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**INTEGRATIVE BIOLOGY 127/L
MOTOR CONTROL
COURSE SYLLABUS AND LECTURE OUTLINE**

Units: Three (3). Two hours of lecture and two hours of lab per week.

Prerequisite Courses: a course in physiology (MCB 136, IB 132 or equivalent). Both the lecture and lab components must be taken concurrently.

Statement of Purpose: To give students an understanding the anatomy and physiology of muscles and of motor systems of the brain, and to synthesize that knowledge into an understanding of the neural control of movement in humans and other animals, using theories of information and control as conceptual frameworks.

Intended Audience: Students in Integrative Biology, other biological sciences and bioengineering, who are interested in control of movement, and the physiology of muscle and nerve; students with special interests in health sciences.

Course Description:

The main goal for the first 5 weeks is to develop an understanding of control at the spinal level. Two lectures and two labs will teach the fundamental properties of feedback control systems. Two lectures will develop the mechanics of muscle and recruitment of motor units. Two lectures will apply the sensory physiology of muscle mechanoreceptors and proprioception, and the simplest reflex circuitry in the spinal cord. A lecture and lab will synthesize these concepts into an understanding of the flexible, task-sensitive final pathway of spinal level motor control. Labs in this part of the class allow students to explore the properties of motor units, muscle mechanics, and spinal reflexes, and also teach control theory by simulation.

In the second 5 weeks we learn about motor systems of the brain. Using development as a guide, we examine the neuroanatomy and physiology of the motor hierarchy, from the spinal cord to the brain stem and cerebellum to the cerebral hemispheres. In this section we read about a quarter of the fine text, Principles of Neuroscience. Labs in this part of the course explore more sophisticated aspects of sensory-motor physiology, and also give access to interactive software and hands-on exhibits for exploring neuroanatomy.

The last 4 weeks of the class are devoted to posture, locomotion and voluntary movements. In lectures I present classical to current papers that illuminate the present understanding of control of posture during quiet standing, locomotion of mammals including people, and voluntary reaching movements of people. For each paper, the emphasis is on the way in which experimenters test

hypotheses regarding mechanisms of motor control. Labs in the last four weeks all involve independent investigations, in which students use techniques learned in earlier labs to test their own hypothesis regarding control of movements by subjects in the lab section. The lab class climaxes at a symposium in which small groups present their independent investigations.

Course Requirements and Grading: There will be two midterm examinations (30% each) and a final exam (40%).

Mode of Instruction: Lectures, class demonstrations, laboratory experiments, study questions, discussion of supplemental readings.

TEXTS:

Required: Kandel ER, Schwartz JH, Jessell TM, Siegelbaum, and Hudspeth, Principles of Neural Science, 5th edition, McGraw-Hill, 2013.

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**Lecture Outline to Midterm 1
 THE MOTOR SERVO**

Week	Date	Lecture Title	Readings*	Lab
1	8/27 8/29	1.Course overview 2.Control theory 1		Control Sims (M section only)
2	9/3 9/5	<i>Labor Day Holiday</i> 3. Control Theory 2		Control Sims (W, Th sections)
3	9/10 9/12	4. Motor servo intro 5. Muscle recruitment	Ch 33 Ch 34	Muscle stim
4	9/17 9/19	6. Muscle 2: mechanics 7. Mechanoreceptors	Ch 21,22	EMG
5	9/24 9/26	8. Motor servo 2 9. Spinal reflex pathways and modulation	Ch 36	Motor Servo Sims

* Readings are chapters in Kandel et al, Principles of Neural Science, 5th Edition, 2013

**IB 127 Motor Control
Lecture Outline to Final Exam
CONTROL OF MOTOR SYSTEMS**

Week	Date	Lecture Title	Readings*	Lab
11	11/5 11/7	18. Posture 1 19. Posture 2	Ch 40,41	Indep Invest expt 1
12	11/12 11/14	<i>Veterans Day Holiday</i> 20. Locomotion 1	Ch 37 Ch 37	No Monday lab Indep Invest 2
13	11/19 11/21 11/22-23	21. Locomotion 2 22. Voluntary 1 <i>Thanksgiving Holiday</i>	Ch 19, 38	M lab only Indep Invest 2
14	11/26 11/28	23. Voluntary 2 24. Learning and memory	Ch 62,63	Indep Invest Symposium
15	12/3-12/7	RRR week: No lectures; Normal office hrs		No Labs

FINAL EXAM TO BE ANNOUNCED

* Readings are chapters in Kandel et al, Principles of Neural Science, 5th Edition, 2013*

**IB 127 Motor Control
Lecture Outline to Midterm 2
MOTOR SYSTEMS OF THE CNS**

Week	Date	Lecture Title	Readings*	Lab
6	10/1 10/3	MIDTERM 1 10. Motor systems of brain	Ch. 17,33	No lab
7	10/8 10/10	11. Spinal cord 12. Brain stem	Ch 34,36	Spinal reflexes
8	10/15 10/17	13. Cereb. cortex 1 14. Cereb. cortex 2	Ch 33,45 Ch 52,38	Neuroanatomy
9	10/22 10/24	15. Cereb. cortex 3 16. Cereb. cortex 4	Ch 42	Neurology exam classics
10	10/29 10/31	17. Cerebellum MIDTERM 2		Sensorimotor Response times

* Readings are chapters in Kandel et al, Principles of Neural Science, 5th Edition, 2013*