



# BROWARD COMMUNITY COLLEGE

## COURSE OUTLINE

**LAST REVIEW: 2008-2009**

**NEXT REVIEW: 2013-2014**

**STATUS: A**

**COURSE TITLE: Mechanical Ventilation**

**COMMON COURSE NUMBER: RET 1264**

**CREDIT HOURS: 3**

**CONTACT HOUR BREAKDOWN**

**CLOCK HOURS:**

Lecture: **48**

Lab:

Clinic:

Other:

**PREREQUISITE(S):** RET1485, RET1026, RET1026L

**COREQUISITE(S):** RET1264L, RET1484, RET1832L

**PRE/COREQUISITE(S):**

### **COURSE DESCRIPTION**

This course describes the concepts of mechanical ventilation, current modes of ventilation, tailoring the ventilator settings to meet patient needs, and patient assessment on mechanical ventilation. The student will learn the concepts of noninvasive ventilation and IPPB. The principles and operation of commonly used ventilators are emphasized.

### **UNIT TITLES**

1. Principles of Mechanical Ventilation
2. Initial Settings for Positive Pressure Ventilation
3. Ventilator Modes
4. Ventilator Alarms
5. Ventilator Circuit
6. Ventilator Monitoring
7. Assessment of the Mechanically Ventilated Patient
8. Indications for Mechanical Ventilation
9. Physiology of Ventilatory Support
10. Scenarios of the Mechanically Ventilated Patient
11. Weaning from Mechanical Ventilation
12. Classifying Ventilators
13. Specific Ventilators and their unique features
14. Noninvasive Ventilation
15. Negative Pressure Ventilation
16. High Frequency Ventilation
17. Independent Lung Ventilation



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## EVALUATION:

**Student may be evaluated but not limited to the following:**

Five in class exams - the lowest exam score will be dropped.

One comprehensive final exam

Five online self tests in Blackboard - the lowest self test score will be dropped.

One assignment on a patient in the hospital setting receiving mechanical ventilation

## GENERAL EDUCATION Competencies and Skills \*:

Please highlight in font all Competencies/Skills from the list below that apply to this course. In the box to the right of the Competency/Skill, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 5.12) that apply.

1. Read with critical comprehension	
2. Speak and listen effectively	
3. Write clearly and coherently	
4. Think creatively, logically, critically, and reflectively (analyze, synthesize, apply, and evaluate)	
5. Demonstrate and apply literacy in its various forms: <i>(highlight in green ALL that apply)</i> ( 1. technological, 2. informational, 3. mathematical, 4. scientific, 5. cultural, 6. historical, 7. aesthetic and/or 8. environmental )	
6. Apply problem solving techniques to real-world experiences	
7. Apply methods of scientific inquiry	
8. Demonstrate an understanding of the physical and biological environment and how it is impacted by human beings	
9. Demonstrate an understanding of and appreciation for human diversities and commonalities	
10. Collaborate with others to achieve common goals.	
11. Research, synthesize and produce original work	
12. Practice ethical behavior	
13. Demonstrate self-direction and self motivation	
14. Assume responsibility for and understand the impact of personal behaviors on self and society	
15. Contribute to the welfare of the community	

\* General Education Competencies and Skills endorsed by '05-'06 General Education Task Force



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Common Course Number: RET 1264

### UNITS

#### Unit 1. Principles of Mechanical Ventilation

General Outcome:

- 1.0 The student will apply the principles of mechanical ventilation to positive pressure ventilation of healthy and diseased lungs.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 1.1 Differentiate between spontaneous versus positive pressure breathing
- 1.2 Calculate static and dynamic lung compliance
  - 1.2.1 Determine the causes of changes in lung compliance
- 1.3 Calculate airway resistance
  - 1.3.1 Determine the conditions that affect airway resistance
- 1.4 Calculate alveolar ventilation, anatomic deadspace and physiologic deadspace.
- 1.5 List the components of minute volume
  - 1.5.1 Calculate  $V_E$
  - 1.5.2 Describe how a ventilator calculates  $V_E$
- 1.6 Identify the components of a hysteresis curve
  - 1.6.2 Describe how a hysteresis curve can be used to determine optimal PEEP
- 1.7 Identify the following airway graphics: pressure/time, volume/time, flow/time, and flow/volume loop during mechanical ventilation

#### Unit 2. Positive Pressure Ventilation

General Outcome:

- 2.0 The student will determine the initial settings for placing a patient on volume ventilation and pressure ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 2.1 Determine the following initial settings for volume ventilation
  - 2.1.2 Tidal Volume
    - 2.1.3 Determine a patient's tidal volume by calculating ideal body weight.
    - 2.1.4 Determine proper tidal volume according to lung pathology.
    - 2.1.5 Calculate normal tidal volume.
    - 2.1.6 Calculate machine tidal volume.
- 2.2 Determine the Machine Rate
  - 2.2.1 Describe rate as it relates to minute ventilation.
  - 2.2.2 Describe normal rates for different patient populations.
  - 2.2.3 Describe how volume and rate affect  $paCO_2$ .
- 2.3 Determine the flowrate and flow waveform
  - 2.3.1 Identify the different wave forms using a graphic display.
  - 2.3.2 Describe normal ranges for different patient populations.
  - 2.3.3 Evaluate a flow waveform to determine patient synchrony.



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- 2.3.4 Determine I time, I:E ratio.
- 2.4 Determine the proper  $fiO_2$ 
  - 2.4.1 Determine initial  $FiO_2$  setting.
  - 2.4.2 Describe the reasons for decreasing  $fiO_2$  as soon as oxygenation improves.
  - 2.4.3 Use  $spO_2$  and arterial blood analysis to monitor oxygenation status.
- 2.5 Determine the proper level of PEEP
  - 2.5.1 Define and describe the physiologic effects of PEEP
  - 2.5.2 Define and describe the effects of Auto PEEP
  - 2.5.3 Describe how PEEP and  $FI02$  affect oxygenation
- 2.,6 Describe the types of sensitivity settings available, identify the graphic display of effort and describe how autocycling can occur if not set properly.
- 2.7 Describe the initial settings for pressure modes of ventilation, including inspiratory pressure, inspiratory time, rise time %, machine rate,  $fiO_2$ , and PEEP.

### Unit 3. Ventilator Modes

General Outcome:

- 3.0 The student will identify specific modes of ventilation, determine the proper settings for each mode and evaluate the graphical analysis of each mode.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 3.1 Identify the modes for volume ventilation, the advantages and disadvantages of each mode and describe the application of each mode
  - 3.1.2 Assist Control (CMV)
  - 3.1.3 SIMV (Synchronized Intermittent Mandatory Ventilation)
- 3.2 Identify the modes for pressure ventilation, the advantages and disadvantages of each mode and describe the application of each mode
  - 3.2.1 Pressure Control
  - 3.2.2 Describe rise time
  - 3.2.3 Inverse Ratio Ventilation
  - 3.2.4 Pressure Support
  - 3.2.5 Pressure Regulated Volume Control
  - 3.2.6 Airway Pressure Release Ventilation
- 3.3 Identify the modes for spontaneous ventilation, the advantages and disadvantages of each mode and describe the application of each mode
  - 3.3.1 CPAP (Continuous Positive Airway Pressure)
  - 3.3.2 Pressure Support

### Unit 4. Ventilator Alarms

General Outcome:

- 4.0 The student will determine how to appropriately set alarms on a mechanically ventilated patient.



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Specific Learning Objectives:

To successfully complete this unit the student will:

- 4.1 List the alarms settings necessary to determine if a patient is not being properly ventilated.
- 4.2 Trouble shoot causes for alarms

### **Unit 5. Ventilator Circuit**

General Outcome:

- 5.0 The student will identify the components of a ventilator circuit, the proper placement of the components, and choose the appropriate humidification system for a patient on mechanical ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 5.1 Identify the inspiratory limb, expiratory limb, dead space tubing, patient wye,
- 5.2 Indicate placement for the in line closed system suction catheter, HME, ETCO<sub>2</sub> monitor/adaptor, nebulizing medications, and O<sub>2</sub> analyzer
  - 5.2.1 Describe the purpose of a heated humidifier and the setup needed for using a heated humidifier.
  - 5.2.2 Describe the factors that impact particle deposition in a mechanically ventilated patient.
  - 5.2.3 Calculate tubing complianc

### **Unit 6. Monitoring**

General Outcome:

- 6.0 The student will identify the parameters that are necessary for monitoring a patient being mechanically ventilated.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 6.1 Describe the necessity of monitoring the following ventilatory parameters to ensure safe and proper ventilation.
  - 6.1.2 Peak inspiratory pressure
  - 6.1.3 Mean airway pressure
  - 6.1.4 Returned tidal volume
  - 6.1.5 Spontaneous tidal volume
  - 6.1.6 Minute ventilation
  - 6.1.7 Respiratory rate
  - 6.1.8 Compliance
  - 6.1.9 Resistance

### **Unit 7. Patient Assessment**

General Outcome:

- 7.0 The student will identify the techniques used to properly assess a patient on mechanical ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:



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- 7.1 Determine how assessing the following data will assist the respiratory therapist in evaluating a patient on mechanical ventilation:
  - 7.1.2 General appearance, work of breathing, total respiratory rate and pattern, chest auscultation, palpation and percussion, vital signs and hemodynamic assessment, level of consciousness, chest inspection, presence of edema in the extremities, and patient comfort
  - 7.1.3 Ventilator synchrony
  - 7.1.4 Cuff pressures/ patency of airway
  - 7.1.5 Ancillary Equipment in room

### **Unit 8. Indications for Mechanical Ventilation**

General Outcome:

- 8.0 The student will list the indications for mechanical ventilation

Specific Learning Objectives:

To successfully complete this unit the student will:

- 8.1 Describe and identify the causes of ventilatory failure
- 8.2 Describe and identify the causes of respiratory failure

### **Unit 9. Physiology of Ventilatory Support**

General Outcome:

- 9.0 The student will describe how positive pressure ventilation affects the lungs and other organs of the body and alters the normal hemodynamics.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 9.1 Identify volutrauma
- 9.2 Identify barotrauma
- 9.3 Describe how endotracheal intubation causes an unprotected airway and leads to a high incidence of nosocomial infection
- 9.4 Describe permissive hypercapnea

### **Unit 10. Patient Scenarios including ABG's and Ventilator graphics:**

General Outcome:

- 10.0 The student will apply the principles of mechanical ventilation to different lung pathologies, analyze the arterial blood gas and recommend appropriate ventilator changes.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 10.1 When given simulated patient conditions and arterial blood gas results, select the most appropriate course of action to improve patient oxygenation.
- 10.2 When given simulated patient conditions and arterial blood gas results, select the most appropriate course of action to improve patient ventilatory status.
- 10.3 Troubleshoot problems utilizing airway graphics including pressure volume curves and flow volume loops.

### **Unit 11. Weaning from Mechanical Ventilation**



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### General Outcome:

11.0 The student will describe the ventilatory and physiologic parameters which are used to evaluate a patient's readiness to be weaned from ventilatory support, and the techniques employed in the weaning process.

### Specific Learning Objectives:

To successfully complete this unit the student will:

- 11.1 List the major parameters which are monitored when weaning patients from artificial mechanical ventilation and describe the findings which would indicate whether weaning is or is not appropriate for the patient.
- 11.2 Describe how oxygenation can be used to evaluate a patient's readiness to wean.
- 11.3 Describe the parameters used to evaluate a patient's cardiovascular status and readiness to wean.
- 11.4 Describe the techniques employed in each of the following weaning procedures
  - 11.4.1 SIMV with pressure support
  - 11.4.2 T-Piece trials
  - 11.4.3 CPAP with pressure support
- 11.5 Describe the major signs and symptoms that would indicate that the weaning process is not going well and may need to be terminated.

### **Unit 12. Classifying ventilators**

#### General Outcome:

12.0 The student will apply the principles of mechanical ventilation to positive pressure ventilation of healthy and diseased lungs.

#### Specific Learning Objectives:

To successfully complete this unit the student will:

- 12.1 Classify the ventilators in current clinical use as pneumatic, electric or fluidic.

### **Unit 13. Modes And Unique Features Of Current Ventilators:**

#### General Outcome:

13.0 The student will apply the principles of mechanical ventilation to the different modes and parameters available on current mechanical ventilators.

#### Specific Learning Objectives:

To successfully complete this unit the student will:

- 13.1 For the following ventilators, describe the following features:
  - 13.1.1 PB840 - tube compensation, APRV, circuit compliance
  - 13.1.2 Servo 300- Automode, Volume support, PRVC
  - 13.1.3 Servo I – PRVC with SIMV, Open Lung Tool, Bilevel Ventilation
- 13.2 For the following ventilators, describe the modes and how to set up for pediatric ventilation:
  - 13.2.1 Servo 300
  - 13.2.2 Servo I



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- 13.3 For the following ventilators, describe the modes, parameters and how to set up for neonatal ventilation:
  - 13.3.1 Sensing devices, Pressure limited ventilation
  - 13.3.2 Viasys
  - 13.3.3 BIRD VIP Gold
- 13.4 Home Care Ventilators
  - 13.4.1 LTV 950
  - 13.4.2 Battery, bleed in for O<sub>2</sub>

### **Unit 14. Noninvasive ventilators**

General Outcome:

- 14.0 The student will give a detailed description of the operation of noninvasive ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 14.1 Describe the clinical indications and hazards of noninvasive ventilation
- 14.2 Identify the correct patient interface with noninvasive ventilation
- 14.3 Distinguish CPAP from BiPAP
- 14.4 Indicate PIP,  $\Delta P$ (Pressure Support) and EPAP with noninvasive ventilation.
- 14.5 Describe the current ventilators used for noninvasive ventilation: BiPAP Vision, BiPAP STD,
- 14.6 Describe indications for IPPB.
- 14.7 Describe how the Bird Mark 7 IPPB Machine is used as a respiratory treatment to deliver positive pressure to the lungs to improve ventilation

### **Unit 15. Negative Pressure Ventilation**

General Outcome:

- 15.0 The student will be given a general overview of the theory of negative pressure ventilation

Specific Learning Objectives:

To successfully complete this unit the student will:

- 15.1 Describe the theory of how negative pressure ventilation can effectively ventilate the lung.
- 15.2 Identify and describe the negative pressure ventilators available
  - 15.2.1 Chest Cuirass

### **Unit 16. High Frequency Ventilation**

General Outcome:

- 16.0 The student will be introduced to the theory of high frequency ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 16.1 Define high frequency ventilation
- 16.2 Describe the types of patients that benefit from high frequency ventilation
- 16.3 Describe the settings used to deliver high frequency ventilation.

### **Unit 17. Independent Lung Ventilation**

General Outcome:



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17.0 The student will describe the indications and set up for independent lung ventilation.

Specific Learning Objectives:

To successfully complete this unit the student will:

- 17.1 Describe the types of patients that benefit from independent lung ventilation
- 17.2 Describe the purpose of an endobronchial tube with independent lung ventilation
- 17.3 Describe how two ventilators are synchronized to deliver independent lung ventilation.