



## Proposal to the Senate Educational Policy Committee

### PROPOSAL TITLE:

Establish a Graduate Concentration in “Cancer Nanotechnology” in the Department of Bioengineering, College of Engineering

### SPONSORS:

Rashid Bashir, Department Head, Bioengineering, Professor of Bioengineering and Electrical and Computer Engineering, 217-333-1867, [rbashir@illinois.edu](mailto:rbashir@illinois.edu), and

Rohit Bhargava, Professor of Bioengineering, 217-265-6596, [rxb@illinois.edu](mailto:rxb@illinois.edu).

### COLLEGE CONTACT:

William Buttlar, Associate Dean for Graduate and Professional Programs, College of Engineering, 217-333-5966, [buttlar@illinois.edu](mailto:buttlar@illinois.edu)

### BRIEF DESCRIPTION:

This proposal seeks the approval of a Cancer Nanotechnology Graduate Concentration to be offered through the Department of Bioengineering. The proposed Concentration requires students to complete a minimum of three courses for a total of 12 credit hours in topics integral to Cancer Nanotechnology (see Appendix A for requirements). Courses will be chosen from existing Illinois graduate courses in engineering, biology, and the sciences, to provide an interdisciplinary experience required for cutting edge research in cancer nanotechnology.

This concentration will be open to students in relevant disciplines within the College of Engineering (Bioengineering, Electrical and Computer Engineering, Materials Science and Engineering, and Mechanical Science and Engineering) with the hope of expanding to relevant disciplines outside the College of Engineering in the future (Biochemistry, Cell and Developmental Biology, Chemistry, etc.). The Concentration will be fully compatible with traditional degree requirements in the various home departments (see Appendix B for departmental approvals). Students are expected to have graduate standing in one of the participating departments.

## **JUSTIFICATION:**

The need for interdisciplinary solutions to complex problems, continuing advancements in computing and informatics, and shortages in the STEM (Science, Technology, Engineering, Mathematics) workforce at all levels, call for a new generation of scientists who are equipped to face these challenges. In response, we will create and evaluate an interdisciplinary concentration that provides a diverse array of graduate students with training in the integration of biological sciences with physical and applied sciences.

It is known that more than a 1.5 million people were diagnosed with cancer and half a million died of cancer in US alone during 2010 (Cancer Statistics 2010, ACS). In spite of a considerable effort, there has been limited success in reducing per capita deaths from cancer since 1950. This calls for a paradigm shift in the understanding, detection and intervention of the evolution of cancer from a single cell to tumor scale. A Cancer Nanotechnology Concentration would allow our graduate students to focus in an area that will address the challenge of understanding, managing, diagnosing, and treatment of cancer using the most recent advancements in nanotechnology.

Nanotechnology is an emerging area and very few programs offer the proposed concentration. We are one of the few sites of the NIH training grants that are in a position to offer this concentration at the leading edge of cancer research and innovation. The availability of this concentration will further enhance our educational offerings and position the college to be a leader in the applications to biomedical problems. Cancer-related industries provide new opportunities for our graduates. Transcription of this credential will provide our graduates with an advantage in the competitive applicant pool for these positions. For our current graduates, this transcriptable concentration is also an achievement and a focus on a problem and technology that distinguishes their training. The emerging intersection of cancer and nanotechnology research is very attractive to many prospective graduate students. A clear, transcriptable designation helps us attract the best students in this area, who would otherwise go to competing programs.

The proposed concentration spans the disciplines included. While the applications in cancer fall into the Bioengineering domain, nanotechnology is widely spread among many disciplines. Notably, Electrical and Computer Engineering, Materials Science and Engineering and Mechanical Science and Engineering, are the closest disciplines in the college and have provided letters of support for this program. Most commonly, advances in one engineering discipline, such as in electromagnetics or nanoparticle formation, need to occur to solve a problem in human disease and physiology. While the eventual design, application, and use is largely within Bioengineering, training in this department alone is insufficient to make significant advances. Hence, we are proposing the concentration to be broader than one department.

We anticipate that 10 graduate students per year will be accepted into this concentration at steady-state. Applicants will follow the established university procedures for indicating their interest in this concentration. Their application and background will be reviewed by the graduate coordinator in Bioengineering who will also provide students with details on this concentration's courses and requirements.

## **BUDGETARY AND STAFF IMPLICATIONS:**

- a. Additional staff and dollars needed

Graduate staff in the Department of Bioengineering has the capacity to absorb this additional program. They will serve as program advisors and maintain the concentration records, process admissions, and coordinate with departments regarding awarding of this concentration.

- b. Internal reallocations (e.g., change in class size, teaching loads, student-faculty ratio, etc.)

We expect that each course could see an enrollment increase of 5-7 students per year. Each department whose course is represented in this proposal has provided a letter indicating that each course has the capacity to absorb this additional enrollment.

- c. Effect on course enrollment in other units and explanations of discussions with representatives of those departments

As per the attached letters in Appendix C, this additional enrollment can be accommodated in each course associated with this concentration.

- d. Impact on the University Library

Those admitted to this concentration will be current University of Illinois graduate students. Therefore, there would be no additional impact beyond what is already accounted for in the typical graduate student population.

- e. Impact on computer use, laboratory use, equipment, etc.

No increase in the graduate student population is expected since those admitted to this concentration will be current University of Illinois graduate students. Therefore, there would be no additional impact beyond what is already accounted for in the typical graduate student population.

**DESIRED EFFECTIVE DATE:** Upon approval

## **STATEMENT FOR PROGRAMS OF STUDY CATALOG (for the Bioengineering Department):**

The Cancer Nanotechnology Concentration prepares students for collaborative research across the disciplines of engineering, biology, and the sciences with an emphasis on the use of Nanotechnology in the diagnosis and treatment of cancer. Students must be enrolled in a graduate degree program from one of the participating departments (Bioengineering, Electrical and Computer Engineering, Materials Science and Engineering, and Mechanical Science and

Engineering). The Cancer Nanotechnology Concentration requires students to earn a B or better in each concentration course. Students must complete 12 credit hours, including at least one core Cancer course and one core Nanotechnology course. Participants may take a second core Cancer course and/or a second core Nanotechnology course as an elective. Fulfillment of these requirements will be monitored by the graduate coordinator in Bioengineering.

Core Cancer courses:

BIOE 479	Cancer Nanotechnology	3 hours
MCB 400	Cancer Cell Biology	3 hours
BIOE 498 RB	Cancer Science and Technology	3 or 4 hours

Core Nanotechnology courses:

ABE 446	Biological Nanoengineering	3 or 4 hours
BIOE 416	Biosensors	3 hours
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems	3 hours

Elective Courses:

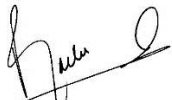
FSHN 480	Basic Toxicology	3 hours
ME 483	Mechanobiology	4 hours
ME 487	MEMS-NEMS Theory and Fabrication	4 hours
ME 586	Mechanics of MEMS and NEMS	4 hours

Alternate courses may be applicable to the Cancer Nanotechnology Concentration pending approval by the Bioengineering Graduate Program. Please note that for those intending to complete both a Cancer Nanotechnology and a Biomechanics Concentration, only one course may overlap.


Courses taken toward this concentration will count toward the graduate degree in each participating program. Students must notify their department of their plan to pursue this concentration. When choosing courses, students must work directly with their department to ensure that all degree requirements will be met. The Statement for Programs of Study Catalog for the other three majors listed in the concentration description can be found in Appendix D.

**CLEARANCES:** (Clearances should include signatures and dates of approval. **These signatures must appear on a separate sheet.** If multiple departments or colleges are sponsoring the proposal, please add the appropriate signature lines below.)


Signatures:

  
\_\_\_\_\_  
Unit Representative (Bioengineering):

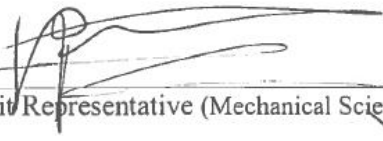
10/13/14  
\_\_\_\_\_  
Date:

  
\_\_\_\_\_  
Unit Representative (Electrical and Computer Engineering):

10/14/14  
\_\_\_\_\_  
Date:

  
\_\_\_\_\_  
Unit Representative (Materials Science and Engineering):

October 10, 2014  
\_\_\_\_\_  
Date:

  
\_\_\_\_\_  
Unit Representative (Mechanical Science and Engineering):

10/14/14  
\_\_\_\_\_  
Date:

\_\_\_\_\_  
College Representative (Engineering):

\_\_\_\_\_  
Date:

\_\_\_\_\_  
Graduate College Representative:

\_\_\_\_\_  
Date:

## Appendix A

### Concentration Courses and Requirements

The Cancer Nanotechnology Concentration requires students to earn a B or better in each concentration course. Students must complete 12 credit hours, including at least one core Cancer course and one core Nanotechnology course. Participants may take a second core Cancer course and/or a second core Nanotechnology course as an elective. Fulfillment of these requirements will be monitored by the graduate coordinator in Bioengineering.

Core Cancer courses:

BIOE 479	Cancer Nanotechnology	3 hours
MCB 400	Cancer Cell Biology	3 hours
BIOE 498 RB	Cancer Science and Technology	3 or 4 hours

Core Nanotechnology courses:

ABE 446	Biological Nanoengineering	3 or 4 hours
BIOE 416	Biosensors	3 hours
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems	3 hours

Elective Courses:

FSHN 480	Basic Toxicology	3 hours
ME 483	Mechanobiology	4 hours
ME 487	MEMS-NEMS Theory and Fabrication	4 hours
ME 586	Mechanics of MEMS and NEMS	4 hours

A Cancer Nanotechnology Concentration Web site will be created to inform prospective students about program requirements. The Web site will also serve as a resource for students pursuing this concentration and will be kept up-to-date with course additions and program updates. Please note that for those intending to complete both a Cancer Nanotechnology and a Biomechanics Concentration, only one course may overlap.

It is understood that alternate courses may be appropriate to include in the Cancer Nanotechnology Concentration. In order for alternate courses to be considered, the student must submit the course syllabus to the Bioengineering graduate coordinator prior to enrolling in the course. The syllabus will be reviewed by the Department of Bioengineering to determine if the course covers the appropriate topics. If approved, both the student and the student's departmental graduate contact will be notified in writing, and the approval will be noted in the student's file. A report of progress toward the concentration will be available to each student upon request.

Applicants will follow the established University procedure for indicating their interest in this concentration. The graduate coordinator in Bioengineering will review the applicant's application and background and provide details on the concentration's courses and requirements. Graduate students are responsible for ensuring that they have the appropriate background for any courses in which they enroll. The Bioengineering graduate coordinator will be available to discuss courses and prerequisites with students considering the Cancer Nanotechnology Concentration. At the conclusion of the student's degree, the Bioengineering graduate coordinator will work with the student's department to review the concentration course progress and certify that the requirements for the concentration have been met.

# Appendix B

## Letters of Support for Concentration

### Electrical and Computer Engineering

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Department of Electrical and Computer Engineering  
William L. Everitt Laboratory  
1406 West Green Street  
Urbana, IL 61801-2991



July 16, 2014

Senate Committee on Educational Policy  
608 South Wright Street  
Urbana, IL 61802

Dear Members of the Senate Educational Policy Committee:

The Department of Electrical and Computer Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The concentration courses listed below will count toward the graduate degree programs in our Department. When choosing courses, graduate students intending to pursue the certificate must work directly with our Department to ensure that all degree requirements will be met. We will consider additional proposed courses on a case-by-case basis.

ABE 446	Biological Nanoengineering
BIOE 416	Biosensors
BIOE 479	Cancer Nanotechnology
BIOE 498 RB	Cancer Science and Technology
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems
FSHN 480	Basic Toxicology
MCB 400	Cancer Cell Biology
ME 483	Mechanobiology
ME 487	MEMS-NEMS Theory and Fabrication
ME 586	Mechanics of MEMS and NEMS

We believe that the integration of biological sciences with physical and applied sciences is instrumental to adequate training in Cancer Nanotechnology and that those graduate students in our Department who choose to pursue this field would benefit from the proposed concentration.

Sincerely,

Sincerely,

A handwritten signature in black ink, appearing to read 'William H. Sanders', written over a horizontal line.

William H. Sanders  
Donald Biggar Willett Professor of Engineering  
Interim Department Head

telephone 217-333-2300 • fax 217-244-7075

# Materials Science and Engineering

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Department of Materials Science and Engineering

College of Engineering  
1304 West Green Street  
Urbana, IL 61801



David G. Cahill  
Willett Professor and Head

(Tel) 217-333-6753  
(Fax) 217-333-2736  
email: d-cahill@illinois.edu

July 14, 2014

To the Members of the Senate Educational Policy Committee:

The Department of Materials Science and Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The concentration courses listed below will count toward the graduate degree programs in our Department. When choosing courses, graduate students intending to pursue the certificate must work directly with our Department to ensure that all degree requirements will be met. We will consider additional proposed courses on a case-by-case basis.

ABE 446	Biological Nanoengineering
BIOE 416	Biosensors
BIOE 479	Cancer Nanotechnology
BIOE 498 RB	Cancer Science and Technology
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems
FSHN 480	Basic Toxicology
MCB 400	Cancer Cell Biology
ME 483	Mechanobiology
ME 487	MEMS-NEMS Theory and Fabrication
ME 586	Mechanics of MEMS and NEMS

We believe that the integration of biological sciences with physical and applied sciences is instrumental to adequate training in Cancer Nanotechnology and that those graduate students in our Department who choose to pursue this field would benefit from the proposed concentration.

Sincerely,

David Cahill  
Willett Professor and Head  
Department of Materials Science and Engineering  
University of Illinois at Urbana-Champaign



# Mechanical Science and Engineering

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Department of Mechanical Science and Engineering  
College of Engineering  
158 Mechanical Engineering Building, MC-244  
1206 West Green Street  
Urbana, IL 61801-2906



217 333-0639 *PMF, tel*  
217 244-6534 *PMF, fax*  
[pferreir@illinois.edu](mailto:pferreir@illinois.edu) *PMF, email*

July 21, 2014

Members of the Senate Educational Policy Committee:

The Department of Mechanical Science and Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The concentration courses listed below will count toward the graduate degree programs in our Department. When choosing courses, graduate students intending to pursue the certificate must work directly with our Department to ensure that all degree requirements will be met. We will consider additional proposed courses on a case-by-case basis.

ABE 446	Biological Nanoengineering
BIOE 416	Biosensors
BIOE 479	Cancer Nanotechnology
BIOE 498 RB	Cancer Science and Technology
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems
FSHN 480	Basic Toxicology
MCB 400	Cancer Cell Biology
ME 483	Mechanobiology
ME 487	MEMS-NEMS Theory and Fabrication
ME 586	Mechanics of MEMS and NEMS

We believe that the integration of biological sciences with physical and applied sciences is instrumental to adequate training in Cancer Nanotechnology and that those graduate students in our Department who choose to pursue this field would benefit from the proposed concentration.

Sincerely,

Placid Ferreira  
Department Head  
Tungchao Julia Lu Professor

telephone 217-333-1176 • fax 217-244-6534

# Appendix C

## Letters Indicating that Courses can Absorb Students

### Agricultural and Biological Engineering (ABE)

#### UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Department of Agricultural and Biological Engineering  
College of Agricultural, Consumer and Environmental  
Sciences and College of Engineering  
338 Agricultural Engineering Sciences Building  
1304 W. Pennsylvania Avenue  
Urbana, IL 61801



July 14, 2014

Members of the Senate Educational Policy Committee:

The Department of Agricultural and Biological Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The ABE concentration course listed below does have the capacity to enroll approximately 5-7 additional students per year. If enrollment surpasses course capacity, we will work with the Bioengineering Department to hire a TA or make other arrangements as necessary. We will consider additional proposed courses on a case-by-case basis.

ABE 446                      Biological Nanoengineering

Sincerely,

A handwritten signature in blue ink that reads 'K.C. Ting'.

K.C. Ting  
Professor and Head  
Department of Agricultural and Biological Engineering

Telephone 217-333-3570 \* fax 217-244-0323  
Email [abe@illinois.edu](mailto:abe@illinois.edu) \* url <http://abe.illinois.edu>

# Electrical and Computer Engineering (ECE)

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Department of Electrical and Computer Engineering  
William L. Everitt Laboratory  
1406 West Green Street  
Urbana, IL 61801-2991



July 15, 2014

Senate Committee on Educational Policy  
608 South Wright Street  
Urbana, IL 61802

Dear Members of the Senate Educational Policy Committee:

The Department of Electrical and Computer Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The ECE concentration course listed below does have the capacity to enroll approximately 10 additional students per year. If enrollment surpasses course capacity, we will work with the Bioengineering Department to hire a TA or make other arrangements as necessary. We will consider additional proposed courses on a case-by-case basis.

ECE/ME 485      Introduction to Micro Electromechanical Devices and Systems

Sincerely,

A handwritten signature in black ink, appearing to read 'Will Sanders', with a long horizontal flourish extending to the right.

William H. Sanders  
Donald Biggar Willett Professor of Engineering  
Interim Department Head

*telephone 217-333-2300 • fax 217-244-7075*

# Food Science and Human Nutrition (FSHN)

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN



**Department of Food Science and Human Nutrition**  
College of Agricultural, Consumer  
and Environmental Sciences  
260A Bevier Hall  
905 S. Goodwin Avenue  
Urbana, IL 61801

**Dr. Shelly Nickols-Richardson, Professor and Head**  
nickrich@illinois.edu

July 15, 2014

Senate Educational Policy Committee  
University of Illinois, Urbana-Champaign  
CAMPUS

Dear Members of the Senate Educational Policy Committee:

The Department of Food Science and Human Nutrition (FSHN) supports the creation of a Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. The FSHN concentration course listed below has the capacity to enroll approximately 5-7 additional students per year. This course is cross-listed as CB 449, CPSC 433 and ENVS 480. The lead instructors of this course, Dr. Michael Biehl from Comparative Biosciences (CB), College of Veterinary Medicine, and Dr. Zeynep Madak-Erdogan from FSHN, have been consulted on this matter and are supportive of the inclusion of FSHN 480 as a course in the Concentration in Cancer Nanotechnology. If enrollment surpasses course capacity, FSHN along with CB will work with the Bioengineering Department to provide a Teaching Assistant or grader or to make other arrangements as necessary. The FSHN Department will consider additional proposed courses on a case-by-case basis.

FSHN 480                      Basic Toxicology                      (cross-listed as CB 449, CPSC 433, ENVS 480)

I look forward to a positive response and anticipate a high level of interest in this proposed concentration.

Sincerely,

A handwritten signature in cursive script, appearing to read 'Sharon M. Nickols-Richardson'.

Sharon M. Nickols-Richardson  
Professor and Head, FSHN Department

*telephone* 217-244-4498 • *fax* 217-333-9689

# Mechanical Science and Engineering (ME)

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

Department of Mechanical Science and Engineering  
College of Engineering  
158 Mechanical Engineering Building, MC-244  
1206 West Green Street  
Urbana, IL 61801-2906



217 333-0639 *PMF, tel*  
217 244-6534 *PMF, fax*  
[pferreir@illinois.edu](mailto:pferreir@illinois.edu) *PMF, email*

July 21, 2014

Members of the Senate Educational Policy Committee:

The Department of Mechanical Science and Engineering supports the creation of Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering. With the exception of ME 487, the MechSE courses below do have the capacity to enroll 10 students next year. For ME 487, registration will be subject to available slots. If enrollment surpasses course capacity, we will work with the Bioengineering Department to hire a TA or make other arrangements as necessary. We will consider additional proposed courses on a case-by-case basis.

ME 483	Mechanobiology
ME 487	MEMS-NEMS Theory and Fabrication
ME 586	Mechanics of MEMS and NEMS

Sincerely,

Placid Ferreira  
Department Head  
Tungchao Julia Lu Professor

*telephone 217-333-1176 • fax 217-244-6534*

## Molecular and Cellular Biology (MCB)

UNIVERSITY OF ILLINOIS  
AT URBANA-CHAMPAIGN

School of Molecular and Cellular Biology  
393 Morrill Hall  
505 South Goodwin Avenue  
Urbana, IL 61801



12 August 2014

Dear Members of the Senate Educational Policy Committee:

The School of Molecular and Cellular Biology supports the creation of the Concentration in Cancer Nanotechnology to be offered through the Department of Bioengineering and the inclusion of MCB 400: Cancer Cell Biology as part of the Concentration requirements. MCB 400 generally has the capacity to enroll approximately 5-7 students from this proposed concentration per academic year starting in Fall 2015. The course is currently offered only in Fall terms. If enrollment surpasses course capacity, we may be able to work with the Department of Bioengineering to hire an additional TA or make other arrangements as necessary, but the likely limiting factor will be the fire code capacity of the classroom to which the course is assigned. MCB 400 has a prerequisite of MCB 250, 251, 252 and 253 with credit or concurrent registration in MCB 354 or MCB 450. While we understand that every student who enrolls may not be able to meet these prerequisites, we want to be clear about the fact that the course will be delivered at a level consistent with that expectation. We understand that this agreement pertains only to MCB 400, and any other required MCB courses for this concentration would be addressed individually.

Sincerely,

A handwritten signature in black ink, appearing to read 'Brenda A. Wilson'.

Brenda A. Wilson, Ph.D., Professor  
Associate Director for Undergraduate Education  
School of Molecular and Cellular Biology

telephone 217-333-3166 • fax 217-265-0927

## Appendix D Statements for Programs of Study Catalog

### Electrical and Computer Engineering

The Cancer Nanotechnology Concentration prepares students for collaborative research across the disciplines of engineering, biology, and the sciences with an emphasis on the use of Nanotechnology in the diagnosis and treatment of cancer. Students must be enrolled in a graduate degree program from one of the participating departments (Bioengineering, Electrical and Computer Engineering, Materials Science and Engineering, and Mechanical Science and Engineering). The Cancer Nanotechnology Concentration requires students to earn a B or better in each concentration course. Students must complete 12 credit hours, including at least one core Cancer course and one core Nanotechnology course. Participants may take a second core Cancer course and/or a second core Nanotechnology course as an elective. Fulfillment of these requirements will be monitored by the graduate coordinator in Bioengineering.

Core Cancer courses:

BIOE 479	Cancer Nanotechnology	3 hours
MCB 400	Cancer Cell Biology	3 hours
BIOE 498 RB	Cancer Science and Technology	3 or 4 hours

Core Nanotechnology courses:

ABE 446	Biological Nanoengineering	3 or 4 hours
BIOE 416	Biosensors	3 hours
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems	3 hours

Elective Courses:

FSHN 480	Basic Toxicology	3 hours
ME 483	Mechanobiology	4 hours
ME 487	MEMS-NEMS Theory and Fabrication	4 hours
ME 586	Mechanics of MEMS and NEMS	4 hours

Alternate courses may be applicable to the Cancer Nanotechnology pending approval by the Bioengineering Graduate Program. Please note that students who intend to complete both a Cancer Nanotechnology Concentration and a Biomechanics Concentration may only overlap one course between the two concentrations.

Courses taken toward this concentration will count toward the graduate degree in each participating program. Students must notify their department of their plan to pursue this concentration. When choosing courses, students must work directly with their department to ensure that all degree requirements will be met.

## Materials Science and Engineering

The Cancer Nanotechnology Concentration prepares students for collaborative research across the disciplines of engineering, biology, and the sciences with an emphasis on the use of Nanotechnology in the diagnosis and treatment of cancer. Students must be enrolled in a graduate degree program from one of the participating departments (Bioengineering, Electrical and Computer Engineering, Materials Science and Engineering, and Mechanical Science and Engineering). The Cancer Nanotechnology Concentration requires students to earn a B or better in each concentration course. Students must complete 12 credit hours, including at least one core Cancer course and one core Nanotechnology course. Participants may take a second core Cancer course and/or a second core Nanotechnology course as an elective. Fulfillment of these requirements will be monitored by the graduate coordinator in Bioengineering.

### Core Cancer courses:

BIOE 479	Cancer Nanotechnology	3 hours
MCB 400	Cancer Cell Biology	3 hours
BIOE 498 RB	Cancer Science and Technology	3 or 4 hours

### Core Nanotechnology courses:

ABE 446	Biological Nanoengineering	3 or 4 hours
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### Elective Courses:

FSHN 480	Basic Toxicology	3 hours
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Alternate courses may be applicable to the Cancer Nanotechnology pending approval by the Bioengineering Graduate Program. Please note that students who intend to complete both a Cancer Nanotechnology Concentration and a Biomechanics Concentration may only overlap one course between the two concentrations.

Courses taken toward this concentration will count toward the graduate degree in each participating program. Students must notify their department of their plan to pursue this concentration. When choosing courses, students must work directly with their department to ensure that all degree requirements will be met.



## Mechanical Science and Engineering

The Cancer Nanotechnology Concentration prepares students for collaborative research across the disciplines of engineering, biology, and the sciences with an emphasis on the use of Nanotechnology in the diagnosis and treatment of cancer. Students must be enrolled in a graduate degree program from one of the participating departments (Bioengineering, Electrical and Computer Engineering, Materials Science and Engineering, and Mechanical Science and Engineering). The Cancer Nanotechnology Concentration requires students to earn a B or better in each concentration course. Students must complete 12 credit hours, including at least one core Cancer course and one core Nanotechnology course. Participants may take a second core Cancer course and/or a second core Nanotechnology course as an elective. Fulfillment of these requirements will be monitored by the graduate coordinator in Bioengineering.

### Core Cancer courses:

BIOE 479	Cancer Nanotechnology	3 hours
MCB 400	Cancer Cell Biology	3 hours
BIOE 498 RB	Cancer Science and Technology	3 or 4 hours

### Core Nanotechnology courses:

ABE 446	Biological Nanoengineering	3 or 4 hours
BIOE 416	Biosensors	3 hours
ECE/ME 485	Introduction to Micro Electromechanical Devices and Systems	3 hours

### Elective Courses:

FSHN 480	Basic Toxicology	3 hours
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Courses taken toward this concentration will count toward the graduate degree in each participating program. Students must notify their department of their plan to pursue this concentration. When choosing courses, students must work directly with their department to ensure that all degree requirements will be met.