NANOTECHNOLOGY: APPLICATION IN FOOD, AGRICULTURE AND ENVIRONMENT (SWS 6932/SWS4932)

3 Credits- Every Spring

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COURSE DESCRIPTION/OBJECTIVES:

Description: Nanotechnology is an emerging field of applied science that engages almost every technical discipline – from chemistry to agriculture – in the study and application of extremely tiny materials with particle sizes ranging from ~1-100 nm. This course will cover the fundamentals of nanoscience and nanotechnology from historical development, concepts and principles to nanomaterial manufacturing and property characterization, and the application of nanotechnology in food science, agriculture and environment.

Objectives (This is a co-taught graduate/undergraduate course):

- To learn the basic concepts, principles, and components of nanotechnology. At the end of the course all students will be able to describe basic theory of nanoscience and nanotechnology.
- To learn about the creation and characterization of nanomaterials. At the end of the course all students will be familiar with methods for characterizing important properties of nanomaterials commonly used in agriculture and the environment.
- To learn the application of nanotechnology in agriculture, food, and environment. At the end of the course all students will be able to apply nanotechnology to solve some problems in the fields of food, agriculture, and environment.
- To learn about toxicology of engineered nanoparticles (EPs) and current methods of assessment. At the end of the course all students will be able to understand potential impact of EPs and conduct simple environmental risk assessment.

DELIVERY METHOD: E-Learning System/Articulate and Audio lectures (with powerpoint presentations and reading materials)

FREQUENCY: Spring semester, every year

TARGET STUDENTS: Graduate /senior undergraduate students who wish to become specialists in food, agriculture, and environment.

CLASS ATTENDANCE: **Attendance of chat sessions is mandatory.** There is 5% grade for chat room participation.

CHAT ROOM SESSION: Chat room session is scheduled 5-7 PM every Thursday except for public holidays.

GRADING:

Homework/Quizzes:	30%
Chat room attendance	5%
Mid-term Examination:	20% (30% for undergraduate)
Review or research Paper / presentation	20% (Not required for undergraduate)
Final Examination	25% (35% for undergraduate)
Total	100%

There will be no make-up homework and exams. Late submission of assignments will result in reduced credit (10% per assignment) if it is not agreed upon in advance.

A	94 – 100%
A-	90 – 93%
B+	87 – 89%
B	83 – 86%
B-	80 – 82%
C+	77 – 79%
C	73 – 76%
C-	70 – 72%
D+	67 – 69%
D	63 – 66%
D-	60 – 62%
E	< 60%

ASSIGNMENTS/ EXAMS/PROJECTS: Nanotechnology is one of the rapidly-developing frontiers with application in many fields including food, agriculture /LECTURES and environment. This course involves new concepts, principles, application, and measurements. It is important that the students have a good understanding of the concepts and principles. Therefore, in addition to lectures, the students will be also provided with supplementary course materials to read and homework to do at the end of each chapter. The students are required to submit homework report timely in order to obtain scores. The mid-term examination is designed to check the study progresses of each student so that some adjustment can be made based on student's performance. For graduate level (SWS 6932), each student is required to conduct an independent nanotechnology project. For this project, students will select one of the nanotechnology application areas (Food processing/preservation, agricultural production/nanofertilizers, soil and water quality, and environment-pollution control/toxicology, etc.), conduct a literature review based on journal articles, book chapters, and/or proceeding papers, discuss the characteristics of the concept/approach, its limitations, and benefits, submit a report, and present results of their independent study.

TEXTBOOK/REFERENCES:
No textbook is required. Reference books, journal articles, and related information links are provided on course website and in disk. Some examples of general readings that support several topics are listed as follows:

Poole Jr., C. A., and F. J. Owens (ed).2003.Introduction to nanotechnology. John Wiley & Sons, Hoboken, NJ, ISBN 0-471-07935-9.

Sellers, K., C. Mackay, L. L. Bergeson, S. R. Clough, M. Hoyt, J. Chen, K. Henry, and J. Hamblen (eds.). 2009. Nanotechnology and the Environment. CRC Press, Boca Raton, FL.

Wiesner, M. R. and J. Y. Bottero (ed). 2007. Environmental Nanotechnology: application and impacts of nanomaterials. The McGraw-Hill Co, New York.

Batley, G. E., J. K. Kirby, and M. J. McLaughlin. 2011. Fate and risks of nanomaterials in aquatic and terrestrial environments. *Accounts of Chemical Research* 46: 854-862.

Bergeson, L. L. 2013. Sustainable nanomaterials: Emerging governance systems. *ACS Sustainable Chemistry and Engineering* 1: 724-730.

Rico, C. M., S. Majumdar, M. Duarte-Gardea, J. R. Peralta-Videa, and J. L. Gardea-Teooresdey. 2011. Interaction of nanoparticles with edible plants and their possible implications in the food chain. *Journal of Agricultural and Food Chemistry* 59: 3485-3498.

Weir, A, P. Westerhoff, L. Fabricius, K. Hristovski and N. von Goetz. 2012. Titanium dioxide nanoparticles in food and personal care products. *Environmental Science and Technology* 46: 2242-2250.

PREREQUISITES: General physics and chemistry at a college level

OFFICE HOURS*:* Open for e-mail and phone call at any time or chat room by appointment.

COURSE CHAPTERS

Nanotechnology: Application in Agriculture, Food and Environment

Chapter 1 Fundamentals of Nanoscience and Nanotechnology
2 Nanoscale Materials: Definition and Properties
3 Manufacturing and Characterization of Nanoparticles
4 Natural Nanoparticles and Their Role in Soil and Water Quality
5 Nanotechnology Application in Agriculture
6 Nanotechnology Application in Food Sciences
7 Nanotechnology Application in the Environment
8 Environmental Fate and Transport of Engineered Nanoparticles
9 Environmental Toxicology of Engineered Nanoparticles
10 Environmental Regulation of Engineered Nanomaterials
11 Smart Nanoscale Systems for Targeted Delivery of Drugs, Nutrients and Pesticides

Teaching schedule*

Week	Topics covered	Lectures/reading materials/assignments
1	Introduction/ historic development and fundamentals of nanoscience and nanotechnology	Lecture 1/Chapter 1 Reading materials Assignment 1
2	Nanoscale materials: definition and properties	Lecture 2/Chapter 2 Reading materials Assignment 2

3	Manufacturing and characterization of nanoparticles	Lecture 3/Chapter 3 Reading materials Assignment 3
4	Natural nanoparticles and their role in soil and water quality	Lecture 4/Chapter 4 Reading materials
5	Nanotechnology application in agriculture I & II	Lectures 5/Chapters 5 Reading materials Assignment 5
6	Nanotechnology application in food sciences	Lecture 6/Chapter 6 Reading materials Assignment 5
7		Spring break
8	Nanotechnology application in the environment	Lecture 7/Chapter 7 Reading materials Assignment 6
9	Course review	Mid-term exam
10	Environmental fate and transport of engineered nanomaterials	Lecture 8/Chapter 8 Reading materials Assignment 7
11	Environmental toxicology of engineered nanoparticles	Lecture 9/Chapter 9 Reading materials Assignment 8
12	Environmental regulation of engineered nanomaterial	Lecture 10/Chapter 10 Reading materials
13	Smart Nanoscale Systems for Targeted Delivery of Drugs, Nutrients and Pesticides	Lecture 11/Chapter 11 Reading materials
14-15	Course review	
16	Final exam	

* Dates for topics or exams are subject to change.

GRADES AND GRADE POINTS: For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

ABSENCES AND MAKE-UP WORK: Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

ACADEMIC HONESTY: As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

STUDENT RESPONSIBILITIES: Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean or Student Honor Court.
More information about student responsibilities are available from the current University catalog, online at: http://www.registrar.ufl.edu/catalog1011/policies/students.html.

SOFTWARE USE: All faculty, staff, and students of the University of Florida are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

CAMPUS HELPING RESOURCES: Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/

  Counseling Services
  Groups and Workshops
  Outreach and Consultation
  Self-Help Library
  Training Programs
  Community Provider Database

- Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/

STUDENTS WITH DISABILITIES: The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

STUDENT COMPLAINTS: Each online distance learning program has a process for, and will make every attempt to resolve, student complaints within its academic and administrative departments at the program level. See http://distance.ufl.edu/student-complaints for more details.