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Fall 2018

# CHE 750 - Environmental Catalysis

Xianqin Wang

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# CHE 750: Environmental Catalysis

## On-line Course

### Fall 2018

**Course Time/Location:**

**Instructor: Xianqin Wang**

**Lecture Materials will be uploaded to NJIT Moodle.**

<http://njit2.mrooms.net/course/view.php?id=24711>

**Office Hours:** You can ask questions by email ([xianqin@njit.edu](mailto:xianqin@njit.edu)) or through Moodle anytime. I will try to **answer all your questions by every Friday evening** if I can not respond you right away due to other activities.

**Prerequisite(s):** ChE undergraduate core courses including Thermodynamics, Kinetics and Reactor Design, and Transport Phenomena

**Required Materials:** The materials covered are mainly from the following text books:

1. Ronald M. Heck, Robert J. Farrauto, Suresh T. Gulati, Catalytic Air Pollution Control (CAPC), Third Edition, ISBN:9780470275030 |Online ISBN:9781118397749
2. John Meurig Thomas, W. John Thomas; Principles and Practice of Heterogeneous Catalysis (PPHC), 2nd Edition, ISBN: 978-3-527-31458-4, Feb 2015, 768 pages

**Course Description:** This course is to introduce students (including MS and PhDs) to the fundamentals of catalysis in abating pollutant emissions and developing future environmentally friendly energy technologies. A review of catalysis fundamentals, including catalyst preparation methods and characterization techniques, and the correlation between structural properties and catalyst activities, will be covered. Several popular environmental processes including mobile and stationary pollution abatement technologies will be discussed, including automobile catalytic converters, diesel truck emission control, and catalytic abatement of chemical plant emissions. In addition, the use of catalysis for “green” alternative energy processes will also be reviewed including fuel cell systems, bio-fuel production, bio-fuel refining, and CO<sub>2</sub> sequestration. For each technology, the discussion will cover both the chemistry occurring on the catalyst surface as well as the engineering involved in the overall process.

**Course Outcomes (CO):** By the end of the course students should be able to:

1. Explain catalysis chemistry and catalytic reactor engineering
2. Understand the modern catalytic pollution abatement and emerging “green” catalytic processes;
3. Know different kinds of catalytic materials and their structural properties
4. Know different kinds of catalyst characterization techniques and data analysis from each technique
5. Understand structural and activity correlations

## **Assignments:**

### **Homework:**

HW work assignments and exam problems will be posted in Moodle. You can submit your homework to the instructor either by email ([xianqin@njit.edu](mailto:xianqin@njit.edu)) or post your homework on Moodle.

### **Group Project:**

Each group will design a creative system or unit using catalytic systems. The project should include a description of the design (draw pictures if necessary) (**written report**), and be presented to the whole class via **Skype (presentation)**. **The files must to be sent to the instructor one day before the presentation.**

*Written report:* 15-20 page technical paper on approved topic with overview, presentation of present status and issues, analysis of sustainability options for the future, and references. All pages must be formatted to fit on 8-1/2 by 11 inch paper with no smaller than 12 point font and margins not less than one inch on every side.

*Oral presentation:* 25 minute formal oral presentation of the topic selected for the term paper plus 5 minutes of Q&A. **The files must be sent to the instructor one day before the presentation.**

### **Grading:**

Homework: 20% (200 pts) (individual effort)

Group design project: (group effort)

    Written report: 20% (200 pts)

    Oral presentation: 20% (200 pts)

Midterm exam (take home) 20% (200 pts) (individual effort)

Final exam (take home): 20% (200 pts) (individual effort)

Letter grades will be awarded for the following totals:

A	900 - 1000 pts
B+	825 - 899 "
B	750 - 824 "
C+	700 - 749 "
C	650 - 699 "
F less than	650 "

**NJIT HONOR CODE:** The NJIT honor code is being upheld on all issues related to the course. Students are expected to be familiar with the code and conduct themselves accordingly.

**Group activities policy:** Each student will be asked at the end of the semester to confidentially rate his/her performance/effort as well as that of all his/her groupmates. This rating will reflect the performance when the members were actually present. The completed evaluation form has to be submitted either as a hard copy in a sealed envelope or as a word-file attached to an e-mail to the instructor. Evaluation forms are due on **reading day**. **Submissions of forms after the**

**due date but before the final exam will result in a 75% reduction of credit that the student would have received if the form was submitted timely.**

date	week	Tentative topics	CAPC	PPHC	Homework
9/3/2018	week1	Introduction	Ch1.	Ch1. Ch2.	
9/10/2018	week2	Catalyst Materials and Preparation	Ch2.	Ch4.	HW1
9/17/2018	week3	Catalyst Characterization and Deactivation	Ch3. Ch5.	Ch3. Ch6.	HW1 due
9/24/2018	week4	Catalyst electronic structure and activity correlation		Ch5.	
10/1/2018	week5	Reactor Design for Environmental Catalysis	Ch4	Ch7.	HW2
10/8/2018	week6	Automotive Catalyst	Ch6. Ch7		HW2 due
10/15/2018	week7	Diesel Engine Emission Control	Ch8. Ch9.		HW3
10/22/2018	week8	Mid-term exam-take home			
10/29/2018	week9	Volatile organic compounds (VOCs control)	Ch11.		HW3 due
11/5/2018	week10	NOx reduction and hydrotreating	Ch12.		HW4
11/12/2018	week11	CO and CHx control	Ch13.		HW4 due
11/19/2018	week12	no lecture (Thanksgiving holiday)			HW5
11/26/2018	week13	Fuel Cells	Ch16		HW5 due
12/3/2018	week14	Biofuels	Ch16		
12/10/2018	week15	Skype Presentation for the project			HW6
12/12/2018	week16	Final exam week-take home			HW6 due
12/22/2018		project written report due			

CAPC: Catalytic air pollution control

PPHC: Principles and Practice of Heterogeneous Catalysis

## **Student Resources:**

### [Academic Advising Success Center](#)

“...assist in the advisement of students who are undecided in their major, transitioning into another major at NJIT, and those students who need additional support to graduate successfully and in a timely manner.”

### [Academic Integrity](#)

NJIT has a zero-tolerance policy regarding cheating of any kind and student behavior that is disruptive to a learning environment. Any incidents will be immediately reported to the Dean of Students. In the cases the Honor Code violations are detected, the punishments range from a minimum of failure in the course plus disciplinary probation up to expulsion from NJIT with notations on students' permanent record. Avoid situations where honorable behavior could be misinterpreted.

### [Academic Support and Student Affairs](#)

“From questions about becoming a student at NJIT – to student engagement – to searching for information on career development, the Division of Academic Support and Student Affairs Staff is here to help.”

### [Additional Tutoring Centers](#)

[Math Learning Center](#); [Chemistry Learning Center](#); [The Writing Center](#); [ECE Study Groups](#)

### [Bookstore](#)

“Show your New Jersey Institute Of Technology pride all year long with our authentic assortment of New Jersey Institute Of Technology collegiate apparel...Plus, our selection of [textbooks](#), [computers](#), and [supplies](#) will ensure every New Jersey Institute Of Technology student is prepared for success.”

### [Center for Counseling and Psychological Services](#)

“The NJIT Center for Counseling and Psychological Services (C-CAPS) is committed to assisting students in the achievement of their academic goals as well as benefiting from their personal experience on campus. College life can be personally challenging and stressful at times. We believe that the educational process is an important component of the development of the individual as a whole person. Our goal is to optimize the college experience and improve the quality of the lives of our students by promoting their mental health and facilitating students' personal, academic and professional growth.”

### [Disability Support Services](#)

“The Disability Support Services office works in partnership with administrators, faculty and staff to provide reasonable accommodations and support services for students with disabilities that have provided our office with documentation to receive services.”

### [IST Service Desk](#)

“The IST Service Desk is the central hub for computing information and first point of contact for getting help and reporting issues related to computing technology at NJIT.

There is much technology here at NJIT, and many ways to find information or get help with it.”

[The Learning Center](#)

“Our mission is to assist students both in the classroom and beyond by providing tutorial services, academic coaching, academic and personal enrichment workshops and staff and peer support so students can meet the demands of their coursework and are prepared for life after graduation.”

[Moodle Help Page](#)

Tutorials for students.

[Robert W. Van Houten Library](#)

“The Van Houten Library offers electronic and print resources essential to the mission of New Jersey's science and technology university, including a core collection of academic books, databases, and journals, as well as research and consultation services.”

[Student Financial Aid Services](#)

“Student Financial Aid Services (SFAS) at NJIT is committed to providing you with every opportunity to obtain funding to support your undergraduate educational costs at NJIT.”