Advanced Transport Phenomena - Course Syllabus

Course Number: CBE 202
Course Title: Advanced Transport Phenomena

Academic Semester: Fall Academic Year: 2016/2017
Semester Start Date: Aug. 21, 2016 Semester End Date: Dec. 15, 2016

Class Schedule: Mon/Thu 1:00-2:30

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Office Hours: Tuesday 3:00-4:00
Teaching Assistant name: Guan Sheng
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COURSE DESCRIPTION FROM PROGRAM GUIDE

The aim of this course is to enable students to i) derive appropriate differential balances for specific material properties, including momentum, thermal energy, and mass species, accounting appropriately for property flux by convective and diffusive (molecular-scale) processes, along with property generation or loss in the material continua; ii) write the Thermal Energy Equation, the Species Continuity Equation, and the Navier-Stokes Equations and pose (simplify) them appropriately for specific transport problems; iii) know appropriate boundary conditions that can be applied to specific transport problems; iv) conduct scale or dimensional analyses of transport problems, using the analyses to help simplify or enhance understanding of underlying transport processes; v) solve and physically interpret one-dimensional steady state conduction and species diffusion problems in rectangular, cylindrical, and spherical geometries, with and without zero-order and first-order generation/loss; vi) use separation of variables technique to solve and physically interpret two-dimensional steady-state conduction and species diffusion problems; vii) use similarity methods to solve and physically interpret unsteady state conduction and diffusion problems in unbounded material regions; viii) use the finite Fourier transform method to solve and interpret unsteady state conduction and diffusion problems in bounded material regions; ix) solve and physically interpret unidirectional steady and unsteady viscous flows in unbounded regions and in bounded regions (i.e. flow conduits or ducts); and x) solve and physically interpret simultaneous convection and diffusion (conduction) problems involving the interaction of thermal or concentration boundary layers with developing or developed velocity profiles.
COMPREHENSIVE COURSE DESCRIPTION

<<Transport Phenomena>> is a graduate level engineering course designed to review the governing relations of momentum, heat, and mass transfer in continua at an advanced level for students who have already been exposed to transport at the undergraduate level. Principal concepts will be illustrated through their application to classical and practical paradigms in transport phenomena. Students will learn useful analytical methods for studying and solving steady state and unsteady state (transient) transport problems with and without fluid convection.

GOALS AND OBJECTIVES

The aim of this course is to enable students to i) derive appropriate differential balances for specific material properties, including momentum, thermal energy, and mass species, accounting appropriately for property flux by convective and diffusive (molecular-scale) processes, along with property generation or loss in the material continua; ii) write the Thermal Energy Equation, the Species Continuity Equation, and the Navier-Stokes Equations and pose (simplify) them appropriately for specific transport problems; iii) know appropriate boundary conditions that can be applied to specific transport problems; iv) conduct scale or dimensional analyses of transport problems, using the analyses to help simplify or enhance understanding of underlying transport processes; v) solve and physically interpret onedimensional steady state conduction and species diffusion problems in rectangular, cylindrical, and spherical geometries, with and without zero-order and first-order generation/loss; vi) use separation of variables technique to solve and physically interpret two-dimensional steady-state conduction and species diffusion problems; vii) use similarity methods to solve and physically interpret unsteady state conduction and diffusion problems in unbounded material regions; viii) use the finite Fourier transform method to solve and interpret unsteady state conduction and diffusion problems in bounded material regions; ix) solve and physically interpret unidirectional steady and unsteady viscous flows in unbounded regions and in bounded regions (i.e. flow conduits or ducts); and x) solve and physically interpret simultaneous convection and diffusion (conduction) problems involving the interaction of thermal or concentration boundary layers with developing or developed velocity profiles.

REQUIRED KNOWLEDGE

Basic knowledge of fluid mechanics, heat & mass transfer, vector analysis, and differential equations

REFERENCE TEXTS

Analysis of Transport Phenomena, WM Deen, Oxford University Press, 1998
METHOD OF EVALUATION

<table>
<thead>
<tr>
<th>Graded content</th>
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<tbody>
<tr>
<td>In-class quiz (10%)</td>
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<tr>
<td>Mid-term exam (close-book, 30%)</td>
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<tr>
<td>Projects (30%)</td>
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<td>Final Exam (open-book, 30%)</td>
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COURSE REQUIREMENTS

Assignments

7 Homework, 1 group project, regular weekly reading assignments

Course Policies

The class encourage in-class discussions between sub-group discussions, hence the class attendance is important to every student. A solid reason will be required for class absence.

Additional Information

N/A

NOTE

The instructor reserves the right to make changes to this syllabus as necessary.