课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**ESE5021 环境纳米技术** **Environmental Nanotechnology**
2.	**课程性质** **Compulsory/Elective**	专业选修课
3.	**课程学分/学时** **Course Credit/Hours**	2/32
4.	**授课语言** **Teaching Language**	英文
5.	**授课教师** **Instructor(s)**	王钟颍
6.	**先修要求** **Pre-requisites**	无
7.	**教学目标** **Course Objectives**	
	This course is an elective one for graduate students in the Environmental Science and Engineering major. The fundamental aspects of environmental nanotechnology, including nanomaterials' synthesis, characterization, environmental applications, environmental transformations and toxicities, will be presented during the lectures. The objectives of this course is to give students an orientation on the various remediation strategies and methods enabled by nanotechnology, as well as a clear understanding of the consequences and risks related to the nanotechnology.	
8.	**教学方法** **Teaching Methods**	
	The fundamental concepts will be presented along with the latest literature as examples and group discussions, to promote critical thinking, to demonstrate applications and implications of modern nanotechnological methods and techniques, and prepare students to get involved in the environmental nanotechnology.	
9.	**教学内容** **Course Contents**	
	Section 1	Lecture 1: Introduction Main content: definition and introduction of nanotechnology, and overview of applications and implications of nanotechnology related to the environment.
	Section 2	Lecture 2: Nanomaterial fabrication Main content: General fabrication methods of nanomaterials, and specificity in the synthesis of a few nanomaterials widely used in environmental engineering, such as zero-valent iron nanoparticle, graphene-based nanomaterials, metallic and metal oxide nanoparticles.
	Section 3	Lecture 3: Characterization of nanomaterials Main content: The principles and applications of various tools for structural and chemical characterizations: SEM, XRD, XPS, etc.
	Section 4	Lecture 4: Environmental applications of nanomaterials I

		Main content: photocatalysis principles and applications (band gap structure, reactive oxygen species, degradation of organic species by TiO_2)
	Section 5	Lecture 5: Environmental applications of nanomaterials II Main content: adsorption principles and applications (adsorption mechanism of heavy metal and its applications using iron oxide nanomaterials, adsorption mechanisms of organics and its applications using carbon-based nanomaterials)
	Section 6	Lecture 6: Environmental applications of nanomaterials III Main content: transport principles and fabrication for membrane (desalination and organics removal process, nanoparticle membrane reactors)
	Section 7	Lecture 7: Environmental applications of nanomaterials IV Main content: disinfection mechanism and applications (disinfection mechanisms and applications of silver nanoparticle, disinfection mechanism and applications of photoactive MoS_2)
	Section 8	Lecture 8: Environmental applications of nanomaterials V Main content: Groundwater remediation principles and practice (TCE removal by zero valent iron nanoparticle, reactivity, fate and lifetime)
	Section 9	Lecture 9: Environmental transformations of nanomaterials I Main content: physical transformation principles and potential impacts (aggregation, redispension, adsorption of NOMs)
	Section 10	Lecture 10: Environmental transformations of nanomaterials II Main content: chemical transformation principles and potential impacts (surface oxidation, dissolution, sulfidation, redox reactions, etc)
	Section 11	Lecture 11: toxicological impacts of nanomaterials I Main content: conventional toxicological assays and complications of testing nanomaterials
	Section 12	Lecture 12: toxicological impacts of nanomaterials II Main content: toxicity and mechanisms of metallic nanomaterials (copper, silver nanoparticles)
	Section 13	Lecture 13: toxicological impacts of nanomaterials III Main content: toxicity and mechanisms of metal oxide nanomaterials (iron oxide, titanium oxide, cerium oxide nanoparticles)
	Section 14	Lecture 14: toxicological impacts of nanomaterials IV Main content: toxicity and mechanisms of carbon-based nanomaterials (single- and multi-walled carbon nanotubes, graphene nanosheets and

		fullerenes)
	Section 15	Lecture 15: Life cycle risks of nanomaterials Main content: life cycle impacts and sustainability
	Section 16	Lecture 16: Future of environmental nanotechnology Main content: research gaps future direction, and group discussion

10. 课程考核
Course Assessment

10 % for attendance and class performance;

40 % for quiz tests (week 6 and 12);

50 % for group projects.

11. 教材及其它参考资料
Textbook and Supplementary Readings

Textbooks:

1. Grassian V.H, “Nanoscience and Nanotechnology – Environmental and health impacts”, John Wiley & Sons, 2008.

2. Sellers.K, Mackay.C, Bergeson.L.L, Clough S.R, Nanotechnology and Environment, CRC Press, 2009.

3. Wiesner M and Bottero J.Y, “Environmental Nanotechnology”, McGraw-Hill, 2007.

Assigned readings for

Introductions:

Nanomaterials in the environment: behavior, fate, bioavailability, and effects." Environmental Toxicology and Chemistry: An International Journal 27.9 (2008): 1825-1851.

Nanomaterial fabrication:

Yin, Yadong, and A. Paul Alivisatos. "Colloidal nanocrystal synthesis and the organic–inorganic interface." Nature 437.7059 (2005): 664-670.

Characterization:

Petosa, Adamo Riccardo, et al. "Transport of two metal oxide nanoparticles in saturated granular porous media: role of water chemistry and particle coating." Water research 46.4 (2012): 1273-1285.

Domingos, Rute F., et al. "Characterizing manufactured nanoparticles in the environment: multimethod determination of particle sizes." Environmental science & technology 43.19 (2009): 7277-7284.

Applications:

Perreault, François, Andreia Fonseca De Faria, and Menachem Elimelech. "Environmental applications of graphene-based nanomaterials." Chemical Society Reviews 44.16 (2015): 5861-5896.

Qu, Xiaolei, Pedro JJ Alvarez, and Qilin Li. "Applications of nanotechnology in water and wastewater treatment." Water research 47.12 (2013): 3931-3946.

Wang, Zhongying, and Baoxia Mi. "Environmental applications of 2D molybdenum disulfide (MoS2) nanosheets." Environmental science & technology 51.15 (2017): 8229-8244.

Transformations:

Lowry, Gregory V., et al. "Transformations of nanomaterials in the environment." (2012): 6893-6899.

Toxicology:

Sharifi, Shahriar, et al. "Toxicity of nanomaterials." Chemical Society Reviews 41.6 (2012): 2323-2343.

Dhawan, Alok, and Vyom Sharma. "Toxicity assessment of nanomaterials: methods and challenges." Analytical and bioanalytical chemistry 398.2 (2010): 589-605.