

**United States Naval Academy
Mechanical Engineering Department**

Catalog Description: EM415 Heat Transfer

Credit: 4 (3-2-4)

Designation: Required, engineering sciences and design

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.

Prerequisites: EM319 - Engineering Thermodynamics
EM324 - Fluid Dynamics

Corequisites: None

Textbooks: Incropera, DeWitt, Bergman and Lavine, Introduction to Heat Transfer, 6th Ed., John Wiley & Sons, Required

Course Director: Prof. A.N. Smith

Course Content:

No.	Topic or Subtopic	hrs.
1	Introduction to Heat Transfer Modes and Problems Solving Methods	2
2	1D Steady Conduction	10
3	Transient Conduction	4
4	Finite Difference Solutions	6
5	Forced Convection	8
6	Free Convection	2
7	Two-Phase Heat Transfer	2
8	Heat Exchangers	5
9	Radiation	6

Assessment Methods:

		YES	NO
A	Quizzes	X	
B	Homework	X	
C	Exams	X	
D	Laboratory Reports	X	
E	Oral Presentations		X
F	Design of Experiments	X	
G	Prototypes/Demonstrations		X
H	Projects	X	
I	Other		X

Course Outcomes : ¹

1. Solve 1-D steady conduction problems using analytical methods in rectangular, spherical and cylindrical systems.
2. Solve combined convection and 1-D steady conduction problems using resistor networks.
3. Solve 2D steady conduction problems using the finite difference method.
4. Solve unsteady conduction problems through lumped capacitance.
5. Solve unsteady conduction problems using the finite difference method.
6. Select appropriate empirical correlations for free and forced convection problems and use the correlations to obtain solutions to problems.
7. Identify the various modes of boiling on the boiling curve and qualitatively describe each mode and its implications.
8. Analyze heat exchanger performance using the effectiveness NTU method.
9. Demonstrate an understanding of emission, reflection, absorption and transmission from blackbodies, gray surfaces and real surfaces.

	Course Outcomes								
Program Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(a)	X	X	X	X	X	X	X	X	X
(b)	X				X			X	
(c)									
(d)									
(e)	X	X	X	X	X	X	X	X	X
(f)									
(g)	X				X			X	
(h)									
(i)									
(j)									
(k)		X	X		X	X			

Date of Latest Revision: 7 FEB 2018, Prof. A.N. Smith