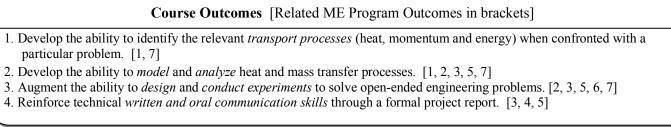
ME 315 HEAT AND MASS TRANSFER



Thermodynamics & Fluid Mechanics Fundamentals (1.5 wks)

Conservation Laws (mass, momentum, energy), Boundary Layer Concept, Velocity Distribution, Laminar and Turbulent Flows, Friction Factor, Pressure Difference, Head Loss, etc.

Heat & Mass Transfer Fundamentals (1.5 wks)

Rate Equations (Fourier's Law, Newton's Law of Cooling, Stefan-Boltzmann Law, Planck's Law, Fick's Law)

Conduction Heat Transfer (4 wks)

- 1. Introduction, Rate Equations
- 2. Rate Equations Combined with Conservation Equations*
- 3. Introduction to Conduction. Generalized Transient Conduction Relationships*
- 4. 1D Steady State Conduction, Thermal Resistance
- 5. Radial Conduction
- 6 Thermal Generation
- 7. Extended Surfaces*
- 8. 2D Steady State Conduction
- 9. Finite Difference Method (steady state)
- 10. Transient Conduction-Lumped Capacitance
- 11. Analytical Results (wall, cylinder, sphere, semi-infinite case)
- 12. Finite Difference Method (transient)

Convection Heat & Mass Transfer (4 wks)

- 1. The Convection Transfer Problem (local & average coefficients)
- 2. Convection Equations
- 3. Dimensionless Forms, Dimensionless Parameters, Similarity
- 4. Heat-Mass Analogy*
- 5. External Flow (flat plate*, cylinder, etc.)
- 6. Internal Flow
- 7. Free Convection
- 8. Two-Phase Heat Transfer (boiling & condensation)
- 9. Heat Exchangers (LMTD and NTU methods)

Radiation Heat Transfer (4 wks)

- 1. Thermal Radiation, Spatial & Spectral Effects
- 2. Energy Balances Incorporating Emission, Absorption & Transmission
- 3. Blackbody Emission
- 4. Real Surface Emission
- 5. Isothermal Enclosure, Kirchhoff's Law
- 6. Gray and Non-Gray Surfaces plus Environmental Radiation
- 7 View Factor
- 8. Blackbody Radiation Exchange
- 9. Diffuse-Gray Surface Radiation Exchange
- 10. Multimode Processes Involving Radiation

Semester Project (8 wk duration) – Typical Projects

• Windshield Defogger

• Heat Exchanger

- Pizza Bag • Jet Impingement

• Heat Sink

- Dimmer Switch (Overheating)
- Thermal Conductivity
- Dynamic Braking

• Silicon Wafer

COURSE NUMBER: ME 315	COURSE TITLE: Heat and Mass Transfer
REQUIRED COURSE OR ELECTIVE COURSE: Required	TERMS OFFERED: Fall and Spring
 TEXTBOOK/REQUIRED MATERIAL: T. Bergman, A.S. Lavine, F.P. Incropera, D.P. DeWitt, <i>Fundamentals of Heat and Mass Transfer</i>, 7th ed, Wiley, 2011. COORDINATING FACULTY: J.H. Choi 	PRE-REQUISITES: ME 308 Fluid Mechanics ME 365 Systems and Measurements CO-REQUISITES: MA 303 Differential Eqns and Partial Differential Eqns for Engineering and the Sciences ME 30801 Fluid Mechanics Laboratory
COURSE DESCRIPTION: Fundamentals of heat transfer by conduction, convection, and radiation; mass transfer by convection. Relevance to engineering applications.	 COURSE OUTCOMES [Related ME Program Outcomes in brackets]: 1. Develop the ability to identify the relevant <i>transport processes</i> (heat, momentum and energy) when confronted with a particular problem.
 ASSESSMENTS TOOLS: 1. Homework 2. 2 90-minute semester exams. 3. Final exam. 4. Laboratory experiment preparation, assignments and summary reports. 5. 8-week open-ended design project. 6. Oral presentations. 7. Final report. 	 [1, 7] 2. Develop the ability to <i>model</i> and <i>analyze</i> heat and mass transfer processes. [1, 2, 3, 5, 7] 3. Augment the ability to <i>design</i> and <i>conduct experiments</i> to solve openended engineering problems. [2, 3, 5, 6, 7] 4. Reinforce technical <i>written</i> and <i>oral communication</i> skills through a formal project report. [3, 4, 5] RELATED ME PROGRAM OUTCOMES: Engineering fundamentals Engineering design Communication skills Ethical/Professional responsibilities Teamwork skills
PROFESSIONAL COMPONENT: 1. Engineering Topics: Engineering Science – 2 credits (50%) Engineering Design – 2 credits (50%)	
NATURE OF DESIGN CONTENT: Problems associated with complicated physical systems which require identifying and rationalizing assumptions. Design-type project on a topic defined by an industrial collaborator or our own staff.	
COMPUTER USAGE : Data acquisition software, LabVIEW, for experiment observations and spread-sheet and/or equation solver software for data analysis and results presentation. Solution of open-ended problems, parameter-sensitivity studies and design-type assignments. Preparation of summary reports for five laboratory experiments and two team project reports. Reports require word processed text and computer-generated graphics.	6. Experimental skills7. Knowledge acquisition skills
 COURSE STRUCTURE/SCHEDULE: 1. Lecture - 3 days per week at 50 minutes 2. Laboratory - 1 day per week at 100 minutes. 	
PREPARED BY: J.H. Choi	REVISION DATE: 10 October 2018