Spring 2021

CHE 370-002: Heat and Mass Transfer

Xianqin Wang

Spring 2021 Academic Calendar

January	18	Monday	Martin Luther King, Jr. Day
January	19	Tuesday	First Day of Classes
January	23	Saturday	Saturday Classes Begin
January	25	Monday	Last Day to Add/Drop a Class
January	25	Monday	Last Day for 100% Refund, Full or Partial Withdrawal
January	26	Tuesday	W Grades Posted for Course Withdrawals
February	2	Tuesday	Last Day for 90% Refund, Full or Partial Withdrawal, No Refund for Partial Withdrawal after this date
February	15	Monday	Last Day for 50% Refund, Full Withdrawal
March	8	Monday	Last Day for 25% Refund, Full Withdrawal
March	14	Sunday	Spring Recess Begins - No Classes Scheduled - University Open
March	21	Sunday	Spring Recess Ends
April	2	Friday	Good Friday - No Classes Scheduled - University Closed
April	5	Monday	Last Day to Withdraw
May	4	Tuesday	Friday Classes Meet
May	4	Tuesday	Last Day of Classes
May	5	Wednesday	Reading Day 1
May	6	Thursday	Reading Day 2
May	7	Friday	Final Exams Begin
May	13	Thursday	Final Exams End
May	15	Saturday	Final Grades Due
TBA			Commencement

1. **ChE 370 Heat and Mass Transfer**
   Spring 2021

Synchronized online class						
Type	**Time**	**Days**	**Where**	**Date Range**	**Schedule Type**	**Instructors**
Class	10:00 am - 12:05 pm	MW	webex	Jan 19, 2021 - May 13, 2021	Lecture	Xianqin Wang

Webex link: invitation is sent through the webex, make sure you accept the invitation!! T

On-time arrival for the start of class is expected.

. **Remember that you're responsible for in-class topics.**

2. **Credits and contact hours**
   (4-0-4) (Lecture hr/wk-lab hr/wk-course credits)

3. **Course coordinator/instructor**

Dr. **Xianqin Wang**
xianqin@njit.edu (e-mail)

Office Hours (via Webex: https://njit.webex.com/meet/xianqin)

Monday and Wednesday 1-2pm

(note: you can always make appointment with me by email if the office hour time conflicts with your classes)

4. **Specific course information**

General:

CHE 370 - HEAT AND MASS TRANSFER (4 credits). The principles of heat and mass transfer in chemical engineering systems are covered. Steady and unsteady heat transfer is examined, with emphasis on the heat exchanger design. Mass transfer by steady and unsteady molecular diffusion, and turbulent convective mass transfer is studied.

Pre-requisites: ChE 240, ChE 260, Math 222.

Textbooks Textbooks: Required - Heat and Mass Transfer: Fundamentals and Applications–by Yunus Cengel and Afshin Ghajar. 6th edition

ISBN 978-0-07-339819-8 (bound edition)
MHID 0-07-339819-5 (bound edition)

ISBN 978-1-260-44002-7 (loose-leaf edition)
MHID 1-260-44002-8 (loose-leaf edition)

Recommended –1) Transport Phenomena Fundamentals, Third Edition by Joel L. Plawsky. ISBN-13: 978-1466555334 ISBN-10: 1466555335 2) Transport Phenomena, Revised 2nd Edition by R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot. ISBN-13: 978-0470115398 ISBN-10: 0470115394

Required Software: Latest versions of Matlab, MS Office, Adobe Reader (all can be downloaded from NJIT IST webpage). Student Mall labs and ChE department PC lab have most of the software. Please see Highlander Pipeline for Matlab tutorial and example programs.

5. Specific goals for the course

a. The student will be able to

1. define heat transfer mechanisms and bring examples of them
2. work with the units of heat transfer variables and convert between different unit systems
3. analyze general heat transfer problems using energy balance
4. define thermal resistance, formulate and solve simple heat conduction problems
5. evaluate fin efficiency and shape factor and use them to solve selected problems
6. formulate and solve steady-state heat conduction equation for multi-dimensional problems
7. find analytical solutions for transient one-dimensional conduction problems in selected examples
8. use the basic concepts of convective heat transfer flows for analysis of selected examples
9. evaluate the friction factor and Nusselt number for laminar and turbulent flows over a flat plate using semi-empirical relations and calculate the heat transfer rate
10. evaluate the friction factor and Nusselt number for fully developed internal laminar and turbulent flow using semi-empirical relations and calculate the heat transfer rate
11. evaluate the Nusselt number for natural convection over vertical, horizontal, and inclined plates and cylinders and calculate the heat transfer rate
12. analyze the performance of heat exchangers using the logarithmic mean temperature difference (LMTD) method
13. analyze the performance of heat exchangers using the number of transfer units (NTU) method
14. use basic concepts of thermal radiation to estimate heat transfer in selected examples
15. define and analyze mass transfer problems using mass balance
16. work with the units of mass transfer variables and convert between different unit systems
17. apply basic models to analyze mass transfer processes in selected examples
18. evaluate the mass transfer rate for convective mass transfer in laminar and turbulent flows using the heat-mass analogy

19. work in a team on a short project to acquire new knowledge on specific heat & mass transfer applications and quantify these processes using concepts learned in the class
19. prepare and submit the project progress/final reports & slides on the class website and give an oral presentation in the class

b. This course explicitly addresses the following student outcomes: 1, 3, 5, 7

6. Topics

1. Introduction and basic concepts
2. Heat conduction equation in 1D, 2D and 3D
3. Steady heat conduction
4. Transient heat conduction
5. Fundamentals of convection
6. Heat exchangers
7. Fundamentals of thermal radiation
8. Mass transfer

7. Grading

The final grade on a 1000 point basis as follows:

Homework (team work)	100 pts	(10%)
Quizzes (individual)	100 pts	(10%)
Group project presentation	150 pts	(15%)
1st term exam (individual)	200 pts	(20%)
2nd term exam (individual)	200 "	(20%)
Final exam (individual)	250 "	(25%)

Letter grades will be awarded for the following totals:

A	850 and above
B+	800-849 "
B	750-799 "
C+	700-749 "
C	650-699 "
D	550-649 "
F less than	550 "

8. Policies on assignments/exams and classroom policy

Homework policy: Homework assignments will be collected and graded. Homework assignments are the responsibility of the students. You are strongly advised to work on the homework problems because you will NOT learn this material unless you get into the materials **"Hands-on".** All solutions will be posted on the course *Canvas* site. All

homework assignments, however, must be *submitted before the solutions are reviewed in class*.

Quizzes There will be quizzes occasionally at the beginning of the class. If you miss the class, you will miss the quiz that day. There will be no makeup quiz! **Close book and close notes!**

Group activities policy:
Everyone within a Term Project group must contribute effort equally. A Peer & Self Evaluation will be done after the group projects are submitted. 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 group-mates. The completed evaluation form has to be attached to an e-mail to the instructor. Evaluation forms are due on May 5th 2021. Submission of the form after May 5th 2021 and before the final exam will result to the late submitter getting 75% of the credit that he/she would had received if the form was submitted timely. Submission of the form at the final exam will lead to a further 25% reduction of the credit. No student will be allowed to take the final exam without prior submission of the self & peer evaluation form.

Exam policy: All exams are open **textbook**/ **instructor lecture** notes. Graded homework problems **cannot** be used during exams. Additional personal notes on the course (or solutions to additional problems), copies of class notes, as well as copies of the instructor's solutions to homework problems are also **not allowed** to be used during exams. Graded exams will be returned a week after they are taken.

1) **Cheating on exams will not be tolerated.**
2) **Your textbook, class notes and calculator are the only things allowed**
3) **Turn on your camera and adjust your camera to allow the instructor to see you.**
4) **Cellphone MUST be OFF except that you use your cellphone camera for your exam!**
5) **It is your own responsibility to make sure you submit all the pages of your exam!!!!**

Policy on exams (other than final): A student must have a compelling reason to miss an exam. Documentation of the reason (e.g., doctor's note) is needed for the instructor to consider giving a make-up exam. A student who cannot make it to an exam needs to either e-mail or call and leave a voice message for the instructor **before** the exam is held. **A single (comprehensive) make-up exam will be given on the reading day (May 5th 2021) for those who have missed an exam for documented/ legitimate reasons.**

Policy on final exam: The final exam will be based on the entire course material. Students missing the final exam without a documented serious excuse fail the course. Students missing the final exam with a documented serious reason get an Incomplete. The Incomplete will be removed after students take the final exam in Fall 2021 (grade to count towards 25% of the composite). If the course is not offered in Fall 2021, a special make-up final will be scheduled during the Fall 2021 finals week.

Disputing a grade on tests/assignments: If a student has questions about the grade he/she has received on an exam, homework, or group activity he/she must talk to the instructor (or the teaching assistant where appropriate) **no later than a week after the graded activity has been returned to students. No grade change will be made after the one week period.**

Term Project: Work in groups (you form). A Peer & Self Evaluation will be done at the conclusion of the project that will impact your grade; more details later. A group project presentation is required at the end of the semester. Everyone should present part of their project. A group project report is recommended, but not mandatory.

***Canvas* Site:** http://canvas.njit.edu --- Please check this site and your email often (at least once a day). Many useful information will be posted

9. Tentative Schedule

				Tentative topics
Lecture 1	Week1	20-Jan	Wednesday	Chapter 1
Lecture 2	Week2	25-Jan	Monday	Chapter 1
Lecture 3		27-Jan	Wednesday	Chapter 2
Lecture 4	Week3	1-Feb	Monday	Chapter 2
Lecture 5		3-Feb	Wednesday	Chapter 2
Lecture 6	Week4	8-Feb	Monday	Chapter 2/3
Lecture 7		10-Feb	Wednesday	Chapter 3
Lecture 8	Week5	15-Feb	Monday	Chapter 3
Lecture 9		17-Feb	Wednesday	Chapter 3
Lecture 10	Week6	22-Feb	Monday	Chapter 4
Lecture 11		24-Feb	Wednesday	Chapter 4
Lecture 12	Week7	1-Mar	Monday	Chapter 4
Lecture 13		3-Mar	Wednesday	Chapter 6
Lecture 14	Week8	8-Mar	Monday	Chapter 6
Lecture 15		10-Mar	Wednesday	1st term exam
	Week9	15-Mar	Monday	spring break
		17-Mar	Wednesday	spring break
Lecture 16	Week10	22-Mar	Monday	Chapter 11
Lecture 17		24-Mar	Wednesday	Chapter 11
Lecture 18	Week11	29-Mar	Monday	Chapter 11
Lecture 19		31-Mar	Wednesday	Chapter 11
Lecture 20	Week12	5-Apr	Monday	Chapter 12
Lecture 21		7-Apr	Wednesday	Chapter 12
Lecture 22	Week13	12-Apr	Monday	Chapter 12
Lecture 23		14-Apr	Wednesday	Chapter 14
Lecture 24	Week14	19-Apr	Monday	Chapter 14
Lecture 25		21-Apr	Wednesday	Chapter 14
Lecture 26	Week15	26-Apr	Monday	Chapter 14
Lecture 27		28-Apr	Wednesday	2nd term exam
Lecture 28	Week16	3-May	Monday	Project presentation
		5-May	Wednesday	Makeup exam
		6-May	Thursday	Reading day
		TBA		Final exam

10. HW problems

Chapter	HW problems
Chapter 1	28,59, 65,70,89,131
Chapter 2	67,72,81,99, 106,122
Chapter 3	28E, 37E, 71,83,96,142

Chapter 4	21,63,94,111,115, 159
Chapter 6	73,88E,98, 103,109,115
Chapter 11	65,78,81,122,130,160
Chapter 12	34,57,94,96,131,136
Chapter 14	64,82,94,107,116E,138

11. Exam preparation

1. Understand lecture materials and basic concepts
2. Do all homework problems
3. Do example problems covered in lectures