Final Exam
EXP 3202 Sensation and Perception

Address each to the topics in the order outlined below. Drawings are encouraged but you should also describe the key points of your drawing in words. Writing in “bullet points”, or outline form is OK, as long as it is clear that you understand the words you use and are not just listing keywords. The sequence of events must be clear.

For example, if your essay was about excitatory chemical synaptic transmission, a picture of a synapse would certainly help, but you would have to describe the sequence of events in words.

Bullet points such as:

• neurotransmitter
• receptor
• ion channel
• depolarization

would not be adequate unless it was something like:

• neurotransmitter: chemicals released by the presynaptic neuron when an action potential reaches the terminal.

• receptor: a specialized protein on the postsynaptic neuron; only certain neurotransmitters will bind to the receptor (like a lock accepting a particular key).

• ion channel: a ligand-gated ion channel is a pore that opens when the neurotransmitter binds to the receptor. It allows only particular ions (charged particles) to go through the membrane.

• Depolarization: Typically, Na⁺ ions enter at excitatory synapses, making the cell more positive on the inside. If the depolarization is great enough, voltage-gated ion channels will open to generate an action potential in the postsynaptic neuron.
Audition

The Stimulus:

Describe the physical properties of sound. Include in your discussion both simple and complex sounds.

Psychophysics:

How do the physical dimensions of sound waves relate to perceptual aspects of sound? Hint: your answer should not be simply physical dimension $A = \text{perception } X$ and physical dimension $B = \text{perception } Y$. It is more complicated than that.

Transduction:

Describe the sequence of events starting from the sound wave and ending at the neural signal sent to the brain by the auditory nerve. Include the workings of the middle ear as well as the cochlea. Make sure to include the events leading to depolarization of the hair cell. (Include drawings of the human ear and of the hair cell)

Explain the place theory of frequency coding and how it relates to Fourier analysis. Describe how knowledge of this has helped in the design of a device to restore auditory perception to the deaf.

Neural coding:

Describe how, in general, information about sound frequency and intensity is coded in the brain.

Describe how the brain analyzes interaural time differences to code the location of a sound.
**Skin senses**

*The Stimulus:*

Describe the physical stimuli that are encoded by the somatosensory system.

*Psychophysics:*

Describe how these physical dimensions relate to the perceptions. *Be sure to discuss the concept of adaptation of receptors responsive to touch.* Discuss whether or placing your hand in 33°C temperature water feel hot or cold?

*Transduction:*

Describe the three major classes of somatosensory receptors and type of stimuli that activate each of them. Provide one example of what physically happens in one of these receptors to result in depolarization.

*Neural coding:*

Describe the two paths to the cortex. Which receptors go through each channel? Where is each synapse in these two paths located (including which side of the nervous system as well as which location)?

Define receptive field and describe the organization of somatosensory information at the cortex.

Describe the gate control theory of pain perception. Draw the circuit and explain why rubbing the site of an injury could relieve pain.

What are endogenous opiates and how do they inhibit pain? In what situations are they thought to play a role in pain control?
Chemical senses

*The Stimulus:*

Describe the physical stimuli that are encoded by the chemosensory systems. *Be sure to note the differences between taste stimuli and olfactory stimuli.*

*Psychophysics:*

What is the major function of our chemosensory systems and what evolutionary significance might there be to the specialized taste receptors that we have?

Provide two examples of conditions that produce a short-term modification of our threshold for a taste stimulus (other than simple adaptation to the taste stimulus we are testing).

*Transduction:*

Describe the transduction process for each of the primary taste qualities. Compare and contrast the olfactory receptor cell and the taste receptor cell.

*Neural coding:*

Is coding in the taste system labeled-line or cross pattern? Provide points from both sides of this argument.

Describe the organization of the olfactory receptors-to-olfactory bulb projections. Explain how this might lead to different patterns of activation in the olfactory bulb when different molecules contact the olfactory epithelium.

Compare and contrast the major neural projections of the taste, olfactory and vomeronasal systems. What functions are thought to be served by these key brain areas?
Vision

**The Stimulus:**

Describe the physical properties of light. What other stimuli is visible light related to?

**Psychophysics:**

How do the physical properties of light relate to what is perceived? *Be sure to comment on why you can’t find your seat when you first walk into a dark theater.*

Provide an example of how our color perceptions can change as a result of a relatively brief visual experience and discuss the mechanism of that change.

**Transduction:**

Draw and label the human eye and identify the key parts and the major function of each.

Describe the process of how light results in an action potential being sent to the brain. (Draw a picture of retinal organization to help explain these steps).

**Neural coding:**

Draw and label the neural paths from retina to cortex. Be sure to explain how the left visual field ends up being processed on the right side of the brain.

What is a receptive field? Describe the types of receptive fields observed at the retina and at the primary visual cortex. Diagram and label the Hubel and Wiesel “hypercolumn”.

Describe the trichromatic theory of color vision.

What are ocular dominance columns and describe the effects of experience on the development of ocular dominance columns.