國立中正大學課程大綱

National Chung Cheng University

Course Syllabus

<table>
<tr><td>學年/學期(Academic Year / Semester)</td><td colspan="3">115/1</td></tr>
<tr><td>課程名稱
(Course name)</td><td colspan="3">Advanced Environmental Chemistry (高等環境化學)</td></tr>
<tr><td>課碼(Course code)</td><td>2365035
2708006</td><td>學分數 Credit(s)</td><td>3</td></tr>
<tr><td rowspan="4">授課教師(Instructor)</td><td colspan="3">Chien-Yen Chen
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Tel: +886-5-2720411 ext. 66220</td></tr>
<tr><td colspan="3">■Professor □Associate Professor □Assistant Professor</td></tr>
<tr><td colspan="3">Sharma, Raju Kumar 夏宇恩
Email: Raju28212@gmail.com</td></tr>
<tr><td colspan="3">■Project Research Fellow</td></tr>
<tr><td>授課方式
(teaching methods)</td><td colspan="3">□ Lab □ Seminar ■ Student Presentation ■ Lecture □ other</td></tr>
<tr><td>先修科目(Prerequisite)</td><td colspan="3">This course provides advanced knowledge of environmental chemistry, focusing on chemical processes in aquatic, terrestrial, and atmospheric systems. The course covers environmental thermodynamics, reaction kinetics, water chemistry, soil and sediment chemistry, atmospheric chemistry, contaminant behavior, environmental analytical methods, and remediation technologies. Through interdisciplinary co-teaching, students will connect fundamental environmental chemistry with current research applications in environmental monitoring, contaminant assessment, and pollution control.</td></tr>
<tr><td>課程介紹與教學目標
(Course Description and Objectives)</td><td colspan="3">Course Description–(3 credits): Advanced Environmental Chemistry provides an in-depth understanding of the chemical principles governing natural and engineered environmental systems. The course focuses on environmental thermodynamics, chemical equilibria, reaction kinetics, contaminant behavior, transport and transformation processes in aquatic, terrestrial, and atmospheric environments. Students will examine the chemistry of metals, organic pollutants, and emerging contaminants, together with modern environmental analytical techniques and remediation technologies. Emphasis is placed on linking fundamental chemical principles with contemporary environmental challenges and current research developments in</td></tr>
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	environmental science. **Objectives**: Students who successfully complete this course should have: a. A comprehensive understanding of chemical processes occurring in aquatic, terrestrial, and atmospheric environments. b. An understanding of environmental thermodynamics, chemical equilibria, reaction kinetics, and contaminant transformation processes. c. Knowledge of the environmental behavior, transport, fate, and risk associated with inorganic and organic pollutants. d. Familiarity with modern environmental analytical techniques used for environmental monitoring and assessment. e. An understanding of remediation technologies and chemical approaches for pollution control and environmental management. f. The ability to critically evaluate scientific literature and apply environmental chemistry concepts to contemporary environmental challenges.
教科書及參考書 (Textbooks and References)	**Textbooks** 1. Manahan, S. E. *Environmental Chemistry*, 11th Edition, CRC Press. 2. Stumm, W. and Morgan, J. J. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*, 3rd Edition, Wiley. 3. Schwarzenbach, R. P., Gschwend, P. M., and Imboden, D. M. *Environmental Organic Chemistry*, 3rd Edition, Wiley. **References** 1. Sparks, D. L. *Environmental Soil Chemistry*, 2nd Edition, Academic Press. 2. Wiesner, M. and Bottero, J. Y. *Environmental Nanotechnology: Applications and Impacts of Nanomaterials*, McGraw-Hill.
學習評量與成績配分 (Assessment and Grade scale)	Exam-1…….20% (Week-09) Exam-2…….30% (Week-18) Homework……20% Oral Presentations…….30%

課程要求 (Course Requirements)	Attendance and presentations are required
課程進度(Course Schedule)	
Week	Contents
PART-1:	**INTRODUCTION TO ENVIRONMENTAL CHEMISTRY**
Week 01	Introduction to Environmental Chemistry: Environmental compartments (atmosphere, hydrosphere, lithosphere, and biosphere). Global environmental challenges and sustainability. Chemical principles governing environmental systems.
PART-2:	**FUNDAMENTAL CHEMICAL PROCESSES IN ENVIRONMENTAL SYSTEMS**
Week 02	Environmental thermodynamics and chemical equilibria: Equilibrium constants, Gibbs free energy, environmental speciation, and chemical partitioning.
Week 03	Environmental reaction kinetics and transformation processes: Reaction rates, degradation pathways, redox reactions, and environmental persistence of pollutants.
PART-3:	**CHEMISTRY OF NATURAL ENVIRONMENTAL SYSTEMS**
Week 04	Aquatic environmental chemistry: Water quality parameters, acid-base equilibria, carbonate systems, alkalinity, hardness, and dissolved oxygen dynamics.
Week 05	Atmospheric chemistry and air pollution: Atmospheric composition, photochemical reactions, greenhouse gases, ozone chemistry, aerosols, and particulate matter.
Week 06	Soil and sediment chemistry: Surface interactions, mineralogy, organic matter, nutrient cycling, sorption processes, and contaminant retention.
PART-4:	**ENVIRONMENTAL CONTAMINANTS AND THEIR FATE**
Week 07	Heavy metals and trace elements in the environment: Sources, speciation, mobility, bioavailability, toxicity, and remediation approaches.
Week 08	Environmental organic chemistry: Pesticides, pharmaceuticals, personal care products, endocrine-disrupting compounds, PFAS, and emerging contaminants.
Week 09	**Mid-term Exam**
PART-5:	**CONTAMINANT TRANSPORT, TRANSFORMATION,**

	AND RISK ASSESSMENT
Week 10	Transport and distribution of contaminants in environmental systems: Advection, dispersion, diffusion, partitioning, volatilization, and bioaccumulation processes.
Week 11	Surface and interfacial chemistry in environmental systems: Adsorption mechanisms, colloidal interactions, and environmental partitioning.
Week 12	Transformation and degradation of environmental contaminants: Hydrolysis, oxidation-reduction, photochemical reactions, and biodegradation pathways.
Week 13	Environmental toxicology and risk assessment: Exposure pathways, dose-response relationships, ecological impacts, and human health considerations.
PART-6:	**ENVIRONMENTAL ANALYTICAL CHEMISTRY AND REMEDIATION**
Week 14	Environmental analytical techniques. UV-Vis, FTIR, ICP-OES, ICP-MS, GC-MS, LC-MS, XRD, SEM, and interpretation of environmental data.
Week 15	Environmental remediation chemistry: Adsorption, advanced oxidation processes, photocatalysis, membrane technologies, and contaminant removal mechanisms.
Week 16	Case studies in environmental pollution and remediation: Critical evaluation of contemporary environmental chemistry research.
Week 17	Specific Topic Presentations by students
Week 18	**Final Exam**