



Fluid Mechanics in Biological and Physiological Systems – 0555.4720
Faculty of Engineering, Department of Biomedical Engineering

Lecturer: Dr. Romina Plitman Mayo, rominap@mail.tau.ac.il

Teaching Assistant: Dr. Jonathan Weissmann, Jonathanw1@mail.tau.ac.il

Lectures: Mondays, 3:00-6:00pm, ZOOM

Practice sessions: Mondays, 6:00-7:00pm, ZOOM

Project: Each student will give a 45min lecture on a topic from the project list (50% grade)

Final Exam: (50% grade)

Pre-requisites: Biofluids 1 (0555.2403), Differential Equations (0509.1545), Partial Differential Equations (0509.2846)

Course Description

The course will provide basic knowledge of fluid mechanics in a physiological context. It is composed of a comprehensive review of fundamental Fluid Mechanics and a focus on blood flow in the cardiovascular system and airflow in the respiratory system.

Course Contents:

- 1 Introduction (Physics of Fluids & Vector Calculus)
- 2-5 Fluid Mechanics Review (Fluid Statics, Conservation of Mass, Inviscid Flow, Conservation of Momentum and Real Fluid Flows)
- 6 The Cardiovascular System (Engineering perspective)
- 7 Blood Flow in Large Arteries (Steady, Startup & Pulsatile flows in Rigid Tubes, Steady, Pulsatile and Wave Propagation Flows in Elastic Tubes)
- 8 Blood Rheology
- 9 Blood Flow in the Heart and Coronaries
- 10 Respiratory Airflow
- 11 Analog Models (Windkessel Model, Electrical Analogs)
- 12 Transcapillary Exchange (Mathematics of Diffusion, Oxygen Transport, Capillary Filtration)
- 13-14 Project Presentations

Course Books:

James A Fay, *Introduction to Fluid Mechanics*, MIT Press, Cambridge, MA, 1994.

George A Truskey, Fan Yuan, David F Katz, *Transport Phenomena in Biological Systems*, 2nd

Edition, Pearson, Upper Saddle River, NJ, 2009.

Wilmer W Nich, Michael F O'Rourke. *McDonald's Blood Flow in Arteries*. 5th Edition, Hodder Arnold, London, 2005.

Stanley Middleman. *Transport Phenomena in the Cardiovascular System*. Willey Interscience, NY, 1972.

Jagan N Mazumdar. *Biofluid Mechanics*. World Scientific, Singapore, 1992.

Yuan-Cheng Fung. *Biomechanics: Circulation*. 2nd Edition, Springer , NY, 1997.

Collin G Caro, Timothy J Pedley, Robert C Schroter, WA Seed. *The Mechanics of the Circulation*. Oxford University Press, Oxford, 1978.

Jay D Humphery, Sherry L Delange. *An Introduction to Biomechanics*. Springer, NY, 2004.

Marshall M Lih. *Transport Phenomena in Medicine and Biology*. John Wiley & Sons, NY, 1975.

John K-J Li. *Arterial System Dynamics*. New York University Press, NY, 1987.

Stanley E Charm, George S Kurland. *Blood Flow and Microcirculation*. John Wiley & Sons, NY, 1974.

Lee Waite, Jerry Fine. *Applied Biofluid Mechanics*. McGraw Hill, NY, 2007.

Krishnan B Chandran, Ajit P Yogabathan, Stanley E Rittgers. *Biofluid Mechanics: The Human Circulation*. Taylor & Francis (CRC). Boca Raton, FL, 2007.

Clement Kleinstreuer. *Biofluid Dynamics: Principles and Selected Applications*. Taylor & Francis (CRC). Boca Raton, FL, 2006.

Ronald L Fournier. *Basic Transport Phenomena in Biomedical Engineering*. 2nd Edition, Taylor & Francis, Philadelphia, PA, 2006.

Morton H Friedman. *Principles and Models of Biological Transport*. 2nd Edition, Springer, NY, 2008.