UNIVERSITY OF SOUTH ALABAMA
COLLEGE OF ALLIED HEALTH PROFESSIONS
DEPARTMENT OF CARDIORESPIRATORY CARE

CRC 331 - Respiratory Anatomy and Physiology **3 semester hours**

COURSEMASTER: William Wojciechowski, MS, RRT
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DESCRIPTION: The structure and function of the respiratory system will be discussed. Emphasis will be placed on the (1) physiological 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 - O_2 Transport
- Unit #2 - CO_2 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 $\dot{V}/\dot{Q}$ Relationships
- Unit #1 - Distribution of Ventilation
- Unit #2 - Distribution of Pulmonary Perfusion
- Unit #3 – Measurement and Physiological Effects of $\dot{V}/\dot{Q}$ Inequities
- Unit #4 – Clinical Causes of $\dot{V}/\dot{Q}$ 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. Unannounced quizzes will also be administered throughout the course. Every 10 quizzes will equal one exam. The final grade will be an average of all 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.

REQUIRED TEXT: Beachey, *Respiratory Care Anatomy and Physiology Foundations for Clinical Practice*, 4th edition, Elsevier.

Kacmarek, et al., *Egan's Fundamentals of Respiratory Care*, 11th ed., Elsevier.

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.

ATTENDANCE POLICY: An excused absence requires that you must have a legitimate reason for being absent. Each unexcused absence, or failure to give prior notice of absence for a legitimate reason, will result in **a 10% reduction** in the exam grade following the missed day (this may also apply to a final exam depending on the timing). Excused absences include death in the immediate family, illness of the student with documentation from a health care clinic, physician's office, student health, etc. Original documentation (not a copy) must be delivered to the department in person within 3 business days of the absence, or within 3 business days of returning from an absence. Failure to deliver the required documentation as stipulated will be counted as an unexcused absence. Students should notify faculty in advance if they know that they will miss a class because of illness, injury, or medical treatment. They should call the office prior to the start of class. Do not schedule medical appointments during class or clinical times. A class roster will be distributed for student signatures or attendance will be taken by the instructor. (NOTE: Clinical attendance is covered in the clinical policies.)

Start of class time is given in the course syllabus. Students are expected to be early. Once a class has reached the published class time you are late. Parking is often a problem; come early. Tardiness will be noted by the faculty; each instance of tardiness will result in a 2% reduction in the exam grade following the tardiness. Tardiness will also apply to a final exam depending on the timing. At the discretion of the course master, the classroom door may be locked at the start of the class, preventing entry to the class to avoid disturbances and disruptions by those who may be tardy.

The total number of unexcused absences and tardiness will be noted in the student's file throughout the time in the program, and may be included in requested letters of recommendation for prospective employers and graduate school admissions committees.

STUDENTS WITH DISABILITIES:

If you have a specific disability that qualifies you for academic accommodations, please notify me and provide certification from Disability Services in the Office of Special Student Services. The Office of Special Student Services is located in Room 270 of the Student Center (460-7212).

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 physiological applications of the law of continuity and other gas laws.
VIII. Describe the structure of the lungs and thorax (chest wall).
IX. Discuss the concepts tidal volume, alveolar volume, and dead space volume.
X. Explain the concepts of minute ventilation, alveolar ventilation, and dead space ventilation.
XI. 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 physiological 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 - O_2 Transport
Unit #2 - CO_2 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 O_2 that dissolves in plasma at any PO_2.
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 physiological significance of the Bohr effect.
X. Identify the forms in which CO_2 is transported in plasma.
XI. Describe the carbon dioxide-hemoglobin dissociation curve.
XII. Trace the reactions of CO_2 when it permeates a red blood cell.
XIII. Explain the significance of the chloride shift.

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.
XI. Discuss bronchial circulation.

Module V - Ventilation/Perfusion Relationships

Unit #1 - Distribution of Ventilation
Unit #2 - Distribution of Pulmonary Perfusion
Unit #3 - Measurement and Physiological Effects of $\dot{V}_A/\dot{Q}_C$ Inequities
Unit #4 - Clinical Causes of $\dot{V}_A/\dot{Q}_C$ 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 $\dot{V}/\dot{Q}$ relationships.
VII. Calculate percent shunt or shunt fraction.
VIII. Compute P_AO_2 using the alveolar air equation.
IX. Discern shunts from diffusion impairments.
X. Discuss the clinical usefulness of the V_D/V_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 roles of the medulla oblongata, pons and cerebral cortex in the regulation of ventilation.
II. Discuss the influences of pH, $[H^+]$, PO_2 and PCO_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 and electrolyte disturbances affect acid-base physiology.
X. Explain how the respiratory and renal systems interact.

CRC 331 – Respiratory Anatomy & Physiology **3 Semester hours**
Fall 2017

Instructor: William V. Wojciechowski, MS, RRT
Class Time: 8:00 A.M.-9:30 A.M.

DAY	DATE	TOPIC	ASSIGNED READINGS
Thurs.	8/17	Respiratory Tract Structures & Function	Beachey • Ch. 1, 2, 4, 7 Optional: Egan • Ch. 9, pp. 171-185, 189-206
Fri.	8/18	Respiratory Tract Structures & Function	
Mon.	8/21	Respiratory Tract Structures & Function	
Tues.	8/22	Respiratory Tract Structures & Function	
Wed.	8/23	**Module I Examination 7:30 – 9:30 AM**	
Thurs.	8/24	Mechanics of Ventilation	
Fri.	8/25	Mechanics of Ventilation	
Mon.	8/28	Mechanics of Ventilation	
Tues.	8/29	Mechanics of Ventilation	Beachey • Ch. 3 Optional: Egan • Ch. 11
Wed.	8/30	Mechanics of Ventilation	
Thurs.	8/31	**Module II Examination 7:30 – 9:30 AM**	
Fri.	9/1	Gas Transport	Beachey • Ch. 7, 8, and 9 Optional: Egan • Ch. 12 pp. 254-262
Mon.	9/4	**Labor Day - No Class**	
Tues.	9/5	Gas Transport	
Wed.	9/6	Gas Transport	
Thurs.	9/7	Gas Transport	
Fri.	9/8	Gas Transport	

DAY	DATE	TOPIC	ASSIGNED READINGS
Mon.	9/11	Gas Transport	
Tues.	9/12	Gas Transport	
Wed.	9/13	**Module III Examination 7:30 – 9:30 AM**	
Thurs.	9/14	Pulmonary Circulation	Beachey • Ch. 6 Optional: Egan • Ch. 9, pp. 183-186
Fri.	9/15	Pulmonary Circulation	
Mon.	9/18	Pulmonary Circulation	
Tues.	9/19	Pulmonary Circulation	
Wed.	9/20	**Module IV Examination 7:30 – 9:30 AM**	
Thurs.	9/21	Ventilation-Perfusion Relationships	Beachey • Ch. 12
Mon.	9/25	Ventilation-Perfusion Relationships	
Tues.	9/26	Ventilation-Perfusion Relationships	
Wed.	9/27	Ventilation-Perfusion Relationships	
Thurs.	9/28	Ventilation-Perfusion Relationships	
Mon.	10/2	**Module V Examination 7:30 – 9:30 AM**	
Tues.	10/3	Control of Ventilation	Beachey • Ch. 11
Wed.	10/4	Control of Ventilation	
Thurs.	10/5	Control of Ventilation	
Mon.	10/9	Control of Ventilation	
Tues.	10/10	Control of Ventilation	
Wed.	10/11	Control of Ventilation	
Thurs.	10/12	**Fall Break - No Class**	

DAY	DATE	TOPIC	ASSIGNED READINGS
Mon.	10/16	**Module VI Examination 7:30 – 9:30 AM**	Beachey • Ch. 21, 22 Optional: Egan • Ch 14, pp. 290-294, 302-306
Tues.	10/17	Renal Structures and Functions	
Wed.	10/18	Renal Structures and Functions	
Thurs.	10/19	Renal Structures and Functions	
Mon.	10/23	Renal Structures and Functions	
Tues.	10/24	Renal Structures and Functions	
Wed.	10/25	Renal Structures and Functions	
Thurs.	10/26	**Module VII Examination 7:30 – 9:30 AM**	
Mon, 10/27 through Wed, 11/8 **TBA**			
TBA		**Comprehensive Final Examination**	

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. Student missing any quizzes will receive a grade of zero (0) on those quizzes.

Lecture material from this course will be tested on seven module examinations. The eighth examination will be a comprehensive final. All exams will be evenly weighted. Quizzes will be given intermittently. Each quiz will be worth 10 points, and 10 quizzes will equal one 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.

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