1. EM415 Heat Transfer

2. Credit Hours (4)/Contact Hours (5)

3. Course Director – Ronald J. Warzoha

4. Fundamentals of Heat and Mass Transfer, 8th Ed., by T.L. Bergman and A.S. Lavine; John Wiley, 2017 – ISBN 978-1-119-32042-5

5. Specific course information

a. Study of thermal radiation, steady and transient conduction, laminar and turbulent convection, internal and external flow, boundary layers and empirical correlations. Applications address fins, nuclear reactor cooling, heat exchangers and interactive computing.
b. Prerequisites: EM319 and EM324
c. Required for Nuclear and Mechanical Engineering Programs

6. Educational objectives for the course

a. Solve 1-D steady conduction problems using analytical methods in rectangular, spherical, and cylindrical systems.
b. Solve combined convection and 1-D steady conduction problems using resistor networks.
c. Solve 2D steady conduction problems using the finite difference method.
d. Solve unsteady conduction problems through lumped capacitance.
e. Solve unsteady conduction problems using the finite difference method.
f. Select appropriate empirical correlations for free and forced convection problems and use the correlations to obtain solutions to problems.
g. Identify the various modes of boiling on the boiling curve and qualitatively describe each mode and its implications.
h. Analyze heat exchanger performance using the effectiveness NTU method.
i. Demonstrate an understanding of emission, reflection, absorption and transmission from blackbodies.

7. Specific program outcomes addressed by this course

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Reinforced | | | | | | | |
| Mastered | X | | | | | X | |

8. Brief list of topics to be covered
    a. Fundamental Modes of Heat Transfer
    b. Conduction Heat Equation
    c. 1D Steady State Conduction
        i. Resistor Networks
        ii. Extended Surfaces
    d. Finite Difference Methods
        i. 2D Steady State Conduction
        ii. Transient Conduction
    e. Lumped Capacitance Method
    f. Convection Heat Transfer
        i. Forced – External Flow
        ii. Forced – Internal Flow
        iii. Natural Convection
        iv. Introduction to Pool and Flow Boiling
    g. Heat Exchangers (effectiveness NTU method)
    h. Radiation Heat Transfer
        i. Blackbody Emission
        ii. Real Surfaces (Absorption, Reflection, Transmission)
        iii. Gray Surfaces
        iv. Solar Radiation
        v. Radiation Exchange between Black Bodies
        vi. Radiation Exchange between Gray Surfaces (2 Surface)