

**ADD, CHANGE OR DELETE UNIT, PROGRAM REQUIREMENTS, OR ACADEMIC POLICIES**

Complete this form consistent with the instructions in Academic Policy 1622.20. Use the form to add, change, or delete a program or unit or to change program policies. Proposed additions and changes must be consistent with Academic Policies 1100.40 and 1621.10 and any other policies which apply.

**SECTION I: Approvals**

Department / Program Chair _____	Date Submitted _____	Graduate Council Chair _____	Date _____
College Dean _____	Date _____	Faculty Senate Chair _____	Date _____
Honors College Dean _____	Date _____	Provost _____	Date _____
Core Curriculum Committee _____	Date _____	Board of Trustees Approval/Notification Date _____	
University Course and Programs Committee _____	Date _____	Arkansas Higher Education Coordinating Board Approval/Notification Date _____	

**SECTION II: Profile Data - Required Information and Name Change Information**

Academic Unit:     Major/Field of Study     Minor     Other Unit \_\_\_\_\_  Policy

Level:             Undergraduate     Graduate     Law    Effective Catalog Year 2013

Program changes are effective with the next available catalog. See Academic Policy Series 1622.20

Current Name \_\_\_\_\_

College, School, Division GRAD

Department Code GRAD

Current Code (6 digit Alpha) \_\_\_\_\_

Proposed Code (6 digit Alpha) NANO-M  
Prior approval from the Office of the Registrar is required.

Interdisciplinary Program

CIP Code 14.1801  
Prior assignment from Office of Institutional Research is required.

Proposed Name Nanotechnology Minor

When a program name is changed, enrollment of current students reflects the new name.

**SECTION III: Add a New Program/Unit**

For new program proposals, complete Sections II and VII and use as a cover sheet for a full program proposal as described in 'Criteria and Procedures for Preparing Proposals for New Programs in Arkansas.' ADHE  
[http://www.adhe.edu/divisions/academicaffairs/Pages/aa\\_academicproposals.aspx](http://www.adhe.edu/divisions/academicaffairs/Pages/aa_academicproposals.aspx)

Program proposal uses courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_

**SECTION IV: Eliminate an Existing Program/Unit**

Code/Name \_\_\_\_\_ Effective Catalog Year \_\_\_\_\_

No new students admitted to program after Term: \_\_\_\_ Year: \_\_\_\_\_

Allow students in program to complete under this program until Term: \_\_\_\_ Year: \_\_\_\_\_

**SECTION V: Proposed Changes to an Existing Program or Program Policies**

Insert here a statement of the exact changes to be made: \_\_\_\_\_

Check if either of these boxes apply and provide the necessary signature:

- Program change proposal adds courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_
- Program change proposal deletes courses offered by another academic college, and that college dean's office has been notified. The signature of the dean of that academic college is required here: \_\_\_\_\_

Check all the boxes that apply and complete the required sections of the form:

- Change of Name and Code (Complete only sections I, II, V and VII.)
- Change Course Requirements: (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change Delivery Site/Method (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change Total Hours (Complete all sections of the form except "Proposed Name" in II, section III, and section IV.)
- Change in Program Policies

## **SECTION VI: Justification**

*Justify this change and state its likely effect on any other degree program (including those outside the school or college). Identify any program or program components (other than courses) to be eliminated if this program is implemented. (Program and course change forms must also be submitted for such related changes.)*

**Nanotechnology is a rapidly developing interdisciplinary field that holds great promise for new applications in a wide range of industries that have large societal impact, including consumer goods, electronics, computers, energy, biotechnology, and medicine. It is projected that 2 million workers are needed in nanotechnology-based businesses by 2020 in the United States alone. This field is expected to continue to grow and increasingly in need of trained scientists and engineers. While there are strong research and education activities and courses at the graduate level at the University of Arkansas (UA), most UA undergraduate students never experience any formal classroom education in nanotechnology. We proposed to establish an interdisciplinary minor program of undergraduate study in nanotechnology that will help participating students prepare for a career in this emerging growing field.**

**This Nanotechnology Minor Program is built upon the considerable existing level of faculty interest, expertise, and facilities in nanoscience and engineering within the College of Engineering (COE), the J. William Fulbright College of Arts and Sciences (CAS), and the Institute for Nanoscience and Engineering (INSE). Initial funding of \$200K from the National Science Foundation (NSF) Nanotechnology Undergraduate Education (NUE) in Engineering Program served as a catalyst for preparing for establishing this new minor program and an additional \$25K was obtained from UA Honors College to supplement the cost of developing an interdisciplinary Nanotechnology Laboratory course as a required course for this minor program.**

**Nanotechnology involves a broad field of study with a number of different major directions, such as synthesis of nanomaterials, fabrication and integration of nanostructures for device and sensing applications, utilization of novel optical, electrical, and mechanical properties for a wide range of application, and integration of bio/abio systems. Nanotechnology Minor is an interdisciplinary program that is designed to provide students with foundational knowledge and skills related to the emerging field of nanotechnology, including hands-on experience in several major areas of nanotechnology, such as synthesis of nanomaterials, nanoscale imaging, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Nanotechnology Minor curriculum provides students with a coherent field of study that not only covers the basic skills in nanotechnology, but also emphasizes different areas of interest of students from participating departments. We have assembled model programs for students from each participating department.**

## **SECTION VII: Catalog Text and Format**

*In the box below, insert the current catalog text which is to be changed, with changes highlighted with the color yellow. Include all proposed changes identified in Section V. Only changes explicitly stated in Section V will be considered for approval by the University Course and Programs Committee, the Graduate Council and the Faculty Senate. If you are proposing a new program, give proposed text with all of the elements listed below. If you are proposing modified text, include these elements as appropriate.*

**Include the following elements, in order, in the catalog text for proposed undergraduate program(s) or program changes:**

- State complete major/program name
- Briefly define or describe the major/program or discipline.
- Identify typical career goals or paths for graduates. (Optional)
- State admission requirements (if any) for entry or entry into upper/advanced level of major/program.
- Identify location in catalog of university, college/school, and department/program requirements which the student must meet in addition to hours in the major, but do not restate these requirements.
- State course requirements in the major and any allied areas, giving number of hours and specific courses; specify electives or elective areas and give numbers of hours and courses in elective pools or categories; identify any other course requirements.

- State any other requirements (required GPA, internship, exit exam, project, thesis, etc.).
- Identify name and requirements for each concentration (if any).
- Specify whether a minor or other program component is allowed or required and provide details.
- State eight-semester plan requirements

**For minors, state requirements in terms of hours, required courses, electives, etc.**

**For graduate program/units, include elements (as needed) parallel to those listed for undergraduate programs above.**

**For Law School program/units, prepare text consistent with current catalog style.**

**For centers, prepare text consistent with current catalog style.**

**The following information is to be entered under the Interdisciplinary Studies in the Undergraduate Catalog of Studies.**

## **MISSION AND OBJECTIVES**

The University provides several options for students to pursue education more broadly than one field of undergraduate study might allow, including interdisciplinary and multidisciplinary programs. These programs allow broader instruction and research opportunities, especially in emerging fields that haven't reached the academic breadth to constitute a full academic department or in cases in which collaboration between one or more departments allows faculty from each existing department to contribute to the interdisciplinary or multidisciplinary major. In the Catalog of Studies, requirements for each interdisciplinary program are listed in the chapter of the college or school that oversees the program.

Three ~~Two~~ interdisciplinary minors — Microelectronics-Photonics, Nanotechnology, and Sustainability — are not administered by an academic department. The minors in Microelectronics-Photonics and Nanotechnology are administered by the Division of Interdisciplinary Studies in the Graduate School. The minor in Sustainability is administered by the Provost's Office. The requirements for completing each minor are listed below.

### **Nanotechnology Minor (NANO-M)**

Gregory Salamo  
Director  
205 NANO  
479-575-5931  
salamo@uark.edu

Min Zou  
Co-Director  
212 NANO  
479-575-6671  
mzou@uark.edu

nano@uark.edu  
<http://nano.uark.edu>

### **Nanotechnology Minor Faculty Coordinators and Curriculum Committee**

- Distinguished Professor Gregory Salamo, director, Physics
- Associate Professor Min Zou, co-director, Mechanical Engineering
- Professor Jin-Woo Kim, Biological and Agricultural Engineering
- Assistant Professor David Zaharoff, Biomedical Engineering
- Associate Professor Donald Keith Roper, Chemical Engineering
- Professor Gregory J. Thoma, Chemical Engineering
- Assistant Professor Jingyi Chen, Chemistry & Biochemistry
- Assistant Professor Shui-Qing (Fisher) Yu, Electrical Engineering
- Associate Professor Chao-Hung S. Tung, Mechanical Engineering
- Associate Professor Po-Hao Adam Huang, Mechanical Engineering

Nanotechnology Minor is an interdisciplinary program that provides students with foundational knowledge and skills related to the emerging field of nanotechnology, including hands-on experience in several major areas of nanotechnology, such as synthesis of nanomaterials, nanoscale imaging, nanostructure assembly and manipulation, device and system integration, and performance evaluation. The Nanotechnology Minor draws faculty expertise and course work from the College of Engineering and the J. William Fulbright College of Arts and Sciences and utilizes the state-of-the-art equipment and facilities at the Institute for Nanoscience and Engineering. The Nanotechnology Minor is intended to prepare participating students for a career in in which nanotechnology is

playing an increasingly important role, and increase students' research competitiveness for graduate studies. The Nanotechnology Minor is designed to be accessible to students majoring in Engineering, Physics, or Chemistry & Biochemistry. It is open to all students who have the necessary prerequisites to enroll in the courses that constitute the minor.

### Requirements for the Nanotechnology Minor:

Students wishing to participate in the Nanotechnology Minor must declare participation formally. The students are required to meet with the faculty coordinator of individual department who will help the student to develop a list of courses suitable for the minor and a schedule for taking those courses. Examples of model programs for each participating department are given below.

Students need to take a total of 15 credit hours, which includes 6 credit hours of required courses and 9 credit hours of elective courses and must earn a grade of 'C' or better for all courses used to fulfill the requirements of the Nanotechnology Minor.

#### 6 hours of required courses:

(1) BENG 4753/BENG 4753H/BMEG 4103/BMEG 4103H/CHEM 4153/CHEM 4153H/MEEG 4323/MEEG 4323H/PHYS 4793/PHYS 4793H Nanotechnology Laboratory

(2) Nanotechnology Research (Independent Study or Honors Thesis in nanotechnology)

Students can choose one from the following listed courses to fulfill the Nanotechnology Research requirement:

- 1) BENG 450V Special Problems
- 2) BENG 451VH Honors Thesis
- 3) BMEG 450VH Honors Thesis
- 4) BMEG 460V Individual Study
- 5) CHEM 400V Chemistry Research
- 6) CHEM 498V Senior Thesis
- 7) CHEG 488V Special Problems – Nanotechnology Research
- 8) ELEG 488V Special Problems
- 9) ELEG 488VH Honors Special Problems
- 10) MEEG 492V Individual Studies
- 11) MEEG 4903H Honors Mechanical Engineering Research
- 12) PHYS 498V Senior Thesis
- 13) PHYS 306V Projects
- 14) PHYS 399VH Honors Physics Research

#### A minimum of 9 hours of elective courses selected from the following list:

- (1) BENG 3733 Transport Phenomena in Biological Systems
- (2) BENG 3743 Food and Bioproducts Systems Engineering
- (3) BENG 4103 or 4103H Measurement and Control for Biological Systems
- (4) BENG 4123 Biosensors & Bioinstrumentation
- (5) BMEG 3633 Biomaterials
- (6) BMEG 3823 Biomolecular Engineering
- (7) BMEG 4243 Advanced Biomaterials and Biocompatibility
- (8) CHEG 3713 Chemical Engineering Materials Technology
- (9) CHEG 5023 Nano Bio Photonics (will be a co-listed 4000 level course in the future)
- (10) CHEG 4043 Colloids and Surfaces (course number has been submitted to curriculum committee, but not formally approved at present)
- (11) CHEM 4123 Advanced Inorganic Chemistry
- (12) CHEM 4213 Instrumental Analysis
- (13) CHEM 4283 Energy Conversion and Storage
- (14) ELEG 4253 Nanotechnology
- (15) ELEG 4203 Semiconductor Devices
- (16) ELEG 4303 Introduction to Nanomaterials and Devices
- (17) ELEG 4213 MEMS and Microsensors
- (18) MEEG 491V Introduction to Micro and Nanosystems
- (19) MEEG 4313 Introduction to Tribology
- (20) MEEG 491V Intermediate Materials
- (21) MEEG 4303 Materials Laboratory
- (22) PHYS 3213 Electronics in Experimental Physics
- (23) PHYS 3614 Modern Physics
- (24) PHYS 4073 Introduction to Quantum Mechanics
- (25) PHYS 4213 Physics of Devices
- (26) PHYS 4713 Solid State Physics

(27) PHYS 4774 Introduction to Optical Properties of Materials

or from other appropriate courses not on this list if approved first by the Nanotechnology Minor Curriculum Committee and by the course instructor. Below are model programs for students from different participating department. Students also have the flexibility to design their own programs according to the stated requirements above. The prerequisites for most of the courses listed above can be found from the university catalogue of studies.

**Model program 1:** for a student with a major in Biological Engineering

6 hours of required courses:

- BENG 4753/BENG 4753H Nanotechnology Laboratory
- BENG 450V Special Problems or BENG451VH Honors Thesis

9 hours of elective courses:

- BENG 3743 Food and Bio-products Systems Engineering
- BENG 4103 or 4103H Measurement and Control for Biological Systems
- BENG 4123 Biosensors & Bioinstrumentation

**Model program 2:** for a student with a major in Biomedical Engineering

6 hours of required courses:

- BMEG 4103/BMEG 4103H Nanotechnology Laboratory
- BMEG 450VH Honors Thesis or BMEG 460V Individual Study

9 hours of elective courses:

- BMEG 3633 Biomaterials
- BMEG 3823 Biomolecular Engineering
- BMEG 4243 Advanced Biomaterials and Biocompatibility

**Model program 3:** for a student with a major in Chemical Engineering

6 hours of required courses:

- PHYS 4793/PHYS 4793H Nanotechnology Laboratory
- CHEG 488V Special Problems – Nanotechnology Research

9 hours of elective courses:

- CHEG 3713 Chemical Engineering Materials Technology
- CHEG 5023 Nano Bio Photonics (will be a co-listed 4000 level course in the future)
- CHEG 4043 Colloids and Surfaces

**Model program 4:** for a student with a major in Chemistry

6 hours of required courses:

- CHEM 4153/CHEM 4153H Nanotechnology Laboratory
- CHEM 400V Chemistry Research or CHEM 498V Senior Thesis

9 hours of elective courses:

- CHEM 4123 Advanced Inorganic Chemistry
- CHEM 4213 Instrumental Analysis
- CHEM 4283 Energy Conversion and Storage

**Model program 5:** for a student with a major in Electrical Engineering

6 hours of required courses:

- PHYS 4793/PHYS 4793H Nanotechnology Laboratory
- ELEG 488V Special Problems or ELEG488VH Honors Special Problems

9 hours of elective courses:

- ELEG 4253 Nanotechnology
- ELEG 4203 Semiconductor Devices
- ELEG 4303 Introduction to Nanomaterials and Devices

**Model program 6:** for a student with a major in Mechanical Engineering

6 hours of required courses:

- MEEG 4323/MEEG 4323H Nanotechnology Laboratory
- MEEG492V Individual Studies or MEEG4903H Honors Mechanical Engineering Research

9 hours of elective courses:

- MEEG 491V Introduction to Micro and Nanosystems
- MEEG 4313 Introduction to Tribology

MEEG 491V Intermediate Materials

**Model program 7:** for a student with a major in Physics

6 hours of required courses:

- PHYS 4793/PHYS 4793H Nanotechnology Laboratory
- PHYS 498V Senior Thesis or PHYS 399VH Honors Physics Research

9 hours of elective courses:

- PHYS 4073 Introduction to Quantum Mechanics
- PHYS 4713 Solid State Physics
- PHYS 4774 Introduction to Optical Properties of Materials

## SECTION VIII: Action Recorded by Registrar's Office

PROGRAM INVENTORY/DARS

PGRM \_\_\_\_\_ SUBJ \_\_\_\_\_ CIP \_\_\_\_\_ CRTS \_\_\_\_\_

DGRE \_\_\_\_\_ PGCT \_\_\_\_\_ OFFC&CRTY VALID \_\_\_\_\_

REPORTING CODES

PROG. DEF. \_\_\_\_\_ REQ. DEF. \_\_\_\_\_  
 Initials \_\_\_\_\_ Date \_\_\_\_\_

### Distribution

Notification to:

- (1) College (2) Department (3) Admissions (4) Institutional Research (5) Continuing Education (6) Graduate School  
 (7) Treasurer (8) Undergraduate Program Committee