COURSE OUTLINE

MECH 343 – HEAT TRANSFER

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CANINO SCHOOL OF ENGINEERING TECHNOLOGY
MECHANICAL AND ENERGY TECHNOLOGY
June 2015
A. **TITLE:** Heat Transfer

B. **COURSE NUMBER:** MECH 343  
**SHORT TITLE:** Heat Transfer

C. **CREDIT HOURS:** 3

D. **WRITING INTENSIVE COURSE:** No

E. **LENGTH OF COURSE:** 15 Weeks

F. **SEMESTER(S) OFFERED:** Fall/Spring

G. **HOURS OF LECTURE:** 3 hours/week

H. **CATALOGUE DESCRIPTION:**

This course explores the various methods of transferring heat from a source to a sink in engineering systems. Topics will focus on the energy balance of a system. The transport phenomena of heat transfer will be studied in detail, allowing students to internalize these physical principles of conduction, convection, and radiation.

I. **PRE-REQUISITES:** Differential Equations (MATH 364)

J. **STUDENT LEARNING OUTCOMES:**

Upon completion of the course, the student will be able to:

<table>
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<tr>
<th>Course Objective</th>
<th>Institutional SLO</th>
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<tr>
<td>a. Define the transport methods of convection, conduction, and radiation.</td>
<td>1. Communication</td>
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<td>b. Calculate the energy flow in combined transfer of conduction, convection, and radiation.</td>
<td>2. Critical Thinking</td>
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<td>c. Calculate the coefficient of convection during laminar, turbulent, and separated flow.</td>
<td>3. Professional Competence</td>
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<tr>
<td>d. Evaluate radiation from a blackbody, gray surface, and diffuse surface.</td>
<td>2. Critical Thinking</td>
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K. **TEXTBOOK:**


L. **REFERENCES:**

M. **EQUIPMENT:** Technology enhanced classroom

N. **GRADING METHOD: (P/F, A-F, etc.):** A-F

O. **MEASUREMENT CRITERIA/METHODS:** Exams, Quizzes, Homework

P. **DETAILED TOPICAL OUTLINE:** See Attached

Q. **LABORATORY OUTLINE:** Not Applicable
DETAILED COURSE OUTLINE

I. Introduction
   A. Origins of conduction, convection, radiation
   B. Conservation of energy
   C. Methodology for problem solving
   D. Overview of heat transfer applications
   E. Units and dimensions

II. Conduction
   A. Thermal properties of materials
   B. Boundary and initial conditions
   C. One-dimensional steady state conduction
      1. Plane walls
      2. Radial systems
      3. Thermal energy generation
      4. Transfer from extended surfaces (fins)
   D. Two-dimensional steady state conduction
      1. Graphical method
      2. Finite-Difference equation
      3. Nodal networks

III. Transient Conduction
   A. Lumped Capacitance
   B. Spatial effects
   C. Semi-infinite solids
   D. Multi-dimensional effects

IV. Convection
   A. Boundary Layers
      1. Velocity dependant
      2. Thermal dependant
   B. Laminar flow
   C. Turbulent flow
   D. Reynolds Analogy
   E. Dimensionless Parameters

V. External flow
   A. Flat plate
   B. Cylinder in cross flow
   C. Banks of tubes in heat exchangers

VI. Internal flow
   A. Flow conditions
   B. Friction factors of developed flow
   C. Newton’s Law of Cooling
   D. Shell and tubes exchangers
   E. Cross and parallel flow heat exchangers

VII. Free Convection
   A. Laminar flow
   B. Turbulent flow
C. Vertical and inclined surfaces and channels
D. Combined free and forced convection

VIII. Boiling and Condensation
A. Boiling of a pool
B. Nucleate boiling
C. Film boiling

IX. Radiation
A. Emission
B. Irradiation
C. Radiosity
D. Blackbody radiation
E. Absorption, reflection and transmission
F. Kirchhoff’s Law
G. Gray surface
H. Exchange between surfaces
I. Radiation shielding