MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 343 Heat Transfer (4) Required

Course Description: (2022-26 Catalog)	Basic principles of heat transfer by conduction, convection, and radiation. Laboratory experiments to characterize thermodynamic material properties, energy conversion processes, thermodynamic cycles, and performance of heat transfer equipment. 3 lectures, 1 laboratory
Prerequisite Courses:	CPE/CSC 101, CSC 231, or CSC 234; and ME 236, ME 302, and ME 341.
Prerequisites by Topic:	Basic engineering courses in fluid mechanics, thermodynamics, solving differential equations, and computer programming.
Textbook: (and/or other required material)	Fundamentals of Heat and Mass Transfer, by Bergman and Lavine, 8th Edition, John Wiley, 2017. ME 350 Heat Transfer Lab Experiments, 7th ed.
References:	Fox and McDonald's Introduction to Fluid Mechanics, by Pritchard and Mitchell, 9th Edition, John Wiley, 2015. Fundamentals of Engineering Thermodynamics, by Moran, Shapiro, Boettner, and Bailey, 8th Edition, 2014.
Course Coordinator/Instructor:	Kim A. Shollenberger, Professor of Mechanical Engineering
Course Learning Outcomes:	1. Explain the physical processes governing conduction, convection, and radiation heat transfer. 2. Solve basic heat transfer problems for temperature distribution and energy transfer rates using both analytical and numerical techniques. 3. Perform thermal/fluids experiments, collect data, and compare reduced data to theoretical models. 4. Interpret laboratory results as related to physical observations and summarize in a report.
Relationship of Course to Mechanical Engineering Student Outcomes:	SO 1: Develop (D) SO 2: Develop (D) SO 3: Develop (D) SO 4:Develop (D) SO 5: Develop (D) SO 6: Develop (D) SO 7:

Topics Covered:

1. Introduction to heat transfer (1 lecture)
2. Introduction to conduction (2 lectures)
   a) Rate equation (Fourier's law)
   b) Conduction energy equation (heat diffusion equation)
3. Steady-state conduction in one-dimension (4 lectures)
   a) Plane wall, cylinder, and sphere
   b) Extended surface (fin) heat transfer and performance
4. Transient Conduction (3 lectures)
   a) Lumped capacitance analysis method
5. Introduction to convection (3 lectures)
   a) Velocity and thermal boundary layer theory
   b) Rate equation (Newton's law of cooling)
   c) Convection energy equation and dimensionless parameters
   d) Analogy between momentum and heat transfer
6. Forced external convection (2 lectures)
   a) Flat plate correlations
   b) Bluff body correlations
7. Forced internal convection (3 lectures)
   a) Velocity and thermal fully developed flow conditions
   b) Overall energy balance analysis; tube correlations
8. Free (or natural) convection (3 lectures)
   a) Physical process for natural convection
   b) Boussinesq approximation for convection energy equation
   c) External flow, internal channel, and cavity correlations
9. Radiation Heat Transfer (3 lectures)
   a) Blackbody Radiation and Spectral Radiation Heat Transfer
10. Radiation Exchange (5 lectures)
    a) Radiation Shape Factors and Radiation Exchange
    b) Multi-mode Heat Transfer

Laboratory Projects: A typical quarter will cover seven experiments that include the following: measurement techniques, heat transfer applications, uncertainty analysis, and report writing.

Class/Lab Schedule: Three 50-minute lectures per week. One 170-minute lab/week.

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credit
(b) Engineering Topics:	3 credits
Design:	1 credit
(c) General Education:	0 credit
(d) Other:	0 credit

Prepared by:
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Date:
8/16/2022