PHM827 PHM/PSL/ZOL 827

FALL 2011

PHYSIOLOGY AND PHARMACOLOGY OF EXCITABLE CELLS

Coordinator: Peter Cobbett (cobbett@msu.edu)

10:20-11:45 a.m. MWF

Room B448-49 Life Sciences Building

LECTURE SCHEDULE:

I. Electrical Properties of Excitable Cells

Aug. 31 Introduction, neuronal membrane structure, channel proteins Atchison
Sept. 2 Channel proteins and ions, electrochemical equilibria Atchison
5 University Closed (Labor Day)
*6 The Nernst Equation, Hodgkin-Huxley-Goldman Equation Atchison
7 Ion pumps and exchangers I: Elemental Ions Galligan
9 Membrane resistance and capacitance Cobbett
12 Cable properties, equivalent circuits Cobbett
14 Gating of voltage-dependent ion channels Cobbett
Online Principles of electrical measurements from cells Cobbett

EXAM 1 (18%)

16 Sodium Channels I Dong
19 Sodium Channels II Dong
21 Ca$^{2+}$ channels I Cobbett
23 Ca$^{2+}$ channels II Cobbett
26 K$^+$ channels: “delayed and anomalous” rectifiers Cobbett
28 G-protein coupled channels Cobbett
30 K$^+$ channels: “Ca-activated” and Cl$^-$ channels Cobbett

Oct. 3 Maintenance of intracellular Ca$^{2+}$ homeostasis I Jackson
5 Maintenance of intracellular Ca$^{2+}$ homeostasis II Jackson

EXAM 2 (20%)

II. Intercellular Communication

Oct. 7 Overview of synaptic transmission Cobbett
10 Mechanisms of synaptic excitation: Nicotinic Cholinergic channels Cobbett
12 Mechanisms of synaptic excitation: Glutamate receptors Cobbett
14 Mechanisms of synaptic inhibition I Cobbett
17 Synaptic integration Cobbett
19 Synaptic plasticity: Long-term potentiation/long-term depression Cobbett
21 Regulated secretion of stored chemicals: Principles I Hegg
24 Regulated secretion of stored chemicals: Principles II Hegg
26 Regulated secretion of stored chemicals: Neurotransmitters I Hegg
28 Regulated secretion of stored chemicals: Neurotransmitters II Hegg
31 Mechanisms of synaptic excitation: ATP and 5-HT-gated channels Galligan

Nov. 2 Mechanisms of slow synaptic excitation Galligan
4 Ion pumps and exchangers II: Neurotransmitters Galligan
EXAM 3 (29%)

III. **Cell Structure and Motility**

Nov. 7  Early neuronal development from neural tube to polarized neurons  Miller
9  The neuronal cytoskeleton: small, medium and large filaments  Miller
11  Actin-based motility in neurons  Miller
14  The growth cone: steering and pathfinding  Miller
16  Axonal transport and other microtubule-based growth functions  Miller
18  The endomembrane system, nucleus to synaptic vesicle  Miller

EXAM 4 (13%)

IV. **Sensory Receptors**

Nov. 21  Sensory transduction and neural processing  Bernard
*22  Somatic and chemical senses  Bernard
23  Vision  Bernard
25  University Closed (Thanksgiving Friday)
28  Hearing  Bernard

V. **Muscle Biology**

Dec. 2  E-C coupling, ryanodine receptor and modulation  Meyer
5  Muscle metabolism and diversity: molecular aspects of muscle development and adaptation  Meyer
7  Smooth muscle physiology  Jackson
9  Cardiac muscle and pacemakers  Jackson

EXAM 5 (20%)

Lectures noted by * indicate a lecture on Tuesday (not scheduled in MSU Course Schedule).

**RECOMMENDED TEXTS:**

- *Neurobiology* (3rd ed.), Shepherd;
- *Ionic channels of Excitable Membranes*, Hille (3rd ed.);
- *Cellular Physiology of Nerve and Muscle*, Matthews (4th ed.);
- *The Neuron (Cell and Molecular Biology)*, Levitan and Kaczmarek (4th ed)

**EVALUATION:**

Exams 1-4 will be held in the evening.

Exam 5 will be held during Final Exam Week, but will not be cumulative.

Each Exam will be worth 100 points and is scheduled for 3.5 hours; each exam is weighted (as indicated above) in calculation of the final grade.

For each exam, the product of % weight and the raw score (points out of 100) obtained gives the weighted score counting toward the final grade. The final grade will be determined after weighted score for all five exams are added together.
**GRADE SCALE:**
The following grade scale will be used based on student’s score determined after weighted score for all five exams are added together:

- 91-100% 4.0
- 81-90%  3.5
- 71-80%  3.0
- 61-70%  2.5
- 51-60%  2.0
- 41-50%  1.0
- <41%   0.0

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