DEN5120C: Physiology
Spring 2021

Course Description:
This course provides foundation knowledge on the structure and normal function of the major body systems including the neurological, pulmonary, cardiovascular, endocrine gastro-intestinal and renal systems. The relationship of structure to normal function is presented with emphasis on components important to a dentist as a dental patient's case manager and to the prevention, diagnosis, and treatment of oral diseases. In addition, this course will provide the fundamental knowledge to support the understanding and appreciation of the interrelationships of systemic and oral health.

I. General Information
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Course Credits: 5
Semester: Spring

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II. Course Goals
This course is designed to provide an in-depth overview of the normal structure and function of body systems, which includes the cardiovascular, pulmonary, renal, neurological, endocrine and gastrointestinal systems. Both systemic health and disease of the body and the relationship of the biology of the whole body to that of the oral-facial complex will be emphasized.
The content of this course follows DEN 5100C, Gross Anatomy, in the first semester to provide a systems-based approach to physiology of the human body so that the student can better appreciate the alterations of normal structure and function that occur in disease or malformation.

III. Course Overview
This is a lecture-based foundation knowledge course utilizing clinical correlations and there are five examinations over two semesters.

IV. Course Outline

A. Introduction to the Course
B. Cell Physiology
   1. Cell membrane / Membrane Transport
C. Neurological
   1. Introduction to Neurophysiology
   2. Neurotransmission
   3. Introduction to the Brain
   4. Cell Membrane/Membrane Transport
   5. Development, Brain Features, and Ventricles
   7. Cerebrovasculature
   8. Somatosensory Pathways
   9. Autonomic Nervous System
   10. Motor Pathways
   11. Cranial Nerves (Basic)
   12. Corticobulbar Tract
   13. Motor Control and Mastication
   14. Cranial Nerves Normal Function (Clinical)
   15. Clinical Correlation- Neuronal Disease
D. Respiratory System
   1. Lung Functional Anatomy
   2. Lung Compliance
   3. Airway Resistance
   4. The Work of Breathing/Surfactant
   5. Alveolar Ventilation & Gas Composition
   6. Gas Diffusion
   7. O2 Content and Delivery
   8. Pulmonary Circulation
   9. Regulation of Breathing
   10. Acid/Base
   11. Pulmonary Edema and Altitude
   12. Clinical Correlation- Pulmonary Diseases
E. Cardiovascular System
   1. Muscle 1
   2. Muscle 2
   3. Cardiovascular Functional Anatomy
   4. Cardiac Electrophysiology- ECG/Arrythmia
   5. Cardiac Cycle
   6. Cardiac Output
   7. Hemodynamics and Venous Returns
   8. Control of Blood Flow
   9. Capillary Exchange
   10. Regulation of Arterial Pressure
   11. Clinical Correlation- Cardiac and Muscle Diseases
   12. Integration of Cardiovascular System
F. Endocrinology
   1. Intro to Endocrinology
   2. Insulin/Glucagon
   3. Pituitary Hormones
   4. Thyroid Hormones, Adrenal Hormones
   5. Calcium Metabolism 1
   6. Calcium Metabolism 2
V. Course Material

Required texts:


Additional Resource:

Dental Lib Guide: http://guides.uflib.ufl.edu/dental

VI. Course Objectives

A. Introduction to the Course
   1. Describe the objective of this course.
   2. Summarize the normal body systems covered in this course.
   3. Describe the grading scale and the mechanism used to determine the final grade for the course.
   4. Describe the remediation procedure and when it will be applied

B. Cell Physiology
   1. Membrane Transport

C. Neurological
   1. Introduction to Neurophysiology
      a. Distinguish the individual parts of the neuron.
      b. Describe the major principals of communication between neurons.
      c. Demonstrate familiarity with the applied nomenclature.
   2. Neurotransmission
      a. Compare and contrast amino acid and peptide neurotransmitters.
      b. Identify and define glutamate receptors.
      c. Relate the role of Ca++ in neurotransmission.
      d. Describe mechanisms of neuroplasticity.
   3. Development, Brain Features, and Ventricles
      a. Identify and differentiate between vesicles in early, mid-, and late-developmental stages
      b. Be able to use directional terms to label a gross brain, be able to identify planes/cuts of brain
         A. E.g., rostral, caudal, horizontal, coronal.
      c. Be able to identify the major lobes, sulci, and gyri found on the brain exterior, mid-sagittal, horizontal, and coronal views; and be able to give their function
      d. Identify the different sections of the ventricular system.
4. Diencephalon, extended brainstem, and spinal cord  
   a. Identify the subdivisions of the diencephalon and be able to define their components  
      A. Thalamus  
      B. Hypothalamus  
      C. Epithalamus  
   b. Identify external structures of the brainstem with emphasis on the cranial nerves.  
   c. Sensory Systems: Spinal cord  
      A. Describe the gross anatomy and microanatomy of the spinal cord.  
      B. Describe the sensory, motor, and autonomic subdivisions.  

5. Cerebrovasculature  
   a. Be able to identify the 2 vascular systems that supply the brain  
   b. Identify which major arteries supply the different parts of brain  
   c. Understand how the blood leaves the brain  
   d. Be able to describe what sinuses are and identify where they are located. Be able to label them on a diagram  
   e. Be able to describe what that Circle of Willis is. Be able to label the different parts on a diagram.  
   f. Be able to describe what anastomosis is  
   g. Be able to describe different pathophysiological conditions associated with blockage of the ACA, MCA, PCA, Superior sagittal sinus, others  
   h. Be able to describe what the blood-brain barrier does  
   i. Be able to describe what a contrecoup contusion is  

6. Somatosensory Pathways  
   a. Describe the types and structure of cutaneous receptors.  
   b. Describe the pathway of touch and proprioception in the spinal cord  
   c. Somatosensory II: Pathway: Identify and describe:  
      anterolateral pathway: projections, terminations and laterality, terminations and laterality  
      ventroposterolateral nucleus: projections, terminations and laterality  
      somatosensory cortex: projections, terminations and laterality  
   d. Be able to identify sensory deficits in response to different lesions in the pathways and their laterality.  

7. Autonomic Nervous System  
   a. Know the characteristics and anatomical-physiological-pharmacological differentiation of the Sympathetic and Parasympathetic visceromotor divisions  
   b. Understand the principles of visceral sensory system and their differences with the somatic sensory system  
   c. Understand the principles behind Horner’s Syndrome and Autonomic Dysreflexia  

8. Motor Pathways  
   a. Be able to describe the hierarchy of motor control  
   b. Differentiate between the functions of the primary motor and premotor areas  
   c. List the functions of each of the following tracts and hypothesize the symptomology upon lesion to each tract:  
      A. Corticospinal tract  
      B. Tectospinal tract  
      C. Vestibulospinal tract  
   d. Be able to define upper (UMN) and lower motor neuron (LMN). Be able to identify the different symptoms caused by UMN and LMN lesions.  

9. Cranial Nerves  
   a. Be able to recognize and identify external cranial nerves  
   b. Be able to recognize and identify the internal anatomy of cranial nerve nuclei and associated tracts  
   c. Be able to list the functions of each cranial nerve and describe the deficits after lesions for each cranial nerve  
   d. Describe the normal motor and autonomic function of cranial nerve III  
   e. Describe the motor functions of cranial nerves IV - VII and X - XII  
   f. Describe the sensory and motor function of cranial nerve IX  

10. Corticobulbar Tract and horizontal eye movements  
    a. Be able to list the cranial nerves that have no cortical input  
    b. Be able to identify the laterality of cortical control for cranial nerves V, VII, IX, X, and XII  
    c. Be able to describe the function of the corticobulbar input to cranial nerve nuclei  
    d. Be able to predict the functional deficits of lesions along the corticobulbar pathway  
    e. Be able to describe the cortical and nuclear control of horizontal eye movements
f. Be able to recognize eye movement deficit syndromes after lesions in specific regions of the brainstem

11. Motor Control and Mastication
   a. Describe the sensory endings in muscle.
   b. Define the sensory motor integration in the brainstem.
   c. Describe the controls of mastication.
   d. Compare and contrast mono- and multisynaptic reflexes.
   e. Trigeminal Motor Systems: Mastication (see Cranial Nerves)
      A. Describe the role of the cranial nerves in mastication.

12. Cranial Nerves Normal Function

13. Clinical Correlation – Neuronal Disease
   a. Review lesion syndromes caused by stroke and tumors in the entire neuraxis
      A. Be able to identify different types of strokes and TBI
      B. Be able to identify different types of tumors
   b. Be able to recognize and identify symptoms of developmental disorders
      A. Chiari malformations
      B. Spina bifida
      C. Lysosomal disorders
   c. Be able to recognize and identify symptoms of neurodegenerative disorders
      A. Alzheimer’s disease (cortical)
      B. Parkinson’s disease (Basal ganglia)

D. Pulmonary
   1. Functional Anatomy
      a. Describe the conductive airways in the human lung.
      b. Identify and characterize the area of gas exchange in the lung.
      c. Outline the function of the chest wall in respiration.
   2. Compliance and Resistance
      a. Define lung compliance.
      b. Identify and compare the factors that contribute to the work of breathing.
   3. Lungs and Related Structures
      a. Describe the osteology of the thorax.
      b. Describe the arrangement and contents of an intercostal space.
      c. Relate the lobes of the lungs to their coverings and recesses.
   4. Resitance
      a. Define airway resistance.
      b. Identify and compare the factors that contribute to the work of breathing.
   5. Alveolar Ventilation
      a. Describe the different lung volumes.
      b. Calculate alveolar ventilation.
      c. Outline the different pressures in the respiratory system.
   6. O2 & CO2 Transport
      a. Explain the mechanism of gas transport in the lung.
      b. Describe the forces for gas transport.
      c. Compare and contrast the physiological mechanisms for hypo- and hyperventilation.
   7. Role of Circulation in O2 Transport
      a. Relate the three factors responsible for O2 transport to the tissue.
      b. Distinguish between O2 capacity, O2 content, and O2 saturation.
      c. Describe how C02 transport is conducted.
   8. Reg. of Breathing
      a. Describe the mechanism for the rhythmicity of respiration.
      b. Relate how H+ and C02 regulate respiration.
      c. Define how O2 regulates respiration.
   9. Acid/Base Regulation
      a. resent how C02 is transported in the blood.
      b. Explain how the lungs regulate ECF pH.
      c. Compare and contrast the compensatory mechanisms for respiratory acidosis and respiratory alkalosis.
   10. Pulmonary Resuscitation
       a. Justify the circumstances in which resuscitation is needed.
       b. Describe the methods of resuscitation.
       c. Point out the effects of resuscitation.
11. Solving Problems in Pulmonary Function
   a. Use basic fundamental knowledge of the functional mechanisms involved in respiration to explain the cause of symptoms observed in specific pulmonary conditions.

12. Clinical Correlation

E. Cardiovascular System
1. Muscle I and II
2. Cardiovascular Functional Anatomy
3. Cardiac Electrophysiology
   a. Describe the concept of resting membrane potential.
   b. Apply the concept of ion channel activation.
   c. Explain the concept of ion channel inactivation.
   d. Defend the localization of fast action potential containing cells.
   e. Describe the ionic currents underlying fast action potentials.
   f. Defend the localization of slow action potential containing cells.
   g. Describe the ionic currents underlying slow action potentials.
4. Electrocardiogram / Arrhythmia
   a. Define the ECG.
   b. Compare in time the ECG and electrophysiology of single cell.
   c. Identify common electrical rhythms and disrhythms of the heart.
5. Cardiac Cycle
   a. Define the cardiac cycle of the heart in time.
   b. Define what is meant by isovolumetric contraction and relaxation.
   c. Explain the relationship between pressure and blood flow through the heart.
6. Cardiac Output
   a. Define stroke volume, heart rate, and cardiac output.
   b. Summarize the regulation of heart rate by sympathetic and parasympathetic nervous system.
   c. Compare the contrast regulation of stroke volume by extrinsic and intrinsic mechanisms.
7. Venous Return
   a. Define venous return.
   b. Describe the concept of mean circulatory filling pressure.
   c. Describe regulation of venous return.
8. Hemodynamics
   a. Define the concept of flow vs velocity.
   b. Describe the concept of resistance to flow.
   c. Explain the concept of resistance vs radius.
9. Local Control of Blood Flow
   a. Outline the role of metabolites in blood flow.
   b. Define myogenic responses.
   c. Explain the concept of autoregulation.
10. Capillary Exchange
    a. Compare and contrast hydrostatic vs oncotic pressure.
    b. Describe the role of plasma proteins.
    c. Explain regulation of capillary exchange.
11. Control of Blood Pressure
    a. Describe baroreceptor feedback loops.
    b. Define the role of atrial "volume" receptors.
    c. Outline the role of hormones in blood pressure control.
12. Integrated Control of Blood Pressure
    a. Describe the role of the kidney in long-term control of blood pressure.
    b. Discuss the physiology of hemorrhage.
    c. Integrate cardiac and vascular control of blood pressure.
13. Clinical Correlation

F. Endocrine
1. Intro to Endocrinology
   a. Discuss the major endocrine organs and their hormones.
   b. Discuss the chemical classification of the different hormones and the general mechanisms of hormone synthesis, secretion, and transport.
   c. Discuss the mechanisms of action of different hormone classes, including their specific receptors.
2. Insulin/Glucagon
   a. Describe different cell types in the pancreas that secrete insulin and glucagon.
b. Discuss cellular and physiological actions of insulin and glucagon. In addition, explain their role in the control of normal plasma glucose.
c. Discuss diabetes mellitus and the cellular basis of the disease.

3. Hypothalamus/Pituitary
   a. Describe the general principles of the structural and functional relationship of the hypothalamus
   b. anterior
   c. posterior pituitary
d. the major hormones of the pituitary and their functions and regulation of secretion

4. Adrenal Hormones
   a. Describe structurally and functionally distinct zones of adrenal gland.
   b. Discuss synthesis and secretion of adrenal hormones
c. Discuss physiological actions of adrenal hormones and pathophysiology associated with their impaired secretion.

5. Calcium Regulation I, II
   a. Discuss the hormonal control of calcium and phosphate regulation by parathyroid hormone (PTH), calcitonin and metabolites in Vitamin D.
   b. Discuss PTH and calcitonin synthesis, secretion and physiological actions.
c. Discuss the mechanisms/sites of formation of Vitamin D metabolites and their physiological actions.
d. Discuss abnormalities of calcium and phosphate homeostasis, including Rickets/Osteomalacia and Osteoporosis.

6. Male/Female Hormones I, II
   a. Describe the anatomy of the male and female reproductive systems.
b. Summarize testicular spermatogenesis and ovarian follicular development.
c. Outline hormonal regulation of the menstrual cycle and neuroendocrine regulation of reproductive hormones.

7. Clinical Correlation
   G. Gastrointestinal
   1. GI nervous system
      a. Describe the neuromuscular system in the normal human gut.
b. Identify the normal functions of gut motility.
c. Outline the motor mechanisms of the esophagus, stomach, and intestines in the normal human.
   2. Liver/Gall Bladder
      a. Relate the composition to the control of normal bile formation by the human liver.
b. Describe the basic pathophysiological mechanisms of gallstone formation in the human.
   3. Gastric Secretion
      a. Outline the different phases of the regulation of stomach secretion in the normal human.
b. Compare and contrast the normal functions of the different gastric cell types in the human.
c. Compare the hormonal and duodenal control of the normal human stomach.
d. Describe the role of histamine in the normal function of the human stomach.
e. Relate how parietal cells act as acid pumps in the normal human.
f. Evaluate the gastric protective mechanisms in the human.
   4. Carbohydrate and Protein Digestion
      a. Define the roles of pancreatic enzymes in the normal small intestine of humans.
b. Define the roles of membrane-associated enzymes in the small intestine of humans.
c. Outline the intestinal transmembrane transport events involved in nutrient absorption.
   5. Lipid Digestion/Secretion
      a. Describe the role of pancreatic enzymes in the absorption or secretion of lipids, water, and electrolytes in the small intestine.
b. Define the mechanisms involved in water and ion absorption and secretion.
c. Compare and contrast the portal blood and lymphatic routes of nutrient absorption.
   6. Salivary Glands
      a. Compare and contrast the normal salivary components and their functions.
b. Explain how saliva formation and secretion is controlled in the normal human salivary glands.
c. Define the cellular mechanisms involved in the secretion of saliva from a normal human salivary gland.
   7. Saliva/Clinic Correlation
      a. Relate the absence of saliva to oral health.
b. Define the cellular/functional loss that results in xerostomia.
c. Describe the possible etiologies of xerostomia.

d.

H. Renal

1. Body H2O and Electrolytes
   a. Identify the fluid compartments in the normal human body.
   b. Outline the composition of the fluid compartments in the normal human body.
   c. Compare and contrast the forces and mechanisms that are responsible for changes in the quantity and composition of fluid in the fluid compartments of the normal human body.

2. Functional Anatomy
   a. Relate the normal physiology of the human renal system to its gross anatomical structures.
   b. Relate the normal function of the normal human nephron to its ultrastructure.
   c. Relate the normal function of the human glomerulus to its ultrastructure.

3. Glomerular Filtration
   a. Identify the major determinants of ultrafiltration that take place in the normal human glomerulus.
   b. Describe the biologic nature of the filtrate material that has passed through the normal human kidney glomerulus.
   c. Relate the factors affecting the filtration process in the normal human kidney glomeruli.

4. Tubular Transport
   a. Breakdown and evaluate the differential transport properties of the different segments of the normal human nephron.
   b. Point out the individual effects of diuretics on the transport.
   c. Compare the various effects of different hormones on nephron segmental transport in the normal human kidney.

5. Urine Formation
   a. Explain how and why dilute urine is produced by the normal human kidney.
   b. Relate how and why concentrated urine is formed by the normal kidney.
   c. Relate a role for antiuretic hormone in the regulation of urine volume.

6. Regulation of Body Fluid Osmolarity and Volume
   a. Describe the biological mechanism for the osmotic regulation of body fluids in the normal human.
   b. Outline the biological mechanisms responsible for fluid conservation in the human body.
   c. Describe the mechanism responsible for fluid excretion from the normal human body.

7. Acid/Base Balance Lipid Digestion/Secretion
   a. Present the mechanism of bicarbonate reabsorption in the normal human body.
   b. Describe the biological mechanism responsible for protein excretion from the normal human body.
   c. Define the mechanism of bicarbonate excretion from the normal human body.

VII. Course Competencies
This course contributes to teaching to the following competencies.

- **Domain III**: Health Assessment – Recognize systemic diseases, substance and patient abuse and evaluate the patient’s medical and oral condition, plan treatment needs and refer, when appropriate.
  - 9. Examination of the Patient: Perform an evidence-based comprehensive patient evaluation to include patient history including medications, chief complaint(s), medical, oral and extraoral conditions, biological, behavioral, cultural, socioeconomic information and consultations(s) to assess the patient’s prognosis and treatment risks.

- **Domain IV**: Health Rehabilitation – Using universal infection control guidelines and managing the patient’s anxiety and pain, perform procedures and restore the patient to oral health or refer appropriately.
  - 16.: Manage conditions requiring surgical procedures of the hard and soft tissues.
  - 20.: Manage oral mucosal and osseous diseases or disorders, including oral cancer.

VIII. Evaluation
This course teaches to the following competencies in the "Competencies for the New Dental Graduate":
3: Apply biomedical science knowledge in the delivery of patient care.
Course Evaluation:
The process for evaluating the student’s performance in this course will consist of five exams. The exams can be made up of multiple choice, short answer, matching, true or false, or short discussion type questions. It is expected that a majority of the questions will be multiple choice. The number of questions on any given topic will be determined by the faculty that presented the material. Exam may cover material presented in the traditional lecture format as well as in laboratory or discussion sessions. The grade from the course will be determined from the performances on all exams.

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<tr>
<th>Exam</th>
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<tbody>
<tr>
<td>Exam I</td>
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<td>Exam IV</td>
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<tr>
<td>Exam V</td>
<td>20%</td>
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<tr>
<td>Total</td>
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The final course grade will be determined from the score from all exams. An average of 65% or greater on the exams must be achieved to pass the course.

In the event of illness students must contact the Office of Education and the Course Director. The student is responsible in making arrangements with the course director to makeup a missed examination. Makeup exams will be composed from questions used in previous years and may not reflect the exact content presented by the lecturers this year.

Repeat Exam: A score of less than 65% on one exam will require that the student take a repeat exam within two weeks. Students that pass the repeat exam will receive the lowest passing score for this examination (65%). Students may take a maximum of two repeat exams on each section.

Course Remediation: If after taking repeat examinations a student receives an "E" grade in this course they must meet with the Course Director within two weeks to determine if they are eligible to take a post course remediation examination or be re-tracked.

IX. Administrative Practices
Administrative practices for all UFCOD courses are universally applied. Exceptions to or deviations from these practices are stated in the individual syllabi by the course director. When not individually stated in the syllabus, course administrative practices default to those identified under “Administrative Practices” in the ECO sidebar for each electronic syllabus. These practices include: Professional Behavior, Student Responsibilities in the Classroom, Attendance, Dress Code, Email Policy, Tutoring, Academy Honesty and the Student Honor Code, Student Accommodations, Post-exam Review, Grading System, Remediation, Student Evaluation of Instruction, Student Complaints, University Counseling Services and Mental Health Services and Electronic Course Material and Social Media.

X. Grade Scale

<table>
<thead>
<tr>
<th>Method</th>
<th>Den5120C Grade Scale</th>
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<tbody>
<tr>
<td>Scale</td>
<td>100</td>
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<tr>
<td>Tolerance</td>
<td>0.5 (Final letter grades within this range will be rounded up.)</td>
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</tbody>
</table>
A  95 - 100
A- 90 - 95
B+ 85 - 90
B  80 - 85
B- 75 - 80
C+ 70 - 75
C  65 - 70
E  0 - 65