MAE 224 **Y. Wang**

Office: EG4231 email: yunw@uci.edu

Advanced Transport Phenomena
SYLLABUS

Catalog Data: **MAE224: Advanced Transport Phenomena** (Credit Units: 4). The course will discuss fundamentals of transport phenomena that are not covered in MAE220-222. The course overs the subjects of conservation equations, fundamentals of diffusion, perturbation methods, ion transport, two-phase transport, and interfacial phenomena. Prerequisite: N/A.

Textbooks: Analysis of Transport Phenomena, William M. Deen, Oxford University Press, 1998.

References:
The Mathematics of Diffusion, 2nd Ed. Crank, J., Oxford University Press (1975). ISBN 0-19853-411-6.
Transport Phenomena, 2nd Edition, R.B. Bird, W.E. Stewart, and E.N.Lightfoot, Wiley, 2001.
Diffusion — Mass Transfer in Fluid Systems, 2nd or 3rd edition, Cussler, E.L., Cambridge University Press (2009).
Electrokinetic and colloid transport phenomena. J. H. Masliyah, and S. Bhattacharjee, S. John Wiley & Sons (2006).
Surface and interfacial forces, M. Kappl, John Wiley & Sons (2009).
PEM Fuel Cells: Thermal and Water Management Fundamentals (Sustainable Energy), Y. Wang, K.S. Chen, and S. C. Cho, Momentum Press (2013)

Instructor: Prof. Wang (4231EG); email: yunw@uci.edu
Office hour: 11-11:45 AM (M and W)

Class info:

Course Outcomes: Students will be able to:

Demonstrate fundamental understanding of physical principles associated with general transport.

Solve transport problems through approximation and simplification methods.

Know some current challenges in transport and associated fundamentals.

Prerequisites By Topic: Fluid Mechanics

Lecture Topics: **Outline (tentative):**

1. General conservation equations: continuity, momentum,

energy, and chemical species equations (2 weeks)
2. Scaling, exact solutions, and perturbation analysis (3 weeks)
3. Diffusion and multi-component diffusion (1 week)
4. Ion transport (battery, fuel cell, …) (2 weeks)
5. Two-phase flows (1 week)
6. Other topics

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

Computer Usage: Used for homework problems (Fortran/C, Matlab and Mathcad) and homework writing (Word, Excel).

Class Project: The project is based on one or a few literature articles that the instructor selects. The selected literature article will be critically evaluated by each member of the class. An additional oral report is required by each class member. Presentation will be given by students in the final classes. The written report is due at the oral presentation. The report follows the format of an ASME conference article.

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

Grading Criteria:

Homework:	20%
Midterm	15% (basic concepts; 80 min)
Quizzes	5-10% (5 min small problems)
Final:	30-35%(analysis & derivation; 120 min)
Project:	25% (10% ppt + 15% report)
	100%

Prepared by Prof. Y. Wang
2021