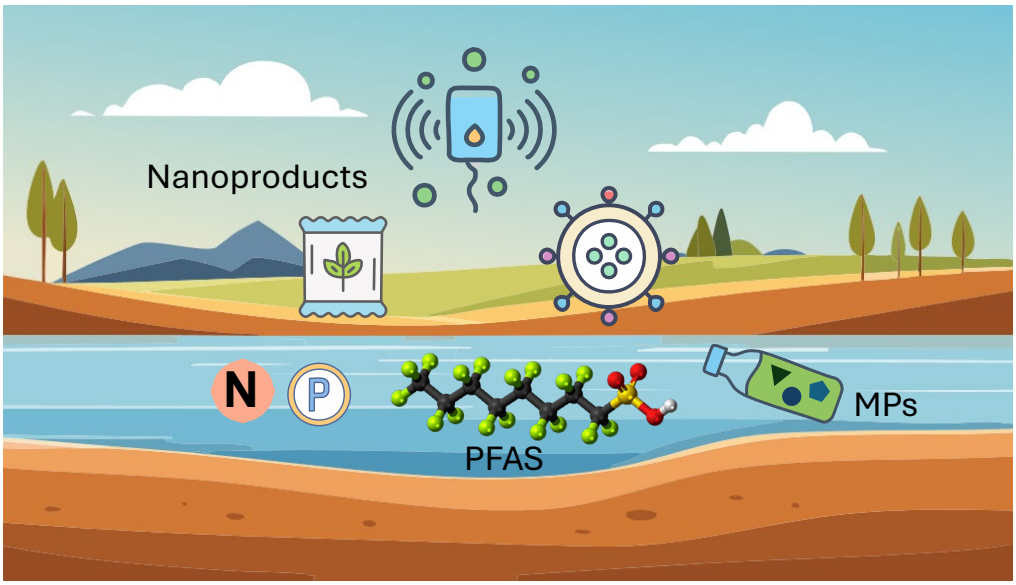
Nanotechnology in Water Research: ABE 6266
Class Periods: M, W, F, 10:40 – 11:30 AM
Location: 283 Frazier-Rogers Hall and Online (Zoom)
Academic Term: Spring 2026



Instructor:

Dengjun (Kevin) Wang, Ph.D., Assistant Professor
Department of Agricultural and Biological Engineering (ABE)
University of Florida
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1741 Museum Road, Gainesville, FL 32603
Faculty Profile: https://abe.ufl.edu/people/faculty/dengjun-wang/
Email: **dengjun.wang@ufl.edu**
Phone: (352) 294-7969
Office Hours: M, W, F, 11:30 AM – 12:00 PM (*walk in policy, no appointment needed*). Appointment is needed for other time slots via email communication.

Teaching Assistant/Peer Mentor/Supervised Teaching Student:

Please contact via Canvas system:

- To Be Determined.

Course Description: 3 Credits.

- *Applications of nanotechnology in water: nano-enabled sorbents, catalysts, membranes, and sensors for water treatment, water quality monitoring, and environmental remediation*
- *Cutting-edge research advancements of nano-enabled remediation of PFAS and microplastics*
- *Application of nanotechnology in agriculture: nanofertilizers and nanopesticides*
- *Artificial Intelligence (AI)-enabled data analysis to further nanotechnology applications*

This course will provide an overview of the state-of-the-art knowledge on the broad applications of nanotechnology in water, soil, and other agricultural, engineered, geological, and environmental systems. Engineered nanomaterials (e.g., sorbents and catalysts), nanosensors, nanofertilizers, and nanopesticides will be discussed to highlight the potentials of nanotechnology in: (1) water treatment, (2) water quality monitoring, (3) environmental remediation, and (4) pest control and crop yield enhancement in agriculture. Recent advancements of nanotechnology for the remediation of new emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) and microplastics (MPs) will be systematically discussed. Finally, AI-enabled large dataset analysis to further nanotechnology applications will be discussed.

Course Pre-Requisites / Co-Requisites:

None.

Course Objectives:

- Gain fundamental knowledge of the terminology of nanotechnology and characterization techniques of nanomaterials
- Understand the impact and potential of nanotechnology in water treatment, water quality monitoring, environmental remediation, and nano-enabled agriculture
- Train skills to employ AI models for large dataset analysis in nanotechnology
- Develop skills in using nano-engineering tools necessary for the practice in environmental nanotechnology, water quality, and environmental remediation
- *Tours at UF Nanoscale Research Facility (NRF), guest lectures from leaders in environmental nanotechnology, hands-on laboratory experiments, and final project presentation, along with other conventional teaching avenues will be employed to facilitate achieving the course objectives.*

Materials and Supply Fees:

None.

Related to Program Outcomes (ABET):

This course addresses the following ABET outcomes.

Outcome	Coverage
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Medium
3. An ability to communicate effectively with a range of audiences.	Medium
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Medium
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives.	Medium
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	High
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	Medium

Coverage is given as high, medium, or low. An empty box indicates that this outcome is not a part of the course outcomes that are addressed.

Required Textbook:

- **Environmental Nanotechnology: Applications and Impacts of Nanomaterials, Second Edition**
  By Mark Wiesner and Jean-Yves Bottero
  Published on October 7, 2016, Second Edition, McGraw Hill
  ISBN-10: 0071828443
  ISBN-13: 978-0071828444
  Link: https://www.amazon.com/Environmental-Nanotechnology-Applications-Impacts-Nanomaterials/dp/0071828443

Recommended Textbook (Optional):

- **Nanotechnology for Water Treatment and Purification**
  By Anming Hu and Allen Apblett
  Published on 28 July, 2014, Springer Cham
  ISBN (hardcover): 978-3-319-06577-9
  ISBN (softcover): 978-3-319-37470-3
  DOI: 10.1007/978-3-319-06578-6
  Link: https://link.springer.com/book/10.1007/978-3-319-06578-6

Recommended Reading Materials:

1. Tratnyek, P.G., Johnson, R.L., 2006. Nanotechnologies for environmental cleanup. ***Nano Today,*** 1: 44–48.

2. Mauter, M.S., Elimelech, M. 2008. Environmental applications of carbon-based nanomaterials. ***Environmental Science & Technology,*** 42: 5843–5859.

3. Alvarez, P.J.J., Chan, C.K., Elimelech, M., Halad, N.J., Villagran, D., 2009. Emerging opportunities for nanotechnology to enhance water security. ***Nature Nanotechnology,*** 13: 634–641.

4. Hodges, B.C., Cates, E.L., Kim, J.H. 2009. Challenges and prospects of advanced oxidation water treatment processes using catalytic nanomaterials. ***Nature Nanotechnology,*** 13: 642–650.

5. Vikesland, P.J. 2018. Nanosensors for water quality monitoring. ***Nature Nanotechnology,*** 13: 651–660.

6. Perreault, F., de Faria, A.F., Elimelech, M. 2015. Environmental applications of graphene-based nanomaterials. ***Chemical Society Reviews,*** 44: 5861–5896.

7. Wang, D., Saleh, N.B., Byro, A., Zepp, R., Sahle-Demessie, E., Luxton, T. P., Ho, K.T., Burgess, R. M., Flury, M., White, J.C., Su, C. 2022. Nano-enabled pesticides for sustainable agriculture and global food security. ***Nature Nanotechnology,*** 17: 347–360.

8. Lowry, G.V., Giraldo, J.P., Steinmetz, N.F., Avellan, A., Demirer, G.S., Ristroph, K.D., Wang, G.J., Hendren, C.O., Alabi, C.A., Caparco, A., da Silva, W., González-Gamboa, I., Grieger, K.D., Jeon, S.J., Khodakovskaya, M.V., Kohay, H., Kumar, V., Muthuramalingam, R., Poffenbarger, H., Santra, S., Tilton, R.D., White, J.C. 2024. Towards realizing nano-enabled precision delivery in plant. ***Nature Nanotechnology,*** 19: 1255–1269.

9. Huang, X., Auffan, M., Eckelman, M.J., Elimelech, M., Kim, J.H., Rose, J., Zuo, K., Li, Q., Alvarez, P.J.J. 2024. Trends, risk and opportunities in environmental nanotechnology. ***Nature Reviews Earth & Environment,*** 5: 572–587.

10. Joyce, P., Allen, C.J., Alonso, M.J., Ashford, M., Bradbury, M.S., Germain, M., Kavallaris, M., Langer, R., Lammers, T., Peracchia, M.T., Popat, A., Prestidge, R.B., Rijcken, C.J.F., Sarmento, B., Schmid, R.B., Schroeder, A., Subramaniam, S., Thorn, C.R., Whitehead, K.A., Zhao, C.X., Santos, H.A. 2024. A translational framework to DELIVER nanomedicines to the clinic. ***Nature Nanotechnology,*** 19: 1597–1611.

11. Li, J., Li, X., Da, Y., Yu, J., Long, B., Zhang, P., Bakker, C., McCarl, B.A., Yuan, J.S., Dao, S.Y. 2022. Sustainable environmental remediation via biomimetic multifunctional lignocellulosic nano-framework. ***Nature Communications,*** 13: 4368.

12. Zhang, W., Zhang, D., Liang, Y. 2019. Nanotechnology in remediation of water contaminated by poly- and perfluoroalkyl substances: A review. ***Environmental Pollution,*** 247, 266–276.

13. Yadav, M., Osonga, F.J., Sadik, O.A. 2024. Unveiling nano-empowered catalytic mechanisms for PFAS sensing, removal and destruction in water. ***Science of the Total Environment,*** 912: 169279.

14. Goh, P.S., Kang, H.S., Ismail, A.F., Hkor, W.H., Quen, L.K., Higgins, D. 2022. Nanomaterials for microplastic remediation from aquatic environment: Why nano matters? ***Chemosphere,*** 299: 134418.

15. Šimůnek, J., Šejna, M., Brunetti, G., van Genuchten, M.Th. The HYDRUS Software Package for Simulating the One-, Two, and Three-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably Saturated Media, Technical Manual I, Hydrus 1D, Version 5.0, PC Progress, Prague, Czech Republic, 334p., 2022.

16. Silva, J. A. K., Šimůnek, J., McCray, J.E. 2022. Comparison of methods to estimate air-water interfacial areas for evaluating PFAS transport in the vadose zone, ***Journal of Contaminant Hydrology,*** 247: 103984.

17. Guo, B., Zeng, J., Brusseau, M. 2020. A mathematical model for the release, transport, and retention of per- and polyfluoroalkyl substances (PFAS) in the vadose zone. ***Water Resources Research,*** 56, e2019WR026667.

18. Zhu, J.J., Boehm, A., Ren, Z.J. 2024. Environmental machine learning, baseline reporting, and comprehensive evaluation: The EMBRACE checklist. ***Environmental Science & Technology,*** 58: 19909–19912.

19. Lowry, G.V., Giraldo, J.P., Steinmetz, N.F., et al., 2024. Towards realizing nano-enabled precision delivery in plants. ***Nature Nanotechnology,*** 19, 1255–1269.

20. Glass, S., Santiago-Cruz, H.A., Chen, W., et al., 2025. Merits, limitations and innovation priorities for heterogeneous catalytic platforms to destroy PFAS. ***Nature Water,*** 3, 644–654.

Required Computer:

UF student computing requirement: https://news.it.ufl.edu/education/student-computing-requirements-for-uf/

Course Schedule:

Topic 1: Nanotechnology: An Introduction
Topic 2: Benefits of Environmental Nanotechnology
Topic 3: Characterizations of Nanomaterials (*include Tour at Nanoscale Research Facility*)
Topic 4: Nanotechnology for the Remediation of Emerging Contaminants (*PFAS and Microplastics*)
Topic 5: Applications of Nanotechnology in Water Treatment: Sorbents (**Exam 1**)
Topic 6: Applications of Nanotechnology in Water Treatment: Catalysts
Topic 7: Applications of Nanotechnology in Water Treatment: Membranes (*include Guest Lecture*)
Topic 8: Applications of Nanotechnology in Water Treatment: Sensors (**Exam 2**)
Topic 9: Applications of Nanotechnology in Environmental Remediation (*include Guest Lecture*)
Topic 10: Applications of Nanotechnology in Agriculture: Nanofertilizers & nanopesticides
Topic 11: Fate & Transport of Nanomaterials in the Subsurface (*Include Lab Experiments*)
Topic 12: AI-Enabled Large Dataset Analysis in Nanotechnology (**Final Poster Presentation**)

Important Dates (Tentative):

02/13/2026 Exam 1 (10:40 – 11:30 AM, 283 Frazier-Rogers Hall)
03/27/2026 Exam 2 (10:40 – 11:30 AM, 283 Frazier-Rogers Hall)
04/30/2026 Final Project Presentation (10:40 AM – 12:00 PM, 283 Frazier-Rogers Hall)

Attendance Policy, Class Expectations, and Make-Up Policy:

- **Attendance Policy:** Requirements for class attendance can be found here at UF Attendance Policies: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/. Please email Dr. Wang at dengjun.wang@ufl.edu, if you have any additional questions that are not covered by UF Attendance Policies, one day prior to the class.
- **Class Expectations:** The instructor will facilitate class discussions. Students are highly encouraged to participate in various class discussion activities by addressing questions, asking questions, and initiating

group discussions during the class lecturing. Bonus points will be provided to simulate classroom discussions.

- **Make-Up Policy:** The student needs to email the instructor, Dr. Wang at dengjun.wang@ufl.edu, about the date of the make-up exam. Contents of the make-up exam will be changed to ensure a fair competition environment for all students.

Evaluation of Grades:

Assignment	Total Points	Percentage of Final Grade
Homework Sets (10)	100 each	30%
Video Presentation	100	10%
Exam 1	100	20%
Exam 2	100	20%
Final Project Presentation	100	20%
	TOTAL	**100%**

Video: A 10 min video (PowerPoint presentation) needs to be submitted to Canvas, which is due in two weeks when the course starts. The topic of the video presentation should be related to one or more aspects of nanotechnology in water research. Students are highly recommended to select your most interested topics on nanotechnology for the video presentation, so the instructor (Dr. Wang) can pay more attention to related topics throughout the course lectures.

Grading Policy:

Percent	Grade	Grade Points
≥ 90.0	A	4.00
87.0 – 89.9	A-	3.67
84.0 – 86.9	B+	3.33
80.0 – 83.9	B	3.00
77.0 – 79.9	B-	2.67
74.0 – 76.9	C+	2.33
70.0 – 73.9	C	2.00
67.0 – 69.9	C-	1.67
60.0 – 66.9	D	1.33
0.00 – 59.9	E	0.00

More information on UF grading policy may be found at:

UF Graduate Catalog
Grades and Grading Policies

Attendance Policy and Resources:

Academic policies for this course are consistent with university policies. See https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/

Campus Health and Wellness Resources:

Visit https://one.uf.edu/whole-gator/topics for resources that are designed to help you thrive physically, mentally, and emotionally at UF.
Please contact UMatterWeCare for additional and immediate support.

Software Use:

All faculty, staff and students of the university 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.

Student Privacy:

- Instructure (Canvas)
  - Instructure Privacy Policy
  - Instructure Accessibility
- Zoom
  - Zoom Privacy Policy
  - Zoom Accessibility