MECHANICAL ENGINEERING PROGRAM

ABET COURSE SYLLABUS

ME 343 Heat Transfer (4) Required

Course Description: (2013-15 Catalog) Basic principles of heat transfer. Conduction, convection, radiation and combined modes. Optional thermal engineering design project. 4 lectures

Prerequisite Courses: ME 341, ME 302 or MATE 380, MATH 244, CSC 231 or CSC 234

Prerequisites by Topic: Basic engineering courses in fluid mechanics, thermodynamics, solving differential equations, and computer programming

Textbook: (and/or other required material) Introduction to Heat Transfer, by Bergman, Lavine, Incropera & DeWitt, 6th Edition, John Wiley and Sons, 2011.

References: Fundamentals of Fluid Mechanics, by Munson, Okiishi, Huebsch, and Rothmayer, 7th Edition, John Wiley and Sons, 2013.
Fundamentals of Engineering Thermodynamics, by M. Moran and H. Shapiro, 6th Edition, John Wiley and Sons, 2008.

Course Coordinator/Instructor: Kim A. Shollenberger, Professor of Mechanical Engineering

Course Learning Outcomes: 1. Understand the physical processes governing the three modes of heat transfer: conduction, convection and radiation.
2. Solve basic heat transfer problems for temperature distribution and energy transfer rates using both analytical and numerical techniques.

Relationship of Course to MECHANICAL ENGINEERING Program Outcomes:												
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	*m*
H	**L**	**M**	**L**	**H**	**M**	**M**	**L**	**M**	**M**	**H**	**H**	**M**

Topics Covered:

1. Introduction to heat transfer (1 lecture)
   a) Processes for conduction, convection, and radiation
   b) Conservation of energy (thermodynamics review)
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. Steady-State conduction in multiple dimensions (3 lectures)
    a) Separation of variables analysis method
    b) Numerical formulation and solution methods
5. Transient Conduction (3 lectures)
    a) Lumped capacitance analysis method
    b) Numerical formulation and solution methods
6. 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
7. Forced external convection (2 lectures)
    a) Flat plate correlations
    b) Bluff body correlations
8. Forced internal convection (3 lectures)
    a) Velocity and thermal fully developed flow conditions
    b) Overall energy balance analysis
    c) Circular and non-circular tube correlations
9. 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
10. Introduction to Radiation (4 lectures)
    a) Physical process and properties for radiation
    b) Blackbody (Plank Distribution) and gray surface radiation
    c) Stefan-Boltzmann law and Kirchoff's law
11. Radiation problems (5 lectures)
    a) View factors
    b) Heat exchange in an enclosure
    c) Multimode heat transfer and participating media

Laboratory Projects: None

Class/Lab Schedule: Four 50-minute lectures per week

Contribution of Course to Meeting the Professional Component:

(a) College-level mathematics and basic sciences:	0 credits
(b) Engineering Topics:	4 credits
Design:	0 credits
(c) General Education:	0 credits
(d) Other:	0 credits

Prepared by:
K. Shollenberger

Date:
9/20/2013