



Alabama A&M University
School of Arts and
Sciences



**“Significant Programs of Study in
Nanoscale Sciences”**

**Faculty Professional Development Workshop
Alabama A&M University
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Alabama A&M University

*School of Arts and
Sciences*

**V. M. Chambers Hall
Chemistry and Physics
Building**





Topics of Discussion

1. Relevant Questions
2. Components of Programs
3. Ph.D's nanoscale programs
4. Master's degree nanoscale programs
5. Graduate certificate nanoscale programs
6. Bachelor degree nanoscale programs
7. Associate degree nanoscale programs
8. Nanoscale course infusion at Alabama A&M University
9. Nanoscale in Solid State Physics (PHY 451) at Alabama A&M University
10. International nanoscale programs





Relevant Questions

- What are the ingredients of excellent programs in nanoscale science or engineering?
 - a. A.A.S. Programs/Minor Programs/Concentrations
 - b. Bachelor programs
 - c. Master's programs/Graduate Certificates
 - d. Ph.D. programs
- What initiatives could existing programs implement to:
 - a. expand course offering?
 - b. increase student learning outcomes?
 - c. more easily assimilate nanoscale content materials?
- What are the techniques for course infusion?





Components of Programs

Components of Programs

1. U. S. A.'s Ph.D. Programs - 15 general discipline hours + 33 area of concentration hours + 12 dissertation hours = 60 credit hours.
2. U. S. A.'s Master Degree Program- 12 general discipline hours + 12 area of concentration hours + 6 thesis = 30 credit hours.
3. Certificate Program - less credits or courses than the master's program, with no thesis.





Components of Programs Continued

4. U. S. A.'s Bachelor Programs - 45 general education hours + 20 discipline support hours + 45 general discipline hours + 18 discipline concentration hours = 128 credit hours.
5. A.A.S. Associate Programs – two years degree programs.
6. Concentration or Option Programs – Are programs provided within a department for its own majors, requiring ~ 18 credit hours.
7. Minor Program – A program within a department that's provided for majors in other departments, requiring ~ 15-18 credit hours.





Ph.D. Programs

Illustrated Programs

- 1. Ph. D. in Science and Engineering with Concentration in Nanophotonics (with 2-year NSF IGERT Fellowship)
 - Rice University, Houston, TX
 - Sampling of Courses:
 - Quantum Mechanics
 - Introduction to Solid State Physics
 - Computational Electrodynamics/Nanophotonics & Nanophotonics CAD Studio
 - Systems Physiology





Ph.D. Programs Continued

2. Ph.D. in Nanoscience and Microsystems

- University of New Mexico, NM
- The Nanoscience and Microsystems Program highlights three technical thrusts: Information Nanotechnology, Nano-Bio Interfaces and Complex Functional Materials.
 - Sampling of Courses:
 - Chemistry & Physics at the Nanoscale
 - Characterization Methods for Nanostructures
 - Synthesis of Nanostructures
 - MEMS Transducer Devices and Technology
 - Societal and Ethical Implications of Nanotechnology





Ph.D. Programs Continued

3. Ph.D. in Materials and Nanotechnology

- North Dakota State University, ND

- DESCRIPTION:

- the core curriculum which consists of:
 - Electronic Properties of Materials
 - Materials Characterization
- Materials Synthesis and Processing
- Fundamentals of Nanotechnology
- Molecular Modeling of Materials
- Preparing Future Researchers
 - Graduate Seminar





4. Ph.D. with Interdisciplinary Graduate Training Program in Nanotechnology for Biology and Medicine (NBMed)

- Johns Hopkins University, MD
 - Required Core Courses:
 - Advance Cell Biology
- Fundamental Physics and Chemistry of Nanomaterials
 - Nano-Bio Laboratory





Ph.D. Programs Continued

5. Ph.D. program in Nanomedicine Science and
Technology

- Northeastern University, Boston, MA
- Key Components of the IGERT PhD Program:
 - * Interdisciplinary Research and Training
 - * Nanomedicine based curriculum
 - * Participation in graduate internship
 - * International opportunities
 - * Stipend of 30K per year for two years





Alabama A&M University



Master's Degree Programs

Rice University

Professional Masters Degree in nanoscale physics with concepts in:

- a. carbon nanotubes
- b. nanoshells
- c. nanobiology
- d. nanostructures
- e. nanotechnology
- f. nanooptics
- g. nanophotonics
- h. characterization
- i. fabrication





Graduate Certificate Programs

1. George Mason University

- Composed of five courses (15 credit hours) focusing on two key areas of knowledge: (1) nanomaterials and nanostructures and their relation to bulk materials, and (2) methods for characterization and production of nanomaterials.
- Graduates will be well prepared to fill the demand for personnel with nanoscience training who can serve as process controllers in area fabrication facilities, and/or participate as members of interdisciplinary science teams.

2. Duke University

Requires: (1) satisfying a set of course requirements; (2) completion of an approved project in association with a research group; and, (3) involvement in the seminar series in Nanoscience.





Bachelor Programs

Illustrated Programs

- 1. B.S. in Physics, with Concentration in Nanoscale Physics
- Northwestern University, Evanston, IL.
- Sampling of Courses:
 - Nanolithography
 - Superconductivity
 - Nanomaterials
 - Applications of Surface Science to Nanomechanics and Nanotribology
 - Introduction to Microelectromechanical Systems
 - Experiments in Micro- and Nanoscience Engineering





Bachelor Programs Continued

2. B.S. in Science and Engineering with Electives in Nanotechnology
 - California Polytechnic State University, CA
 - Sampling of Courses:
 - Thermal Physics
 - Solid State Physics
 - Nanotechnology, Biology, Ethics and Society
 - Micro Systems Design & Manufacturing
 - Materials Characterization
 - Surface Chemistry of Material





A.A.S. Degree Programs

1. Dakota County Technical College, MN
 - 2-year A.A.S. Degree in Nanoscience Technology
 - The program offers an A.A.S. 72 credit degree of which 39 credits are nano-specific courses. Sampling of Courses:
 - Fundamentals of Nanoscience
 - Computer Simulation
 - Nanobiotech/Agriculture
 - Nanomaterials
 - Nanoelectronics
 - Introduction to Materials Characterization
 - Elements of Micro- & Nanoelectronics Manufacturing





A.A.S. Degree Programs Continued

2. North Seattle Community College, WA

The program offers an A.A.S.-T. 100 credit degree of which 30 credits are nano-specific courses.

- Sampling of Courses:
 - Introduction to Nanotechnology
 - Laboratory Procedures and Quality Control
 - Nano Device Fabrication and Testing
 - Materials Deposition and Characterization
 - Nanotechnology Lab Practicum
 - Physics, Chemistry, Biology





Nanoscale course Infusion and New courses at Alabama A&M University

Courses having Infusion at Alabama A&M University

- Introduction to Solid State Physics Phy 451
- Quantum Mechanics Phy 421 and 521
- Electrooptics Phy 663
- Physical Sciences Phy 101 and 102
- Che 101, 102 and 402
- Bio 101, 102 and 330

- New courses Development
- Nanotechnology Phy 450
- Biophotonics Phy 650





Introduction to Solid State Physics
Phy 451

Infused nanoscale concepts for Phy 451:

- 1. Imaging Techniques for nanostructures
 - a. Electron microscopy
 - b. atomic force microscopy
- 2. Electronic structure of 2D, 1D and 0D systems
 - a. one-dimensional subband
 - b. metallic quantum dots - spherical potential well
- 3. Electrical transport in 2D, 1D and 0D systems
- 4. Vibrational and thermal properties





International Programs

Illustrated Programs

1. University of Wollongong of New South offers a three-year coursework interdisciplinary Bachelor Science degree in Nanotechnology, with nano courses:
 - a. Nano 101 Current Perspectives in Nanotechnology 6 credit point
 - b. Nano 201 Research Topics in Nanotechnology
 - c. Nano 301 Research Project in Nanomaterials
2. Sejong University of Seoul, the Republic of Korea having in-depth courses in Nanotechnology
 - a. Nanoelectronic devices and systems
 - b. Nanomaterials
 - c. Nanofabrication





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