CENG 2220 Transport Phenomena I [3-1-0:3]

Prerequisite: PHYS 1111 or PHYS 1112 or PHYS 1312
Background: BIEN/CENG 2310 or basic programming.

Instructor: I-Ming Hsing (CYT 2002A, kehsing@ust.hk), Office hrs: W 4:30-5:30, or by appointment

Teaching assistant: TBC

Course objectives:

Fundamentals of transport phenomena with emphasis on physical properties, flow behavior and diffusive transport of fluids in chemical and biological systems. Engineering derivation and quantitiatve analysis of fluid tranport in confined domains. Emphasis on practical application of transport phenomena in chemical and biological engineering. Use of software for solving problems in transport phenomena.

Textbook (recommended):
Bird R.B., Stewart W.E., Lightfoot E.N, Klingenberg D.J.: Introductory Transport Phenomena, Wiley, 2015.
A simplified version of the classic BSL Transport Phenomena book with more mathematical derivations comprehensible by undergraduate students. Good review of vectors and tensors in appendix.
William M. Deen: Introduction to Chemical Engineering Fluid Mechanics, Cambridge University Press, 2016
A nice book written by MIT professor, an ideal text for a one-semester course
Welty J.R., Rorrer G.L., Foster D.G.: Fundamentals of Momentum, Heat, and Mass Transfer, 6th edition, Wiley 2015
This is a recommended textbook to be used at CENG 3220

Additional references (optional):
Fournier R.L.: Basic Transport Phenomena in Biomedical Engineering, 4th edition, CRC Press, 2018
Truskey G.A., Yuan F., Katz D.F.: Transport Phenomena in Biological Systems, 2nd edition, Pearson Prentice-Hall, 2009

Recitation: The objective of recitation class is to discuss HWs and quiz problems, and to review the lectured material and give more in-class examples. Some recitation session may be swapped with regular lecture hours.

Exam and grading: There will be quiz I, quiz II, and final exam taking up 25%, 25%, and 35 % of the grade, respectively. Homework assignments will be regularly given and will take 15% of the final grade.

Classes:
Lec. 15:00-16:20, W.F., **Room 5583 (lift 30)**
Rec. 11:00-18:50 pm, Thurs, **LG3008 (lift 10-12)**

POLICY FOR ACADEMIC CONDUCT:

The assignments and exams, which are required, have the primary function of helping you learn the material. The secondary function of these homework assignments is to help the staff in assessing your understanding of the class material, in particular when the time comes to provide a final grade for the course. To this end, the extent to which you collaborate with your colleagues in preparing these materials must be understood and agreed upon by both the students and the staff. The following is our policy regarding permissible levels of collaboration. This is intended to provide guidance, but please recognize that a violation of this policy will be dealt with in the most severe manner available to the staff.

The homework assignments are intended nearly exclusively to serve as a learning tool. As such, we are comfortable with collaboration amongst students on the solving of these assignments provided all collaborators are equal contributors to the solution. None the less, the written materials, which you hand in must be your own, and any discussion or collaborations with fellow students must be identified in writing on the cover page of the homework document. (E.g., the solution documented for problem 3 was the result of a discussion with IM Hsing and Kathy Vaeth). The HW will be graded 50% based on the effort and the rest 50% based on the accuracy.

Quizzes and final exams are important to the staff in assessing your performance. Collaboration or cheating in taking these exams is absolutely **NOT** permitted.

If you have any suggestion or feedback to the policy or material of the course, please let me know.

COURSE INTENDED LEARNING OUTCOMES (CILOS)

By the completion of the course

- The students are expected to understand the constitutive equations and fluid properties and how they impact the fluid flow behavior.
- The students are expected to know how to apply the knowledge of mathematics and physics and the principle of conservation equation to formulate and understand fluid flow problems.
- The students are expected to be able to appreciate, conceptualize, and analyze transport problems in practical chemical and biological systems.

Weekly class schedule

DATE	Reading and Info.	Topics
Week 1		Course administrative matters, properties, dimensions and scales, basics of vectors and tensors
02/06 recitation	**Regular lecture (for lecture of week 7)**	
Week 2	**HW 1 out**	Definition of transport processes, relative importance of convection and diffusion
02/13 recitation	**Regular lecture (for lecture of week 7)**	Dimensionless numbers in transport processes
Week 3	**HW 2 out**	Pipe flow
02/20 Recitation	**HW 1 due before the recitation starts, late submission won't be accepted**	HW1 recap
Week 4		fluid frictions in pipes, engineering Bernoulli equation, Drag on submerged objects
02/27 Recitation	**HW 2 due**	HW2 recap
Week 5	**Quiz I (March 5)**	Fluid statics: pressure, gravity, surface tension
03/06 Recitation		Quiz I recap
Week 6		Fluid statics: pressure, gravity, surface tension
03/13 Recitation	**Regular lecture (for lecture of week 7)**	Hydrostatics, manometry
Week 7	**No lecture classes (IMH away), HW 3 out**	Hydrostatics, manometry
03/19, 03/20 Recitation		Class materials recap
Week 8	**HW 4 out**	Fluid kinematics, streamline, stream function, vorticity
03/27 Recitation	**HW 3 due**	HW3 recap
Week 9		Microscopic balances: conservation of mass and momentum
04/10 Recitation	**HW 4 due**	HW4 recap
Week 10	**Quiz II (April 16)**	Mass transport: diffusion and diffusive flux

04/17 Recitation		Quiz II recap
Week 11		Mass transport in chemical/biological system: diffusion and diffusive transport
04/24 Recitation		Course materials recap
Week 12	**HW 5 out**	Steady-state diffusion
Week 13		Thermal diffusion in semiconductor
05/08 Recitation	**HW 5 due**	HW5 recap
Final Exam (TBA)	**Final Exam**	