<table>
<tr><td>Course title</td><td colspan="5">Molecules, cells, tissues and organs II</td></tr>
<tr><td>Course code</td><td colspan="5">MD-104</td></tr>
<tr><td>Course type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">1st cycle: undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 1 / Semester 2 (Spring)</td></tr>
<tr><td>Teacher’s name</td><td colspan="5">Annita Achilleos</td></tr>
<tr><td rowspan="2">ECTS</td><td rowspan="2">15</td><td>Large Group Learning
per Week</td><td>Tutorials
per Week</td><td>Small group work
per Week</td><td>Laboratories</td></tr>
<tr><td>6.5</td><td>3</td><td>3</td><td>6</td></tr>
<tr><td>Course purpose and objectives</td><td colspan="5">The main objectives of the course are to:
1. Describe the structural components and functions of biological membranes, including mechanisms of protein trafficking and post-translational modifications.
2. Compare active and passive transport processes across biological membranes, including the concepts of osmolality and tonicity.
3. Discuss clinical applications of isotonic, hypotonic, and hypertonic solutions, as well as body fluid compartments and their ionic compositions.
4. Explain cellular transport mechanisms and general principles of drug action, including pharmacodynamics and pharmacokinetics.
5. Describe how proteins are targeted to different cellular locations and the role of post-translational modifications in protein function.
6. Outline the types of cellular signaling processes, such as paracrine, autocrine, and endocrine signaling, and their relevant receptor classes.
7. Discuss major signaling pathways, drug design targeting molecular receptors, and key pharmacodynamic terms.
8. Describe the structure and function of the extracellular matrix and the cytoskeleton, including their roles in cell movement and migration.
9. Explain how muscle fibers contract and the role of the neuromuscular junction in muscle contraction, along with the processes of inflammation and immune cell migration.
10. Discuss embryonic development processes, including gamete formation, early stages of development, and implications of abnormal implantation.
11. Describe the characteristics and functions of epithelial tissues, including the structure of the skin and its immune functions.
12. Classify connective tissues, outline their functions, and describe the extracellular matrix's contribution to connective tissue properties.</td></tr>
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	13. Compare and contrast the structure and function of smooth, skeletal, and cardiac muscle tissues and their repair abilities. 14. Describe the structure and function of nervous tissue, including neurons and glial cells, as well as principles of neuronal signaling and the role of the nervous system. 15. Outline the major organs of the human body and their systematization, recognizing their primary functions and interrelationships within organ systems. 16. Compare innate and adaptive immunity, defining key lymphoid organs and the roles of blood and lymph in the adaptive immune response. 17. Discuss major milestones in the history of medicine, including the evolution of practices and contributions from various scientific disciplines, and reflect on future innovations in healthcare.
Learning outcomes	**<u>Theme 1: Membranes, vesicle and cellular traffic</u>** 1. Describe the structural components and functional properties of biological membranes. 2. Compare and contrast active and passive transport process across biological membranes. 3. Describe the mechanisms involved in movement of water and solutes across biological membranes. 4. Define osmolality and tonicity and the relevance of these concepts to cellular environments. 5. Briefly describe the clinical applications of isotonic, hypotonic and hypertonic solutions. 6. Describe the various body fluid compartments and their ionic composition (intracellular, extracellular – interstitial/plasma) 7. Describe the processes by which material is transported in and out of the cell. 8. Describe the general principles of drug action, including pharmacodynamics and pharmacokinetics. 9. Briefly explain how endogenous transport mechanisms facilitate drug action and how these affect the pharmacokinetic parameters of drugs. 10. Explain how proteins are targeted to different cellular locations. 11. Discuss post-translational modifications and their role in protein function and targeting. **<u>Theme 2: Cellular communication</u>** 12. Describe paracrine, autocrine and endocrine signalling and provide examples. 13. Describe the different types of receptor classes (ligand-gated, G-protein coupled, kinase and nuclear receptors) and their functions.

14. Discuss major signalling pathways such as G-protein coupled receptor signalling, enzyme coupled receptors and cytokine signaling.
15. Explain how drugs have been designed to affect molecular targets, including receptors.
16. Define the terms agonist, antagonist, efficacy, potency and affinity, and understand their significance in pharmacodynamics.
17. Discuss the communication amongst neuronal cells.

Theme 3: Cellular movements

18. Describe the structure and function of the extracellular matrix of eukaryotic cells.
19. Describe the components of the cytoskeleton and their functions.
20. Describe the role and impact of cytoskeletal reorganization in cell migration.
21. Describe the different types of intercellular junctions and their function.
22. Describe the structure and function of muscle fibres and how actin and myosin filaments interact to produce muscle contraction.
23. Discuss the neuromuscular junction and its role in muscle contraction.
24. Explain how Newton's laws of motion and forces affect movement in the human body.
25. Define inflammation and name its main characteristics.
26. Discuss the mechanisms by which immune cells migrate to sites of infection or inflammation.
27. Describe the differences between acute and chronic inflammatory responses (in terms of cells recruited and effector functions).

Theme 4: An introduction to embryology and cellular differentiation

28. Describe the processes of gamete formation in humans.
29. Discuss the first week of development; the ovarian cycle, cleavage and blastocyst formation.
30. Discuss examples of birth defects that can arise during the first week of development.
31. Describe the key events and changes that take place during the second week of gestation.
32. Describe the differentiation and roles of the embryoblast and trophoblast in early development.
33. Discuss what abnormal implantation and ectopic pregnancy are and their implications.
34. Explain gastrulation and vasculogenesis and their importance in embryonic development.

35. Outline the formation of the notochord and the establishment of axes and their significance.
36. Briefly discuss developmental disruptions associated with laterality.
37. Discuss the advantages and disadvantages of the use of animal models, such as zebrafish embryos, in medical sciences.
38. List the cellular components of the immune cell and their basic functions.
39. Outline the development of immune cells from haematopoietic stem cells in the bone marrow.

Theme 5: Epithelial tissue

40. Describe the characteristics and functions of epithelial tissues and the various types (apical, lateral, basal).
41. Describe the histological and anatomical features of the integumentary components.
42. Describe the organization and components of the skin and the different types of skin cells.
43. Describe the protective and immune functions of the skin and mucous membranes acting as the first lines of immune defence.
44. Describe the role of the skin in sensory perception.

Theme 6: Connective tissue

45. Describe the classification of connective tissue and the major histological characteristics of the different types.
46. Briefly describe the characteristics and functions of special connective tissue.
47. Discuss how the extracellular matrix contributes to structural and functional properties of connective tissue.

Theme 7: Muscle tissue

48. Describe and contrast the structure and function of smooth, skeletal and cardiac muscle.
49. Describe the principles of muscle excitation and contraction (the E-C coupling) and the sliding filament theory
50. Describe the cellular structure and histological features of skeletal, smooth and cardiac muscle.
51. Discuss the repair and regenerative abilities of skeletal, smooth and cardiac muscle.
52. Discuss the types of muscle fibres and explain how physiological adaptation occurs depending on the different types of external stimulation (e.g. during exercise)
53. Discuss motion and statics of the body and how kinematics, dynamics and energetics are relevant to human motion.

Theme 8: Nervous tissue

54. Describe the structure and function of neurons and glial cells.
55. Briefly describe embryological formation of the spinal cords.
56. Discuss basic physical principles applied to neuronal cells and their communication.
57. Explain electrical signalling of the body and how it can regulate cardiac function.
58. Analyse the signals seen in an electrocardiogram (ECG) with a focus on understanding the underlying physics of electrical conduction in the heart.
59. Explain the resting and action potential by ion channels and concentration gradients.
60. Explain the mechanisms of nerve signal transmission.
61. Discuss the function of synapses and how they facilitate communication between neurons.
62. Describe the organization and structure (pre- and post-synaptic neurons) of the peripheral nervous system, its functions, receptors and neurotransmitters involved.
63. Explain how drugs have been designed to target the peripheral and cental nervous system.
64. Briefly outline the structural arrangement and functional regions of the central, autonomic and peripheral nervous systems.
65. Briefly explore the role of the nervous and endocrine systems and how they can control organ activities.

Theme 9: Organs of the body and an introduction to systems of the body.

66. Recognize and locate the major organs of the human body
67. Outline the anatomical positions and relationships between major organs.
68. Explain the primary functions of each organ.
69. Discuss the concept of organ systems; for each of the body systems identified, outline its principal role(s) and outline the type of problems that might result when a serious malfunction occurs with each of these body systems.

Theme 10. Introduction to the immune system

70. Define and give characteristics of active and passive immunity.
71. Compare and contrast innate and adaptive immunity, including their fundamental roles in the immune response, with specifications on humoral and cell-mediated immunity.
72. Indicate the main differences between a primary and a secondary immune response in what these responses entail and their timelines.
73. Describe the stages in lymphoid cell maturation from stem cells to maturity and describe the specific membrane markers for each stage.

74. Name the primary and secondary lymphoid organs and differentiate between their roles.
75. Describe normal lymph node morphology and discuss the function of its various compartments and constituent cells.
76. Describe the cellular components of the innate and adaptive immune system including macrophages, granulocytes, NK cells, T cells, B cells, and dendritic cells, alongside their specific functions.
77. Define naive, effector and memory lymphocytes.
78. Outline the first lines of immune defence, barriers and initial responses that prevent pathogen entry.
79. Describe the main killing mechanisms employed by immune cells during phagocytosis.
80. Define inflammation and name its main characteristics, as well as the roles macrophages, neutrophils, and dendritic cells play during this response.
81. Describe the mechanisms of how leukocytes enter tissues during inflammation.
82. Define cytokines, modes of action and specific roles of IL-1, IL-6, TNF and Interferons in the immune response.
83. Name the main pattern recognition receptor families and their significance in immunity.
84. Briefly describe the three different pathways of complement activation and effector functions.
85. Outline the role of regulatory proteins in the complement system (properdin, C1INH, DAF, factor I, CD59).
86. Explain the generation of disease through immune deregulation, providing specific examples.

Theme 11: History of Medicine and Medical Practice

87. Outline the major milestones in the development of medical knowledge from ancient practices to modern advancements.
88. Discuss the evolution of medical practices from traditional remedies to evidence-based practices.
89. Discuss the social, cultural and scientific contexts that shaped the history of medicine.
90. Recognize the contributions of various scientific disciplines to medical advancements.
91. Discuss the impact of future innovations and technology in healthcare.

Climate change and health

92. Define the concept of ‘climate change’.

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<tr><td></td><td colspan="3">93. Explore the foundations of and intersections between climate change, public health, One Health, and Planetary Health.
94. Describe the key indicators and impacts of climate change on global weather patterns and ecosystems.</td></tr>
<tr><td>Prerequisites</td><td>Molecules, Cells, Tissues and Organs I</td><td>Required</td><td>None</td></tr>
<tr><td>Course content</td><td colspan="3">Themes:
1. Membranes, vesicle and cellular traffic
2. Cellular communication
3. Cellular movements
4. An introduction to embryology and cellular differentiation
5. Epithelial tissue
6. Connective tissue
7. Muscle tissue
8. Nervous tissue
9. Organs of the body and an introduction to systems of the body
10. Introduction to the immune system
11. History of Medicine and Medical Practice</td></tr>
<tr><td>Teaching methodology</td><td colspan="3">Lectures
Tutorials
Flipped learning
Directed self-study
Group Work</td></tr>
<tr><td>Bibliography</td><td colspan="3">Required Textbooks/Reading:
<table>
<tr><th>Authors</th><th>Title</th><th>Edition</th><th>Publisher</th><th>Year</th><th>ISBN</th></tr>
<tr><td>N.A. Campbell, L.A. Urry, M.L. Cain, S.A. Wasserman , P.V. Minorsky, J.B. Reece</td><td>Biology: A Global Approach</td><td>12th Edition</td><td>Pearson</td><td>2020</td><td>9781292341637</td></tr>
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	T.W. Sadler	Langman's Medical Embryology	15th Edition	Wolters Kluwer	2020	9781496399991
	Pawlina, Wojciech; Ross, Michael H.	Histology: A Text and Atlas with Correlated Cell and Molecular Biology	9th Edition	Wolters Kluwer	2018	9781496347906
	John E. Hall, Michael E. Hall Guyton and Hall	Textbook of Medical Physiology	14th Edition	Elsevier	2021	9780323597128

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter	Molecular Biology of the Cell	7th Edition	Norton & Company	2022	9780393884852
Ronald W. Dudek	BRS Embryology	6th Edition	Lippincott Williams & Wilkins	2016	9781496309359
Geraldine O'Dowd, Sarah Bell, Sylvia Wright	Wheater's Functional Histology: A Text and Colour Atlas	7th Edition	Elsevier	2014	9780702045975

Assessment	• Midterm exam (30%) • Final exam (50%) • Coursework (10%)
Language	English