# SDSU Systems Neuroscience

## Professor:
Marty Sereno -- email: msereno@sdsu.edu
class time (2018): MWF 9:00-9:50 AM (grad: F 8:00-8:50 AM)
location: SSW 2667
expect to take copious notes
exams mostly based on lecture content

## Readings:
readings, lecture videos (links, top of homepage)
background reading (neuroscience reference texts):

background reading (undergrad neuroscience textbooks):

## Exams:
multiple question short-answer, each question with a few subsections, examples given in lecture
undergraduate: 2 midterms, final (midterms: 30% each, final: 40%)
graduate: 2 midterms, final (midterms: 24% each, final: 32%), and short final paper (20%)
old pdf answer keys from my similar UCSD Systems Neuroscience course (2007) here and here

## Learning Objectives:
Students will be able to do the following:
1. describe neuronal electrochemistry, development, and relation to simple dendritic, Hebbian, and attractor models
2. diagram neuroanatomical structures/connections from low to high levels in visual, somatosensory, auditory sensory systems
3. diagram structures/connections involving superior colliculus, cerebellum, striatum, motor cortex, and limbic systems
4. analyze sequential processing stages in visual, somatosensory, auditory systems from signals and systems perspective
5. describe neural models of eye movement planning, hierarchical motor control, and body position and orientation

N.B.: consult with me if a disability hinders your performance so we can use University resources to maximize learning

## Lecture Topics: (Spring 2018)

### Week of Jan 15 (WF) -- Introduction
introduction to course
membrane (Nernst) potential

### Week of Jan 22 (MWF) -- Cellular Physiology
action potential, voltage-gated channels
post-synaptic potentials, ligand-gated channels
NMDA channels, synaptic-timing-dependent plasticity

### Week of Jan 29 (MWF) -- Relation to Neural Models
dendritic propagation, equivalent circuits
relation to simple Hebbian network models
relation to simple attractor network models

### Week of Feb 05 (MWF) -- Neural Development
gastrulation, neural plate, neural tube, optic cup
cylindrical coordinate system, temporal lobe formation
the ‘rule of Sereno’

### Week of Feb 12 (MWF) -- Visual System I
dLGN (layers, non-lagged/lagged)
visual map structure (conformal maps)

### Week of Feb 19 (MWF) -- Visual System II
general scheme for cortical layers
edges, brightness, and primary motion in V1
1st midterm review

### Week of Feb 26 (MWF) -- Visual System III
aperture problems in general (color intro)
aperture problems for vis. pattern translation, optical flow
visual attention
visual object recognition

### Week of Mar 05 (MWF) -- Somatosensory System
somatosensory receptor types
arm diagram (length, force, alpha/gamma motoneurons)
pathways (dorsal column, spinothalamic, spinocerebellar)
somatosensory cortical areas
somatosensory cortical plasticity

### Week of Mar 12 (MWF) -- Auditory System I
auditory transduction and hair cell receptors
monaural cochlear nuclei responses

### Week of Mar 19 (MWF) -- Auditory System II
auditory brainstem sound localization
echolocation and speech sound processing
auditory cortical areas

### Week of Mar 26 -- SPRING BREAK

### Week of Apr 02 (MWF) -- Motor System I
motor cortex

cortical and spinal pattern generators

corticospinal (double-step memory saccade)
sensorimotor coord transforms

cerebellum anatomy, physiology
cerebellum and learning/conditioning connectional overview

### Week of Apr 09 (MWF) -- Motor System II
motor system overview
cortical and spinal pattern generators
motor cortex

### Week of Apr 16 (MWF) -- Motor System III
cerebellum anatomy, physiology
cerebellum and learning/conditioning connectional overview

### Week of Apr 23 (MWF) -- Limbic System
connectional overview limbic system
H.M. and intermediate term memory vs. inertial guidance
place cells
head direction cells
grid cells

models: theta rhythms, attractor networks

### Week of Apr 30 (MWF) -- Neuroimaging EEG/MEG
hardware, spin vs. precession, Bloch equation
spin echo and gradient echo

phase-sensitive detection, intro to complex numbers,
frequency-encoding -- incorrect and correct intuitions

signal-to-noise

neural source of EEG/MEG signals

current source density, linear forward solution

### May 07 -- Final Exam 8-10 AM

**Graduate students: final paper due May 10**

[47x41]retinal circuitry and streams