Spring 2019

CHE 370-102: Heat and Mass Transfer

Boris Khusid

Syllabus
ChE 370 Heat and Mass Transfer
Spring 2019

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

Spring 2019 Academic Calendar

January	21	Monday	Martin Luther King, Jr. Day
January	22	Tuesday	First Day of Classes
January	26	Saturday	Saturday Classes Begin
February	1	Friday	Last Day to Add/Drop a Class
February	1	Friday	Last Day for 100% Refund, Full or Partial Withdrawal
February	2	Saturday	W Grades Posted for Course Withdrawal
February	4	Monday	Last Day for 90% Refund, Full or Partial Withdrawal - no refund for partial withdrawal after this date
February	18	Monday	Last Day for 50% Refund, Full Withdrawal
March	11	Monday	Last Day for 25% Refund, Full Withdrawal
March	17	Sunday	Spring Recess Begins - No Classes Scheduled - University Open
March	24	Sunday	Spring Recess Ends
April	8	Monday	Last Day to Withdraw
April	19	Friday	Good Friday - No Classes Scheduled - University Closed
May	7	Tuesday	Friday Classes Meet
May	7	Tuesday	Last Day of Classes
May	8	Wednesday	Reading Day 1
May	9	Thursday	Reading Day 2
May	10	Friday	Final Exams Begin
May	16	Thursday	Final Exams End
May	18	Saturday	Final Grades Due
TBA			Commencement

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: Thursday: CKB 204, 05:45 PM - 09:35 PM

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

Credits and contact hours
(4-0-4) (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)
https://chemicaleng.njit.edu/faculty/khusid (website)

Office Hours Thursday: 4:00 – 5:30 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 Moodle website give a summary of the material. Please print and bring them along with your textbook, laptop, 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 examples
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%
Group project (team work)	25%
Mid-exam (individual)	20%
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.
- Feedback on the homework will be provided during lectures, solutions will be discussed and posted on the MOODLE 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.

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 (up to 3) to carry out a short project on specific applications of heat & mass transfer process, prepare and post the progress/final reports & slides on the MOODLE 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 MOODLE 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. 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 May 9, 2019.
- Submission of the form after May 9, 2019 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, computer and calculators can be used. However, the use of the Internet, emails, and cell phones is not allowed to prevent any communication with the outside people.

- Exact date of the midterm exam will be announced a week before.
- The comprehensive final exam during Finals' week will cover the course materials and the topics of students' projects.
- 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.

Course delivery: Converged Learning

Accommodations due to disability: If you need accommodations due to a disability please contact Chantonette Lyles, Associate Director of 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 .

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 7/8
8	Chapter 9/10 Midterm exam
9	Chapter 8/9
10	Chapter 11
11	Chapter 11/12
12	Chapter 12
13	Chapter 12/14
14	Chapter 14
15	Chapter 14/Project presentation

ChE 370 Heat and Mass Transfer
Self and Peer Rating of Project Team Members

Name **Group #:**

Please write the names of all of your team members, INCLUDING YOURSELF, and rate the degree to which each member fulfilled his/her responsibilities in completing the project assignment. The possible ratings are as follows:

Excellent	Consistently went above and beyond (tutored teammates, carried more than his/her fair share of the load)
Very good	Consistently did what he/she was supposed to do, very well prepared and cooperative
Satisfactory	Usually did what he/she was supposed to do, acceptably prepared and cooperative
Ordinary	Often did what he/she was supposed to do, minimally prepared and cooperative
Marginal	Sometimes failed to show up or complete assignments, rarely prepared
Deficient	Often failed to show up or complete assignments, rarely prepared
Unsatisfactory	Consistently failed to show up or complete assignments, unprepared
Superficial	Practically no participation
No show	No participation at all

These ratings should reflect each individual's level of participation, effort, and sense of responsibility, NOT his or her academic ability.

NAME OF TEAM MEMBER	**RATING**

Your signature: Date :