School of Engineering and Physical Sciences
Department of Mathematics and Physics

Course Name	Introduction to Nanotechnology
Course Code	PHY 380
Course Credit Hours	03
Prerequisite	PHY 250
Course Objective	The objective of this course is to introduce the basic physics related to nanoscale materials, as well as their fabrication and state-of-the-art characterization tools and techniques.
Course Description	Students become familiar with fundamental physics related to nanoscale materials and systems. Students learn about fabrication of nanomaterials using top-down and bottom-up techniques. They also learn about theoretical aspects of different tools and techniques used for nanoscale material characterization such as electron microscopy, probe microscopy, and spectroscopy. Students also become familiar with the application of nanomaterials to a wide range of disciplines, spanning from solar cells to drug delivery.
Method(s) of Instruction(s)	Interactive lectures, simulations

COURSE CONTENT BY TOPIC

Module #1	**Basic Solid State Physics and Quantum Mechanics:** Atomic Structures, Crystals, Crystal Structures, Miller Indices, Schrödinger's Equation, Particle in a Two Dimensional System, Linear Harmonic Oscillator, Bohr Exciton Radius, Band Gap, Quantum Size Effect
Module #2	**Energy at the Nanoscale:** Surface Energy, Surface Stabilization, Capillarity, Pair Potential, Surface Energy of Low – Index Crystals, Surface Energy of Nanoparticles, Surface Energy Minimization Mechanism
Module #3	**Nano Scale Materials :** Clusters, Particles, Wires, Films, Coatings, Porous Materials, Carbon Fullerenes and Nanotubes, Nanomaterials in Nature
Module #4	**Fabrication Methods:** Top-Down Methods: Mechanical, Thermal, High Energy, Chemical Fabrication, Lithographic Methods; Bottom-Up Methods: Gaseous Phase, Liquid Phase, Template Assisted Growth
Module #5	**Characterization Techniques:** Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy, Spectroscopic Methods
Module #6	**Application of Nanotechnology:** Single Nanoparticle Devices, Targeted Drug Delivery, Quantum Dot Solar Cells, Nanocatalyst, Biomimetics, Nanocomposite, Nanosensors and Related Applications
Actual contact hours: Lecture: 3 hours per week; 36 hours per semester	

TEXTBOOK REQUIREMENT

1. Introduction to Nanoscience and Nanotechnology, Chris Binns
2. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, Harry F. Tibbals, Joydeep Dutta, John J. Moore

ASSESSMENT STRATEGY AND GRADING SCHEME

NSU's grading and performance evaluation policies will be followed in assigning your grade. Please note that all final grades are subject to departmental review and approval. A guideline of course assessment is as follows-

Class Attendance	Quiz	Assignments/Projects	Midterm	Final
5%	15%	15%	30%	35%

MAPPING OF COURSE OUTCOMES

CLO-#	Outcome Types	Bloom's Taxonomy level (C- Cognitive, A- Affective, P- Psychomotor)	Delivery Method	Assessment Tools	
CLO #1	Describe materials and their properties at the atomic and nanometer level.	C2, P2	Lecture and discussion	Quiz	Midterm Exam
CLO #2	Classify nanomaterials based on dimensionality, and explain the effect of surface to volume ratio with reducing size.	C2, C4	Lecture and discussion	Quiz	
CLO #3	Explain the effect of the reduction in dimensionality and its relationship to material properties.	C2, P3	Lecture and discussion	Quiz	
CLO #4	Explain the top down and bottom up approaches for nanomaterial fabrication.	C2, P3	Lecture and discussion	Quiz	Final Exam
CLO #5	Analyze the tools and techniques used for nanomaterial characterization.	C4, P3	Lecture and discussion	Quiz	
CLO #6	Apply the key concepts in physics, chemistry, biology, and engineering to the field of nanotechnology.	C3, P4	Lecture and discussion	Projects and Final Exam	