NANOTECHNOLOGY IN FOOD, AGRICULTURE AND ENVIRONMENT
(AGG6503)

3 Credits- Every Spring

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CATALOG DESCRIPTION:
Application of nanotechnology in crop production, food processing and preservation, and environmental remediation; behavior of engineered nanoparticles in plant, soil and the environment, and environmental toxicology and regulations of engineered nanoparticles.

PRE-REQUISITES/CO-REQUISITES:
Basic knowledge in soil sciences, soil and water chemistry, or environmental sciences.

COURSE OBJECTIVES:
This course will cover the fundamentals of nanoscience and nanotechnology, application of nanotechnology in crop production, food processing and preservation, and environmental remediation; behavior of engineered nanoparticles in plant, soil and the environment, and environmental toxicology and regulations of engineered nanoparticles.

- Understand 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.
- Develop skills in 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.
- Gain expertise in 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.
- Learn 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: Online-Canvas E-Learning System and audio/video lectures (with powerpoint presentations and reading materials)

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

FREQUENCY: Spring semester, every year

TARGET STUDENTS: Graduate students who wish to expand their knowledge in emerging sciences and become a specialist 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:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework/Quizzes</td>
<td>30%</td>
</tr>
<tr>
<td>Chat room attendance</td>
<td>5%</td>
</tr>
<tr>
<td>Mid-term Examination</td>
<td>20%</td>
</tr>
<tr>
<td>Review or research Paper / presentation</td>
<td>20%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
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</tbody>
</table>

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 midterm examination is designed to check the study progresses of each student so that some adjustment can be made based on student’s performance. In this course, 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:

Reference Books:

Journal Articles:


COURSE CHAPTERS
Nanotechnology in Agriculture, Food and Environment

Module I Basic concepts and principles of nanotechnology
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

Module II Nanotechnology Applications
  5 Nanotechnology Application in Agriculture
  6 Nanotechnology Application in Food Sciences
  7 Nanotechnology Application in the Environment

Module III Behavior, environmental toxicology and regulations of nanoparticle
  8 Environmental Fate and Transport of Engineered Nanoparticles
  9 Environmental Toxicology of Engineered Nanoparticles
  10 Environmental Regulation of Engineered Nanomaterials

Module IV Smart nano-delivery systems
  11 Smart Nanoscale Systems for Targeted Delivery of Drugs, Nutrients and Pesticides

Teaching schedule*

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics covered</th>
<th>Lectures/reading materials/assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction/ historic development and fundamentals of nanoscience and nanotechnology</td>
<td>Lecture 1/Chapter 1 Reading materials Assignment 1</td>
</tr>
<tr>
<td>2</td>
<td>Nanoscale materials: definition and properties</td>
<td>Lecture 2/Chapter 2 Reading materials Assignment 2</td>
</tr>
<tr>
<td>3</td>
<td>Manufacturing and characterization of nanoparticles</td>
<td>Lecture 3/Chapter 3 Reading materials Assignment 3</td>
</tr>
<tr>
<td>4</td>
<td>Natural nanoparticles and their role in soil and water quality</td>
<td>Lecture 4/Chapter 4 Reading materials</td>
</tr>
<tr>
<td>5</td>
<td>Nanotechnology application in agriculture I &amp; II</td>
<td>Lectures 5/Chapters 5 Reading materials Assignment 5</td>
</tr>
<tr>
<td>6</td>
<td>Nanotechnology application in food sciences</td>
<td>Lecture 6/Chapter 6 Reading materials Assignment 5</td>
</tr>
<tr>
<td>7</td>
<td>Spring break</td>
<td></td>
</tr>
</tbody>
</table>
|   | 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  
| 14-15 | Course review | Reading materials  
| 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](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](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](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](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 RESOURCES:

Health and Wellness
U Matter, We Care:
If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.
Counseling and Wellness Center:
http://www.counseling.ufl.edu/cwc/Default.aspx, 392-1575;

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department, 392-1111 (or 9-1-1 for emergencies).
http://www.police.ufl.edu/

Academic Resources
E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learningsupport@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.
http://www.crc.ufl.edu/

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
http://teachingcenter.ufl.edu/

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
http://writing.ufl.edu/writing-studio/

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf
On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process

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 with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students
will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**ONLINE COURSE EVALUATION:** Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at [https://evaluations.ufl.edu](https://evaluations.ufl.edu). Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at [https://evaluations.ufl.edu/results/](https://evaluations.ufl.edu/results/).

**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](http://distance.ufl.edu/student-complaints) for more details.

*The grading rubric for graduate student’s final project*
<table>
<thead>
<tr>
<th>Components</th>
<th>Poor (≤ 60 %)</th>
<th>Acceptable (61-80 %)</th>
<th>Good (81-90 %)</th>
<th>Excellent (91-100 %)</th>
<th>Full score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific questions</td>
<td>No obvious scientific questions to be addressed.</td>
<td>Scientific question is not explicitly presented.</td>
<td>There is a scientific question clearly stated.</td>
<td>Significant questions are logically addressed.</td>
<td>10</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>No hypothesis.</td>
<td>There is hypothesis, but not well presented.</td>
<td>There is a well presented hypothesis.</td>
<td>Meaningful hypotheses are logically addressed.</td>
<td>5</td>
</tr>
<tr>
<td>Methodology</td>
<td>No experimental design and lack of adequate methods.</td>
<td>There is experimental design, but lack of adequate methods.</td>
<td>There is experiment design with measurement methods.</td>
<td>The experiments are statistically designed with adequate methods.</td>
<td>10</td>
</tr>
<tr>
<td>Data process &amp; statistical analysis</td>
<td>No statistical analysis of the data.</td>
<td>There is statistical analysis of the data but not sufficient.</td>
<td>The data are statistically analyzed but not well presented.</td>
<td>The data are statistically analyzed and well presented.</td>
<td>5</td>
</tr>
<tr>
<td>Results and Discussion</td>
<td>Interpretation of the data is lacking.</td>
<td>The results are presented but not well discussed.</td>
<td>The results are adequately presented and discussed.</td>
<td>The results are well presented and discussed.</td>
<td>20</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>No logical structure of the paper and presentation.</td>
<td>The paper and presentation is structured in a way but hard to follow.</td>
<td>The paper and presentation is logically structured.</td>
<td>Well organized with proper proportions of text, figures, and pictures.</td>
<td>10</td>
</tr>
<tr>
<td>Language</td>
<td>Poor with many errors in grammar and spelling.</td>
<td>Adequate with minor errors in grammar and spelling</td>
<td>Written clearly without obvious errors in grammar and spelling</td>
<td>Well written with good flow of ideas and easy to follow</td>
<td>10</td>
</tr>
<tr>
<td>Colors &amp; figures</td>
<td>Colors are arbitrarily chosen and figures are poorly designed.</td>
<td>Use of some colors and figures to present information.</td>
<td>Colors and figures are used to enhance presentation.</td>
<td>Colors and figures are well designed to communicate ideas.</td>
<td>10</td>
</tr>
<tr>
<td>Presentation</td>
<td>Not clear and timely</td>
<td>Good speech but not timely</td>
<td>Good speech and timely</td>
<td>Well presented and timely</td>
<td>10</td>
</tr>
<tr>
<td>Acknowledgment</td>
<td>Minimal citation</td>
<td>With some citations and references</td>
<td>Completely cited and acknowledged.</td>
<td>Well cited and acknowledged with journal standards</td>
<td>10</td>
</tr>
</tbody>
</table>