

SDSU Systems Neuroscience

Professor:

Marty Sereno -- email: msereno@sdsu.edu
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):
Squire, Berg et al., eds. (2008/2013) *Fundamental Neuroscience*, 3rd/4th ed.
Kandel, Jessell, Schwartz, eds. (2008/2012) *Principles of Neural Science*, 5th/6th ed.
Nieuwenhuys, Voogd, van Huijzen (2008) *The Human Central Nervous System*, 4th ed.
background reading (undergrad neuroscience textbooks):
Nicholls et al. (2012) *From Neuron to Brain*, 5th ed.
Bear, Connors, and Paradiso (2006/2015) *Neuroscience: Exploring the Brain*, 3rd/4th ed.

Exams:

multiple question short-answer, each question with a few subsections, 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](#) and [here](#)

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
echolocation 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