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Spring 2020

CHE 370-002: Heat and Mass Transfer

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Syllabus
ChE 370 Heat and Mass Transfer
Spring 2020

Otto H. York Department of Chemical & Materials Engineering
New Jersey Institute of Technology

Spring 2020 Academic Calendar

January	20	Monday	Martin Luther King, Jr. Day
January	21	Tuesday	First Day of Classes
January	25	Saturday	Saturday Classes Begin
January	31	Friday	Last Day to Add/Drop a Class
January	31	Friday	Last Day for 100% Refund, Full or Partial Withdrawal
February	1	Saturday	W Grades Posted for Course Withdrawals
February	3	Monday	Last Day for 90% Refund, Full or Partial Withdrawal, No Refund for Partial Withdrawal after this date
February	17	Monday	Last Day for 50% Refund, Full Withdrawal
March	9	Monday	Last Day for 25% Refund, Full Withdrawal
March	15	Sunday	Spring Recess Begins - No Classes Scheduled - University Open
March	22	Sunday	Spring Recess Ends
April	6	Monday	Last Day to Withdraw
April	10	Friday	Good Friday - No Classes Scheduled - University Closed
May	5	Tuesday	Friday Classes Meet
May	5	Tuesday	Last Day of Classes
May	6	Wednesday	Reading Day 1
May	7	Thursday	Reading Day 2
May	8	Friday	Final Exams Begin
May	14	Thursday	Final Exams End
May	16	Saturday	Final Grades Due

General course information

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.

Days/ Times: Monday, 01:00 PM - 03:05 PM, KUPF 106
Wednesday, 11:30 AM - 01:35 PM, KUPF 209

Pre-requisites: Chemical Process Calculations II (ChE 240), Fluid Flow (ChE 260), Differential Equations (Math 222)

Credits and contact hour
4 credits, 4 contact hours

Course coordinator/instructor
Dr. Boris Khusid
Faculty Memorial Hall 215 (office); 973-596-5707 (phone); khusid@njit.edu (e-mail)
http://chemicaleng.njit.edu/people/khusid.php (website)

Office Hours Faculty Memorial Hall R215, Monday, 9 am-12:20 pm
Note: you can always schedule an appointment by email if the office hour time conflicts with your classes

Specific course information
Textbooks: **Required** - Yunus Cengel and Afshin Ghajar, Heat and Mass Transfer: Fundamentals and Applications, 5th Ed, McGraw-Hill, 2015
https://www.mheducation.com/highered/product/M0073398187.html

Recommended –1) J.R. Welty, G.L. Rorrer, D.G. Foster, Fundamentals of Momentum, Heat and Mass Transfer, 6th Edition, Wiley, 2014
http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118804279.html
2) R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, Transport Phenomena, Revised 2nd Edition, Wiley, 2009
https://www.wiley.com/en-us/Transport+Phenomena%2C+Revised+2nd+Edition-p-9780470508633

Other learning material: The lecture notes to be posted on the class website give a summary of the material. Please print and bring them along with your textbook and calculator to the class. You will make additional notes during the lectures.

Required software: Latest versions of 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.

Course objectives
1: Provide students with knowledge of fundamental concepts of heat & mass transfer and skills for design of heat & mass transfer components and systems
2: Teach students how to develop mathematical models of heat & mass transfer and use them in analysis of practical applications
3: Develop skills to work in a team to acquire new knowledge on specific heat & mass transfer applications and communicate it in written & verbal form

Grading
Your performance will be graded on an absolute scale, so your grade is not affected by how others do. Final letter grades will be awarded based on your weighted average score as follows:

Homework (individual)	10%
Quizzes (individual)	10%
In-class group activities	10%
Group project (team work)	20%
Mid-exam (individual)	15%
Final exam (individual)	35%

Letter grades will be assigned automatically by an Excel code based on the following totals:

A (Superior)	85% and above
B+ (Excellent)	80%-84.9%
B (Very Good)	75%-79.9%
C+ (Good)	70%-74.9%
C (Acceptable)	65%-69.9%
D (Minimum)	55%-64.9%
F (Inadequate)	Less than 55%

For success, you are strongly advised to

Review/work on the material of the previous lecture before the next class.
Read the lecture notes and covered sections of the required textbook,
Bring the printed lecture notes to class along with the computer and calculator,
Take additional notes during the lectures
Work out all derivations and examples in the lecture notes and in-class examples on your own after each lecture.
In case of questions, please see the instructor during Office Hours or raise questions in the class. Do not delay this to the exam week.

Policies on assignments/exams and classroom policy
Homework is an integral part of the course:

- Homework is collected at the beginning of the class.
- Late homework will not be accepted for grading; if you cannot attend the class you have send the solution to the instructor before the class in **.doc or .pdf formats**.
  Do not send images taking with cell phone!
- Feedback on the homework will be provided during lectures, solutions will be discussed and posted on the class website; graded homework will be returned
- Each problem will be graded individually

You are allowed to discuss HW problems with peer students, but cannot copy the solution.

CME Department policy on electronic devices:

- Electronic devices (i.e., cell phones, tablets, and laptops) are allowed for using in class only when the work specifically assigned requires live external connection for data, or during in-class presentations.
- The use of electronic devices (i.e., cell phones, tablets, and laptops) that can communicate externally is not allowed during quizzes and exams.

Classroom policies:

- Attendance is important. There is a high correlation between failure and poor class attendance
- Eating and drinking are not allowed during class

- Behave professionally and show respect to fellow students and the instructor

Quizzes:

There will be quizzes occasionally in the class. If you miss the class, you will miss the quiz that day. There will be no makeup quiz.

Group project assignment

Students will work as a team by cooperating in a group to carry out a short project on specific applications of heat & mass transfer process, prepare and post the progress/final reports & slides on the class website, and give an oral presentation at the class. **Guidelines** for preparing a project, topics & abstracts of previously presented projects and **detailed criteria for grading** the project report and oral presentation are posted on the class website. Topics previously presented serve as examples, **but cannot be copied**!

In-class project/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 group-members. The evaluation form is listed in the syllabus and posted on the class website. 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.
- Submission of the form after Reading Day and before the final exam will lead to 25% reduction of the credit for project.
- A student **will not be allowed** to take the final exam without prior submission of the self & peer evaluation form.

Exam policy:

There will be one midterm and one final exams; both are open book & lecture notes, calculators can be used. Exact date of the midterm exam will be announced a week before.

- The comprehensive final exam during Finals' week will cover the course materials.
- The midterm and final exams must be completed individually, in accordance with the NJIT Honor Code.
- Each exam problem will be graded independently.
- A missed midterm exam will be averaged into the final grade as zero, unless an excuse is obtained. Excuses are granted only for very serious circumstances attested to by the NJIT Dean of Student Office. A student who has been excused will be required to take a makeup exam.
- A students missing the final exam without a documented reason will get an Incomplete.

Disputing a grade on tests/assignments:

If a student has questions about the grade received for an exam, homework, or project, 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.

Accommodations due to disability: If you need accommodations due to a disability please contact Center for Student Success Disability Support Services, Fenster Hall Room 260 to discuss your specific needs. A Letter of Accommodation Eligibility from the Disability Support Services office authorizing your accommodations will be required.

Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your

educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf .

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

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 post 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: a, d, e, g, i, k; 1, 3, 5, 7

Tentative weekly listing of topics (15-week schedule)

Week	Book Chapters
1	Chapter 1
2	Chapter 1/2

3	Chapter 2
4	Chapter 2/3
5	Chapter 4
6	Chapter 4/6
7	Chapter 6/7 Midterm exam
8	Chapter 7/8
9	Chapter 8/9
10	Chapter 10/11
11	Chapter 11/12
12	Chapter 12/14
13	Chapter 14
14	Chapter 14
15	Chapter 14/Project presentation