SYLLABUS

NAME OF COURSE: Neuromuscular Physiopathology II (PHPA-212)

LENGTH OF COURSE: 3.5 units, 55 hours (5 hours lecture/week),

COURSE DESCRIPTION: This course examines a number of nervous system functions and the pathologies that affect them. The mechanisms by which the nervous system controls sensory and motor processes, vision and autonomic function will be explored along with pathologies that affect these functions.

PREREQUISITES: PHYS-122, PHPA-131, ANAT-138

COURSE OFFERED BY: Basic Sciences Department

Required Text: NMPhPa 2 - course notes **(Canvas)**
NMPhPa 2 - study guide **(Canvas)**
Blumenfeld H. Neuroanatomy through Clinical Cases, 2nd ed., 2010

Recommended texts: Fitzgerald. Clinical Neuroanatomy and Neurosciences. 2016 (available Ebook via library website)
Waxman S. Clinical Neuroanatomy. 28th ed., 2016
Kierman, J Barr's The Human Nervous System. 10th ed., 2014
Vanderah TW, Nolte's The Human Brain. 7th ed, 2015
Splittgerber, R. Snell's.Clinical Neuroanatomy.8th ed., 2018
Cramer G., Darby S. Clinical Anatomy of the Spine, Spinal Cord and ANS, 3nd ed., 2014

REFERENCE TEXTS: Kandel ER. Principles of Neural Science. 5th ed, 2012
MATERIALS: handouts may be provided

METHOD OF INSTRUCTION: lecture, assignments, Q&A as applicable/as time allows

EVALUATION:

MT 1 (Wed. week 5):	25%
MT 2 (Wed. week 9):	25%
Final **(comprehensive)**:	50%
Assignments	pass/fail

Exam questions may be drawn from the following formats (in any combination or proportion):

* multiple – choice, T/F,
* fill in the blank, short answer
* short answer/written

Quarter grades will be assigned according to the following percentage ranges:

A	Superior Work	90-100%
B	Above Average Work	80-89%
C	Average Work	70-79%
F	Failure - The student must REPEAT the course	below 70%

I Incomplete - The Student has failed to take all required exams and/or has failed to turn in other required work.

0 Overcut - The Student has accumulated more than 10% absence in the course.

EXTRA CREDIT: **There will be no extra credit work permitted in this class.**

Grades and the Grading System Final Grades are available online through the CAMS student portal. If there are any questions on grading procedures, computation of grade point average, or the accuracy of the grade report, please contact the Registrar's Office or the Office of Academic Affairs. Grades will be reported and evaluation will be based on the Academic Policies, Procedures, & Services. Please refer to Evaluation Policy **(Policy ID: OAA.0007)**

In order to maintain **Satisfactory Academic Progress**, a student must maintain a 2.0 or better in each and every course. **Any grade less than a C must be remedied by repeating the class.** Please refer to Satisfactory Academic Progress **(Policy ID: OAA.0006)**

Attendance: Please refer to Attendance Policy (**Policy ID: OAA.0002**)

Conduct and
Responsibilities: Please refer to the Personal Conduct, Responsibility and Academic Responsibility Policy (**Policy ID: OAA.0003**)

Make-up Exams: Please refer to Make-up Assessment Policy (**Policy ID: OAA.0001**)

Request for
Special Testing: Please refer to Request for Special Testing (**Policy ID: OAA.0004**)

Accommodation
for Students with Disabilities:
If you have approved accommodations, please make an appointment to meet with your instructor as soon as possible. If you believe you require an accommodation, but do not have an approved accommodation letter, please see the Academic Counselor Lori Pino in the Office of Academic Affairs. Contact info: Lpino@lifewest.edu or 510-780-4500 ext. 2061. Please refer to Service for Students with Disabilities Policy
(**Policy ID: OAA.0005**)

Electronic Course Management:

Canvas is LCCW's Learning Management System (LMS). Canvas will be used throughout the quarter during this course. Lectures, reminders, and messages will be posted. In addition, documents such as the course syllabus and helpful information about the class project will be posted. Students are expected to check Canvas at least once a week in order to keep updated. The website address for Canvas is https://lifewest.instructure.com/login/canvas Please refer to the Educational Technologies Policy (**Policy ID: OAA.0009)**

PROCEDURES FOR REVIEWING EXAMS:

The instructor had not authorized distribution of old exams. Any possession of old exams is prohibited. The instructor may either conduct review sessions in class or may meet with a student to review his or her exam during office hours **for two weeks following the exam (unless there is a shorter time period until the last scheduled office hour during the last week of classes.)** Students may not review mid-term exams during final exam week. The possession of any exam other than during a review session constitutes unprofessional conduct.

COURSE GOAL:

As the last basic science course in neurology, the goal of NMPHPA 2 is to help students solidify and expand their understanding of the structure and function of the nervous system, to further prepare the student for the NBCE part 1 examinations, and to serve as a bridge between the basic science courses of neuroanatomy, neurophysiology, neuropathology, and the clinical application subjects of neurologic examination and diagnosis.

COURSE OBJECTIVES – OVERVIEW
(see detailed, week-by-week objectives after the Student Learning Outcomes and Program Learning Outcomes sections below)

1. Review the basic embryology of the nervous system.

2. Review and further discuss the anatomy and physiology (structure and function) of the nervous system:

CNS:
a. cerebral hemispheres
b. diencephalon (thalamus & hypothalamus)
c. brainstem & cranial nerves
d. cerebellum
e. basal ganglia
f. spinal cord

PNS:
a. spinal nerves
b. peripheral nerves

3. Describe the somatosensory system from receptors to the somatosensory cortex.

4. Describe the somatomotor system from somatomotor cortex to skeletal muscle.

5. Describe the basic anatomy and function of the autonomic nervous system.

6. Discuss relevant pathologies affecting each portion of the nervous system.

7. Discuss the neurologic mechanisms involved in modulation of nociception:

    a. suprasegmental
    b. segmental (spinal gating)

8. Discuss the "dysafferentation" model of subluxation and differentiate it from the "garden hose" model.

9. Discuss sclerogenic connective tissue referred pain and referral patterns from cervical and lumbar joints.

STUDENT LEARNING OUTCOMES (SLOs):

1. The student will be able to discuss the basic clinically relevant anatomy and physiology of the nervous system (brain, spinal cord, spinal nerves, & peripheral nerves). [PLO: 1, 8]

2. The student will be able to discuss relevant pathologies affecting each portion of the nervous system, including the nature of the pathology, and the major associated symptoms and signs. [PLO: 1, 8]

3. The student will be able to describe dermatome and peripheral nerve sensory distributions, and for any given area of pain/tingling/numbness the student will be able to identify the likely involved spinal nerve and peripheral nerve. [PLO: 1, 2, 4, 8]

4. The student will be able to analyze neurologic exam data to localize classic neurologic lesions - peripheral and central. [PLO: 1, 2, 4, 6, 8]

5. The student will be able to compare & contrast UMN & LMN lesion signs. [PLO: 1, 4]

6. The student will be able to explain the concept of sclerogenic referred connective tissue pain, and describe referred pain patterns associated with cervical and lumbar joints. [PLO: 1, 2, 4, 8, 10]

7. The student will able to explain the neural mechanisms involved in modulation of nociception (segmental and suprasegmental), and how the chiropractic adjustment potentially activates these mechanisms. [PLO: 1, 2, 3, 4, 6, 8, 10

Program Learning Outcomes (PLO): Students graduating with a Doctor of Chiropractic degree will be proficient in the following:

1. **ASSESSMENT AND DIAGNOSIS:** An assessment and diagnosis requires developed clinical reasoning skills. Clinical reasoning consists of data gathering and interpretation, hypothesis generation and testing, and critical evaluation of diagnostic strategies. It is a dynamic process that occurs before, during, and after the collection of data through history, physical examination, imaging, laboratory tests and case-related clinical services.
2. **MANAGEMENT PLAN:** Management involves the development, implementation and documentation of a patient care plan for positively impacting a patient's health and well-being, including specific therapeutic goals and prognoses. It may include case follow-up, referral, and/or collaborative care.
3. **HEALTH PROMOTION AND DISEASE PREVENTION:** Health promotion and disease prevention requires an understanding and application of epidemiological principles regarding the nature and identification of health issues in diverse populations and recognizes the impact of biological, chemical, behavioral, structural, psychosocial and environmental factors on general health.
4. **COMMUNICATION AND RECORD KEEPING**: Effective communication includes oral, written and nonverbal skills with appropriate sensitivity, clarity and control for a wide range of healthcare related activities, to include patient care, professional communication, health education, and record keeping and reporting.
5. **PROFESSIONAL ETHICS AND JURISPRUDENCE**: Professionals comply with the law and exhibit ethical behavior.
6. **INFORMATION AND TECHNOLOGY LITERACY**: Information literacy is a set of abilities, including the use of technology, to locate, evaluate and integrate research and other types of evidence to manage patient care.
7. **CHIROPRACTIC ADJUSTMENT/MANIPULATION**: Doctors of chiropractic employ the adjustment/manipulation to address joint and neurophysiologic dysfunction. The adjustment/manipulation is a precise procedure requiring the discrimination and identification of dysfunction, interpretation and application of clinical knowledge; and, the use of cognitive and psychomotor skills.
8. **INTERPROFESSIONAL EDUCATION**: Students have the knowledge, skills and values necessary to function as part of an inter-professional team to provide patient-centered collaborative care. Inter-professional teamwork may be demonstrated in didactic, clinical or simulated learning environments.
9. **BUSINESS**: Assessing personal skills and attributes, developing leadership skills, leveraging talents and strengths that provide an achievable expectation for graduate success. Adopting a systems-based approach to business operations. Networking with practitioners in associated fields with chiropractic, alternative medicine and allopathic medicine. Experiencing and acquiring the hard business skills required to open and operate an on-going business concern. Participating in practical, real time events that promote business building and quantifiable marketing research outcomes
10. **PHILOSOPHY:** Demonstrates an ability to incorporate a philosophically based Chiropractic paradigm in approach to patient care. Demonstrates an understanding of both traditional and contemporary Chiropractic philosophic concepts and principles. Demonstrates an understanding of the concepts of philosophy, science, and art in

chiropractic principles and their importance to chiropractic practice.

COURSE OBJECTIVES - DETAILED

Week 1-5: MT 1 content

- review the syllabus: policies & procedures

- provide an overview of the course

- differentiate the “dysafferentation” and “garden hose” theories of subluxation

- discuss the basic principles of neurologic exam & diagnosis

- define basic neurologic terms (radiculopathy, neuropathy, myelopathy, etc.)

- provide an overview of nervous system structure and function

- discuss the division of the nervous system into motor and sensory divisions, and into somatic and visceral divisions (GSE, GVE, GSA, GVA)

- review spinal cord anatomy
  - gray matter
    - dorsal, ventral, and lateral horns (IML), lamina of Rexed
  - white matter (anterior, lateral, posterior columns)
    - tracts located in the different columns
  - compare and contrast somatomotor and visceromotor output/projections

- compare & contrast the transmission of pain/temp and tactile sensation in the CNS (STT vs. DC/ML)
- review the basic anatomy of upper & lower motor neurons (UMN & LMN);
  - describe the lateral vs. medial motor systems of the spinal cord,
  - describe the vestibulospinal tract’s role in maintaining balance and UMN innervation of intrinsic spinal muscles
  - describe the role of the medial longitudinal fasciculus (MLF) in the coordination of head and eye movement

- describe the basic anatomy of the autonomic nervous system (ANS), including the - intermediolateral cell column (IML),
  - pre-ganglionic and post-ganglionic neurons,
  - sympathetic paravertebral chain
  - sympathetic innervation of the upper & lower extremities
  - sympathethetic innervation of the head & face, and Horner's syndrome

- provide a review of PNS structure/function: spinal & peripheral nerves
  - discuss spinal nerves and their anatomic relations to IVFs and discs in the cervical and lumbar spine
  - discuss causes of radiculopathy
  - discuss the localizing value of the distribution of pain, tingling, and numbness
    - review dermatomes and peripheral nerve sensory distributions
  - review the motor functions of spinal nerves ("myotomes") & peripheral nerves
  - review the distribution and functions of peripheral nerves in the UE & LE
  - identify peripheral nerve entrapment sites (pronator teres, supinator, etc.)

- discuss Cauda Equina Syndrome (CES)
  - discuss the significance of "saddle anesthesia" as a "red flag" for cauda equina syndrome (CES), the potential parasympathetic S&S of CES, and the appropriate clinical management of CES

- discuss the clinical picture of vertebral DJD
  - introduce the concept of CT referred (sclerogenic) pain; describe sclerogenic referred pain pattern from cervical & lumbar joints
  - introduce radiculopathy
  - introduce cervical spondylotic myelopathy: pathophysiology, radiologic measurement of the spinal canal, S&S

- briefly discuss the cerebrum **(further discussion in week 10, as time allows)**
  - lobes and their basic function(s)
  - somatosensory cortex, and its homunculus distribution (also see SS system)
  - motor cortex, and its homunculus distribution (also see somatomotor system) - vascular supply
  - language centers
  - prefrontal cortex
  - subcortical nuclei ('corpus striatum')

- briefly discuss the basal ganglia **(also see somatomotor system)**
  - main components
  - connection with motor cortex
  - relation between side of lesion and side of clinical S&S

- briefly discuss cerebellum (also see somatomotor system)
  - functional divisions
  - main functions
  - connections to motor cortex
  - relation between side of lesion and side of clinical S&S

- briefly discuss the thalamus **(further discussion in week 10, as time allows)**

- briefly discuss the hypothalamus **(further discussion in week 10, as time allows)**

- Somatosensory system: discuss the somatosensory system from receptor to somatosensory cortex

    - discuss the primary afferent fibers, their receptors & functions, and their categorization based upon conduction velocity
    - discuss the deep tendon (DTR) / muscle stretch reflex (MSR)
    - differentiate the function of muscle spindle and GTO
    - describe how GTO mechanisms may explain the reduction of taut fibers after an adjustment
    - review the sensory distributions of spinal nerves (dermatomes) & peripheral nerves
    - review somatosensory transmission in the spinal cord
    - discuss spinal cord pathologies
        - review syringomyelia
        - review Brown-Sequard syndrome
    - discuss somatosensory transmission in the brainstem
        - review somatosensory transmission from the body through the brainstem
        - discuss somatosensory transmission from the face (trigemino-spinal tract and nucleus), and the classic somatosensory deficits associated with dorsolateral medullary (Wallenberg) syndrome
        - discuss cervicogenic facial pain (convergence of nociceptive input from the upper cervical region and the face)
    - review thalamic relay of somatosensory information
        - describe thalamic pain syndrome, and differentiate “neuropathic” and “nociceptive” pain

    - discuss the somatosensory cortex
        - review the somatosensory body map (homunculus), and it’s vascular supply
        - discuss “agnosis’: “astereognosis”, “agraphognosis”/”agraphesthesia”‘ and “extinction”

    - discuss modulation of nociception
        - discuss ‘segmental” modulation of nociception (“spinal gating”), and the relevance of chiropractic
        - discuss "suprasegmental" modulation of nociception

- start discussion of somatomotor system (as time allows)
    - review the basic concept of UMNs & LMNs

Week 6-9: Midterm 2 content

- Somatomotor system: discuss somatomotor system anatomy, physiology, and pathology from motor cortex to skeletal muscle

    - discuss UMN & LMN anatomy and function
    - review the motor cortex (homunculus, vascular supply, etc.)
    - review UMNs in brain and spinal cord
    - differentiate alpha & gamma motor neuron innervation of extrafusal & intrafusal muscle fibers
    - discuss the control of the sensitivity the muscle spindle receptor
    - compare & contrast the clinical S&S of UMN and LMN lesions

    - discuss examples of UMN lesion
        - CVA/stroke
        - spinal cord injury
        - multiple sclerosis
        - subacute combined systems disease (posterolateral sclerosis)
        - parasagittal meningioma

    - discuss examples of LMN lesion
        - Bell's palsy
        - poliomyelitis
        - Guillain-Barre syndrome (acute inflammatory demyelinating polyradiculoneuropathy)

    - discuss NMJ anatomy, physiology, and pathology
        - discuss Myasthenia Gravis
        - discuss botulism and Lambert-Eaton syndrome

    - discuss myopathy
        - define "muscular dystrophy"
        - describe the S&S of myopathy
        - list the lab tests used to confirm suspected myopathy

    - discuss the cerebellum
        - discuss cerebellar anatomy, physiology, and pathology
        - describe the transverse and longitudinal anatomy

- describe the cortical and subcortical anatomy
- describe the microscopic anatomy (cells, fiber types)
- discuss the functional regions
- discuss the S&S of cerebellar lesion
- describe tests of limb coordination and appropriate terminology

- discuss the Romberg test
  - differentiate “positive” vs. “negative” Romberg signs
  - discuss the significance of a “positive” Romberg sign
  - describe how polyneuropathy and multiple sclerosis may cause a positive” Romberg sign

- discuss basal ganglia anatomy, physiology, and pathology
  - list the components of the basal ganglia
  - describe the connection of the basal ganglia & the motor cortex
  - discuss the major S&S of basal ganglia lesion
  - discuss Parkinson disease
    - describe the pathophysiology of PD
    - describe the common S&S of PD

Week 9-10: additional content for final exam

- discuss cranial nerve anatomy, physiology, and pathology
  - identify cranial nerves with sensory, motor, and reflex functions
  - identify cranial nerves with parasympathetic functions
  - discuss causes of loss of smell (anosmia)
  - describe the visual pathway, and discuss the visual deficits associated with pre-chiasmal, chiasmal, and retro-chiasmal lesions
  - discuss the pupillary/light and consensual pupillary/light reflex
  - discuss the innervation and control of extraocular movement
  - discuss dysconjugate gaze and diplopia
  - differentiate parasympathetic & sympathetic effects on pupillary size
  - differentiate ptosis caused by CN III lesion and Horner’s syndrome based upon pupillary size;
  - describe the sensory, motor, and reflex functions of the trigeminal nerve
  - discuss Opthalmic Herpes
  - discuss trigeminal neuralgia
  - describe the jaw jerk reflex
  - describe the corneal/blink reflex
  - describe the sensory, motor, and reflex functions of the facial nerve
  - discuss Bell’s palsy (LMN facial weakness), and differentiate it from UMN facial weakness; discuss the natural history of Bell’s palsy
  - describe cranial nerve innervation of taste
  - describe cranial nerve innervation of salivation
  - discuss the sensory functions of CN VIII

- describe the auditory pathway
- define “conductive” & “sensorineural” hearing loss
- discuss acoustic neuroma & cerebellopontine angle tumors
- describe vestibular input, and its connections and functions
- discuss the significance of uvula deviation and palatal paresis
- discuss the significance of tongue deviation upon protrusion
- discuss the innervation of the SCM and upper trapezius

AS time allows (based upon holidays and other class cancellations):

- Cerebral hemisphere: further discussion of cerebral hemisphere anatomy, physiology, and pathology

  - describe the components of the cerebral hemispheres (cortex, subcortex, corpus striatum)
  - list the components of the basal ganglia; describe the connections of the basal ganglia and motor cortex, common S&S of BG lesions
  - list the lobes of the cerebral cortex and their basic functions
  - describe the primary & uni-modal association sensory cortical regions
  - describe the primary & uni-modal motor cortical regions (primary motor & motor association cortex)
  - describe the multi-modal association cortical regions (PTO & prefrontal)
  - discuss the functions of the prefrontal cortex, and implications of dysfunction
  - describe the body map (homunculus) of the somatosensory & somatomotor cortex
  - describe the vascular supply to the cerebral cortex (int. carotid vs VB; ACA vs MCA)
  - describe the language centers of the cerebral cortex; describe & differentiate Wernicke’s & Broca’s aphasia
  - define “seizure”, “tonic-clonic” & “absence” seizure
  - discuss dementia & Alzheimer’s disease

- Thalamus: further discussion of thalamic anatomy, physiology, and pathology

  - discuss the “integrative” functions of the thalamus (thalamus as “gate-keeper” rather than “gateway”)
  - discuss Dr. Carrick’s article “Changes in brain function following manipulation of the cervical spine”, and the concepts of ‘blind spots” & “hemisphericity”
  - describe the relay functions of the thalamus (somatosensory, special sensory, somatomotor, limbic, etc.)
  - discuss the diffuse-projecting nuclei of the thalamus, and their role regulating cortical neuronal activity (consciousness & arousal aspect of nociception)
  - discuss the reticular nucleus and it’s role in regulating neuronal activity of other thalamic nuclei

- Hypothalamus: discuss hypothalamus anatomy, physiology, and pathology

    - describe role in maintenance of homeostasis
    - describe role in autonomic function
    - define Horner's syndrome, and discuss its etiology (Pancoast tumor, etc.), and S&S
    - describe role in endocrine function, and connections to the anterior and posterior pituitary
    - describe role in suprasegmental modulation of nociception