

# AM5130 - Quantitative Physiology - Syllabus

## Course description:

AM5130 Quantitative Physiology shall focus mainly on organ transport systems. Specifically, this course shall focus on energy and mass flow to various organs at various levels using specific examples (Examples: Ions - cellular level, Fluids - Cardiovascular system & Renal system, Gases - Respiratory system). There shall be mathematical treatment of most of these phenomena. Emphasis will mainly be on the cardio-vascular system with respiratory and renal systems being optional topics that may be discussed based on availability of time.

## Course content:

Physical and chemical foundations of physiology - Nature of Physiology as a quantitative science - Homeostasis and its importance - Continuity equation - Derivation of Poiseuille's Law and Laplace's law

Membrane physiology: Transport across membranes - Diffusion - Facilitated diffusion - Active transport - Osmosis and Osmotic pressure

Cellular Physiology of Excitable cells: Resting Membrane potential - Nernst Planck Electrodiffusion equation (derivation) - Goldman-Hodgkin-Katz equation (Derivation) - Chord conductance equation – Nernst equation

Action potential - Threshold potential, Refractory periods - Propagation of action potential - description using cable equations

CardioVascular Physiology: Overview of the cardiovascular system and blood - Models of peripheral circulation - Types of cells in blood - Heart as a pump - Modeling the intact system - Cardiac action potential and electrophysiology of myocardial cells - Physical basis of Electrocardiography (ECG) - Clinical Electrocardiography and Arrhythmias - Non-linear time series based analysis of ECG\* (Detrended fluctuation analysis of ECG\* -readings from current literature\*) - Control and integration on cardiovascular system - Physiological fluid mechanics

Respiratory Physiology: Lung volumes - Mechanics of breathing - Gas exchange - Oxygen and carbon dioxide transport – Control of breathing

Renal Physiology: Body fluids - Functional anatomy of kidney - Glomerular filtration - Regulation of fluid and electrolyte balance

## Text Books:

1. Quantitative Human Physiology. Joseph Feher, Academic Press, 2012 edition.
2. Physiology, Linda Costanzo, 4/e, Saunders, 2009 edition

## Reference Book:

Berne & Levy Physiology, 6th Updated Edition, Bruce M. Koeppen and Bruce A. Stanton, Mosby, 2009 edition.