# Special Topics: Biotransport (Spring 2008)

**ME 8873 KU, Q3** (CRN 22285, 25511)
**BMED 8813 KU** (CRN 25774)
**CHE 8803**
3-0-3

**Instructors:** David N. Ku, MD, PhD (IBB 2307, david.ku@me.gatech.edu)

**Lectures:** TR ESM 209, Simulcast to GT-Lorraine

**Description:** This graduate level course covers the analysis of fluid flow phenomena in the human body, cardiovasculature, respiratory system and other organ systems

**Prerequisites:** Students are expected to have completed an undergraduate course in fluid dynamics, and mass transport or heat transfer.

**Grading:** 30% class participation, 20% homework, 20% midterm exam, 30% final exam.

**Text:** Recommended:
Ethier CR and Simmons CA. Introductory Biomechanics, Cambridge University Press, 2007 ISBN-13 978-0-521-84112-2

Additional text references:
Fung YC, Biodynamics: *Circulation,* Springer-Verlag, New York, 1984
Caro CG, Pedley TJ, Schroter RC, Seed WA; The Mechanics of the Circulation
Guyton AC, Textbook of Medical Physiology
Berne RM, Levy MN, Cardiovascular Physiology
Truskey GA, Yuan F, Katz, D.F., *Transport Phenomena in Biological Systems*, Pearson Prentice Hall, 2004.

Major questions for this Graduate course:

- Why do we have blood flow?
- How do we quantify this transport?
- Is Biofluid mechanics a cause or consequence of disease?
- What is evidence for correlation and causation?
- How can we measure and quantify fluid dynamic parameters in vivo and ex vivo?
- How do we create different fluid conditions?
- Can we design an alternative system to circumvent disease?

## Topics

This graduate level course in unsteady, non-Newtonian fluid mechanics will cover the following topics:

- Conservation equations-Poiseuille flow,
- Overview of the cardiovascular system
- Steady flow in elastic tubes

- Oscillating flow in rigid and elastic tubes
- Artery flows
- Flow measurements
- Experimental Methods
- Hemodynamics and atherogenesis
- Stenotic collapsible tube flows
- Heart Valves
- Sudden Cardiac Death - Thrombosis
- New topics in Biofluid Dynamics

Learning will be active by the students requiring discussion, background reading, a willingness to learn an analytical approach and innovate.

# Special Topics: Biotransport (Spring 2011)

**ME 8873**
**BMED 8813**
3-0-3

**Instructors:** David N. Ku, MD, PhD (IBB 2307, david.ku@me.gatech.edu)
Brandon Dixon, PhD (IBB 2312, dixon@gatech.edu)

**Lectures:** TR 1:35-2:55

**Description:** This graduate level course covers the analysis of fluid flow phenomena in the human body, cardiovasculature, respiratory system and other organ systems

**Prerequisites:** Students are expected to have completed an undergraduate course in fluid dynamics, and mass transport or heat transfer.

**Grading:** 40% class participation/HW, 20% midterm exam, 20% final exam, 20% project

**Text:** Recommended:
Chandran, K, Biofluid Mechanics, Taylor & Francis, 2007

Additional text references:
Ethier CR and Simmons CA. Introductory Biomechanics, Cambridge University Press, 2007
Fung YC, Biodynamics: *Circulation,* Springer-Verlag, New York, 1984
Caro CG, Pedley TJ, Schroter RC, Seed WA; The Mechanics of the Circulation
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## Topics

Learning will be active by the students requiring discussion, background reading, a willingness to learn an analytical approach and innovate.

Week 1: Jan 11,13 – Course Overview (DK), Dimensional Analysis (DK)
Week 2: Jan 18, 20 – Control Volume (BD), Differential Analysis (BD)
Week 3: Jan 25, 27 – Conduit Flow (BD)
Week 4: Feb 1, 3 – Anatomy/Physiology (DK)
Week 5: Feb 8, 10 – Unsteady Flow – Stokes & Womersley (BD)
Week 6: Feb 15, 17 – Interstitial/Transvascular Flow (BD), Lymphatic Flow (BD)
Week 7: Feb 22, 24 –Hydraulic conductivity (BD), **Midterm Exam (2/24)**
Week 8: March 1, 3 – Autologous Chemotaxis (BD), Atherosclerosis (DK),
Week 9: March 8, 10 – Carotid/Aorta Flow (DK), Flow measurement techniques (DK)
Week 10: March 15, 17 – CFD (DK), Entrance effects (DK),
Week 11: March 29, 31 – Particulate flow (DK), Collapsible Tubes (DK),
Week 12: April 5, 7 – Cellular Physiology (BD), Mechanotransduction (BD)
Week 13: April 12, 14 – Cell Adhesion/Rolling (BD)
Week 14: April 19, 21 – Thrombosis (DK), **Project Due (4/21)**
Week 15: April 26, 28 – Heart Valves (DK), Bone/Joints (BD)
**May 3, 2:50-5:40 - Final Exam**

Winter 1987 – ME 8383 – Biofluid Mechanics
Winter 1990 - ME 7750 – Biofluid Mechanics
Winter 1991 – ME 7750 - Biofluid Mechanics
Winter 1992 - ME 7750 – Biofluid Mechanics
Winter 1993 – ME 7780 - Biofluid Mechanics
Winter 1994 – ME 7780 - Biofluid Mechanics
Winter 1995 – ME 7780 - Biofluid Mechanics
Winter 1996 – ME 7780 - Biofluid Mechanics
Winter 1997 – ME 7780 - Biofluid Mechanics
Winter 1998 – ME 7780 - Biofluid Mechanics
Winter 1999 – ME 7780 - Biofluid Mechanics
Winter 2004 – ME 8873 - Biotransport
Winter 2005 – ME 8873/ CHE 8803/ BMED 8813 – Biotransport
Winter 2006 – ME 8873 - Biotransport
Winter 2007 – ME/BME/ChE 8873 – Biotransport
Winter 2008 - ME/BME/ChE 8873 – Biotransport