Spring 2011 **MAE-295** Y. Wang
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# FUNDAMENTALS OF MULTIPHASE TRANSPORT
# SYLLABUS

**Catalog Data:** **MAE295: FUNDAMENTALS OF MULTIPHASE TRANSPORT** (Credit Units: 4). Through this course, a student will be able to: Analyze and characterize multiphase systems; Appreciate the role of structure in multiphase flows and the role it plays in obtaining engineering solutions; Understand what assumptions may be made to simplify multiphase transport and when they might be employed; Understand the limitations of the modeling of multiphase transport. A great deal of effort will be placed on averaging, droplet dynamics, flow patterns, flow in porous media, and sprays. Prerequisite: MAE130A and 120.

**Textbooks:**
- ❖ Fundamentals of Multiphase Flow, *C. E. Brennen, Cambridge University Press, (2005).*

**References:**
- ♦ Multiphase Flow Handbook, Clayton T. Crowe, CRC Press; 1 edition (September 19, 2005).
- ♦ Interfacial Phenomena: Equilibrium and Dynamic Effects, C.A. Miller and P. Neoqi, CRC Press; 2 edition (October 8, 2007).
- ♦ Two-Phase Flow and Heat Transfer, P.B. Whalley, Oxford (1996).
- ♦ Thermo-fluid Dynamics of Two-Phase Flow, M. Ishii and T. Hibiki, Springer (November 29, 2005).
- ♦ Essentials of Multiphase Flow in Porous Media, George F. Pinder and William G. Gray, Wiley-Interscience (August 4, 2008).
- ♦ Two-phase Flow in Complex System, S. Levy, Wiley-Interscience; 1 edition (August 2, 1999).

**Instructor:** Prof. Wang (4231EG) email: yunw@uci.edu

**Time:** T TH: 12:30pm to 1:50pm

**Course Outcomes:** Students will be able to:
(1) Demonstrate a fundamental understanding of multiphase transport phenomena;
(2) Apply these fundamentals to engineering applications such as thermal/power systems.

**Prerequisites By Topic:** MAE130A: Introduction to Fluid Mechanics; MAE 120: Heat Transfer

**Lecture Topics:**
(1) Introduction to multiphase transport phenomena
(2) The governing equations (Local Instant Formation and Averaged balance equations)
(3) Droplet/Bubble Dynamics (surface tension, Work of adhesion and cohesion, droplet removal, Rayleigh-Plesset equation)

(4) Flow patterns
(5) Flow in porous media (Disperse, Separated, Annulus and Slug Flows)
(6) Spray systems (Capillary pressure, Relative permeability, and 1-D analysis)
(7) Multiphase transport and heat transfer (Heat pipe effects)
(8) Modeling such as the VOF and LBM

**Class Schedule:** Each class meets ~3 hours per week for 10 weeks.

**Computer Usage:** Data analysis (Excel, Matlab, Mathcad), and report writing (Word, LaTex).

**Professional Component:** Contributes toward the Mechanical Engineering Topics courses.

**Relationship to Program Outcomes:** This course relates to the MAE Graduate Program as stated at:
http://mae.eng.uci.edu/grad/graduate_program.html
The course provides practical engineering issues related to thermal transport which reinforce, amplify, and extend the concepts of thermodynamics, fluid flow, mass transport, and heat transfer.

**Design Content Description**

**Grading Criteria:**

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|---|---|
| HWs: | 20% |
| Class Project: | 40% |
| Final: | 40% |
| | 100% |

*Prepared by Prof. Yun Wang*

*Mar. 2011*