

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
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) 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, somatosens., and 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

retinal circuitry and streams

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
1st Midterm Exam -- Fri, Feb 23

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

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 09 (MWF) -- Motor System II

motor system overview
cortical and spinal pattern generators
motor cortex
2nd midterm review
2nd Midterm Exam -- Fri, Apr 13

Week of Apr 16 (MWF) -- Motor System III

cerebellum anatomy, physiology
cerebellum and learning/conditioning connectional overview
connectional/functional overview striatum
striatum and hierarchical sequencing

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 (MW) -- 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
course review

May 07 -- Final Exam 8-10 AM

Graduate students: final paper due May 10