MAE 214A, Spring 2017
Introduction to Turbulence and Turbulent Mixing

Prof. Sutanu Sarkar
Mechanical and Aerospace Engineering
Mail Code 0411
Office: 578 EBU II
Phone: 534-8243
Email:sarkar@ucsd.edu

- **Course description:** Fundamental aspects of turbulent flow will be discussed. Examples will be drawn from experimental and numerical studies of homogeneous turbulence, mixing layers, jets, wakes and boundary layers. Applications in engineering and in nature will be considered. Analytical tools to describe turbulent flows and associated mixing will be studied.
- **Prerequisites:** MAE 210A and 210B.
- **Textbooks:** The following book will be used as the primary reference: *Turbulent Flows* by S. B. Pope. The book *Turbulent Flow* by P. S. Bernard and J. M. Wallace will also be used.

  A reading list is provided with the books in that list on reserve in the S&E library.
- **Course work:** There will be four HWs (60 %) and a take-home exam due during Finals week. (40 %). **The HWs and exam must be your own work**.
- **Lectures:** The times and location are: EBU 2, Room 584 on Tuesday and Thursday, 11:00 - 12:20 PM
- **Office hours:** Tues 1:00 PM - 2:00 PM or by appointment
- **Grading Policy** HWs must be your OWN work. Do not copy off OTHER (friends, solution manuals, books, etc.) sources. Ditto for exams. Any copying as defined above will be grounds for a F grade. See http://www-senate.ucsd.edu/manual/Appendices/app2.htm.

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Reading list
(* books are on S&E library reserve)

* S. B. Pope, Turbulent flows, Cambridge University Press, 2000.

* P. S. Bernard and J. M. Wallace, Turbulent Flow: Analysis, Measurement and Prediction, John Wiley and Sons, 2002.

* H. Tennekes and J. L. Lumley, A first course in turbulence, Cambridge, Mass., MIT Press, 1972.

P. A. Davidson, Turbulence: An Introduction for Scientists and Engineers, Oxford University Press, 2015.

M. Lesieur, Turbulence in fluids, 3rd revised ed, Kluwer Academic Publishers, 1997

* H. Schlichting, Boundary-layer theory, 8th revised and enlarged edn, Springer, 2000.

A. A. Townsend, The structure of turbulent shear flow, Cambridge University Press, 1976.

J. O. Hinze, Turbulence, 2nd edition, New York, New York : McGraw-Hill, 1975.

P. A. Libby, An introduction to turbulence, Taylor and Francis, 1996.

A. Papoulis, Probability, Random Variables, and Stochastic Processes, 3rd edn.: McGraw-Hill, 1991.

* J. S. Bendat and A. G. Piersol,Random data: analysis and measurement procedures, 3rd edn, Wiley, 2000.

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Course Outline

Week 1. April 4, 6	Examples of instabilities and turbulence. Nature of turbulent flows. Averaging, Mean momentum equations, Reynolds stresses. Chap. 1, 4 (Pope). Also, read Chap. 1 (B&W).
Week 2. April 11(moved), 13	Makeup lecture on TBD. Free shear flows (start). Chap. 5.
Week 3. April 18, 20	Free shear flows (complete). Mean turbulence (turbulent kinetic energy, enstrophy) transport equations. Chap. 5. Also, read Chap. 5 (B&W).
Week 4. April 25, 27	Statistical tools: Chap. 3. Also, read Chap. 2 (B&W).
Week 5. May 2, 4	Scales of turbulent motion. Chap. 6.
Week 6.May 9 (moved)), 11	Makeup lecture on TBD. Stratified shear flows.
Week 7. May 16, 18	Wall flows. Chap. 7 (Pope) & Chap. 4 (B&W).
Week 8. May 23, 25	Wall flows, continued. Geophysical boundary layers.
Week 9. May 30 (moved), June 1	Makeup lecture on TBD. Turbulent dispersion Chap. 11 (B&W), 12.4 (Pope). Scalar spectra Chap 8.6 (T&L)
Week 10. June 6, June 8.	Numerical Modeling