ENG ME/MS 527 Transport Phenomena

Catalog Data:
ENG ME/MS 527 Transport Phenomena Prereq: ENG EK304. 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, 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.

Course Schedule: 4 lecture hours/week

Status in the Curriculum: Elective

Textbooks:
Transport Phenomena Fundamentals, Joel Plawsky, Second Edition, CRC Press, 2010

References:
Transport Phenomena by Bird, Stewart, and Lightfoot, Second Edition, Wiley, 2002
S. Kou, Transport Phenomena in Materials Processing, John Wiley and Sons, New York (1996)

Coordinator: Srikanth Gopalan, Associate Professor of Mechanical Engineering

Prerequisites by topic:
1. An understanding of engineering thermodynamics as taught in EK 304.

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.

Computer Usage:
This course uses symbolic manipulation software such as MAPLE, MATHEMATCA or MATLAB in a few assignments and the COMSOL software package.

Course Learning Outcomes:

As an outcome of completing this course, students will:

i. Gain a fundamental understanding of the principles of momentum, heat and mass transport.

ii. Be able to formulate with boundary and initial conditions and solve differential equations pertaining to momentum, heat and mass transport in various situations encountered in materials science, electrochemistry, mechanical engineering, chemicals processing and bioengineering.

iii. 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	O	P
Course:	i,ii, iii		ii,iii	iii	ii		iii	iii	iii	iii	i,ii	i,ii				
Emphasis:	5	1	3	4	4	1	5	2	2	2	3	4	1	1	1	1

Topics:

1. Fluxes, gradients and transport Properties
2. One-dimensional steady state diffusive transport
3. Generation and accumulation
4. Transport enhancement using extended surfaces
5. Multidimensional effects, potential functions and fields
6. Convective transport: Microscopic balances
7. Laminar boundary layers
8. Radiative transport
9. Irreversible thermodynamics
10. Electrochemical systems

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

Status of Continuous Improvement Review of this Course:
Date Last Reviewed: Not reviewed in 2009-2010

Prepared by: Srikanth Gopalan Date: 9/7/2010

Grading

35% - Midterm
45% - Final
20% - Computational Project