NANOSCIENCE (NAN)

NAN 105 Nanotechnology: Fundamentals and Applications 3
Introduction to major concepts in nanotechnology. Covers a range of topics in nanotechnology from fundamental properties of nanomaterials, applications of nanotechnology in consumer products, and biomedical applications, including vaccines and drug delivery systems.

NAN 220 3D Printing and Computational Modeling 3
3D printing is the process of building an object layer by layer using a digital representation of that object. With no prior coding experience necessary, in this course we will apply principles of scripting and coding to generate computational representations of 3D structures using programmatic computer-aided design for 3D printing.
Prerequisites: MAT 183 or MAT 151 or MAT 190 or MAT 184 or MAT 191 or MAT 196.

NAN 417 Introduction to Synthetic Biology 3
Synthetic biology will address conceptual/qualitative, quantitative, and computational approaches to the analysis and design of biological and biologically-inspired molecular systems for useful biotechnological or translational applications.
Prerequisites: BIO 355 or BIO 481 or BIO 418 or BIO 409 or CHE 456, or permission of instructor.

NAN 419 Introduction to Nanotechnology 3
This course introduces students to the emerging field of nanotechnology and exposes them to current research and topics that are being influenced by nanomaterials including biology, healthcare, and the environment.
Prerequisites: BIO 392, BIO 355, CHE 342, CHE 351, or permission of instructor.
Notes: Same as BIO 419.

NAN 450 Emerging Infectious Diseases and Biosafety Level-3 Laboratory Training 1
This is an elective course for students interested in learning more about emerging infectious diseases and the proper safety bio-safety protocols and procedures to study them in BSL3 lab.
Prerequisites: BIO 111 or permission of instructor.

NAN 499 Undergraduate Research 1-3
Independent research in Nanoscience under the direction of a Nanoscience faculty member, culminating in a written report. Research will include laboratory work, directed readings of the literature, and/or theoretical work in areas of Nanoscience.
Prerequisites: Permission of the instructor.
Notes: May be repeated for up to 6 s.h. credit.

NAN 519 Introduction to Nanotechnology 3
This course introduces students to the emerging field of nanotechnology and exposes them to current research and topics that are being influenced by nanomaterials including biology, healthcare, and the environment.
Notes: Same as BIO 519.

NAN 600X Experimental Course 1-6
This number reserved for experimental courses. Refer to the Course Schedule for current offerings.

NAN 601 Nanomaterials Chemistry 3
Review of materials chemistry, synthesis of nanoparticles such as carbon nanotubes and fullerenes, chemical reactions and a survey of medicinal chemistry for pharmaceutical applications.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 602 Physical Biology 3
Emphasis on cellular and intracellular mechanisms including biological self-assembly, single-molecule and single-cell biophysics, cytoskeletal interactions, protein folding, membrane dynamics, biological energetics, molecular biotechnologies, and cell-cell interactions as well as biomaterials.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 603 Principles of Quantum and Solid State Physics 3
Emphasis on the areas of physics critical to nanoscience including solid state physics, statistical mechanics, quantum concepts, biophysics, chemical physics, and nanodevices based on semiconductors.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 604 Nanotechniques 3
Fundamental techniques used in nanotechnology, including methods for nanofabrication, nanocharacterization, and nanomanipulation.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 605 Mathematical Methods in Modeling Complex Systems 3
An emphasis of this required course will be on the areas of mathematics critical to nanoscience and nanoengineering including application of differential equations to numerical and analytical modeling of nanostructures.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 609 Nanosafety 3
An interdisciplinary course utilizing variety of academic disciplines (chemistry, physics, biology). Addresses the impact of nanomaterials through the range of organization that exists within living systems (molecular to societal).

NAN 610 Systems and Synthetic Biology 3
Systems and synthetic biology will address quantitative and computational approaches to the analysis and re-design of biological and biologically-inspired molecular systems for useful biotechnological or translational applications.

NAN 611 Nanoscience Laboratory Rotation 1
A 7-week laboratory rotation intended to develop skills with scientific equipment and provide initial experience with nanoscale research. Four distinct laboratory rotations are required for the PhD in nanoscience.
Prerequisites: Graduate student in nanoscience or permission of instructor.
Notes: May be repeated for credit.

NAN 615 Spectroscopy Methods in Nanoscience 3
Introduction to spectroscopy methods that, widely used in physics, chemistry, and biological sciences, provide knowledge for estimating applicability ranges of various methods, and teach basics of spectroscopy instruments and data analysis.

NAN 616 Principles of Nanoscience I: Physical, Chemical, and Biological Foundations 3
Covers the fundamental concepts in chemistry, biology and physics that are central to the interdisciplinary field of Nanoscience. Topics covered in this course include concepts in statistical mechanics (thermal, entropic, quantum, and fluctuation effects), self-assembly, diffusion, molecular recognition, molecular nanotechnology and nanomaterials, intermolecular and surface/interfacial forces at the nanoscale, cell adhesion and recognition, quantum phenomena, polymer physics, near-field optics, and nanoscale metrology, microscopy, and imaging.

NAN 617 Principles of Nanoscience II: Analytical, Statistical, and Computational Foundations 3
Covers the application and theory of different mathematical techniques that enable the statistical analysis of data, modeling of complex systems, and the proper application of mathematical operations to describing nanoscale problems and mechanisms. Topics covered may include but are not limited to, descriptive statistics, practical algorithms for statistical analysis, and mathematical modeling of nanoscale systems: analytical and numerical solutions to differential equations and linear algebra methods.

NAN 618 Lab Protocols and Practice 3
Initial research experience for all incoming Nanoscience Ph.D. students. The goal of this course is to provide training in laboratory safety, basic laboratory techniques, oral and written communication, and review and criticism of scientific literature.

NAN 619 Science Communications 3
Seminar-style course that instructs the Nanoscience student in methods for critiquing scientific literature, methods for writing and organizing scientific proposals, and written and oral techniques for defending one's work.

NAN 620 Immunology 3
A study of the molecular and cellular basis of the immune system. Topics include the properties of antigens and immunoglobulins, the development and regulation of humoral and cell-mediated immunity, resistance and immunization to infectious diseases, allergies, and autoimmune and immunodeficiency disorders.
Prerequisites: UNCG graduate student in sciences.

NAN 621 Professional Development Seminar I 1
Workplace issues including ethics, confidentiality, writing and presentation skills, innovation, entrepreneurship, and emerging issues in nanotechnology.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 622 Professional Development Seminar II 1
Workplace issues including business plans, globalization, emerging issues in nanotechnology, and further development of writing and presentation skills, innovation, and entrepreneurship.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 623 Optical Microscopy for Nanoscience 4
This course presents the fundamental principles underlying modern optical microscopy in the context of nanoscience and the demonstrated application and practice of advanced optical microscopy techniques in the context of laboratory experiences.
Prerequisites: NAN 604 for Nanosicence students or permission of instructor for students in other programs.
Notes: Registration restricted to science majors (Nanoscience, Chemistry, Biology, Nutrition, or related majors).

NAN 624 Particle Beam Microscopy for Nanoscience 4
This course presents the fundamental principles underlying modern particle beam microscopy in the context of nanoscience and the demonstrated application and practice of advanced particle beam microscopy techniques in the context of laboratory experiences.
Prerequisites: NAN 604 or permission of instructor.

NAN 625 Molecular Biology in Nanosciences 3
A lecture and laboratory course introducing graduate level science students to the principles and practices of molecular biology with emphasis on its application and integration with nanoscience.
Prerequisites: Graduate students in nanoscience or other program with permission of instructor. Must have taken Basic Biology (Biology 111-112) and chemistry classes (Chem 111-115) or equivalent.

NAN 626 Introduction to Stem Cell Biology and Ethics 3
Fundamental issues, experimental approaches, and emerging areas in stem cell research accompanied by an understanding of the attendant ethical issues that arise from their use in healthcare applications.
Prerequisites: UNCG graduate student in sciences.

NAN 630 Advances in Nano-Biosensors 3
Interdisciplinary cutting-edge advances in biosensors with nano-perspectives; specific emphasis on fundamentals, principles and progresses of various types of nanobiosensors, and applications in disease diagnosis, biomedicines, life science and environmental monitoring.
Prerequisites: NAN 601, NAN 602, NAN 603, or equivalent courses.
Corequisites: Graduate students at UNCG or JSNN or permission of instructors.

NAN 634 Robust Equipment and Process Control Techniques 3
This course covers methods that enable proper and efficient instrument operation. Topics include calibration, process development, emerging technologies, and troubleshooting. The goal of the class is to reinforce the connection between data collection strategies and data analysis.
Prerequisites: Permission of the instructor.

NAN 635 Nanomechanics 3
Nanomechanics will address practical and theoretical topics regarding how forces arise and are measured at the nanoscale, and how they drive emergent behaviors in chemistry, biology, and materials science.
Prerequisites: NAN 605 or equivalent graduate-level mathematics.

NAN 640 The Science and Engineering of Thin Films 3
This course will discuss the science and engineering aspects of the most commonly used thin film formation techniques and their applications in research and technology.

NAN 641 SemiSynBio, Advanced Materials, and Beyond 3
Overview of nanoelectronics trends, an introduction into the emerging synthetic biology and advanced functional nanomaterials technology landscapes, applies critical thinking skills to uncover technology gaps and assess potential pathfinding opportunities, and exercises technical written and oral communication skills.
Prerequisites: Permission of the instructor.

NAN 642 Breakthrough Convergence in Research and Development 3
This course examines the roles of pathfinding, convergence, divergence, and diversity on research, translation, and society. Students apply and exercise written and oral communication and critical thinking skills to concurrently assess and prioritize convergent research strategies, translational opportunities, and the societal and ethical implications emerging technologies.
Prerequisites: Permission of the instructor.

NAN 650 Emerging Infectious Diseases and Biosafety Level-3 Laboratory Training 1
This introductory course introduces students to the basic biology of emerging infectious disease, immunological mechanisms of pathogenesis, and vaccine development. Students will be taught differences in BSL levels focusing on BSL-3 laboratory operation. The course is intended for anyone who seeks a basic understanding of infectious disease and BSL-3 facilities.
Prerequisites: A basic biology class or permission of instructor.

NAN 655 Biomimetics and Biomaterials 3
Emphasizes the biomimetic and biological materials development and characterization. Topics range from natural to synthetic biomaterials, characterization of biomaterial properties, and discovery and application of novel biologically inspired materials.

NAN 676 Current Topics in Nanoscience 3
Seminar dealing with topics that include advances in nanoscience and corollary fields such as synthetic biology, materials science, nanomaterials, and nanotechnology.
Prerequisites: Graduate study in Nanoscience or another STEM field.

NAN 692 Directed Studies in Nanoscience 1-4
This course gives students flexibility in guided readings, research, and individual project work under direction of a staff member that compliments their graduate project related to nanoscience.
Prerequisites: Permission of the Director of Graduate Study in Nanoscience and the professor who will supervise the study.
Notes: Repeatable up to 4 credits.

NAN 698 Capstone Experience 3
Students will engage in an independent project designed to synthesize their academic experience into a practice that explores the impact of nanotechnology in a variety of potential settings. Potential projects include internships with a local industrial partner or working with JSNN staff/faculty members.
Prerequisites: Graduate student in Nanoscience or permission of instructor.
Notes: Grading method is Satisfactory/Unsatisfactory (S/U).

NAN 699 Thesis 1-6

NAN 700 Principles of Nanoscience I: Physical, Chemical, and Biological Foundations 3
Covers the fundamental concepts in chemistry, biology and physics that are central to the interdisciplinary field of Nanoscience. Topics covered in this course include concepts in statistical mechanics (thermal, entropic, quantum, and fluctuation effects), self-assembly, diffusion, molecular recognition, molecular nanotechnology and nanomaterials, intermolecular and surface/interfacial forces at the nanoscale, cell adhesion and recognition, quantum phenomena, polymer physics, near-field optics, and nanoscale metrology, microscopy, and imaging.

NAN 705 Macromolecular and Supramolecular Chemistry 3
This course provides the fundamental concepts of macromolecular and supramolecular chemistry, self-assembly methodologies for supramolecular architectures, synthesis of hybrid nanomaterials and their applications in nanoscience and nanoengineering.
Prerequisites: Nanochemistry (NAN 601) or Advanced Organic Chemistry course (CHE 553) or equivalent.

NAN 706 Principles of Nanoscience II: Analytical, Statistical, and Computational Foundations 3
Covers the application and theory of different mathematical techniques that enable the statistical analysis of data, modeling of complex systems, and the proper application of mathematical operations to describing nanoscale problems and mechanisms. Topics covered may include but are not limited to, descriptive statistics, practical algorithms for statistical analysis, and mathematical modeling of nanoscale systems: analytical and numerical solutions to differential equations and linear algebra methods.

NAN 707 Lab Protocols and Practice 3
Initial research experience for all incoming Nanoscience Ph.D. students. The goal of this course is to provide training in laboratory safety, basic laboratory techniques, oral and written communication, and review and criticism of scientific literature.

NAN 708 Science Communications 3
Seminar-style course that instructs the Nanoscience student in methods for critiquing scientific literature, methods for writing and organizing scientific proposals, and written and oral techniques for defending one's work.

NAN 710 Scientific Integrity 1
Explores contemporary issues related to scientific integrity and responsible conduct in research. Case-driven topics expose students to the issues that arise in scientific research and ways to handle these issues.
Prerequisites: Student at UNCG or JSNN or Permission of Instructor.

NAN 727 Principles of Quantum and Solid State Physics 3
Emphasis on the areas of physics critical to nanoscience including solid state physics, statistical mechanics, quantum concepts, biophysics, chemical physics, and nanodevices based on semiconductors.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 728 Nanotechniques 3
Fundamental techniques used in nanotechnology, including methods for nanofabrication, nanocharacterization, and nanomanipulation.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 729 Mathematical Methods in Modeling Complex Systems 3
An emphasis of this required course will be on the areas of mathematics critical to nanoscience and nanoengineering including application of differential equations to numerical and analytical modeling of nanostructures.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 731 Systems and Synthetic Biology 3
Systems and synthetic biology will address quantitative and computational approaches to the analysis and re-design of biological and biologically-inspired molecular systems for useful biotechnological or translational applications.

NAN 732 Nanomaterials Chemistry 3
Review of materials chemistry, synthesis of nanoparticles such as carbon nanotubes and fullerenes, chemical reactions and a survey of medicinal chemistry for pharmaceutical applications.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 733 Physical Biology 3
Emphasis on cellular and intracellular mechanisms including biological self-assembly, single-molecule and single-cell biophysics, cytoskeletal interactions, protein folding, membrane dynamics, biological energetics, molecular biotechnologies, and cell-cell interactions as well as biomaterials.
Prerequisites: Graduate student in Nanoscience or permission of instructor.

NAN 734 Robust Equipment and Process Control Techniques 3
This course covers methods that enable proper and efficient instrument operation. Topics include calibration, process development, emerging technologies, and troubleshooting. The goal of the class is to reinforce the connection between data collection strategies and data analysis.
Prerequisites: Permission of the instructor.

NAN 740 Nonlinear Waves in Biological Excitable Media 3
Dynamics of reaction-diffusion waves and implementation of theoretical methods to the analysis of these waves in cardiac muscle and nerves.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 741 SemiSynBio, Advanced Materials, and Beyond 3
Overview of nanoelectronics trends, an introduction into the emerging synthetic biology and advanced functional nanomaterials technology landscapes, applies critical thinking skills to uncover technology gaps and assess potential pathfinding opportunities, and exercises technical written and oral communication skills.
Prerequisites: Permission of instructor.

NAN 742 Breakthrough Convergence in Research and Development 3
This course examines the roles of pathfinding, convergence, divergence, and diversity on research, translation, and society. Students apply and exercise written and oral communication and critical thinking skills to concurrently assess and prioritize convergent research strategies, translational opportunities, and the societal and ethical implications emerging technologies.
Prerequisites: Permission of the instructor.

NAN 743 Optical Microscopy for Nanoscience 4
This course presents the fundamental principles underlying modern optical microscopy in the context of nanoscience and the demonstrated application and practice of advanced optical microscopy techniques in the context of laboratory experiences.
Prerequisites: NAN 728 for Nanosicence students or permission of instructor for students in other programs.
Notes: Registration restricted to science majors (Nanoscience, Chemistry, Biology, Nutrition, or related majors).

NAN 744 Particle Beam Microscopy for Nanoscience 4
This course presents the fundamental principles underlying modern particle beam microscopy in the context of nanoscience and the demonstrated application and practice of advanced particle beam microscopy techniques in the context of laboratory experiences.
Prerequisites: NAN 728 or permission of instructor.

NAN 745 NanoImaging 3
Use of nanoparticles for in vivo diagnostic medical imaging and therapy.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 746 Nanosafety 3
An interdisciplinary course utilizing variety of academic disciplines (chemistry, physics, biology). Addresses the impact of nanomaterials through the range of organization that exists within living systems (molecular to societal).

NAN 748 Macromolecular and Supramolecular Chemistry 3
This course provides the fundamental concepts of macromolecular and supramolecular chemistry, self-assembly methodologies for supramolecular architectures, synthesis of hybrid nanomaterials and their applications in nanoscience and nanoengineering.
Prerequisites: Nanochemistry (NAN 732) or Advanced Organic Chemistry course (CHE 705) or equivalent.

NAN 749 Spectroscopy Methods in Nanoscience 3
Introduction to spectroscopy methods that, widely used in physics, chemistry, and biological sciences, provide knowledge for estimating applicability ranges of various methods, and teach basics of spectroscopy instruments and data analysis.

NAN 750 Nanomedicine 3
General underlying mechanisms leading to inflammation, infectious disease, cancer, and autoimmune disease and the potential nanotechnology has on diagnosing, preventing, and treating these diseases.
Prerequisites: Graduate student in nanoscience or permission of instructor. Basic biology.

NAN 750X Experimental Course 1-6
This number reserved for experimental courses. Refer to the Course Schedule for current offerings.

NAN 752 Molecular Biology in Nanosciences 3
A lecture and laboratory course introducing graduate level science students to the principles and practices of molecular biology with emphasis on its application and integration with nanoscience.
Prerequisites: Graduate students in Nanoscience or other program with permission of instructor. must have taken basic biology (BIO 111-112) and chemistry classes (CHE 111-115) or equivalent.

NAN 753 Introduction to Stem Cell Biology and Ethics 3
Fundamental issues, experimental approaches, and emerging areas in stem cell research accompanied by an understanding of the attendant ethical issues that arise from their use in healthcare applications.
Prerequisites: Graduate student in sciences.

NAN 754 Immunology 3
A study of the molecular and cellular basis of the immune system. Topics include the properties of antigens and immunoglobulins, the development and regulation of humoral and cell-mediated immunity, resistance and immunization to infectious diseases, allergies, and autoimmune and immunodeficiency disorders.
Prerequisites: Graduate student in sciences.

NAN 755 Biomimetics and Biomaterials 3
Emphasizes the biomimetic and biological materials development and characterization. Topics range from natural to synthetic biomaterials, characterization of biomaterial properties, and discovery and application of novel biologically inspired materials.

NAN 756 The Science and Engineering of Thin Films 3
This course will discuss the science and engineering aspects of the most commonly used thin film formation techniques and their applications in research and technology.

NAN 757 Nanomechanics 3
Nanomechanics will address practical and theoretical topics regarding how forces arise and are measured at the nanoscale, and how they drive emergent behaviors in chemistry, biology, and materials science.
Prerequisites: NAN 729 or equivalent graduate-level mathematics course.

NAN 758 Advances in Nano-Biosensors 3
Interdisciplinary cutting-edge advances in biosensors with nano-perspectives. Specific emphasis on fundamentals, principles and progresses of various types of nanobiosensors, and applications in disease diagnosis, biomedicines, life science and environmental monitoring.
Prerequisites: NAN 727, NAN 732, NAN 733, or equivalent courses.
Corequisites: Graduate students at UNCG or JSNN or permission of instructors.

NAN 760 Applied Nanoscience 3
Provides a translational perspective to nanoscience study and research. Introduces students to the various applications of nanoscience in their daily lives while emphasizing the fundamental properties of nanomaterials that enable these applications. Introduces them to industries with job opportunities for their skill set.

NAN 762 Nanoscale Reactions 3
A comprehensive introduction to principles, mechanisms and applications of homo-and heterogeneous chemical or physic-reactions from nano-scale perspective incorporating recent research activities from selected peer-reviewed articles.
Prerequisites: NAN 727, NAN 732, NAN 733 or equivalent courses. graduate student at UNCG or JSNN or permission of instructors;
Notes: Registration restricted to Nanoscience, Chemistry, Biology and Physics graduate students.

NAN 764 Materials, Syntheses, and Processes by Design 3
Protocols for developing structure-property correlations, stable instrumentation, efficient nanomaterial experimentation, and concurrent hypothesis testing that facilitate structural and mechanistic insight into the properties of relevant nanochemical and nanobiological systems.

NAN 771 Computational Quantum Nanochemistry 3
Fundamentals of computational quantum mechanics and related computational methods applicable to nanoscience. Includes hands-on computer exercises.
Prerequisites: Graduate student in nanoscience or permission of instructor.

NAN 772 Nanomachines and Micromachines 3
Introduces natural and artificial nanomachines and micromachines with an emphasis on their structure and design, mechanisms of operation, and function.

NAN 776 Current Topics in Nanoscience 3
Seminar dealing with topics that include advances in nanoscience and corollary fields such as synthetic biology, materials science, nanomaterials, and nanotechnology.
Prerequisites: Graduate study in Nanoscience or another STEM field.

NAN 790 Doctoral Research 3
Research course for second year Nanoscience students to engage in independent research to collect the preliminary data that will be necessary for preparing their proposal document.

NAN 799 Nanoscience Dissertation Research 1-12
Student will carry out original research in nanoscience with the guidance of bis/her faculty advisor and committee as part of the Ph.D. in Nanoscience degree program.

NAN 801 Thesis Extension 1-3
Thesis Extension.

NAN 802 Dissertation Extension 1-3
Dissertation Extension.

NAN 803 Research Extension 1-3
Research Extension.