**SDSU Systems Neuroscience**

**Professor:**
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class time (2017): MWF 9:00-9:50 AM (grad: F 8:00-8:50 AM)
location1: lectures: SSW 2667
location2: exams: SSW 2650
expect to take copious notes
exam 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 subections, examples given in lecture
undergraduate: 2 midterms, final -- short-answer (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](http://mri.sdsu.edu/sereno/596) and [here](http://mri.sdsu.edu/sereno/596)

**Learning Objectives:**
Students will be able to do the following:
(1) explain neuronal chemistry, electronics, development, and evolution
(2) describe and diagram neuroanatomical structures and their connections in visual, somatosensory, auditory, motor, limbic systems
(3) describe and analyze sequential processing stages in visual, somatosensory, auditory, motor, limbic systems from a signals and systems perspective
N.B.: consult with me if a disability hinders your performance so we can use University resources to maximize learning

**Lecture Topics: (Spring 2017)**

**Week of Jan 16 (WF) -- Introduction**
introduction to course
membrane (Nernst) potential

**Week of Jan 23 (MWF) -- Cellular Physiology**
action potential, voltage-gated channels
post-synaptic potentials, ligand-gated channels
NMDA channels, spike-timing-dependent plasticity

**Week of Jan 30 (MWF) -- Relation to Neural Models**
dendritic propagation, equivalent circuits
relations to simple Hebbian network models
relation to simple attractor network models

**Week of Feb 06 (MWF) -- Neural Development**
gastrulation, neural plate, neural tube, optic cup
cylindrical coordinate system, temporal lobe formation
the 'rule of Sereno'

**Week of Feb 13 (MWF) -- Visual System I**
retinal circuitry and streams
dLGN (layers, non-lagged/lagged)
visual map structure (conformal maps)

**Week of Feb 20 (MWF) -- Visual System II**
general scheme for cortical layers
edges, brightness, and primary motion in V1
1st midterm review
**1st Midterm Exam – Fri, Feb 24, SSW 2650**

**Week of Feb 27 (MWF) -- Somatosensory System I**
aperture problems in general (color intro)
aperture problems for vis. pattern translation, optical flow
visual attention
visual object recognition

**Week of Mar 06 (MWF) -- Somatosensory System II**
somatosensory receptors types
arm diagram (length, force, alpha/gamma motoneurons)
main pathways (dorsal column, spinothalamic, spinocerebellar)
somatosensory cortical areas
somatosensory cortical plasticity

**Week of Mar 13 (MWF) -- Auditory System I**
auditory transduction and hair cell receptors
monaural cochlear nuclei responses

**Week of Mar 20 (MWF) -- Auditory System II**
auditory brainstem sound localization
ecolocation and speech sound processing
auditory cortical areas

**Week of Mar 27 -- SPRING BREAK**

**Week of Apr 03 (MWF) -- Motor System I**
gaze stabilization (VOR, OKN, pursuit)
superior colliculus retinal and motor maps
sensorimotor coord transforms (double-step memory saccade)
multisensory map interactions -- sup. collic visual/auditory
multisensory map interactions -- VIP somatosensory/visual

**Week of Apr 10 (MWF) -- Motor System II**
motor system overview
cortical and spinal pattern generators
motor cortex
2nd midterm review
**2nd Midterm Exam – Fri, Apr 14, SSW 2650**

**Week of Apr 17 (MWF) -- Limbic System**
cerebellum anatomy, physiology
cerebellum and learning/conditioning
connectional/functional overview striatum
striatum and hierarchical sequencing

**Week of Apr 24 (MWF) -- Neuroimaging MRI**
connectional overview limbic system
H.M. and intermediate term memory
place cells
head direction cells
grid cells
models: theta rhythms, attractor networks

**Week of May 01 (MW) -- Intro to Neuroimaging**
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 EEG/MEG signals
current source density, linear forward solution
course review

**May 08 -- Final Exam (8-10 AM)**
*Graduate students: final paper due May 11*