BAKER COLLEGE
STUDENT LEARNING OUTCOMES

ME 4310 Heat Transfer
3 Semester Hours

Student Learning Outcomes & Enabling Objectives

1. Explain the fundamental principles of heat transfer:
    a. Describe forms of heat transfer: conduction, convection, radiation.
    b. Describe relationship to First Law of Thermodynamics.
    c. Explain the separation of thermodynamics, fluid mechanics, and heat transfer.
    d. Define units of measurement in the SI and U.S customary systems for the basic quantities.
2. Analyze conduction mechanism of heat transfer:
    a. Explain the conduction rate equation.
    b. Explain thermal conductivity and other pertinent properties.
    c. Use the heat diffusion equation.
    d. Explain boundary and initial conditions.
3. Analyze 1-D steady state conduction:
    a. Analyze the plane wall case, including temperature distribution, thermal resistance, composite wall, and contact resistance.
    b. Solve radial conduction through a cylindrical and spherical wall.
    c. Analyze conduction with thermal energy generation plane wall and radial systems.
    d. Analyze conduction from extended surfaces (fins) with uniform and non-uniform cross sections.
4. Analyze 2-D steady state conduction:
    a. Examine alternative approaches.
    b. Use method of separation of variables.
    c. Solve finite difference equation.
        i. Explain nodal network
        ii. Use finite difference form of heat equation
        iii. Use energy balance method
        iv. Solve finite difference equation
5. Examine transient (non-steady state) conduction:
    a. Explain lump capacitance method and its validity.
    b. Use general lumped capacitance method analysis.
    c. Explain spatial effects.
    d. Solve plane wall with convection.
    e. Solve radial systems with convection.

6. Analyze convection mechanism of heat transfer:
    a. Explain velocity and thermal boundary layers.
    b. Determine local and average convection coefficients.
    c. Examine laminar and turbulent flow.
    d. Explain boundary layer equations for laminar & compressible flow.
    e. Describe the physical interpretation of dimensionless parameters.
    f. Describe the momentum and heat transfer Reynolds analogy.
7. Examine external flow:
    a. Explain empirical method.
    b. Solve flat plate in parallel flow laminar flow, laminar and turbulent.
    c. Solve flow over isothermal plate.
    d. Explain methodology for convection calculations.
    e. Solve cylinder in cross flow.
    f. Explain flow across banks of tubes.
8. Analyze heat exchangers:
    a. Describe heat exchanger types.
    b. Obtain the overall heat transfer coefficient.
    c. Analyze heat exchangers using the log mean temperature difference in parallel and counter flow.
    d. Analyze heat exchangers using the effectiveness – NTU method.
    e. Design heat exchangers including performance calculations.
9. Analyze radiation process:
    a. Explain fundamental concepts.
    b. Define radiation heat fluxes.
    c. Determine radiation intensity.
    d. Describe blackbody radiation.
    e. Calculate absorption, reflection and transmission by real surfaces.
    f. Explain Kirchhoff's Law.
    g. Describe gray surfaces.
    h. Determine radiation exchange between surfaces view factor and blackbody radiation exchange

---

These SLOs are not approved for experiential credit.

Effective: Fall 2017