Nanotechnology in Agriculture and the Environment

COURSE IDENTIFICATION

CODE	SEM	HT	HS	HP	HA	CR SCT	PREREQUISITES	COURSE LEVEL OR CATEGORY	RESPONSABLE UNIT
	Summer School	1	0	0	2	2	Postgraduate inscription	Elective	Postgraduate School

One SCT credit point is equivalent to 25 student learning hours.

COURSE DESCRIPTION

This course presents an introduction into nanotechnology with an overview of the methods used for synthesis of nanoparticles and their physical characteristics. With this background there will be a presentation of specific applications for the use of nanotechnology in the areas of agriculture and the environment. Examples will be provided from the literature and (where available) examples from an applied context. The student will be expected to end this course with a good understanding of the expected benefits and challenges to using nanotechnology in agricultural and environmental context.

LEARNING STRATEGIES

Lectures, group discussion, and student poster presentations.

COURSE COMPETENCIES (Type: B = Basic, G = Generic, E = Specific)

At the conclusion of this class, students will be able to:

- List forms of nanomaterials and their general properties (B).
- Have a good understanding of the use of nanotechnology in agricultural and environmental context (E).
- Be aware of the potential downsides of the use of nanotechnology and of methods that can be used to ameliorate them (G).

LEARNING RESOURCES

Lectures, library access, and open discussion with professors.

COURSE OUTLINE

Chapter	Content
An introduction to nanotechnology	An overview of the field of nanotechnology. Divided into three sections (what is nanotechnology, the physical properties of nanomaterials, and examples of nanomaterials and how they are created.)
Nanotechnology and smart agriculture	Due to their physical properties, nanomaterials are often utilized as sensors for the detection of chemical species. The topic will also discuss the use of computational methods to identify the physical properties of nanomaterials related to potential applications such as sensors This topic will discuss the application of nano-sensor technology in order to promote the creation of responsive technologies which will allow “smart agriculture”.
Nanofarming: Applied nanotechnology in agriculture	This topic will address the use of nanotechnology in a direct agricultural context. In particular, nanofertilizers, nanopesticides and topics such as the interactions of nanoparticles with agricultural plants will be addressed.
Environmental remediation with nanotechnology	Nanomaterials show a number of properties that makes them suitable for use as agents for the remediation of environmental damage. This topic will be an overview of the application of nanomaterials for the remediation of water, and soil resources.
Nanotoxicology: The dark side of the nano revolution.	While nanomaterials show great promise in a range of applications, there have also been issues with the potential impacts that these nanomaterials can have on human health. This topic will be a brief overview of the toxicological impacts of nanomaterials followed by strategies in risk assessment and management that can be utilised to reduce them.
Nanoparticles in the environment	The behaviour and fate of nanoparticles in the environment and its interactions with different components of the natural world will be addressed.

COURSE STRUCTURE

The course will take place between Monday January 4th and Thursday January 28th 2021 over a four week period. The course will have eight 3-hour virtual sessions.
The three-hour sessions will be divided into three 30/45-minute direct teaching sessions with 15/30 minute Student/Instructor discussions. Final assignment will be the generation of a poster on a theme related to the topic followed by a three-minute presentation. These sessions will occur on Monday from 12pm to 3pm (Chilean time). and from Thursday 9am to 12pm. The sessions will be divided as follows

Session	Date/Time (Chilean (+3hrs UK, +4 hrs Sweden+ Austria, -2hrs Michigan)	Instructor	Topic
1	Monday 04/01/2021 12:00-15:00	Joseph Govan	Introduction
		Joseph Govan	Basics of nanoscience
		Everyone	Poster session Assignments
2	Thursday 07/01/2021 09:00-12:00	Joseph Govan	Forms of nanomaterials
		Vadim Kessler Gulaim Seisenbaeva	Synthesis methods for nanomaterials
3	Monday 11/01/2021 12:00-15:00	Joseph Govan	Nanosensors
		Iseult Lynch, Peng Zhang	Smart agriculture.
		Vadim Kessler, Gulaim Seisenbaeva	Computational aspects
4	Thursday 14/01/2021 09:00-12:00	Iseult Lynch Peng Zhang Vadim Kessler Gulaim Seisenbaeva	Nanofarming
5	Monday 18/01/2021 12:00-15:00	Vadim Kessler Gulaim Seisenbaeva	Nanotech and environmental remediation
6	Thursday 21/01/2021 09:00-12:00	Wei Zhang Iseult Lynch Peng Zhang	Nanoparticles in the environment
7	Monday 25/01/2021 12:00-15:00	Iseult Lynch, Peng Zhang Vadim Kessler Gulaim Seisenbaeva	Nanotoxicology
		Florian Part	Risk Assessment
8	Thursday 28/01/2021 09:00-12:00	Everybody	Student Poster presentations. End of course

READING MATERIALS

- Shivendu Ranjan,Nandita Dasgupta and Eric Lichtfouse: 2017 Nanoscience in Food and Agriculture 4, Sustainable Agriculture Reviews book series (SARV, volume 24), Springer p.305
- Azamal Husen and Mohammad Jawaid (Eds.) Nanomaterials for Agriculture and Forestry applications, Elsevier p.532
- Dong-Wook Han and Wojciech Chrzanowski (Eds.) 2018, Frontiers in Toxicity and Functionalization of Nanomaterials, Nanomaterials MDPI p.172
- Kamel A. Abd-Elsalam (Ed) 2019. Carbon nanomaterials for Agri-food and environmental applications. Elsevier p.652

INSTRUCTORS (List non-exclusive)

Instructor	*Department*	*Area or major field*
Joseph Govan	Soil and Engineering, University of Chile	Chemistry, nanotechnology, water remediation
Wei Zhang	Department of Plant, Soil and Microbial Sciences. Michigan State University	Environmental soil physis, nanomaterials in the environment
Florian Part	Department of Water-Atmosphere-Environment, University of Natural Resources and Life Sciences, Vienna (BOKU)	Environmental science, nanomaterials in the environment. Processing of waste nanomaterials.
Vadim Kessler	Department of Molecular Sciences, Swedish University of Agricultural Sciences	Molecular sciences, nanotechnology in agriculture, biocatalysis
Gulaim Seisenbaeva	Department of Molecular Sciences, Swedish University of Agricultural Sciences	Molecular sciences, nanotechnology in agriculture, biocatalysis
Iseult Lynch	School of Geography, Earth & Environmental Sciences, University of Birmingham	Nanotoxicology, nanoparticles in the environment, nanotechnology in agriculture
Peng Zhang	School of Geography, Earth & Environmental Sciences, University of Birmingham	Nanotoxicology, nanoparticles in the environment, nanotechnology in agriculture

GRADING (under review every term)

Activity	*Percentage (%)*
Poster Presentation (3 minute presentation)	100