CRC 331 - Respiratory Anatomy and Physiology 3 semester hours- Fall Semester

COURSEMASTER: William Wojciechowski, MS, RRT
TELEPHONE #: 251-445-9284
E-MAIL: wwojciec@usouthal.edu
COURSE FORMAT: Lecture

DESCRIPTION: The structure and function of the respiratory system will be discussed. Emphasis will be placed on the (1) physiologic ramifications associated with respiratory therapeutic interventions and (2) interrelationships between the pulmonary and renal systems and how these two systems influence and control the body’s acid-base status.

COURSE CONTENT: Module I - Respiratory Anatomy
Unit #1 - Upper Respiratory Tract
Unit #2 - Lower Respiratory Tract

Module II – Mechanics of Respiration
Unit #1 - Anatomy
Unit #2 - Compliance and Elastance
Unit #3 – Resistance and Conductance
Unit #4 – Flow Patterns
Unit #5 – Ventilation Time Constants
Unit #6 – Surface Tension
Unit #7 – Altered Mechanics

Module III - Gas Transport
Unit #1 - O₂ Transport
Unit #2 - CO₂ Transport

Module IV - Pulmonary Circulation
Unit #1 - Structure of Pulmonary Circulation
Unit #2 - Pressure, Flow, and Resistance
Unit #3 - Recruitment and Distention
Unit #4 - Lung Volumes and Pulmonary Vascular Resistance (PVR)
Unit #5 - Starling's Law of the Capillaries

Module V - Ventilation/Perfusion Relationships
Unit #1 - Distribution of Ventilation
Unit #2 - Distribution of Pulmonary Perfusion
Unit #3 – Measurement and Physiological Effects of Inequities
Unit #4 – Clinical Causes of Inequities
Module VI - Control of Ventilation
   Unit #1 - Medullary, Pontine, and Cerebral Centers
   Unit #2 - Peripheral and Central Chemoreceptors
   Unit #3 - Lung Reflexes
   Unit #4 - Acid-Base Implications

Module VII - Renal Structure and Function
   Unit #1 - Gross and Microscopic Anatomy
   Unit #2 - Glomerular Filtration
   Unit #3 - Diffusion, Secretion, Osmosis, and Reabsorption
   Unit #4 - Regulatory Mechanisms

EVALUATION:

Lecture material from this course will be tested on eight written examinations. The eighth examination will be a comprehensive final. All exams will be evenly weighted. Quizzes will be given daily. Each quiz will be worth 10 points and 10 quizzes will equal 1 exam. The final grade will be an average of all exams (including the quizzes used as exams) presented in this course. Successful completion of this course is defined as achieving a minimum average of 70% of all exams. No make-up exams will be offered unless a student experiences extenuating circumstances as judged by the instructor.

The examinations will consist of the following types of questions:
   1. multiple choice
   2. true-false
   3. fill-in-the-blank
   4. essay

Grading scale:
   A = 90-100
   B = 80-89
   C = 70-79
   D = 60-69
   F = 59 and below

REQUIRED TEXT:

A printed or e-book version of the textbook is required for this course.


ATTENDANCE POLICY:

Students are expected to be in-class for all scheduled sessions because the information is cumulative and the amount of information presented each class is significant. Missing class will tend to have a negative influence on the student’s grades.

Chronic absenteeism will be dealt with at the discretion of the instructor. Attendance on examination
dates is mandatory. Failure to attend class on an examination date will result in the student receiving a grade of F (0) for that exam. No make-up exams will be administered, unless extenuating circumstances prevail.

A grade of F* will be assigned in cases where the student does not officially withdraw, but fails to attend, or fails to complete assignments, or who fails to participate in class activities. It will be used when, in the opinion of the instructor, completed assignments or course activities are insufficient to make normal evaluation of academic performance possible.

OFFICE HOURS:

Monday through Friday from 9AM to 4 PM. Please call in advance for an appointment when a meeting demands a lengthy time; otherwise, drop-in visits are acceptable. Also, feel free to talk with me after class.

STUDENTS WITH DISABILITIES:

In accordance with the Americans with Disabilities Act, students with bona fide disabilities will be afforded reasonable accommodations. The Office of Special Student Services (OSSS) will certify a disability and advise faculty members of reasonable accommodations. If you have a specific disability that qualifies you for academic accommodations, please notify the instructor/professor and provide certification from the Office of Special Student Services. OSSS is located at 5828 Old Shell Road at Jaguar Drive, (251-460-7212).

CHANGES IN COURSE REQUIREMENTS:

Not all classes progress at the same rate thus course requirements might have to be modified as circumstances dictate. You will be given written notice if the course requirements need to be changed.

ACADEMIC DISRUPTION POLICY:

The University of South Alabama’s policy regarding Academic Disruption is found in The Lowdown, the student handbook, http://www.southalabama.edu/lowdown/academicdisruption.shtml: Disruptive academic behavior is defined as individual or group conduct that interrupts or interferes with any educational activity or environment, infringes upon the rights and privileges of others, results in or threatens the destruction of property and/or is otherwise prejudicial to the maintenance of order in an academic environment. Students are expected to be cordial, courteous and respectful of faculty members and fellow students.

STUDENT ACADEMIC CONDUCT POLICY:

The University of South Alabama’s policy regarding Student Academic Conduct Policy is found in The Lowdown http://www.southalabama.edu/lowdown/academicconductpolicy.shtml: The University of South Alabama is a community of scholars in which the ideals of freedom of inquiry, freedom of thought, freedom of expression, and freedom of the individual are sustained. The University is committed to supporting the exercise of any right guaranteed to individuals by the Constitution and the Code of Alabama and to educating students relative to their responsibilities.
ONLINE WRITING SUPPORT:

The University of South Alabama provides online writing tutoring services through SMARTTHINKING, an online tutoring service. SMARTTHINKING is available at http://services.smarthinking.com. Students may enter the site by logging on with their Jag number and using the last four digits of the social security number as the password. For log-on problems, technical questions and/or on-campus writing assistance, contact the USA Writing Center at 251-460-6480 or e-mail csaint-paul@usouthal.edu.

CRC 331 - Respiratory Anatomy & Physiology
Goal: Upon successful completion of this course, the student will have an understanding of respiratory anatomy and physiology, and related renal physiology. The student will establish a foundation of knowledge from which to develop clinical skills for treating patients who have cardiopulmonary diseases.

Module I - Respiratory Anatomy

Unit #1 - Upper Respiratory Tract
Unit #2 - Lower Respiratory Tract

Through written examination the student will be able to:

OBJECTIVES

I. Describe the structures of the upper respiratory tract.
II. Locate on a model the structure comprising the larynx.
III. Describe the structure of the trachea.
IV. Differentiate among the various structures of the respiratory tract.
V. Calculate % relative humidity, % body humidity, and humidity deficit.
VI. Explain the structure of the 23 generations of the tracheobronchial tree.
VII. Discuss the physiologic applications of the law of continuity.
VIII. Describe the structure of the lungs and thorax (chest wall).
IX. Describe bronchial circulation.
II. Discuss the concepts tidal volume, alveolar volume, and dead space volume.
III. Explain the concepts of minute ventilation, alveolar ventilation, and dead space ventilation.
V. Discuss the various lung volumes and capacities.

Module II - Ventilatory Mechanics

Unit #1 - Anatomy
Unit #2 - Compliance and Elastance
Unit #3 – Resistance and Conductance
Unit #4 – Flow Patterns
Unit #5 – Ventilation Time Constants
Unit #6 – Surface Tension
Unit #7 – Altered Mechanics

Through written examination the student will be able to:
OBJECTIVES

I. Describe the structure of the lungs and chest wall (thorax).
II. Explain the mechanism of ventilation.
III. Describe various breathing patterns and their physiologic implications.
IV. Calculate compliance and elastance.
V. Describe how data for compliance and elastance are obtained.
VI. Discuss Poiseuille’s law.
VII. Calculate airway resistance.
VIII. Describe how data for resistance measurements are obtained.
IX. Discuss ventilation time constants.
X. Explain various pressure gradients associated with ventilation.
XI. Discuss the concept of surface tension.
XII. Describe various conditions that alter normal pulmonary mechanics.
XIII. Solve mathematical problems pertaining to mechanics of respiration.

Module III - Gas Transport

Unit #1 - O₂ Transport
Unit #2 - CO₂ Transport

Through written examination the student will be able to:

OBJECTIVES

I. Describe the concept of diffusion across the A/C membrane.
II. Discuss the application of the two forms of Graham’s law of diffusion.
III. Describe the influence of Henry's Law on dissolved oxygen.
IV. Calculate the amount of O₂ that dissolves in plasma at any PO₂.
V. Explain the structure of the hemoglobin molecule.
VI. Calculate arterial oxygen saturation.
VII. Compute arterial-venous oxygen content difference.
VIII. Interpret the oxyhemoglobin dissociation curve under various clinical conditions.
IX. Describe the physiologic significance of the Bohr effect.
X. Identify the forms in which CO₂ is transported in plasma.
XI. Describe the carbon dioxide-hemoglobin dissociation curve.
XII. Trace the reactions of CO₂ when it permeates a red blood cell.
XIII. Explain the significance of the chloride shift.
IX. Physiologically apply the Haldane effect.

Module IV - Pulmonary Circulation

Unit #1 - Structure of Pulmonary Circulation
Unit #2 - Pressure, Flow, and Resistance
Unit #3 - Recruitment and Distensibility
Unit #4 - Lung Volumes and Pulmonary Vascular Resistance (PVR)
Unit #5 - Starling's Law of the Capillaries

Through written examination the student will be able to:
OBJECTIVES

I. State the functions of pulmonary circulation.
II. State the structure of pulmonary vessels.
III. Describe the application of the law of continuity to pulmonary circulation.
IV. Discuss the relationship between lung volume and pulmonary vascular resistance.
V. Explain recruitment and distention.
VI. Describe the three-zone lung model.
VII. Describe the various forces, pressures, and resistances occurring throughout pulmonary circulation.
VIII. Explain the hypoxic pulmonary vasoconstriction response.
IX. State Starling’s law of the capillaries.
X. Solve problems using Starling’s law of the capillaries.

Module V - Ventilation/Perfusion Relationships

Unit #1 - Distribution of Ventilation
Unit #2 - Distribution of Pulmonary Perfusion
Unit #3 - Measurement and Physiological Effects of V/Q Inequities
Unit #4 - Clinical Causes of V/Q Inequities

Through written examination the student will be able to:

OBJECTIVES

I. Describe the causes of unequal distribution of ventilation
II. Discuss how regional variations in transpulmonary pressure throughout the respiratory tract cause regional differences in ventilation.
III. Describe clinical causes of nonuniform ventilation.
IV. Describe the cause of nonuniform pulmonary blood flow throughout the pulmonary vasculature.
V. Discuss the tests for determining nonuniform ventilation and for nonuniform pulmonary blood flow.
VI. Define terms associated with V/Q relationships.
VII. Calculate percent shunt or shunt fraction.
VIII. Compute P\textsubscript{A}O\textsubscript{2} using the alveolar air equation.
IX. Discern shunts from diffusion impairments.
X. Discuss the clinical usefulness of the V\textsubscript{D}/V\textsubscript{T} ratio.

Module VI - Control of Ventilation

Unit #1 - Medullary, Pontine and Cerebral Centers
Unit #2 - Peripheral and Central Chemoreceptors
Unit #3 - Lung Reflexes
Unit #4 - Acid-Base Implications

Through written examination the student will be able to:

OBJECTIVES

I. Describe the role of the medulla oblongata, pons and cerebral cortex in the regulation of
II. Discuss the influence of pH, [H\(^+\)], \(P_{O_2}\) and \(P_{CO_2}\) on ventilation.
III. Explain the interaction between the central and peripheral chemoreceptors.
IV. Describe various lung reflexes.
V. State the relationship among cerebrospinal fluid, blood, and ventilation.
VI. Discuss the influence ventilation has on acid-base status.

Module VII - Renal Structure and Function

   Unit #1 - Gross and Microscopic Anatomy
   Unit #2 - Glomerular Filtration
   Unit #3 - Diffusion, Osmosis, Secretion, and Reabsorption
   Unit #4 - Regulatory Mechanisms

Through written examination the student will be able to:

OBJECTIVES

I. Identify various anatomical components of the kidney and the nephron.
II. Identify arterial and venous blood vessels in the kidney.
III. Discuss the basic theory of nephron function.
IV. Describe the dynamics of glomerular filtration.
V. Calculate the glomerular filtration pressure using Starling’s law of the capillaries.
VI. Differentiate between reabsorption and secretion in the tubular system of the kidney.
VII. Discuss the role of diffusion and osmosis in renal physiology.
VIII. Describe certain renal regulatory mechanisms.
IX. Explain how renal function affects acid-base physiology.
X. Explain how the respiratory and renal systems interact.
CRC 331 – Respiratory Anatomy & Physiology
Fall Semester, 2012
Instructor: William V. Wojciechowski, MS, RRT
Class Time: 8:00 A.M.-9:30 A.M.

<table>
<thead>
<tr>
<th>DAY</th>
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<tbody>
<tr>
<td>Tues.</td>
<td>8/21</td>
<td>Respiratory Tract Structures &amp; Function</td>
<td>Beachy, Ch. 1,2,4,7 Wojciechowski, Ch. 3, pp. 177-204, Ch. 4, pp. 287-294</td>
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<td>Weds.</td>
<td>8/22</td>
<td>Respiratory Tract Structures &amp; Function</td>
<td>Wojciechowski, Ch. 4, pp. 287-294</td>
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<td>Thurs.</td>
<td>8/23</td>
<td>Respiratory Tract Structures &amp; Function</td>
<td>Optional: Egan, Ch. 8, pp. 155-168, 174-193</td>
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<td>Fri.</td>
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<td>Respiratory Tract Structures &amp; Function</td>
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<td>Mon.</td>
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<td>Respiratory Tract Structures &amp; Function</td>
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<td>Tues.</td>
<td>8/28</td>
<td><strong>Module I Examination</strong></td>
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<td>Weds.</td>
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<td>Mechanics of Ventilation</td>
<td>Beachy, Ch. 3 Wojciechowski, Ch 4, pp. 315-353</td>
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<td>Mechanics of Ventilation</td>
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<td>Thurs.</td>
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<td><strong>Module II Examination</strong></td>
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<td>Fri.</td>
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<td>Gas Transport</td>
<td>Beachy, Ch. 7,8,9 Wojciechowski, Ch. 3, pp. 205-220, Ch. 6, pp. 481-491</td>
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<td>Gas Transport</td>
<td>Optional: Egan, Ch. 11, pp. 244-257</td>
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<td><strong>Module III Examination</strong></td>
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<td>Tues.</td>
<td>9/18</td>
<td>Pulmonary Circulation</td>
<td>Beachy, Ch. 4 Wojciechowski, Ch 4, pp. 353-361,364-371</td>
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<td>Pulmonary Circulation</td>
<td>Optional: Egan, Ch. 8, pp. 168-171</td>
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<td>Tues.</td>
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<td>Pulmonary Circulation</td>
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<td>Weds.</td>
<td>9/26</td>
<td><strong>Module IV Examination</strong></td>
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| Thurs. | 9/27 | Ventilation-Perfusion Relationships | Beachy, Ch. 12,14  
| Mon.   | 10/1 | Ventilation-Perfusion Relationships | Wojciechowski, Ch 3,  
|        |      |                                | pp. 231-235, 238-245                     |
| Tues.  | 10/2 | Ventilation-Perfusion Relationships |                                          |
| Weds.  | 10/3 | Ventilation-Perfusion Relationships |                                          |
| Thurs. | 10/4 | Ventilation-Perfusion Relationships |                                          |
| Mon.   | 10/8 | **Fall Break – No Class**      |                                          |
| Tues.  | 10/9 | **Fall Break – No Class**      |                                          |
| Wed.   | 10/10| **Module V Examination**       |                                          |
| Thurs. | 10/11| Control of Ventilation         | Beachy, Ch. 11                           |
| Mon.   | 10/15| Control of Ventilation         |                                          |
| Tues.  | 10/16| Control of Ventilation         |                                          |
| Wed.   | 10/17| Control of Ventilation         |                                          |
| Thurs. | 10/18| Control of Ventilation         |                                          |
| Mon.   | 10/22| **Module VI Examination**      |                                          |
| Tues.  | 10/23| Renal Structures and Function  | Beachy, Ch. 22, 23  
|        |      |                                | Optional: Egan, Ch 13,  
|        |      |                                | pp. 284-290                     |
| Weds.  | 10/24| Renal Structures and Function  |                                          |
| Thurs. | 10/25| Renal Structures and Function  |                                          |
| Mon.   | 10/29| Renal Structures and Function  |                                          |
| Tues.  | 10/30| Renal Structures and Function  |                                          |
| Weds.  | 10/31| **Module VII Examination**     |                                          |
| Thurs. | 11/1 | TBA                            |                                          |
| Mon.   | 11/5 | TBA                            |                                          |
| Tues.  | 11/6 | TBA                            |                                          |
| Weds.  | 11/7 | TBA                            |                                          |
| Thurs. | 11/8 | TBA                            |                                          |
| Mon.   | 12/10| **Comprehensive Final Examination** |                                          |