Course Syllabus & Lesson Plan

Physiology for Medical

Sciences-II (SCBM-262)

Credit Hour: 2 (2-0)

(Online)

Academic Year: 2020

January 12 – March 5, 2021

SCBM 262: Physiology for Medical Sciences-II

Academic Year 2020/2

**Course Title** Physiology for Medical Sciences-2

**Course Code** SCBM-222

**Course Credit** 3 (2-0)

**Prerequisite**

**Course Description**

Functions of the cardiovascular and respiratory systems, mechanisms of homeostatic regulation of circulation and respiration, common pathological examples; integration of these systems in responses to extrinsic factors such as exercise and hemorrhagic shock to maintain homeostasis

**หน้าที่ของระบบหัวใจและหลอดเลือดและระบบหายใจ กลไกการควบคุมการทรงสภาพของการไหลเวียนและการหายใจ ตัวอย่างพยาธิสภาพที่พบบ่อย การประสานงานของระบบต่างๆเพื่อตอบสนองต่อปัจจัยภายนอก ได้แก่ การออกกำลังกาย และภาวะช็อคจากการเสียเลือด เพื่อให้เกิดการทรงสภาพของร่างกาย**

## Course Objectives

After completing this course, students should be able to:

1. Explain functional principles, regulation, co-ordination and factors influencing on cardiovascular system

2. Explain functional principles, regulation, co-ordination and factors influencing on respiratory system

3. Discuss the abnormal conditions and indicate the causes affecting the functions of cardiovascular system and respiratory system

4. State the significance of physiology in diagnosis of diseases and treatment of patients

Course Overview:

Physiology for Medical Sciences-II is organized for undergraduate students in the programs related to medical science or biological science. The course provides the fundamental concepts and principles of cardiovascular and respiratory systems in the aspects of functional principles, regulation, coordination and controls. Response to environmental changes and some clinical examples will be introduced to encourage the critical understanding of conceptual information. Active participation of students will be emphasized in the class of formative evaluation.

# Course Organization:

1. **Lectures**

There are total of 30-hr lectures (Cardiovascular System 15-h, Respiratory System 15-h) to cover the concepts of the two systems.

1. **Group Discussion Sessions**

There are two group discussion sessions (1-hr for each session) during formative evaluation. The sessions involve examination and then discussion on question related to lectures. Individual and group activities in discussion to conclude the best explanation for the exam answer are the main focus.

**Teaching Media:**

1. PowerPoint presentation

2. Text-books

# Student Assessment:

1. **Examinations:**

Examinations will be conducted twice in the end of the cardiovascular and respiratory lectures, respectively. The exam questions are multiple choices with 4 choices and/or the essay exam.

|  |  |  |  |
| --- | --- | --- | --- |
| **Exam I:** Cardiovascular system | 120 | points | (45.0%) |
| **Exam II:** Respiratory system | 120 | points | (45.0 %) |
| SUM | **240** | **points** | **(90% of Total)** |

1. **Quiz & Performance for Activities**

The 10% the total weight of score has been set for after class quizzes (weekly)

Student achievement will be graded according to the faculty and university standard using the symbols: A, B+, B, C+, C, D+, D, and F.

Recommended Textbooks:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th ed, MOSBY Elsevier, Philadelphia, PA, USA.

2. Boron W.F. and Boulpaep E.L. (2005) *Medical Physiology: A cellular and Molecular Approach*, Updated Edition, Elsevier Saunders, Philadelphia, PA, USA.

3. Levitzky MG. (2003) Pulmonary Physiology. 6th ed. New York McGraw-Hill, USA.

4. West JB. (2005) Respiratory Physiology: The essentials. 7th ed. Philadelphia: Lippincott Williams & Wilkins, USA.

# Course Management:

**Course Coordinator:**

Assoc. Prof. Tepmanas Bupha-Intr, Ph.D. Room: B-508

Tel: 0-2201-5610 E-mail: tepmanas.bup@mahidol.ac.th

**Lecturers:**

**Dept. of Physiology, Faculty of Science:**

**Room Phone No.**

Assoc. Prof. Tepmanas Bupha-Intr, Ph.D. PR-403 0-2201-5503

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**Physiology for Medical Sciences 2 (SCBM 262)**

**2 credits (2-0-4)**

**Academic Year 2020 Semester 2**

| **Day** | **Date** | **Time** | **Topics** | **h** | **Lecturers** |
| --- | --- | --- | --- | --- | --- |
| 1 | Tuesday Jan 12 | 09.00–09.30 | Course orientation | 0.5 | Tepmanas |
|  |  | 09.30–10.30 | Introduction to the cardiovascular system | 1 | Tepmanas |
|  |  | 10.30–12.00 | Electrophysiology of the heart | 1.5 | Tepmanas |
| 2 | Thursday Jan 14 | 09.00–10.30 | Electrocardiogram | 1.5 | Tepmanas |
|  |  | 10.30–11.30 | Hemodynamics | 1 | Tepmanas |
|  |  | 11.30–12.00 | Cardiac muscle | 0.5 | Tepmanas |
| 3 | Tuesday Jan 19 | 09.00–11.00 | Cardiodynamics and Cardiac pump | 2 | Tepmanas |
|  |  | 11.00-12.00 | Arterial physiology | 1 | Tepmanas |
| 4 | Thursday Jan 21 | 9.00–10.00 | Capillary and venous system | 1 | Tepmanas |
|  |  | 10.00–12.00 | Vasomotor controls | 2 | Tepmanas |
| 5 | Tuesday Jan 26 | 09.00–10.00 | CVS response to exercise | 1 | Tepmanas |
|  |  | 10.00–11.00 | Common pathophysiology of CVS system | 1 | Tepmanas |
|  |  | 11.00–12.00 | CVS response to hemorrhagic hypotension | 1 | Tepmanas |
|  | Thursday Jan 28 | 10.00–11.00 | Formative Evaluation | 1 | Tepmanas |
|  | **Tuesday Feb 2** | **09.00–12.00** | **EXAM I: Cardiovascular system** | **3** | **SIM staff** |
| 6 | Tuesday Feb 9 | 09.00–10.00 | Introduction to respiratory system | 1 | Tepmanas |
|  |  | 11.00-12.00 | Mechanics of breathing part I | 2 | Tepmanas |
| 7 | Thursday Feb 11 | 09.00–10.00 | Mechanics of breathing part II | 1 | Tepmanas |
|  |  | 10.00-12.00 | Gas transfer process | 2 | Tepmanas |
| 8 | Tuesday Feb 16 | 09.00–11.00 | Lung ventilation and pulmonary blood flow | 2 | Tepmanas |
|  |  | 10.00–12.00 | Ventilation-perfusion relationship | 1 | Tepmanas |
| 9 | Thursday Feb 18 | 09.00–10.00 | Control of breathing | 1 | Tepmanas |
|  |  | 10.00–11.00 | Respiratory response during exercise | 1 | Tepmanas |
|  |  | 11.00–12.00 | Common pathophysiology of the lung | 1 | Tepmanas |
| 10 | Tuesday Feb 23 | 09.00–10.00 | Effect of high altitude | 1 | Tepmanas |
|  |  | 10.00–11.00 | Effect of diving | 1 | Tepmanas |
|  |  | 11.00–12.00 | COVID 19: Respiratory complication | 1 | Tepmanas |
|  | Thursday Feb 25 | 10.00–11.00 | Formative Evaluation in Respiration | 1 | Tepmanas |
|  | Tuesday March 2 | The Anniversary of the Royal Bestowal of the Name Mahidol University | | | |
| **12** | **March 1-5** | **EXAM II: Respiratory system (09.00 AM – 12.00 PM)** | | | |
| **Total hour (Exclude Exam and Formative Evaluation)** | | | | **30** | **hours** |

**LESSON PLAN OF THE COURSE**

**Lecture 1: Introduction to the Cardiovascular System**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 12, 2021/ 09.30-10.30

**Learning Objectives:**

Students should be able to:

1. Explain the role of cardiovascular system in maintaining body homeostasis.
2. Discuss the structure-function relations of the circulatory system.
3. Discuss the arrangements of organ systems and the operating concept of cardiovascular system to achieve its main objective.
4. Explain the homeostatic concept of cardiovascular system.
5. Explain the operating circuit in controlling cardiovascular function.

**Content Outline:**

1. Significance of the cardiovascular system in body homeostasis.

2. The structure-function relations of the circulatory system.

3. Operation concepts:

3.1 Homeostasis of Mean Arterial Blood Pressure:

3.2 Balance concept

1. Cardiovascular control:

**Learning Organization:**

1. Lecture 50 min.
2. Question and answer 10 min.

**Learning Materials:**

1. Transcript of lecture objectives and outline
2. Lecture presentation

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 15: Overview of Circulation, pp.289-291, MOSBY Elsevier, Philadelphia, PA, USA.

**Student Assessment:** MCQ and/or Written Exam

# Lecture 2: Electrophysiology of the Heart

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 12, 2021/ 10.30-12.00

**Learning Objectives:**

Students should be able to:

1. Identify the components and propagation pathway of cardiac electrical signals
2. Explain the ionic basis of cardiac resting membrane potential, fast response action potential, and slow response action potential
3. Describe the mechanism and significance of action potential duration, diastolic depolarization, refractory periods, and conduction velocity
4. Describe the sequence of activation of the heart and indicate the importance of timing of the various events to efficient function

**Content Outline:**

1. Cardiac resting membrane potentials

2. Cardiac cell action potentials

3. Propagation pathway of cardiac action potentials

4. Cardiac excitability

5. Conduction velocity

6. Physiological changes in action potentials of the heart

**Learning Organization:**

1. Study the suggested reading materials in advance

2. A sessions of 80-min lecture

3. A session of 10-min class discussion

**Learning Materials:**

1. Transcripts of lecture outline
2. PowerPoint lecture presentation

**References:**

* 1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 16: Elements of Cardiac Funstion, pp.292-317, MOSBY Elsevier, Philadelphia, PA, USA.
  2. Levick JR. An Introduction to Cardiovascular Physiology, 4th ed. Arnold, London, 2003.
  3. Mohrman DE and Heller LJ. Cardiovascular Physiology, 5th ed. McGraw Hill, 2003.

**Student Assessment:** MCQ and/or Written Exam **Lecture 3: Electrocardiogram**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 14, 2021/ 09.00-10.30

**Learning Objectives:**

Students should be able to:

1. Describe the principle of dipole and apply the dipole principle for ECG recording
2. Draw a typical ECG record labeling the waves and indicate the timing of the electrical activation of cells following the sequence of activation of the heart
3. Indicate the ECG conventions of leads I, II and III as well as determine the mean electrical axis of a heart

**Contents Outline:**

1. Principles of Electrocardiography
2. Vectors and the sequence of activation
3. Electrodes and recording leads
4. Recording the dipole in a specific lead
5. ECG, the conduction system, and timing

**Learning Organization:**

1. Study the suggested reading materials in advance
2. A session of 80-min lecture
3. 10-min class discussion

#### Learning Materials:

1. Transcripts of lecture outline.
2. PowerPoint lecture presentation.

**References:**

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Guyton AC and Hall JE. Textbook of Medical Physiology. 11th ed. Philadelphia: Elsevier Saunders, 2006.

# Student Assessment: MCQ and/or Written Exam

#### Lecture 4: Hemodynamics

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 14, 2021/ 10.30-11.30

**Learning Objectives:**

Students should be able to:

1. Discuss the relationship between pressure gradient, fluid flow, and resistance to flow
2. Describe factors determining the blood flow in terms of the Poiseuille’s equation
3. Describe the pressure changes that occur as blood flows through a simple vascular network and relate them to the vascular resistance of the various vascular segments

**Content Outline:**

1. Blood flow
   1. Pressure gradient and resistance
   2. Poiseuille’s equation
   3. Fahraeus-Linqvist effect
   4. Reynold’s number
2. Bernoulli’s principle
3. Elastic properties of blood vessel
   1. Compliance
   2. Wall tension

**Learning Organization:**

1. Study the suggested reading materials in advance
2. 50-min lecture
3. 10-min class discussion

**Learning Materials:**

Transcripts of lecture objectives and outline

PowerPoint lecture presentation

**References:**

1. Guyton AC and Hall JE. Textbook of Medical Physiology. 11th ed. Philadelphia: Elsevier Saunders, 2006.
2. Levick JR. An Introduction to Cardiovascular Physiology 4th ed. Arnold, London, 2003.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 5:** **Cardiac Muscle**

**Lecturer:**  Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:**  January 14, 2021/ 11.30-12.00

**Learning Objectives:**

Students should be able to:

1. Explain the process of excitation-contraction coupling of cardiomyocytes.
2. Discuss the factors that affect the mobilization of intracellular calcium in cardiomyocytes.
3. Discuss the effect of sympathetic activity on the contraction/relaxation of cardiomyocytes.

**Content Outline:**

1. Excitation contraction coupling of cardiomyocytes

2. Calcium-induced calcium release process

3. Cellular activation upon adrenergic stimulation on cardiomyocytes

**Learning Organization:**

1. Study the learning materials provided in advance

2. Lecture 30 min.

**Learning Materials:**

1. Transcript of lecture objectives and outline
2. Textbooks and references
3. PowerPoint presentation of the lecture

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 16: Elements of Cardiac Function, pp. 317-329, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 18: Cardiac Pump, pp. 245-259, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 14: The Cardiac Pump, pp. 237-251, Lippencott Williams & Wilkins, Baltimore, MD, USA.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 6:** **Cardiodynamics and Cardiac Pump**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 19, 2021/ 09.00-11.00

**Learning Objectives:**

Students should be able to:

1. Define the cardiac cycle and describe its events
2. Explain the contractile events underlying pressure generation
3. Discuss the determinants of stroke volume and their effects on cardiac output
4. Discuss the determinants of heart rate and their effects on cardiac output

5. Explain the generation and alterations of the cardiac function curve

**Content Outline:**

1. Structure of the heart in relation to function

1.1 Cardiac chambers and valves

1.2 Myocardial cell

a) Frank-Starling relationship

b) Excitation-contraction coupling

c) Myocardial contractile machinery and contractility

d) Heart sounds

2. Cardiac pump cycle

2.1 The cardiac volumes and dynamics

2.2 The cardiac cycle in terms of ventricular volume-pressure relationship

a) Volume-pressure relation during a “beat” of the heart

b) Heterometric autoregulation

c) Homeometric regulation

2.3 Regulation of cardiac output

2.4 The cardiac function curve or so called Starling curve

a) Generation of the cardiac function curve

b) Alterations in Starling (cardiac function) curves

2.5 Subcellular mechanism for regulation of cardiac function

**Learning Organization:**

1. Study the learning materials provided in advance

2. Two session of 50 min.

3. Questions and answers 2 x 10 min.

4. Self study

**Learning Materials:**

1. Transcript of lecture objectives and outline
2. Textbooks and references
3. PowerPoint presentation of the lecture

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 16: Elements of Cardiac Function, pp. 317-329, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 18: Cardiac Pump, pp. 245-259, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 14: The Cardiac Pump, pp. 237-251, Lippencott Williams & Wilkins, Baltimore, MD, USA.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 7: Arterial Physiology**

**Lecturer:**  Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 19, 2021/ 11.00-12.00

**Learning Objectives:**

## Students should be able to:

1. Discuss the basic relationships between cardiac output, systemic arterial pressure, and total peripheral resistance to the flow of blood

2. Discuss the relationships between stroke volume, heart rate, systemic vascular resistance, mean arterial pressure, pulse pressure, and vascular compliance

**Content Outline:**

1. Where do the pressure and pressure gradients come from?
2. Arterial elasticity and determinants of the arterial blood pressure
3. Measurement of arterial blood pressure

**Learning Organization:**

1. Study the learning materials provided in advance

2. Lecture 50 min.

3. Questions and answers 3 x 10 min.

4. Self study

**Learning Materials:**

1. Transcript of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 17: Properties of the Vasculature, pp. 336-342, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 21: Arterial System & Chapter 23: Peripheral Circulation and Its Control, pp. 288-297 and pp. 309-319, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 15: The Systemic Circulation, pp. 252-261, Lippencott Williams & Wilkins, Baltimore, MD, USA.

**Student Assessment:**  MCQ and/or Written Exam

**Lecture 8: Capillary and venous system**

**Lecturer:**  Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 21, 2021/ 09.00-10.00

**Learning Objectives:**

## Students should be able to:

1. Describe the significance of capillary network on capillary flow

2. Discuss the physical factors governing fluid movement across the capillary membrane

3. Discuss the vasoactive substances generated from endothelial cells

4. Describe the function of the venous system as the blood reservoir

5. Explain the effects of external pressures on venous return

**Content Outline:**

1. Capillary network and transcapillary exchange
2. Other functions of the endothelial lining
3. Basic features of the venous system
4. Factors that alter venous pressure and venous return
5. Factors that influence blood flow in and out of the venous system

**Learning Organization:**

1. Study the learning materials provided in advance

2. Lecture 50 min.

3. Questions and answers 10 min.

4. Self study

**Learning Materials:**

1. Transcript of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 17: Properties of the Vasculature, pp. 336-342, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 21: Arterial System & Chapter 23: Peripheral Circulation and Its Control, pp. 288-297 and pp. 309-319, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 15: The Systemic Circulation, pp. 252-261, Lippencott Williams & Wilkins, Baltimore, MD, USA.

**Student Assessment:**  MCQ and/or Written Exam

## Lecture 9: Vasomotion Controls

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 21, 2021/ 10.00-12.00

**Learning objectives:**

## Students should be able to:

1. Explain factors involved in the cardiovascular control system
2. Describe the role of autonomic (sympathetic and parasympathetic) outflow in controlling cardiovascular system
3. Discuss the functions of the baroreceptors and chemoreceptors in the cardiovascular control system
4. Discuss the involvements of humoral and physical factors in cardiovascular control

**Content outline:**

1. Factors involved in cardiovascular control

1.1 Extrinsic control

a) Neural influences on circulatory control

b) Humoral factors

* 1. 1.2 Intrinsic or local control

a) Myogenic regulation

b) Endothelial-mediated regulation

c) Metabolic regulation

2. Coupling between the heart and the blood vessels

3. How does the cardiovascular control operate?

**Learning Organization:**

1. Studying the learning materials provided in advance

2. two sessions of 50 min lecture.

3. Questions and answers 2 x 10 min.

4. Self study

**Learning Materials:**

1. Transcripts of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 18: Regulation of the Heart and Vasculature, pp. 370-392, and Chapter 19: Integrated Control of the Cardiovascular System, pp. 393-414, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 23: Peripheral Circulation and Its Control, pp. 309-318, Chapter 24: Control of Cardiac Output: Coupling of the Heart and Blood Vessels, pp. 320-332, and Chapter 26: Interplay of Central and Peripheral Factors in control of the Circulation, pp. 346-360, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 18:Control Mechanisms in Circulatory Function, pp. 290-308, Lippencott Williams & Wilkins, Baltimore, MD, USA.

**Student Assessment:**  MCQ and/or Written Exam

## Lecture 10: CVS response to exercise

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 26, 2021/ 09.00-10.00

**Learning Objectives:**

Students should be able to:

1. State the relationships between exercise intensity and major cardiovascular parameters
2. Discuss the effects of dynamic exercise on the cardiovascular system and mechanisms involved
3. Compare the cardiovascular responses to dynamic exercise with those to isometric exercise

4. Indicate the effects of chronic exercise and physical conditioning on cardiovascular variables

**Content Outline:**

1. Definition of maximal oxygen consumption

2. Cardiovascular effects of dynamic exercise

3. Cardiovascular effects of isometric exercise

4. Effects of exercise training on cardiovascular variables

**Learning Organization:**

1. Study the providing material online 45 minute
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Laughlin MH Cardiovascular Response to Exercise. *Am. J. Physiol. 277 (Adv. Physiol. Educ. 22): S244–S259, 1999.*
3. Opie LH. Heart Physiology: From cell to circulation. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

**Student Assessment:** MCQ and/or Writen Exam

## Lecture 11: Common pathophysiology of CVS system

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 26, 2021/ 10.00-11.00

**Learning Objectives:**

Students should be able to:

1. Explain the cause of heart failure and the cardiovascular compensation.
2. Discuss the effect of valvular diseases on arterial blood pressure and cardiac output.
3. Discuss the cause and consequent effect of high arterial blood pressure.

**Content Outline:**

1. Systolic and Diastolic heart failure

2. Valvular disorders

3. Pathophysiolgy of hypertension

**Learning Organization:**

1. Study the providing material online 45 minutes
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Laughlin MH Cardiovascular Response to Exercise. *Am. J. Physiol. 277 (Adv. Physiol. Educ. 22): S244–S259, 1999.*
3. Opie LH. Heart Physiology: From cell to circulation. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

**Student Assessment:** MCQ and/or Writen Exam

## Lecture 12: CVS response to hemorrhagic hypotension

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** January 26, 2021/ 11.00-12.00

**Learning Objectives:**

Students should be able to:

1. Differentiate hemorrhagic shock from other types of shock
2. Classify the different states of hemorrhage
3. Describe the pathophysiology during the early phase of different classes of hemorrhage
4. Explain the major organ systems involved in the compensatory mechanisms to blood loss
5. Explain the decompensatory mechanisms that are evident during hemorrhage

**Content Outline:**

1. Types of shock
2. Hemorrhagic hypotension: classes and severity
3. Compensatory mechanisms (negative feedback mechanisms):
4. Decompensatory mechanisms (positive feedback mechanisms):

**Learning Organization:**

1. Study the providing material online 45 minute
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 19: Integrated Control of the Cardiovascular System, pp. 409-412, MOSBY Elsevier, Philadelphia, PA, USA.

2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 26: Interplay of Central and Peripheral Factors in Control of the Circulation, pp. 351-355, MOSBY Elsevier, Phiadelphia, PA, USA.

3. Gutierrez G, Reines HD, and Wulf-Gutierrez ME. Clinical review: Hemorrhagic shock. *Critical Care* 8: 373-381, 2004.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 13: Introduction to the Respiratory System**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 9, 2021/ 09.00-10.00

**Learning Objectives:**

Students should be able to

1. Discuss structupe and function of upper and lower airways.
2. Outline the sequential steps of gas transfer between the cells and the external environment
3. Understand the basic physical principles that govern the process of gas transfer in the respiratory physiology

**Lecture Outline:**

1. Structural organization of the respiratory system
2. Cells of the airways.
3. Steps of gas transfer between the cells and the external environment
4. Physical principles of gases

**Learning Organization:**

1. Studying the learning materials provided in advance
2. Lecture 50 min
3. Questions and answers 10 min
4. Self study

**Learning Materials:**

1. Transcripts of PowerPoint presentation

**References:**

1. Levitzky MG. Pulmonary Physiology, 5th ed. New York: McGraw-Hill, 1999.
2. West JB. Respiratory Physiology – The essential, 6th ed. Baltimore: Williams & Wilkins, 2000.
3. Koeppen BM and Stanton BA. Berne & Levy Physiology 6th ed. Mosby & Elsevier, 2007.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 14: Mechanics of Breathing**

**Instructor:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 9, 2021/ 11.00-12.00 and February 11, 2021/ 09.00-10.00

**Learning Objectives:**

Students should be able to:

1. Describe the mechanical events associated with breathing.
2. Describe the physical factors influencing pulmonary ventilation.
3. Explain the relative roles of the respiratory muscles and lung elasticity in effecting lung volumes.
4. Discuss the role of surfactant and its physiological significant
5. Define airways resistance and list factors that alter the resistance to airflow.
6. Distinguish between the restrictive and obstructive lung diseases including the spirometric abnormality and work of breathing associated with each category

**Lecture Outline:**

1. Pulmonary ventilation
   1. -Inspiration
   2. -Expiration
2. Lung volumes and capacities
3. Lung compliance
4. Airway resistance
5. The work of breathing

**Learning Organization:**

1. Studying the learning materials provided in advance
2. Three sessions of 50 min lecture
3. Questions and answers 3 x 10 min
4. Self study

**Learning Materials:**

* 1. Transcripts of lecture outline
  2. PowerPoint presentation/handout

**References:**

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 15: Gas Transfer Process**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 11, 2021/ 10.00-12.00

**Learning objectives:**

Students should be able to

1. Discuss structure and function of upper and lower airways.
2. Outline the sequential steps of gas transfer between the cells and the external environment
3. Understand the basic physical principles that govern the process of gas transfer in the respiratory physiology

**Lecture outline:**

1. Structural organization of the respiratory system
2. Cells of the airways.
3. Steps of gas transfer between the cells and the external environment
4. Physical principles of gases

**Learning organization:**

1. Studying the learning materials provided in advance
2. Two sessions of 50 min lecture
3. Questions and answers 2 x 10 min
4. Self study

**Learning materials:**

1. Transcripts of PowerPoint presentation

**References:**

1. Levitzky MG. Pulmonary Physiology, 5thed. New York: McGraw-Hill, 1999.
2. West JB. Respiratory Physiology – The essential, 6th ed. Baltimore: Williams & Wilkins, 2000.
3. Koeppen BM and Stanton BA. Berne & Levy Physiology 6th ed. Mosby & Elsevier, 2007.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 16**:  **Lung Ventilation and Pulmonary Blood Flow**

**Lecturer**: Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 16, 2021/ 09.00-11.00

**Learning Objectives**

The students should be able to:

1. Distinguish anatomical and physiological dead space.
2. Discuss the role of dead space in governing partial pressure of alveolar gases.
3. Describe the effect of hypo- and hyperventilation on alveolar gas tension.
4. Describe the factors causing non-uniform distribution of ventilation in the lungs.
5. Compare the physiological characteristics between pulmonary circulation and systemic circulation.
6. List factors influencing pulmonary vascular resistance.
7. Discuss how distribution of blood flow is not uniformed throughout the lungs.

**Content Outlines**

1. Pulmonary ventilation

* Minute ventilation, dead space, and alveolar ventilation
* Effects of ventilation on alveolar gases.
* Regional distribution of inspired gas in the lungs

2. Pulmonary circulation

* Physiological characteristics
* Pulmonary vascular resistance
* Regional distribution of pulmonary blood flow

**Learning Organization**

1. Studying the learning materials provided in advance.
2. Two sessions of 50 min lecture.
3. Questions and answer 2 x 10 min.
4. Self-study.

**Learning Materials**

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

**References:**

1. Koeppen BM, Stanton BA. (2008) Berne & Levy Physiology, 6th ed. Philadelphia: Mosby. Sec 4, Ch 22.
2. Levitzky MG. (2003) Pulmonary Physiology. 6th Ed. New York McGraw-Hill.
3. Rhoades RA, Bull DR. (2013) Medical physiology: Principles for Clinical Medicine, 4th ed. Philadelphia: Wolter Kluwer/ Lippincott Williams & Wilkins. Ch 18.
4. Sherwood L. (2001) Human Physiology: From cells to systems. 4th ed. California: Brooks/Cole.
5. West JB. (2005) Respiratory Physiology: The essentials. 7th ed. Philadelphia: Lippincott Williams & Wilkins.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 17:**  **Ventilation-Perfusion Relationships**

**Lecturer**: Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 16, 2021/ 10.00-12.00

**Learning Objectives**

The students should be able to:

1. Describe the distribution of VA/Qc ratios in normal and diseased lungs.
2. Explain how mismatching of alveolar ventilation and perfusion can lead to hypoxemia.

**Content Outlines**

1. Ventilation-perfusion (VA/Qc) relationship

* Distribution of VA/Qc ratio in the lung
* Effects of regional VA/Qc inequality on gas exchange

**Learning Organization**

1. Studying the learning materials provided in advance.
2. Lecture 40 min
3. Questions and answer 10 min
4. Self study.

**Learning Materials**

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

**References:**

1. Koeppen BM, Stanton BA. (2008) Berne & Levy Physiology, 6th ed. Philadelphia: Mosby. Sec 4, Ch 22.
2. Levitzky MG. (2003) Pulmonary Physiology. 6thed. New York McGraw-Hill.
3. Rhoades RA, Bull DR. (2013) Medical physiology: Principles for Clinical Medicine, 4th ed. Philadelphia: Wolter Kluwer/ Lippincott Williams & Wilkins. Ch 20.
4. Sherwood L. (2001) Human Physiology: From cells to systems. 4th ed. California: Brooks/Cole.
5. West JB. (2005) Respiratory Physiology: The essentials. 7th Ed. Philadelphia: Lippincott Williams & Wilkins.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 18: Control of Breathing**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 18, 2021/ 09.00-10.00

**Learning Objectives:**

Students should be able to:

1. Identify the groups and function of neurons that are thought to play a role in the regulation of breathing.
2. Give two examples of reflexes involving pulmonary receptors that influence pattern of breathing.
3. Identify the location of chemoreceptors in the respiratory system.
4. Describe the effects of changes in the partial pressure of oxygen, carbon dioxide, and hydrogen ion level on the control of breathing.
5. Describe the role of respiratory system in acid-base regulation.

**Lecture Outline:**

1. Neural control of breathing
   1. Generation of spontaneous respiratory pattern
   2. Medullary respiratory center
   3. The pons respiratory center

1.4 Reflexes control of respiration

1. Chemical control of breathing
   1. The peripheral arterial chemoreceptor
   2. The central chemoreceptor
2. Acid-base regulation

**Learning Organization:**

1. Study the providing material online 45 minute
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 19: Respiratory response during exercise**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 18, 2021/ 10.00-11.00

**Learning Objectives:**

Students should be able to:

1. Explain the sensory inputs that stimulate the respiratory center during exercise.
2. Explain the relationship between exercise intensity and changes in respiratory function.
3. Discuss the effect of exercise training on respiratory adaptation.

**Lecture Outline:**

1. Sensory input during exercise
2. Ventilatory threshold
3. Respiratory adaptation after aerobic training

**Learning Organization:**

1. Study the providing material online 45 minute
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 20: Common pathophysiology of the lung**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 18, 2021/ 11.00-12.00

**Learning Objectives:**

Students should be able to:

1. Discuss common pathophysiology leading to hypoventilation
2. Discuss common pathophysiology leading to lung diffusion defect
3. Discuss common pathophysiology leading to ventilation-perfusion mismatch

**Lecture Outline:**

1. Lung fibrosis and emphysema
2. Asthmatic attack
3. Pneumothorax
4. Pulmonary edema
5. Pulmonary embolism

**Learning Organization:**

1. Study the providing material online 45 minutes
2. 10-min post-quiz
3. 5- min answer the post-quiz question

#### Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

**References:**

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 21: Effect of high altitude**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 18, 2021/ 09.00-10.00

**Learning Objectives:**

Students should be able to:

1. Explain the effect of hypobaric onpartial pressure of oxygen in the blood.
2. Explain the respiratory and cardiovascular response due to altitude hypoxia.
3. Discuss the body acclimatization after prolonged exposure to altitude.

**Lecture Outline:**

1. Partial pressure and high altitude
2. Acute response to hypoxia
3. Acute mountain sickness
4. Acclimatization to high altitude

**Learning Organization**

1. Studying the learning materials provided in advance.
2. Lecture 50 min
3. Questions and answer 10 min
4. Self-study.

**Learning Materials**

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

**References:**

1. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
2. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.
3. Brown and Grocott. Humans at altitude: physiology and pathophysiology. Continuing Education in Anaesthesia Critical Care & Pain, 2013;13:17–22

**Student Assessment:** MCQ and/or Written Exam

**Lecture 22: Effect of diving**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 23, 2021/ 10.00-11.00

**Learning Objectives:**

Students should be able to:

1. Explain the effect of hyperbaric to the lung function
2. Explain the cause of bends
3. Discuss the gas mixture for scuba diving tank

**Lecture Outline:**

1. Respiratory response to diving during ascent and descent
2. The bends
3. Scuba gas mixture and respiratory function

**Learning Organization**

1. Studying the learning materials provided in advance.
2. Lecture 40 min
3. Questions and answer 10 min
4. Self study.

**Learning Materials**

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

**References:**

1. Diving physiology. NOAA Diving Manual. Department of Commerce (DOC) National Oceanic and Atmospheric Administration (NOAA).
2. Levett and Millar. Bubble trouble: a review of diving physiology and disease. BMJ journal 2008; 84:571-578.

**Student Assessment:** MCQ and/or Written Exam

**Lecture 23: COVID 19: Respiratory complication**

**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.

**Date/Time:** February 25, 2021/ 10.00-11.00

**Learning Objectives:**

Students should be able to:

1. Explain the size effect of particle on respiratory infestation.
2. Discuss the respiratory transmission on SARS-CoV-2 virus.
3. Discuss the pathophysiology of SARS-CoV-2 virus on lung function.

**Lecture Outline:**

1. Air flow and particle deposition on airways.
2. SARS-CoV-2 virus particle and transmission
3. Lung pathology in patient with SARS-CoV-2 virus infection.

**Learning Organization**

1. Studying the learning materials provided in advance.
2. Lecture 50 min
3. Questions and answer 10 mins
4. Self-study.

**Learning Materials**

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

**References:**

1. Heyder, J. Deposition of Inhaled Particles in the HumanRespiratory Tract and Consequences for RegionalTargeting in Respiratory Drug Delivery. Proceedings of the american thoracic society, 2004; 1:315-320
2. Rissler et. al. Deposition efficiency of inhaled particles (15-5000 nm) related to breathing pattern and lung function: an experimental study in healthy children and adults. Particle and Fibre Toxicology, 2017;14:10.
3. Yuki, Fujiogi, Koutsogioannaki,. COVID-19 pathophysiology: A review. Clin Immunol. 2020; 215:108427.

**Student Assessment:** MCQ and/or Written Exam