mathematical Methods in Nanoscience and Nanoengineering	3

NANO 702	Fundamentals of Nanoengineering Physical Principles	3
NANO 703	Fundamentals of Nanoengineering Chemical – Biochemical Principles	3
NANO 704	Fundamentals of Nanomaterials	3
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biology	3

General Nanoengineering Course Requirements: Students must complete an additional 18 credit hours fromconcentration-specific courses in addition to the common core courses. Students who have completed an M.S. in Nanoengineering will take other domain/disciplinary courses in the place of the General Nanoengineering course requirements, as recommended and in consultation with their advisor. Additionally, based on students' qualifications (undergraduate/Master's major) and interests and their advisor, graduate program director, and Department Chair approval, students may take courses from other programs limited to 9 credits.

Course No.	Course Title	Credit Hours
NANO 701	Mathematical Methods in Nanoscience and Nanoengineering	3
NANO 702	Fundamentals of Nanoengineering Physical Principles	3
NANO 703	Fundamentals of Nanoengineering Chemical – Biochemical Principles	3
NANO 704	Fundamentals of Nanomaterials	3
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biology	3
NANO 711	Introduction to Nanoprocessing	3
NANO 721	Nanobioelectronics	3
NANO 731	Introduction to Nanomodeling and Applications	3
NANO 741	Colloidal and Molecular Self-Assembly	3
NANO 771	Intro to Nano Thermodynamics	3
NANO 781	Intro to Synthetic Biology	3
NANO 782	Techniques in Synthetic Biology	3
NANO 784	Professional Development	3
NANO 811	Polymeric Materials Engineering	3
NANO 812	Process Modeling in Composites	3
NANO 814	Nanomechanics-Modeling and Experiments	3
NANO 821	Advanced Nanosystems	3
NANO 823	Compound Semiconductors and Nanostructured Devices	3
NANO 825	Thin Film Technology for Device Fabrication	3
NANO 827	Solid State Devices (cross listed with ECEN 802)	3
NANO 831	Advanced Nanomodeling and Applications	3
NANO 841	Intermolecular and Surface Forces	3

NANO 861	Advanced Nano Energy Systems	3
NANO 871	Advanced Nano Thermodynamics	3
NANO 881	Nano and Synthetic Biology	3
NANO 882	Adv Biomedical Nanomaterials	3
NANO 885	Special Topics in Nanoengineering	3

Synthetic Biology Concentration Course Requirements: Students must complete 18 credit hours from concentration-specific courses in the Synthetic Biology Concentration. Students who have completed an M.S. in Nanoengineering will take other domain/disciplinary courses in the place of the Synthetic Biology Concentration course requirements, as recommended and in consultation with their advisor. Students must pass 18 credit hours, based on the student's qualifications (Undergraduate/master's major), interests, and advisor's recommendations. The student will take courses from the specific synthetic biology courses listed below. In addition, students may take course from other programs as advised by the department.

Course No.	Course Title	Credit Hours
NANO 705	Nanosafety	3
NANO 706	Systems and Computational Biology	3
NANO 721	Nanobioelectronics	3
NANO 781	Intro to Synthetic Biology	3
NANO 782	Techniques in Synthetic Biology	3
NANO 784	Professional Development	3
NANO 881	Nano and Synthetic Biology	3
NANO 882	Adv Biomedical Nanomaterials	3
NAN 612	Food/Agricultural Nanotech	3
NAN 620	Immunology	3
NAN 626	Intro Stem Cell Bio and Ethics	3
NAN 630	Advances in Nano-biosensors	3
NAN 655	Biomimetics and Biomaterials	3
NAN 740	Nonlinear Waves in Biological Excitable Media	3
NAN 741	Nanoimaging	3
NAN 750	Nanomedicine	3

NOTE: The number of courses taken from the Department of Nanoscience cannot exceed the number of courses taken at N.C. A&T in any semester. For all practical purposes, the limit is one Nanoscience course per semester.

Lab Rotations: Students must choose three (3) credit hours of lab rotations from lab course offerings, including JSNN graduate programs, North Carolina A&T State University, and the University of North Carolina at Greensboro. Current graduate-level course offerings from the Nanoengineering Department at JSNN are:

Course No.	**Course Title**	**Credit Hours**
NANO 851	Computational Nanomodeling Laboratory	1
NANO 852	Nanoelectronics Laboratory	1
NANO 853	Nano-Bio Electronics Lab	1
NANO 854	Nanomaterials Laboratory	1
NANO 855	Nanoenergy Laboratory	1
NANO 856	Interfacing with Nano Lab	1
NANO 857	Synthetic Biology Laboratory I	1
NANO 858	Synthetic Biology Laboratory II	1
NANO 859	Synthetic Biology Laboratory III	1

Elective/Domain Courses (6 credit hours at the 800+ level): Elective/Domain courses strengthen and build thetechnical background and proficiency to ensure appropriate depth of knowledge in the student's discipline. Thestudent, with their advisor, will select the appropriate courses. These graduate-level courses will come from JSNN's graduate programs, North Carolina A&T State University, and the University of North Carolina at Greensboro in science, mathematics, and engineering. Current graduate-level course offerings from the Nanoengineering Department at JSNN are:

Course No.	**Course Title**	**Credit Hours**
NANO 811	Polymeric Materials Engineering	3
NANO 812	Process Modeling in Composites	3
NANO 814	Nanomechanics-Modeling and Experiments	3
NANO 821	Advanced Nanosystems	3
NANO 823	Compound Semiconductors and Nanostructured Devices	3
NANO 825	Thin Film Technology for Device Fabrication	3
NANO 827	Solid State Devices (cross listed with ECEN 802)	3
NANO 831	Advanced Nanomodeling and Applications	3
NANO 841	Intermolecular and Surface Forces	3
NANO 861	Advanced Nano Energy Systems	3
NANO 871	Advanced Nano Thermodynamics	3
NANO 881	Nano and Synthetic Biology	3
NANO 882	Adv Biomedical Nanomaterials	3
NANO 885	Special Topics in Nanoengineering	3

Course offerings in the Department of Nanoscience at JSNN are:

Course No.	**Course Title**	**Credit Hours**
NAN 612	Food/Agricultural Nanotech	3
NAN 620	Immunology	3

NAN 626	Intro Stem Cell Bio and Ethics	3
NAN 630	Advances in Nano-biosensors	3
NAN 655	Biomimetics and Biomaterials	3
NAN 710	Science Integrity	1
NAN 724	Nanoscale Reactions	3
NAN 735	Nanomaterials & Reactions by Design	3
NAN 740	Nonlinear Waves in Biological Excitable Media	3
NAN 741	Nanoimaging	3
NAN 750	Nanomedicine	3

In addition, the students must complete the following as outlined in the Ph.D. program structure.

NANO 994	Doctoral Supervised Research (Research Methods)	3
NANO 997	Doctoral Dissertation	18

NOTE: The number of courses taken from the Department of Nanoscience cannot be more than the number of courses taken at NCA&T in any semester. For all practical purposes, the limit is one Nanoscience course per semester

3.3.3 Advisor and Dissertation Committee

The Ph.D. student must select an advisor by the end of their first semester of enrollment. Failure to secure a Ph.D. advisor by the end of the first semester may result in termination from the Program. The student must form their dissertation committee by the end of their third semester and before the Candidacy Exam. Failure to begin work on Ph.D. dissertation research by the end of the fourth semester will terminate the student from the Nanoengineering Ph.D. program.

The dissertation committee shall consist of at least four affiliated members of the Nanoengineering graduate program, with the advisor serving as the chair. The advisor and a majority of committee members must be primary faculty members of the Nanoengineering graduate program. The student selects their dissertation committee in consultation with their advisor. The Graduate Coordinator (or Department Chair) must approve the committee members. The Graduate College verifies the eligibility of faculty to serve on the dissertation committee and appointsan 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) assures the dissertation process follows all appropriate procedures, and (c) provides an "outside" point of view by sharing expertise with a new perspective or theoretical advantage that might not otherwise be available. The advisor and dissertation committee directthe student in establishing a Plan of Graduate Study, plan dissertation topic, and guide the student's dissertation research. The committee also conducts the student's Candidacy Exam and the final oral defense of the dissertation.

3.3.4 Plan of Study

After admission to the Nanoengineering Ph.D. Program, all Ph.D. students must file a Plan of Graduate Study by the end of their first semester in the Ph.D. Program. Failure to submit the Plan of Graduate Study prevents the student from enrolling in classes for their third semester. The Nanoengineering Ph.D. program maystructure the student's Plan of Graduate Study based on the requirements of the Nanoengineering Ph.D.Program and may be structured to meet the specific needs of the student. The Plan of Graduate Study needs to be established by the student working with the advisor, approved by the 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 to fulfill the Ph.D. degree requirements.

3.3.5 Teaching Requirement

A doctoral student must serve as a teaching assistant or a lab instructor for at least one semester to earn the Ph.D. degree. Tasks may include assignments as a Nanotechnology Education and outreach assistant, course/lab planning, classroom/lab teaching, lecture/lab preparation, student evaluation, andgrading. The student's faculty mentor observes and provides feedback to the student and evaluates the student's performance. The student needs to provide documentation signed by the teaching mentor toprove satisfactory completion of this requirement.

3.3.6 Doctoral Supervised Research (NANO 994)

NANO 994 is a research course on a Nanoengineering topic and supervised under the mentorship of a Nanoengineering graduate faculty. This course intends to expose the 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 systematicinquiry, and problem-solving. The course does not intend to serve as part of the doctoral student's dissertation topic and will not occur in one semester with multiple sections of NANO 994.

3.3.7 Qualifying and Candidacy Examinations

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

The student completes the two exams in the following order: **Qualifying Examination** and a **Candidacy Examination** (i.e., Ph.D. Dissertation Proposal). The objectives of these exams are to assess if the student has a sufficient knowledge base to conduct Ph.D. research; if the student is capable of processing and communicating research in oral and written form; and if the student is capable of formulating a novel research plan that produces a research proposal based on the scientific and engineering method(s), respectively.

3.3.7.1 Qualifying Examination

The Qualifying Exam tests a Ph.D. student's ability to prepare and present a comprehensive overview of a topic based on existing journal literature. The Qualifying Exam is based on the student's written Review Paper of an approved student-selected topic in the student's proposed field of study. The student will write the Review Paper in the style and format of a peer-reviewed journal article. The review paper provides a comprehensive discussion of the literature, scientific theory, problems or theoretical deficiencies, and possible research areas related to nanotechnology. The student's advisor must approve the topic and format of the Review Paper before the Committee will review the paper.

To be eligible to take the Ph.D. qualifying examination, students should have completed a minimum of 6 courses (18 credit hours), are currently enrolled full-time, and passed all courses with a minimum of B average grade.

Failure to "Pass" the Qualifying Exam results in a *failure to qualify*, and the student will be dismissed from the Nanoengineering Ph.D. program.

3.3.7.1.1 Qualifying Exam Guidelines

a. The student selects a Review Committee of at least three faculty members and at least 50 percent primary Nanoengineering faculty members, including the student's advisor. The Review Committee must be selected and approved at least four (4) weeks before the Qualifying Exam.

b. In consultation with their advisor, the student selects a research topic in the area of research the student plans to pursue their doctoral dissertation***. (NOTE this topic may or may not be the final dissertation topic but still must be in a closely related field of the expected dissertation topic).***

c. The Qualifying Exam is held no earlier than two weeks after the delivery of the Review Paper. Preceding the Qualifying Exam, the student presents an open (i.e., public) seminar on the Review Paper topic. Following the student's seminar on their review topic, the Review Committee conducts with the student a closed review and a preliminary overview of the student's research topic.

d. The Qualifying Exam will occur during the student's third semester in the program and before the end of the Comprehensive Exam Week published in the Graduate School Calendar of that semester. For a student who must retake the Exam, the second Qualifying Exam MUST occur before the end of the Ph.D. student's third semester of enrollment.

e. The student's Committee uses a rubric (See Appendix H) to assess the Review Paper compiled by the student. The student's Committee will evaluate his/her Review Paper and 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 the presentation.

f. The student will earn a "Pass" or "Fail." A student will receive a "Fail" grade when the

Review Committee assesses that the student did not demonstratea sufficient capability to conduct background literature research and did not demonstrate the independence to learn a new topic based on prior art.

g. To PASS the Qualifying Exam, the student must receive a committee average of "Competent" or Better in each category and a committee average total score of at least 21.

h. Students may only take the Qualifying Exam twice and must pass the Exam before the end of the third semester.

3.3.7.1.2 Qualifying Review Format

In general, the Faculty expects a student to review at least 25 peer-reviewed literature articles relevant to the research topic. The final number of documents to review is subject to the advisor's approval. The length of the submitted Review Paper should be sufficient to demonstrate a comprehensive synthesis and review of the literature, scientific theory, problems or theoretical deficiencies, and possible areas of research related to nanoengineering. The determination of the sufficiency of the Review Paper length will be in consultation with the student's advisor. The size of the Review Paper is not to exceed 25 pages. The page length counts only the body of the review. The content such as Title Page, Table of Contents, List of Figures, References, plagiarism evaluation, and Bibliography are not counted. The final document should adhere to APA format (https://apastyle.apa.org/) or similar professional format guidelines (approved by the student advisor) with tables and figures to support the discussion as needed.

A review is not a "cut and paste" of their or others' review articles. *Plagiarism or Academic misconductof any kind, whether intentional or unintentional, is not tolerated and will result in failure of the exam and lead to dismissal from the Nanoengineering program. The North Carolina A&T State University Academic Dishonesty Policy provides definitions of misconduct. Specifically, plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit. Plagiarism also includes appropriation or recycling of another person's ideas, processes, results, or words in a content changed, tailored, or designed to show statistical differences between the original content and the changed or manipulated content.*

Timeline:

- As soon as possible, after selecting their advisor, the student and their advisor meet to discuss potential topics for the Review Paper and the Qualifying Exam.
- After consultations and discussions with their advisor, the student selects a topic area for their Review Paper.
- The student in consultation with their advisor, form a Committee.
- The advisor informs the other Committee members of the selected Review Paper topic.
- The student meets periodically and regularly with the advisor to discuss and review the progress and issues of the Review Paper.

- The advisor and the student schedule the Qualifying Exam. The Ph.D. Qualifying Exam must occur before the end of the Comprehensive Week of the Graduate College's Calendar of the third semester after entering the Program. If a second try is required, the second exam MUST occur by the endof the Ph.D. student's third semester of courses.
- The student submits the Review Paper to the advisor and the other Committee members no later than two (2) weeks before the scheduled seminar and exam date.
- The advisor notifies committee members at least three weeks in advance of the time and date of the presentation.
- The Committee Members send their completed **Committee Assessment Scorecard** and any comments to the advisor. The advisor will compile and calculate the average scores.
- The student will be notified about their performance within two weeks after completing the presentation and examination.
- Students who enter the master's Program will have their financial aid reduced to master's student funding.

3.3.7.2 Candidacy Examination (Dissertation Research Proposal)

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 according to the University Graduate Catalog. The student must defend no later than theend of the student's fourth semester (**Note:** only under valid circumstances will extensions be granted with the approval from the student's dissertation committee in consultation with the student's advisor).

3.3.7.2.1 Candidacy Examination Guidelines and Timelines

The student should write a detailed research proposal in the format of an NIH, NSF, or similar grant proposal. The proposed project should bewithin the Nanoengineering scope and have the student's advisor's input. The student's dissertation committee must receive a complete written dissertation proposal at least two weeks beforethe date of the Candidacy Examination.

3.3.7.2.2 Important Milestones and Dates

- On or before **March 1** - Before submitting copies of the proposal to Dissertation Committee members, 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 ten business days to return writtenwork. The student should plan appropriately.
- On or before **April 15** - AFTER the advisor has approved the student's proposal, the student submits the proposal to other dissertation committee members for comments. Dissertation committee members should receive their "final" advisor-approved proposal copy no later than **April 15**. Each committee member will returnwritten comments to the student within ten (10) business days of receiving the proposal.(Please note that the comments may not be extensive – and may simply state, "this proposal is defendable.")
- All dissertation committee members must either sign their approval on the proposal as

defendable or ask for revisions. All committee members must approve the proposal via email before scheduling the defense. However, the student may reserve a provisional date before the approval **Before May 1** - The proposal defense date is scheduled to take place by the end ofthe spring semester.

- Students are responsible for reserving a room and scheduling a time when allcommittee members can meet for a two-hour block of time.

3.3.7.2.3 Candidacy 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 orally present an overview of the proposal. All the dissertation committee members will have read the proposal before the defense. The oral presentation should be around 30 minutes long. Afterward, the Committee will challenge the student on the proposal's content. The student will be asked to answer a series of questions related to the proposal material, includingbackground information or techniques related to the proposal. At the end of the defense, the committeewill ask the student to leave the room briefly. In the student's absence, the committee will discuss theproposal defense. The Dissertation Committee evaluates the student's performance and decides "Full-Pass," "Conditional Pass," or "Fail." After the committee reaches a decision, the student returns to the room for their decision. At this point, the committee can discuss more candidly with the student their critiques and suggestions on the project's merit, scope, and research plan.

3.3.7.2.4 Results of the Candidacy Exam

Students will receive either (1) a "Full Pass" (the committee does not require any further action of thestudent for candidacy) or (2) a "Conditional Pass" (the committee requires further action on the part of the student), or (3) a "Fail."

The committee gives a Conditional Pass if they find areas needing to be addressed by the student. Forexample, if a student is deficient in a specific area that the committee feels is essential for their success in the Ph.D. program, they may require the student review and be re-tested in that area. Re-writing a section of the grant proposal to clarify/correct a point that was not clear in the original version is another common condition that the committee mayassign to students receiving a "Conditional Pass."

In the case of a Fail, the committee has the option of allowing a re-examination. Suppose the committeetakes the option to reexamine. In that case, the committee must reexamine the student within four months on those aspects of the defense indicated by the committee as unsatisfactory. Re-examinationcan only occur once.

If the student receives a Fail and a re-examination does not occur, the student DOES NOT qualify forcandidacy and will exit the Ph.D. program. The committee may recommend that the student be giventhe option to enroll in the Nanoengineering Master program.

3.3.7.2.5 Application for Re-examination

Suppose a student wishes to continue pursuing Ph.D. candidacy after failing a Nanoengineering Qualifying or Candidacy Exam. In that case, they must submit a written request to their advisor and examination committee no later than two (2) weeks after the student receives the exam result. After the request is reviewed by the examination committee and 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), who must approve the request.

3.3.7.3 Doctoral Dissertation (NANO 997)

The student may not register for doctoral dissertation credits (NANO 997) before finishing all other course requirements or passing the Qualifying Exam. The Ph.D. program does not allow the studentto count more than 18 dissertation credit hours towards the total credit hours required for the Ph.D. degree.

3.3.7.3.1 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 dissertation committee member. The examination may not be held earlier than six months after the proposal defense. The student's academic/dissertation advisor schedules the oral dissertation defense and informs the Graduate Collegeto request a graduate faculty representative before the examination. 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. The dissertation committee will determine if the student passes the oral defense upon deliberation. If the student fails, the student's dissertation committee may permit one re-examination with sufficient consideration. At least one entire semester must elapse before the re-examination. Failure on the second attempt will result in dismiss from the Nanoengineering Ph.D. program.

3.3.7.3.2 Submission of Dissertation

The dissertation submission must follow the guidelines set by the 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 musthave the final dissertation approved by each dissertation committee member. The approved dissertation must be submitted to the Graduate College by the deadline given in the University's academic calendar.

3.4 Application for Graduation and Graduate Clearance

Students must apply for graduation by the posted deadline. Students must be in good academic standing and meet all requirements specified on their Ph.D. Program Plan of Graduate Study with an overall GPA of 3.0 or higher. Students must be enrolled in the semester in which they apply for graduation.

4.0 Post-Baccalaureate Certificate Programs

The Department of Nanoengineering offers four post-baccalaureate certificate programs for students seeking specialized graduate-level knowledge without enrolling in a Master's or Ph.D. program. The four post-baccalaureate certificate programs are:

- Post-Baccalaureate Certificate in STEM Entrepreneurship
- Post-Baccalaureate Certificate in Advanced Materials
- Post-Baccalaureate Certificate in Micro and Nano Devices
- Post Baccalaureate Certificate in Systems and Synthetic Biology

4.1 Post-Baccalaureate Certificates in STEM Entrepreneurship

The purpose of the certificate program is to train and educate students from NC A&T and students from around the country with a background or interest in science, technology, engineering, and mathematics (STEM) in concepts related to entrepreneurship, technology transfer, and commercialization, and the laws of intellectual property. The education and training gained by the students will provide them with the skills necessary to establish their own start-up companies or conduct work in academic, industry, or government sectors where entrepreneurship in STEM skills are required. The post-baccalaureate program in STEM Entrepreneurship is an interdisciplinary program that not only combines concepts from the STEM disciplines and entrepreneurship but also requires a converging technologies training approach. Thus, it is well aligned with the interdisciplinary educational approaches already being offered at JSNN, where the co-location with start-up companies will allow a seamless exposure to this emerging field.

4.1.1 Admission to the Program

The post-baccalaureate certificate in STEM Entrepreneurship is a program for any student interested in learning how to establish or operate a business based on research and development in a STEM discipline. The certificate is open to students interested in furthering their knowledge on technology transfer, commercialization, intellectual property, laws governing I.P., marketing, and entrepreneurship, and who have completed 90 credits hours as an undergraduate OR Graduate Standing.

4.1.2 Certificate Requirements: 12 Total Credit Hours	
Core Courses (6 Credit Hours): ***Select two (2) from the following***	
NANO 609	Entrepreneurship for Scientists, Technologists, Engineers, and Mathematicians
NANO 668	Technology Transfer and Commercialization
NANO 669	The Laws of Intellectual Property

Electives (6 Credit Hours): ***Select two (2) from the following***	
NANO 669	The Laws of Intellectual Property
MGMT 612	Foundations of Enterprise Management
MKTG 716	Strategic Marketing
NANO 796	Project

4.2 Post-Baccalaureate Certificate in Advanced Materials

The purpose of the certificate program is to train and educate students from N.C. A&T and students from around the country in concepts related to the design of advanced materials, understanding of their physical, mechanical, chemical, and structural properties, and the knowledge needed to correlate these properties to their function given that advanced materials and nanotechnology are interwoven nowadays. The education and training gained by the students will provide them with the skills needed to acquire employment opportunities in various industries, including medical, healthcare, pharmaceutical, electronics, automotive, and aerospace industries. It will also prepare them for careers in government agencies and advanced graduate studies in science, technology, and engineering fields.

4.2.1 Admission to the Program

The post-baccalaureate certificate in Advance Materials: Nanoengineering is a program for any students interested in learning about advanced materials and the process to create them and who has completed 90 credits hours as an undergraduate OR Graduate Standing.

4.2.2 Certificate Requirements: 12 Total Credit Hours	
Core Courses (6 Credit Hours):	
NANO 704	Fundamentals of Nanomaterials: Nanomaterial Fundamentals
NANO 711	Introductions to Nanoprocessing: Nanomaterial Processing

Technical Electives (6 Credit Hours): ***Select two (2) from the following***	
NANO 741	Colloidal and Molecular Self-Assembly: Colloidal Materials
NANO 812	Process Modeling in Composites: Composite Materials
NANO 882	Advanced Biomedical Nanomaterials: Biomedical Materials

4.3 Post-Baccalaureate Certificate in Micro and Nano Devices

The purpose of the certificate program is to train and educate students from N.C. A&T and students from around the country in concepts related to the design of micro and nano, understanding of their properties, and the knowledge needed to correlate these properties to their function. The education and training gained by the students will provide them with the necessary skills to acquire employment opportunities in various industries, including medical, healthcare, pharmaceutical, electronics, automotive, and aerospace industries. It will also prepare them for careers in government agencies and advanced graduate studies in science, technology, and engineering fields. The post-baccalaureate program in Micro and Nano Devices is an interdisciplinary program that combines concepts from the sciences and engineering fields and requires a converging technologies training approach.

4.3.1 Admission to the Program

The Post Baccalaureate Certificate in Micro and Nano Devices is open to any student who has completed 90 credits hours as an undergraduate OR Graduate Standing.

4.3.2 Certificate Requirements: 12 Total Credit Hours	
Core Courses (6 Credit Hours):	
NANO 702	Fundamentals of Nanoengineering: Physical Principles
NANO 721	Nanobioelectronics

Technical Electives (6 Credit Hours): ***Select two (2) from the following***	
NANO 821	Advances in Nanosystems
NANO 823	Compound Semiconductor and Nanostructured Devices
NANO 827	Solid State Devices

4.4 Post-Baccalaureate Certificate in Systems and Synthetic Biology

The purpose of the certificate program is to train and educate students from N.C. A&T and students from around the country in the concepts of the new and emerging fields of Systems and Synthetic Biology. These systems and synthetic biology field is expected to be a $5 Billion industry within the next decade. The goal is to train and educate students to prepare for research and careers in this field.

4.4.1 Admission to the Program

The Post Baccalaureate Certificate in Micro and Nano Devices is open to any student who has completed 90 credits hours as an undergraduate OR Graduate Standing.

4.4.2 Certificate Requirements: 12 Total Credit Hours	
Core Courses (6 Credit Hours):	
NANO 703	Fundamentals of Nanoengineering: Chemical and Biochemical Principles
NANO 706	Systems and Computational Biology

Technical Electives (6 Credit Hours): ***Select two (2) from the following***	
NANO 781	Intro to Synthetic Biology
NANO 782	Techniques in Synthetic Biology
NANO 881	Nanosynthetic Biology
NANO 882	Advanced Biomedical Nanomaterials

Appendix A: Student's Responsibilities

It is the student's responsibility to familiarize themselves with University policies and regulations:

a. Each student is responsible for the timely completion of their academic program, maintaining good academic standing, and meeting all other degree requirements.

b. Students supported on stipends or assistantships must complete service assignments and work/research in labs to meet their degree requirements. Students are expected to fulfill the required obligations, including working 20 hours/week.

c. First-year students with financial support must work 20 hours/week for Department-assigned research or service.

d. Full-time students supported on stipends or assistantships (20 hours/week) cannot work outside the JSNN.

e. Each student's responsibility is to be knowledgeable of the published academic regulations and requirements outlined in the Nanoengineering Student Handbook, Graduate Catalog, its revisions, University policies and regulations, and the specific requirements of the academic program.

f. Each student is also responsible for compliance with announcements published by the Department, JSNN, the Graduate College, the Office of the Registrar, the Office of the 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 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, academic integrity, and research ethics.

i. Responsible Conduct of Research (RCR): According to NSF, "The responsible and ethical conduct of research (RCR) is critical for excellence, as well as a public trust, in science andengineering. Consequently, education in RCR is considered essential in the preparation offuture scientists and engineers." For more information on the NSF RCR, please visit: (http://www.nsf.gov/bfa/dias/policy/rcr.jsp). Students involved in federally funded researchprojects may be required to complete further training to meet the responsible conduct ofresearch requirements. Please get in touch with your advisor as well as N.C. The A&T Division of Research and Economic Development (DORED) will complete any additional required RCR training.

j. Students and other researchers (for example, postdoctoral fellows) at JSNN share lab spaces. Students must complete an annual lab safety training and an annual specific lab safety training. Students must maintain and ensure a clean and safe working environment for all researchers, faculty, and staff. JSNN will sanction any student violating safety protocols. Sanctions may include loss of lab access, loss of assistantships, or dismissal from the Nanoengineering graduate program.

k. All students are required to attend JSNN and Departmental seminars and meetings.

l. All students are required to know and observe all regulations of campus life and student behavior. Department expectations are for each student to participate in campus and community life and to reflect positively upon the student and the University. The Department expects all students to abide by the Student Handbook.

m. Email is the official form of communication at the University. Consequently, the University expects all students to regularly (e.g., daily) check their University email. Students are responsible and expected to maintain their current contact information, 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 meet the graduation requirements, a student must demonstrate satisfactory coursework performance after being admitted to the Nanoengineering graduate program. Satisfactory performance 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 satisfactoryprogress 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 are not limited to, inadequate GPA, inadequate research and research skills, failure to obtain satisfactory grades in required courses, or failing the qualifying, 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 receives an academic warning. Students on academic warning cannot enroll in more than nine (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 is placed on academic probation for the subsequent regular (non-summer) semester. A student on academic probation must 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 nine (9) semester credit hours.

Dismissal: A student on probation who fails to achieve an overall GPA of 3.0 or higher by the end of the probationary period can 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, the student does not make adequate progress onresearch projects, fails to obtain satisfactory grades in the required courses, or fails 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 advisor by the time designated in the Graduate Student Handbook;
g. is guilty of ethical misconduct or violates the University's Student Conduct Handbook requirements and policies.

Readmission after Academic Dismissal: A student dismissed for academic reasons will be eligible tosubmit a new application after one academic year and may be admitted only upon the recommendationof 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 Post Baccalaureate Certificate Courses
NANO 609 - Entrepreneurship for STEM Professionals
NANO 668 - Technology Transfer and Commerce
NANO 669 - Laws of Intellectual Property (IP)

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 - Nanosafety
NANO 706 - Systems and Computational Biology

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 771 - Introduction to Nano Thermodynamics
NANO 781 - Introduction to Synthetic Biology
NANO 782 - Techniques in Synthetic Biology
NANO 784 - Professional Development
NANO 785 - Special Topics in Nanoengineering

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

Doctoral Courses (Open to Master's Students, with prior instructor approval)
NANO 811 - Polymeric Materials Engineering
NANO 814 - Nanomechanics-Modeling and Experimental Methods
NANO 812 - Process Modeling in CompositesNANO 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 871 - Advanced Nano Thermodynamics
NANO 881 - Nano and Synthetic Biology

NANO 882 - Adv Biomedical Nanomaterials
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
NANO 856 - Interfacing with Nano Lab
NANO 857 - Synthetic Biology Laboratory
NANO 858 - Synthetic Biology Laboratory
NANO 859 - Synthetic Biology 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 609 - Entrepreneurship for STEM Professionals.
This course is designed for senior-level undergraduates, graduate students, or professionals who wish to understand the concepts of entrepreneurship about establishing innovations in science, technology, engineering, and mathematics. In this course, students will acquire a foundational knowledge of the capacity of entrepreneurship, how to access the market, and further understand how to market their ideas to appropriate markets. Students will also be exposed to basic principles for developing business plans and organizational intelligence to become successful entrepreneurs.
Prerequisites: Completed 90 credits hours as an undergraduate OR Graduate Standing
Credits: 3 (3-0)

NANO 668 - Technology Transfer and Commercialization
This course is designed for senior-level undergraduates, graduate students, or professionals who wish to understand the concepts of technology transfer and commercialization. The course will focus on developing innovations from research and development work done in science, technology, engineering, and mathematics and the stepwise steps necessary to move from research to commercialization, including intellectual property protection, ownership, and developing commercialization plans. Students will also learn the fundamental steps needed to become successful entrepreneurs.
Prerequisites: Completed 90 credits hours as an undergraduate OR Graduate Standing
Credits: 3 (3-0)

NANO 669 - The Laws of Intellectual Property
This course covers the basic concepts of patent laws, invention disclosure, innovation protection, and the licensing process. The course teaches students how the law protects inventors and creators from infringement. The course further exposes students to the legal and business aspects of intellectual property and provides the foundation to help inventors take their products to market.

Students will learn about laws and regulations about patents, trademarks, secrets, and copyrights and learn various aspects of the America Invents Act (AIA).
Prerequisites: Completed 90 credits hours as an undergraduate OR Graduate Standing
Credits: 3 (3-0)

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 nanostructured metals, carbon nanotubes, soft matter, and multiscale modeling techniques.
Prerequisites: None
Credits: 3 (3-0)

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

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

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

NANO 705 - Nanosafety
This interdisciplinary course 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 nanosafety and new materials from the primary literature. The pedagogy followed in this course fosters student critical thinking about the interaction of nanomaterials with the biological world.
Prerequisites: None
Credits: 3 (3-0)

NANO 706 - Systems and Computational Biology
This course focuses on teaching bioinformatics and statistics skills needed in academic, biomedical engineering, and pharmaceutical laboratories to analyze laboratory data. The students will learn mainstream bioinformatics tools and statistical concepts and their application to data

collection,analysis, and data presentation. Students learn how to evaluate data sources and choose appropriate data analysis methods. Additional topics covered will include experimental design, statistical hypothesis testing, and methods for comparing discrete and continuous data (e.g., ANOVA, t-test, correlation, and regression). An emphasis of this course is on high throughput assays and multivariateanalysis techniques
Prerequisites: 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.
Prerequisites: 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 particular emphasis is placed on problem-based learning targeting current issues in nanobioelectronics.
Prerequisites: NANO 702 or NANO 703 or consent of instructor.
Credits: 3 (3-0)

NANO 731 - Introduction to Nanomodeling and Applications
This graduate-level course introduces nanomodeling and applications for students with a background in engineering, physical, mathematical, or biological sciences focusing on atomistic and molecular dynamics modeling.
Prerequisites: NANO 702 or NANO 703 or consent of instructor.
Credits: 3 (3-0)

NANO 741 - Colloidal and Molecular Self-Assembly
This course introduces 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.
Prerequisites: None
Credits: 3 (3-0)

NANO 761 - Introduction of Nano Energy
This course is a 3-credit comprehensive course on nanomaterials and devices for energy application. The course will introduce emerging energy technologies and the fundamentals required to design suchgreat technology at the nanoscale and will cover the description of basic energy principles, nanoarchitectured energy material and its device concept used in all

forms of energy harvesting,conversion, and storage.
Prerequisites: None
Credits: 3 (3-0)

NANO 771 - Introduction to Nano Thermodynamics.
This course is an introduction to the first principles of nano thermodynamics. Topics covered will include thermodynamic principles associated with nano engines and motors such as Feynman ratchet; stochastic energetics; stochastic entropy and second law; Maxwell demon and feedback; Jarzynski relation and Crooks fluctuation theorem.
Prerequisites: None
Credits: 3 (3-0)

NANO 781 - Introduction to Synthetic Biology
Synthetic biology and genetic engineering is a modern approach to biotechnology that takes advantage of our knowledge in biology at the molecular level, which enables changing an organism's genes to introduce or remove a particular trait. Synthetic biology uses biological tools and engineering rules to make things, reprogram pathways and components, and provide non-existing solutions. Because our tools no longer rely upon breeding alone, it is now possible to transfer genes between different organisms. Further, DNA no longer needs to come from a living organism but can be entirely synthetic. This course will use biological tools and engineering rules to understand and harness synthetic biology. This course is in synergy with national conversations aboutthe opportunities and challenges we will face as engineers, scientists, technologists, and citizens. Along the way, we will learn about what other people have made out of biological systems and the techniques currently at our disposal. We will also address safety and ethical considerations.
Prerequisites: Graduate Standing
Credits: 3 (3-0)

NANO 782 - Techniques in Synthetic Biology
This graduate-level course focuses on research techniques in synthetic biology, including methods inDNA and protein synthesis and genomic and proteomic analysis. Students will learn approachesto characterize materials on the atomic and molecular scale and the application of optical and electron microscopy in synthetic biology. The course will focus on experimental design, data analysis, interpretation, and data dissemination from each technique covered. Students will be required to participate in and lead discussions on the course material and relevant materials.
Prerequisites: Graduate Standing
Credits: 3 (3-0)

NANO 783 - Evolutionary Biology for Nanoengineers
This course explores the discipline of evolutionary biology through the range of organization that exists within the biological sciences (molecular to societal). Students will read and discuss the established principles of evolution and new material from the primary literature. Thepedagogical approach utilized in this course introduces students to how topics in evolutionary biologyare approached and solved. Furthermore, it examines why and how evolutionary reasoning is essentialto modern biology and fully integrated into the general scientific method.

Prerequisites: Graduate Standing
Credits: 3 (3-0)

NANO 784 - Professional Development
This graduate-level course focuses on research methods in nanoengineering, including the scientific method and experimental design, data analysis, presentation, and dissemination of results. Students will learn practical and accessible skills to develop their research topic and design, execute, analyze and interpret experiments applicable to their Master's or doctoral work. Concepts related to effective time management, working on a research team, writing and evaluating proposals will be explored. Students will be required to participate in and lead discussions on the course materialand relevant materials.
Prerequisites: Graduate Standing
Credits: 3 (3-0)

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

NANO 794 - Masters Supervised Research
This course is supervised research under the mentorship of a faculty member and is not intended to serveas the project or thesis topic of the master's student.
Prerequisites: 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 that outlines the project's nature and must be submitted for approval. This course is only available to project option students.
Prerequisites: Master's level standing with project option.
Credits: 3 (3-0)

NANO 797 - Master's Thesis
Master of Science thesis research conducted under the supervision of the thesis committee chairperson leading to completing 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 course is a continuation of NANO 797 and is for master's students who have completed allrequired credit hour requirements.
Prerequisites: 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, emphasizing applying basic knowledge in nanoengineering applications.
Prerequisites: 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 814 - Nanomechanics-Modeling and Experimental Methods
This course focuses on nanoscale mechanics, relevant modeling, and experimental techniques. Concepts of molecular to continuum methods in nanomechanics modeling are discussed. Experimental methods for nanomechanical characterization are presented. Specific examples of research and literature applications will be discussed. The course will involve lectures and application projects.
Prerequisites: None
Credits: 3 (3-0)

NANO 821 - Advanced Nanosystems
This course is designed to teach advanced nanosystems, which result from 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 onproblem-based learning targeting current issues in nanosystem integration.
Prerequisites: NANO 721 or consent of the instructor.
Credits: 3 (3-0)

NANO 823 - Compound Semiconductor and Nanostructure Devices
This course covers the 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 the 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

epitaxialgrowth 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 the 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 devicemodeling 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 the nanoscale, focusing on the principles and background theory of the modeling methods and applications relevant to crystalline, amorphous, ceramic, cementitious, and biosystems.
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 natural material systems.
Prerequisites: Basic courses in thermodynamics recommended.
Credits: 3 (3-0)

NANO 851 - Computational Nanoscale Modeling Laboratory
This course 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 course is a laboratory rotation course to expose and educate the students on the equipment and toolsavailable in the nanoelectronics laboratory.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

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

NANO 854 - Nanomaterials Laboratory

This course is a laboratory rotation course to expose and educate the students on the equipment and toolsavailable 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 one (1) credit practical and hands-on-oriented laboratory course on energy storage material and devices. The laboratory course will provide hands-on experiences with the specific topicsregarding advanced nanomaterials such as battery anode and cathode material for energy storage applications. The student will learn how to design and synthesize energy storage material for battery, assemble its device, and evaluate batter performance.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 856 - Interfacing with Nano Laboratory. This hands-on laboratory course trains students on the measurement and manipulation of surfaces and interfacial properties. The laboratory course will provide hands-on experiences with the specific topics and instrumentation for surface energy, interfacial tension and emulsions, and manipulation of surface chemistry. Students will learn laboratory methods used to characterize and fabricate those interfaces.
Prerequisites: Student in Nanoengineering/Nanoscience Ph.D. program.
Credits: 1 (0-1)

NANO 857 - Rotation in Synthetic Biology I
This graduate-level course is for students in the Ph.D. program in Nanoengineering with a concentration in Synthetic Biology. The students will learn how to conduct new or ongoing research on and interact with biomaterials, cellular and molecular biology reagents, protocols, methods, and materials. The subjects will be selected based on discussions with the course instructor and determined at the beginning of the course, based on the students' background and per the instructor's determination. These subjects are intendedto increase knowledge on diverse and state-of-the-art methodologies in the mentioned fields.
Prerequisites: Consent of the instructor.
Credits: 1 (0-1)

NANO 858 - Rotation in Synthetic Biology II
This graduate-level course is for students in the Ph.D. program in Nanoengineering with a concentrationin Synthetic Biology. The students will learn how to conduct new or ongoing research on and interact with biomaterials, cellular and molecular biology reagents, protocols, methods, and materials. The subjects will be selected based on discussions with the course instructor and determined at the beginning of the course, based on the students' background and per the instructor’s determination. These subjects are intendedto increase knowledge on diverse and state-of-the-art methodologies in the mentioned fields.
Prerequisites: Consent of instructor.
Credits: 1 (0-1)

NANO 859 - Rotation in Synthetic Biology III

This graduate-level course is for students in the Ph.D. program in Nanoengineering with a concentration in Synthetic Biology. The students will learn how to conduct new or ongoing research on and interact with biomaterials, cellular and molecular biology reagents, protocols, methods, and materials. The subjects will be selected based on discussions with the course instructor and determined at the beginning of the course, based on the students' background and per the instructor's determination. These subjects are intendedto increase knowledge on diverse and state-of-the-art methodologies in the mentioned fields.
Prerequisites: Consent of instructor.
Credits: 1 (0-1)

NANO 861 - Advanced Nano Energy System
NANO 861 is a 3-credit advanced and more practical oriented energy storage material and system course. The course will specifically touch on 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 elucidate the failure mechanism using a nanoscale fundamental analysis.
Prerequisites: None
Credits: 3 (3-0)

NANO 871 - Advanced Nano Thermodynamics
This course will cover advanced concepts introduced in the earlier course on introduction to nano thermodynamics. The course will involve analytical and modeling methods of the governing principles, associated applications, and projects.
Prerequisites: None
Credits: 3 (3-0)

NANO 881 - Nano and Synthetic Biology
Synthetic biology uses biological tools and engineering rules to make things, reprogram pathways and components, and provide non-existing solutions. This course will use biological tools and engineering rules to understand and harness synthetic biology for nanotechnology and engineering applications. Aligned with the goals of SemiSynBio Roadmap (which is a national priorityto merge nanotechnology, semiconductor industry, and synthetic biology), this course will increase the students' awareness of this emerging merger. Therefore, this course is in synergy with current national priorities.
Prerequisites: NANO 781
Credits: 3 (3-0)

NANO 882 - Advanced Biomedical Nanomaterials
This course focuses on nanoscale materials and their application in biomedicine and biomedical engineering, an interdisciplinary field encompassing biology, chemistry, medicine, and engineering to treat and heal damaged or diseased tissues, organs, and biological systems. Concepts related to the fundamentals of nanomaterials, their synthesis, characterization, biocompatibility, and functionalization will be presented. Students will expand their current understanding of the application of nanomaterials on topics including nanocarriers, nanomedical devices, nanosensors, tissue engineering, and nanomaterials in medicalimaging. Case studies of specific nanomaterial applications in the fields of cancer, infectious diseases, and the human

circulatory system will be discussed. Students will be required to participate in and lead discussions onthe course material and relevant journal articles.
Prerequisites: NANO 782
Credits: 3 (3-0)

NANO 885 - Special Topics Nanoengineering
This course allows the introduction of a potential new course 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 before registration.
Prerequisites: Consent of the instructor.
Credits: 3 (3-0)

NANO 994 - Doctoral Supervised Research
This course is supervised research under the mentorship of a graduate faculty member. It is not intendedto serve as the doctoral student's dissertation topic. The student receives a Pass/Fail, and no lettergrade is given upon completion.
Prerequisites: Doctoral level standing.
Credits: 3 (3-0)

NANO 997 - Doctoral Dissertation
This course represents the supervised research leading to the dissertation for the doctoral student. The studentreceives a Pass/Fail grade only after completing the final Ph.D. oral defense.
Prerequisites: 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. The student receives a Pass/Fail and no letter grade given upon completion. This course can be repeated by the students as needed.
Prerequisites: Completion of all dissertation credits in nanoengineering.
Credits: 1 (1-0)

Appendix D: Graduate Faculty and Staff in the Department of 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 (Kingston, Canada); Ph.D. Biomedical Engineering, McGill University (Montreal, Canada)

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

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
Shanthi Iyer	106I	336-285-3710	iyer@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

Appendix E: Student Academic Conduct

The following guidelines apply to all matters of student academic conduct in the Nanoengineering Department. Violation of any of the following codes of conduct will lead to sanctions. Sanctions can result in dismissal from the program leading to dismissal from the Department and University. The JSNN Academic Integrity Committee determines such sanctions.

Academic Honesty
Suppose a student is uncertain about an issue of academic honesty. In that case, they should consult the faculty member to resolve questions in any situation before the submission of the academic exercise.Violations of academic honesty include but are not limited to:

Cheating
Cheating is intentionally using or attempting to use unauthorized materials, information,notes, study aids, or other devices or materials in any academic exercise.
Explanation
Students completing any examination are prohibited from looking at another student's examination and using external aids (for example, books, notes, calculators, having a conversation with others) unless specifically allowed in advance by the faculty member proctoring that specific exam. Students may not have others conduct research or prepare work for them without advance authorization from the faculty member. This includes, but is not limited to, the services of commercial term paper companies.

Fabrication, Falsification, and Forgery

Fabrication is the intentional invention and unauthorized alteration of any information or citation in an academic exercise. Falsification is a matter of altering information, while fabrication is inventing or counterfeiting information in any academic activity or University record. Forgery is the act of imitating or counterfeiting documents, signatures, and the like.
Explanation
“Invented” or fabricated information shall not be used in any laboratory experiment, reported results, or academic exercise. It is improper, for example, to analyze one sample in an experiment and then "invent" data based on that single experiment for several more required analyses. Students shall acknowledge and cite the actual source from which they obtained information. For example, a student shall not take a quotation from a book review and then indicate that it was obtained from the actual book. Falsification of University records includes altering or forging any University document or record, including identification material issued or used by the University.

Multiple Submission

In Multiple submissions, the student submits substantial portions of the same work (including oral reports) for credit more than once without authorization from instructors of all classes for which the student submits the work.

Explanation

Examples of multiple submissions include but are not limited to:

- Submitting the same paper for credit in more than one course without all faculty members' permission.
- Making revisions in a credit paper or report (including oral presentations) and submitting it again as if it were new work.
- Submitting sections of an M.S. thesis for a dissertation without permission from the members of the student's M.S. and dissertation committee members.

Plagiarism

Plagiarism is intentionally, knowingly, or carelessly presenting someone else's work as one's own (i.e., without proper acknowledgment of the source). The sole exception to the requirement of acknowledging sources is when the ideas, information, etc., are common knowledge. Instructors should provide clarification about the nature of plagiarism.

Explanation

- Direct Quotation: The paper's author (i.e., the student) must identify any direct quotes by quotation marks or appropriate indentation and must properly acknowledge, in the text by citation or in a footnote or endnote.
- Paraphrase: Prompt acknowledgment is required when material from another source is paraphrased or summarized, in whole or in part, in one's own words. To acknowledge a paraphrase properly, one might state: "To paraphrase Locke's comment,..." and then conclude with a footnote or endnote identifying the exact reference.
- Borrowed facts: Information gained in reading or research which is not common knowledge must be acknowledged.
- Common knowledge includes generally known facts such as the names of leaders of prominent nations, basic scientific laws, etc. Materials that add only to a general understanding of the subject may be acknowledged in the bibliography and need not be footnoted or endnoted.
- Footnotes, endnotes, and in-text citations: One footnote, endnote, or in-text citation is usually enough to acknowledge indebtedness when several connected sentences are drawn from one source. When using direct quotations, however, quotation marks must be inserted, and acknowledgment made. Similarly, when paraphrasing a passage, acknowledgment is required. Faculty members are responsible for identifying any specific style/format requirement for the course. Examples include but are not limited to American Psychological Association (APA) style and Modern Languages Association (MLA) style.

Complicity

Complicity is intentionally or knowingly helping or attempting to help another to commit an act ofacademic dishonesty.

Explanation
Examples of complicity include: knowingly allowing another to copy from one's paper during an examination or test; distributing test questions or substantive information about the materials to be tested before the scheduled exercise; collaborating on academic work knowing that the collaboration is not reported; taking an examination or test for another student, or signing another's name on an academic exercise.

NOTE: Collaboration and sharing information are characteristics of academic communities. These become violations when they involve dishonesty. Faculty members should make clear to students expectations about collaboration and information sharing. Students should seek clarification when in doubt.

Computer Misuse
Academic computer misuse is the use of software to perform work that the instructor has told the student to do without software assistance.

Conduct in Research
Research and creative activities occur in various settings at the University, including class papers, theses, dissertations, reports or projects, grant-funded projects, and service activities. Research and creative activities rest on a foundation of mutual trust. Misconduct in research and creative activity destroys that trust and is prohibited. Students shall adhere to professional standards of integrity in both artistic and scientific research, including appropriate representationsof originality, authorship, and collaborative crediting.

Definition: Misconduct in research is serious deviation, such as fabrication or falsification of data, plagiarism, or scientific or creative misrepresentation, from accepted professional practices of the discipline or University in carrying out research and creativeactivities or in reporting or exhibiting/performing the results of research and creative activities.It does not include honest errors or honest differences in judgments or interpretations of data.

Explanation
Examples of misconduct in research include but are not limited to:

- Fabrication of Data: Deliberate invention or counterfeiting of information.
- Falsification of Data: Dishonesty in reporting results, ranging from unauthorized alteration of data, improper revision or correcting of data, gross negligence in collecting or analyzing data, to selective reporting or omission of conflicting data.
- Plagiarism and Other Misappropriation of the Work of Another: The representation of another person's ideas or writing as one's own, in such ways as stealing others' results or methods, copying or presenting the writing or ideas of others without acknowledgment, or otherwise taking credit falsely. Representing another's artistic or technical work or creation as one's own. Just as there are standards to which one must adhere in the preparation and publication of written works, there are standards to which one must abide in creative works in the tonal, temporal, visual, literary, and dramatic arts.
- Abuse of Confidentiality: Taking or releasing the ideas or data of others given in the

expectation of confidentiality, e.g., stealing ideas from grant proposals, award documents, or manuscripts intended for publication or exhibition/performance when one is a reviewer for granting agencies or journals or when one is a juror.

- Dishonesty in Publication or Exhibition/Performance: Knowingly publishing, exhibiting, or performing work that will mislead, e.g., misrepresenting material, particularly its originality, or adding or deleting the names of other authors without permission.
- Deliberate Violation of Requirements: Failure to adhere to or receive the approval required for work under research regulations of federal, state, local, or university agencies, including guidelines for the protection of human subjects or animal subjects and the use of recombinant DNA, radioactive material, and chemical or biological hazards.
- Failure to Report Fraud: Concealing or otherwise failing to report known misconduct or breaches of research or artistic ethics.

Research Board Requirements

Misconduct in research includes failure to comply with requirements of the conduct of research and creative activities, e.g., the protection of human subjects, the welfare of laboratory animals, radiation, and biosafety. The Human Subjects Institutional Review Board, the Institutional Animal Care and Use Committee, and the Institutional Biosafety Committee may bring allegations in these areas.

Appendix F: Compliance with the Americans with Disabilities Act (ADA)

The University, the School, and the Department will make all reasonable efforts to accommodate the needs of students with documented disabilities. If you have a disability that requires accommodation during the semester, please REGISTER with the Office of Veterans and Disability Service (OVDSS) located on campus in Murphy Hall (334-7765). Ensure 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! 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.

Appendix G: 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.

Graduate College Forms

(Graduate College Forms - Aggie Hub | North Carolina A&T State University (ncat.edu))

Plan of Study
https://www.ncat.edu/tgc/continuing-students/forms/planofstudy.pdf

Degree Clearance
https://www.ncat.edu/tgc/continuing-students/forms/degreeaudit.pdf

Graduate Clearance Form
https://hub.ncat.edu/secure/administrative/research/compliance-ethics/graduate-clearance-form-updated08202020.docx

Report of Thesis Committee Composition
https://www.ncat.edu/tgc/continuing-students/forms/thesis-committee-form.pdf

Report of Dissertation Committee Composition
https://www.ncat.edu/tgc/continuing-students/forms/dissertation-committee-form.pdf

Request to Schedule Thesis/Dissertation Defense
https://www.ncat.edu/tgc/continuing-students/forms/schedule-oral-defense.pdf

Request to Conduct Remote Thesis/Dissertation Defense
https://www.ncat.edu/tgc/continuing-students/forms/remote-defense-request.pdf

Oral Defense Results
https://www.ncat.edu/tgc/continuing-students/forms/oral-defense-results-form.pdf

Thesis and Dissertation Handbooks

Thesis and Dissertation Formatting Handbook
https://www.ncat.edu/tgc/continuing-students/thesis/NCAT%20T-D%20Handbook.pdf

Thesis/Dissertation Template
https://www.ncat.edu/tgc/continuing-students/thesis/template.doc

Other Forms

Application for Add-on Certificate
https://www.ncat.edu/tgc/continuing-students/forms/add-on-certificate-application.pdf

Application for a Double Major
https://www.ncat.edu/tgc/continuing-students/forms/doublemajor.pdf

Application for Re-enrollment Application
https://www.ncat.edu/admissions/graduate/re-enrollment-in-the-graduate-college.php

Appendix H: Nanoengineering Ph.D. Qualifying Exam (Literature Review) Rubric

Dimension	Criteria	Scoring	Comments
Introduction	The importance of the topic to the field is clear. Adequate background and a brief history of the topic are included. A rationale for the study of the topic is strongly evident and well-articulated.	Developing – Competent – Exemplary 1 2 3 4 5 6	
Critical Analysis	Exhibits a fundamental understanding of the topic. Evidence of depth in fundamental knowledge in the field is clear. Acknowledgment of the knowledge gap in the literature is included. Critical evaluation of the sources in the body of the paper is evident throughout the paper.	Developing – Competent – Exemplary 1 2 3 4 5 6	
Comprehensiveness	The content is comprehensive, including the current state of the art, experimental, analytical work, and applications. Both literature and patents are evident, preferably from different authors (suggest 25 – 30 references are used)	Developing – Competent – Exemplary 1 2 3 4 5 6	
Summary and Conclusions	Studies and other sources are on the research project are synthesized. Conclusions as well as future research directions are evident. The summary includes a synthesis based on a critical evaluation of all the literature.	Developing – Competent – Exemplary 1 2 3 4 5 6	
Writing, Style, and Format	There is clarity of writing throughout. Sentences/paragraphs are clear and concise. Topics are organized logically. No spelling errors are evident. Professional terms are properly displayed. Citations are correctly displayed throughout the paper. Writing is original, following established rules to avoid plagiarism.	Developing – Competent – Exemplary 1 2 3 4 5 6	
Presentation	The presentation is clear, organized, and concise. Time limits are strictly adhered to. The presenter speaks clearly and succinctly. Answers questions with informed and effective responses.	Developing – Competent – Exemplary 1 2 3 4 5 6	

<u>Nanoengineering Ph.D. Qualifying Exam (Literature Review) Rubric</u>	
Committee Assessment Scorecard	
The committee chair will use this rubric to calculate the average assessment of the literature review. To PASS the Qualifying Exam the student must receive a committee average of "Competent" or better ineach category and a committee average total score of at least 21.	
Student Name:__________________________	Date of Exam:__________________________

	Attempt: 1st □ 2nd □

Dimension	Score 1	Score 2	Score 3	Average Score	Pass/Fail
Introduction					PASS if average score ≥ 3
Critical Analysis					PASS if average score ≥ 3
Comprehensiveness					PASS if average score ≥ 3
Summary andConclusions					PASS if average score ≥ 3
Writing, Style, andFormat					PASS if average score ≥ 3
Presentation					PASS if average score ≥ 3
Total Score					PASS if score ≥ 21 AND ALL dimension scores above are PASS

Committee Members	**Signatures**
1. ________________________________	
2. ________________________________	
3. ________________________________	

North Carolina A&T State University Academic Dishonesty Policy

Relevance to the Nanoengineering Ph.D. Qualifying Exam
In instances where a student has clearly been identified as having committed an act of academic dishonesty, *the Qualifying Exam Committee is **obligated** to take appropriate disciplinary action, awarding a grade of "FAIL" for the Qualifying Exam. Failure of the Qualifying Exam **disqualifies** the student from candidacy to theNanoengineering Ph.D. program.*

Academic dishonesty includes, but is NOT LIMITED TO, the following:

1. **Plagiarism** (unauthorized use of another's words or ideas, as one's own), which includes, but is not limited to, submitting **exams**, **theses**, reports, drawings, laboratory notes, or other materials as one'sown work when such work has been prepared by or copied from another person;
2. **Cheating** or knowingly assisting another student in committing an act of cheating or other academic dishonesty;
3. **Unauthorized possession of exams** or reserved library materials; destroying or hiding the source,library or laboratory materials or experiments or any other similar actions;
4. **Unauthorized changing of grades**, or marking on an exam or in an instructor's grade book or suchchange of any grade record;
5. **Aiding or abetting** in the infraction of any of the provisions anticipated under the general standards ofstudent conduct;
6. Hacking into a computer and gaining access to a test or answer key prior to the test being given. NC A&T reserves the right to search the emails and computers of any student suspected of such computer hacking if a police report of the suspected hacking was submitted prior to the search; and
7. Assisting another student in violating any of the above rules.

A student who has committed an act of academic dishonesty has failed to meet a basic requirement of satisfactory academic performance. Thus, academic dishonesty is not only a basis for disciplinary action, butmay also affect the evaluation of a student's level of performance. Any student who commits an act of academic dishonesty is subject to **disciplinary action**.

In instances where a student has clearly been identified as having committed an act of academic dishonesty, *an instructor may take appropriate disciplinary action, including a loss of credit for an assignment, exam or project; or awarding a grade of "F" for the course, **subject to review and endorsement by the Chair of the Department of Nanoengineering and the Dean of JSNN.***