ENG ME 527/MS 527 Transport Phenomena in Materials Processing

2008-2009 Catalog Data:
ENG ME 527/MS 527 Transport Phenomena in Materials Processing Prereq: ENG ME 304 or consent of instructor. Introduction to momentum, heat, and mass transport phenomena occurring in various processes. Whereas transport phenomena underlie many processes in engineering—agriculture, meteorology, physiology, biology, analytical chemistry, materials science, pharmacy, and other areas—they are key to specific applications in diverse areas such as materials processing, green manufacturing of primary materials, biological membranes, fuel cell engineering, and synthesis of clean fuels. This course covers three closely related transport phenomena: momentum transfer (fluid flow), energy transfer (heat flow), and mass transfer (diffusion). The mathematical underpinnings of all three transport phenomena are closely related and the differential equations governing them are frequently quite similar. Since in many situations the three transport phenomena occur together, they are presented and studied together in this course. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Status in the Curriculum: Elective

Textbook(s) and/or Other Required Material: Proirer and Geiger, *Transport Phenomena in Materials Engineering*
Bird, Steward and Lightfoot, *Transport Phenomena*
Transport Phenomena Archive: http://teaching.matdl.org/

Coordinator: Adam Powell, Assistant Adjunct Professor, Mechanical Engineering

Prerequisites by topic:
1. An understanding of engineering thermodynamics.

Goals:
This is designed to provide graduate students and senior undergraduates an introduction to transport phenomena and its applications in various fields such as materials science, electrochemistry, mechanical engineering, chemicals processing and bioengineering.

Course Learning Outcomes:
As an outcome of completing this course, students will:

i. Gain an understanding of conservation laws and constitutive equations as they apply to convective and diffusive (or viscous) transport of mass, heat and momentum.
ii. Be able to solve simple 1-D diffusion, heat conduction or fluid flow problems using the transport equations.
iii. Understand the technique of dimensional analysis of problems, and recognize its importance.

iv. Comprehend enough transport to be able to be conversant in the topic with engineers of various disciplines who spend more time learning these subjects and have access to more powerful tools, as students will likely work in multidisciplinary teams with such engineers throughout their careers.
v. Be able to understand present in a seminar a topic of current research interest in transport phenomena to an audience of peers.

Course Learning Outcomes mapped on to Program Outcomes:

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i,ii, v		ii-v	iv, v	ii, iii	v	v	v	iv, v	v	i-v	i,iv, v	iii, iv	
Emphasis:	5	1	3	3	4	3	5	3	2	3	3	4	2	1

Topics:

1. Properties of fluids
2. Laminar flow momentum balance
3. Turbulent flow results
3. Energy balance in fluid flow
4. Fourier law of heat conduction
5. Heat transfer/energy equation
6. Heat transfer with convection
7. Heat conduction
8. Solidification heat transfer
9. Radiation heat transfer
10. Thermal behavior of packed beds
11. Fick's law
12. Mass transfer in fluid systems
13. Interphase mass transfer

Contribution of Course to Meeting the Professional Component:
Engineering topics: 50% Math: 50%

Status of Continuous Improvement Review of this Course:
Prepared by: Adam Powell **Date:** 6/17/2009