

Course Title	<b>Physiology I</b>			
Course Code	<b>MED-203</b>			
Course Type	Required			
Level	Undergraduate			
Year / Semester	Year 2/ Semester 3 (Fall)			
Teacher's Name	<b>Course Lead:</b> Prof Marios Panos			
ECTS	6	Lectures / week	3	Laboratories / week / 2
Course Purpose and Objectives	<p>The main objectives of the course are:</p> <ul style="list-style-type: none"> <li>• To describe fundamental mechanisms underlying normal function of cells, tissues, organs, and organ systems of the human body.</li> <li>• To explain basic mechanisms of homeostasis by integrating the functions of cells, tissues, organs, and organ systems.</li> <li>• To enhance an understanding of anatomy, by linking structure and function.</li> <li>• To provide a strong scientific basis to medicine, the clinical counterpart of physiology.</li> </ul>			
Learning Outcomes	<p>The following list provides the learning objectives (LOBs) that will be covered in the lectures and practicals of each week (please note that no new learning objectives will be covered in tutorials since these will be used to revisit previous topics and answer students' questions):</p> <p><b>Week 1</b></p> <p><b>LOBs covered during lectures:</b></p> <ol style="list-style-type: none"> <li>1. Describe cell structure and function.</li> <li>2. Describe the composition of body fluid compartments.</li> <li>3. Define osmolality and tonicity.</li> <li>4. Describe the structure of the cell membrane.</li> <li>5. Outline water and solute transport.</li> <li>6. Explain resting and action potential by ionic channel and concentration gradients.</li> <li>7. Explain action potential generation and propagation, voltage and ion gated channels.</li> <li>8. Describe the function of the synapse.</li> <li>9. Outline pre- and post- transmitter release, reception and breakdown in relation to impulse transmission and muscle fibre contraction.</li> </ol>			

## Week 2

### **LOBs covered during lectures:**

10. Explain synapse function (pre- and post- transmitter release reception and breakdown).
11. Describe excitation-contraction coupling in striated muscle.
12. Outline Muscle mechanics.
13. Describe and contrast smooth muscle and cardiac muscle.
14. Describe cardiac function and electro-mechanical coupling.
15. Describe the Cardiac Cycle.
16. Explain the origin of normal and abnormal heart sounds in relation to the Cardiac Cycle.

## Week 3

### **LOBs covered during lectures:**

17. Outline the function of the Electrocardiogram.
18. Explain the origin of the PQRST electrical wave and identify electrocardiographic changes in cardiac arrhythmias, myocardial infarction and myopathies.
19. Describe coronary endothelium and secretory function, vascular smooth muscle, microcirculation and lymph flow (including mechanisms of atherosclerosis).
20. Explain cardiac cycle and its relation to intracardiac pressure changes, heart sounds and the electrocardiogram.
21. Describe the physiology of the circulation, defining stroke volume, cardiac output and total peripheral resistance (TPR) and explain how they are linked by Starling's Law of the Heart.
22. State Laplace's law and explain the link to heart work and mural tension.
23. Describe Cardiac Output (preload, afterload and contractility).
24. Describe the process of atherosclerosis and thromboembolism.
25. State and explain Poisseulles' Law.

## Week 4

### **LOBs covered during lectures:**

26. Outline the dynamics and local control of blood flow and circulation in specific vascular beds.
27. Describe the dynamics and control of coronary blood flow, heart muscle oxygen consumption and biochemistry and explain events leading to ischaemia.
28. Describe the basic organization of the cardiovascular system

29. Describe the relationship of vascular anatomy, radius, flow and pressure gradients and Poiseuille's Law.
30. Describe the generation of arterial blood pressure and its control and mechanisms of arterial hypertension.

***LOBs covered during practical:***

31. Practice finding main points of palpation of the pulse, measurement of pulse rate, arterial Blood Pressure and identify the jugular venous pulse (Method and pitfalls).
32. Measure the effect of change in posture (supine/erect) and exercise on pulse rate and arterial blood pressure and observe the recovery stage.

**Week 5**

***LOBs covered during lectures:***

33. Outline the regulation of the systemic circulation and describe changes in response to cold, heat and shock.
34. Describe the factors influencing the maintenance of blood pressure.
35. Describe inspired air gas content and the mechanics of air flow to the alveoli and alveolar ventilation.
36. Describe Fick's law of diffusion and how it moves gases from air to blood to cells.
37. Describe the origin, composition and physical properties of pulmonary surfactant and explain how its lack leads to alveolar collapse during expiration.
38. Outline pulmonary gas exchange.
39. Describe pulmonary circulation and carriage of oxygen in blood by haemoglobin, from lungs to tissues.
40. Describe respiratory control and outline ways in which failure to gas exchange leads to hypoxaemia/hypercapnia.
41. Explain what determines airway resistance in normal lung and what changes in Chronic Obstructive Pulmonary Disease (COPD).
42. Explain the overall respiratory and non-respiratory functions of the respiratory system.

**Week 6**

***LOBs covered during lectures:***

43. Describe the lung and the circulation of blood in the foetus and how these change at birth.
44. Describe ways of intercellular communication and signal transduction.

45. Contrast the location and signalling pathways of membrane bound and intracellular hormone receptors.
46. Compare and contrast hormone actions that are exerted through changes in gene expression with those exerted through changes in protein activity, such as through phosphorylation.
47. Contrast the signal transduction pathways involved in G-protein coupled receptors, receptor enzymes and ligand-gated ion channels.

### **Week 7**

#### ***LOBs covered during lectures:***

48. Explain the effects of secretion, excretion, degradation, and volume of distribution on the concentration of a hormone in blood plasma.
49. Describe tropic hormones and the function and control of pituitary target glands and explain the importance of patterns of hormone secretion, such as pulsatile, circadian (diurnal) and menstrual.
50. Explain the principle of negative and positive feedback and feed forward control of hormone secretion.
51. Outline the synthesis, regulation, storage, secretion, transport, target, mechanism of action, effect, and secretion of the key hormones associated with the hypothalamic –pituitary axis.
52. Explain the role of the hypothalamus in temperature regulation.
53. Outline the anatomy and function of the anterior and posterior pituitary glands.
54. Outline the synthesis, regulation, storage, secretion, transport, target, mechanism of action, effect, and secretion of the key hormones associated with the thyroid gland, parathyroid gland, pancreas, kidney, adrenal gland, ovary and testis.
55. Describe calcium and phosphate regulation.
56. Describe thyroid hormone functions, secretion, feedback control and hyperthyroid/hypothyroid states.
57. Describe adrenal cortex hormone secretion and control.

### **Formative Midterm Exam**

### **Week 8**

#### ***LOBs covered during lectures:***

58. Describe adrenal cortex, the renin-angiotensin system and mineralocorticoid effects on the kidney and blood pressure.
59. Outline the role of the adrenal medulla in catecholamine secretion.
60. Describe the role of the adrenalin stress response.
61. Describe the role of steroid hormones, including vitamin D.

***LOBs covered during practical:***

62. Practice recording respiratory rate - measure at rest, exercise and in recovery stages, lung function by spirometry measure oxygen saturation by pulse oximeter, and the use of a stethoscope.
63. Measure lung function by spirometry (tidal volume, forced expiratory volume, Forced vital capacity) and understand the respiratory loop.
64. Measure oxygen saturation with a pulse oximeter at rest, after a 30 second breath hold and after 30 seconds of hyperventilation.
65. Gain initial experience in the use of a stethoscope to listen to breath sounds.

**Week 9**

***LOBs covered during lectures:***

66. Differentiate the processes of ingestion, digestion, absorption, secretion, and excretion for the major classes of nutrients (carbohydrates, proteins, fats) and state the location in the GI tract where each process occurs.
67. Describe the dynamic pressure changes that occur in the regions of the oesophagus after initiation of the swallowing reflex and how these pressure changes propel a bolus of food from the mouth to the stomach.
68. Describe the functions of the duodenum, jejunum, ileum, large intestine and pancreas.
69. Explain the contribution of pancreatic secretion and bile in producing alkaline pH in the duodenum.
70. Describe liver function/acinar structure, synthetic and metabolic functions of hepatocytes, bile secretion, gallbladder function and the actions of cholecystokinin.
71. Describe the function of the jejunum, ileum, pancreas and pancreaticobiliary tree with respect to the digestion and absorption of food.

**Week 10**

***LOBs covered during lectures:***

72. Describe the control of peristalsis by the enteric nervous system, endocrine and neural regulatory functions, including gastrointestinal (neuroendocrine) hormones.
73. Describe the sequence of events in the colon and anal sphincters occurring during reflexive defecation, differentiating those movements under voluntary control and those under autonomic control.

	<p>74. Describe the disorders of motility that can lead to gastroparesis, achalasia, diarrhoea, constipation, megacolon and Irritable Bowel Syndrome.</p> <p>75. Describe the location and process of water and electrolyte absorption.</p> <p>76. Compare and contrast the function of the stomach, duodenum, small and large bowel.</p> <p>77. Describe gastrointestinal defence mechanisms and gut flora.</p> <p><b>Week 11</b></p> <p><b>LOBs covered during lectures:</b></p> <p>78. Describe the role of the adrenal in the manufacture of sex hormones.</p> <p>79. Describe the events occurring at adrenarche in both sexes and some common conditions in which the events do not occur normally.</p> <p>80. Explain the role of pancreatic islets, peptide hormones, insulin, glucagon, somatostatin and neuroendocrine hormones.</p> <p>81. Describe pancreatic hormone actions on carbohydrate, fat and protein metabolism.</p> <p>82. Describe pancreatic hormone interactions with cortisol, epinephrine and growth hormone.</p> <p>83. Describe energy balance (intake-expenditure) and nutritional requirements, nutritional status assessment.</p> <p>84. Describe the features of metabolic adaptation to starvation, protein-calorie malnutrition, vitamin deficiencies and Anorexia Nervosa.</p> <p>85. Describe blood constituents, the production and function of red cells, haemoglobin, O<sub>2</sub> and CO<sub>2</sub> transport, transport proteins.</p> <p>86. Describe the role of platelets and the intrinsic and extrinsic systems in the coagulation cascade of haemostasis.</p> <p><b>Week 12</b></p> <p><b>LOBs covered during lectures:</b></p> <p>87. Describe multisystem homeostatic mechanisms which contribute towards adaptation to extreme heat, cold, high altitude (low atmospheric pressure) and deep sea diving (high atmospheric pressure).</p>		
Prerequisites	None	Required	None
Course Content	<p><b>Topics covered in lectures</b></p> <ul style="list-style-type: none"> <li>• Introduction to Physiology and Homeostasis - Body Fluid Compartments.</li> </ul>		

- Cell physiology, Body Fluid Compartments and Solute Transport.
- Plasma membrane potential.
- Nerve conduction - Resting, action potential and ionic movement.
- Propagation of Nerve Action Potential, synapses and neurotransmitters.
- The Neuromuscular Junction.
- Muscle Physiology.
- Skeletal, Cardiac and Smooth Muscle.
- **CARDIOVASCULAR SYSTEM:**
  - Cardiac physiology and anatomy- the heart as a pump.
  - Mechanical events in cardiac cycle, pressure changes and heart sounds.
  - Concept of preload and afterload.
  - The ECG, coronary blood flow, atherosclerosis.
  - Circulation, blood vessels, physics of blood flow.
  - Blood pressure and its control.
  - More on Blood pressure control, postural changes, exercise, shock
  - Cardiovascular adaptation to exercise, cold, heat and shock.
- **RESPIRATORY SYSTEM:**
  - Anatomy, Mechanics, Upper and Lower airways.
  - Pulmonary gas exchange.
  - Control of Respiration
  - Restrictive and obstructive disease.
  - Foetal lung, circulation, changes at birth.
- **ENDOCRINE SYSTEM:**
  - Principles of neural and hormonal communication.
  - Hormonal synthesis, secretion, signalling.
  - Hormone secretion, degradation, the central endocrine glands, Pineal Gland and Circadian Rhythms.
  - Central Endocrine Glands (Hypothalamus, anterior/posterior pituitary/pineal glands).
  - Thyroid, Parathyroid, Hyperthyroidism, Hypothyroidism, Control of Calcium metabolism.
  - Control of Calcium and bone metabolism
  - Thyroid. Normal function, hypothyroidism
  - Adrenal Glands (adrenal cortex-adrenal medulla, glucocorticoids)
  - Adrenal Glands (adrenal cortex-adrenal medulla, renal)

	<ul style="list-style-type: none"> <li>-Adrenarche in both sexes and common abnormal conditions and sex hormones</li> <li>-Pancreas and Control of Fuel Metabolism</li> <li>• GASTROINTESTINAL SYSTEM: <ul style="list-style-type: none"> <li>- Digestive tract and accessory digestive organs, mouth, pharynx, oesophagus.</li> <li>- Stomach, Gastric Secretion, Duodenum.</li> <li>- Duodenum and pancreatic secretion.</li> <li>- Liver, gall bladder, bile secretion.</li> <li>- Small bowel and absorption.</li> <li>- Large bowel and overview of motility of the Gastrointestinal Tract.</li> <li>- Enteric nervous system and disorders of motility.</li> </ul> </li> <li>• ENERGY BALANCE and NUTRITIONAL STATUS ASSESSMENT.</li> <li>• THE BLOOD: <ul style="list-style-type: none"> <li>-Red blood cells, white blood cells, platelets &amp; haemostasis</li> </ul> </li> <li>• ADAPTATION TO ENVIRONMENTAL EXTREMES: <ul style="list-style-type: none"> <li>- Heat and cold</li> <li>- High altitude</li> <li>- Deep sea diving</li> </ul> </li> </ul> <p><b>Topics covered in practicals:</b></p> <ul style="list-style-type: none"> <li>• Cardiovascular Practical</li> <li>• Respiratory Function Practical</li> </ul>																								
Teaching Methodology	Lectures, Practicals, Tutorials.																								
Bibliography	<p><b>Required Textbooks/Reading:</b></p> <table border="1" data-bbox="485 1433 1490 1671"> <thead> <tr> <th>Authors</th> <th>Title</th> <th>Edition</th> <th>Publisher</th> <th>Year</th> <th>ISBN</th> </tr> </thead> <tbody> <tr> <td>Sherwood, Laura Lee</td> <td>Human Physiology: from Cells to Systems</td> <td>9<sup>th</sup> Edition</td> <td>CENGAGE Learning</td> <td>2015</td> <td>9781285866932 (hardcover)</td> </tr> </tbody> </table> <p><b>Recommended Textbooks/Reading:</b></p> <table border="1" data-bbox="485 1736 1490 1924"> <thead> <tr> <th>Authors</th> <th>Title</th> <th>Edition</th> <th>Publisher</th> <th>Year</th> <th>ISBN</th> </tr> </thead> <tbody> <tr> <td>Costanzo, Linda</td> <td>Physiology</td> <td>6<sup>th</sup> Edition</td> <td>Saunders/ Elsevier</td> <td>2017</td> <td>9780323478816</td> </tr> </tbody> </table>	Authors	Title	Edition	Publisher	Year	ISBN	Sherwood, Laura Lee	Human Physiology: from Cells to Systems	9 <sup>th</sup> Edition	CENGAGE Learning	2015	9781285866932 (hardcover)	Authors	Title	Edition	Publisher	Year	ISBN	Costanzo, Linda	Physiology	6 <sup>th</sup> Edition	Saunders/ Elsevier	2017	9780323478816
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	Costanzo, Linda	BRS: Physiology	7 <sup>th</sup> Edition	Lippincott Williams & Wilkins	2018	9781496367617
	Thomas A. Brown	Rapid Review Physiology	2 <sup>nd</sup> Edition	Mosby	2011	9780323072601
Assessment	For the course MED-203 Physiology I there will be an online Formative Midterm Exam. The grade for the course will be contributed by an Oral Presentation (10%) and a Summative Final Exam (90%). Written exams consist of Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).					
Language	English					