<table>
<tr><td>Course title</td><td colspan="5">Development, Tissues and Organs</td></tr>
<tr><td>Course code</td><td colspan="5">GEMD-102</td></tr>
<tr><td>Course type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 1, Semester 1</td></tr>
<tr><td>Teacher’s name</td><td colspan="5">Annita Achilleos</td></tr>
<tr><td rowspan="3">ECTS</td><td rowspan="3">13</td><td colspan="4">Teaching Periods per Week</td></tr>
<tr><td>Large Group Learning</td><td>Small Group Learning</td><td>Laboratories & Skills</td><td>Clinical Practice</td></tr>
<tr><td>8</td><td>6</td><td>2</td><td>4</td></tr>
<tr><td>Course purpose and objectives</td><td colspan="5">The aim of the course is to enable the students to develop an in-depth and well-rounded understanding of the events that underlie the conception and development of the embryo and how disturbance can lead to disease, as well as a detailed understanding of how differentiated cells are equipped to support the function of specific tissues.
Overall, the student will, by the end of the course, be able to:
• Describe the process of gamete formation and correlate meiotic events with chromosomal abnormalities in the embryo
• Outline events during the first week of embryonic development and discuss related clinical applications
• Explain the key events that underlie the conversion of the early embryo into a recognisable foetus
• Describe extraembryonic development and discuss clinical applications and correlates
• Apply the following outcomes to the cardiovascular, respiratory, digestive, genitourinary, nervous and musculoskeletal systems:
o Briefly outline the relevant developmental events and correlate with the anatomical topography of the system
o Illustrate how disturbance in embryonic development causes congenital anomalies
o Outline the role of environmental and genetic factors in congenital anomalies in the different systems and illustrate with examples
o Describe the different tissue types correlating specific cellular morphology/ histology to the functional requirements of the organ system</td></tr>
<tr><td>Learning outcomes</td><td colspan="5">At the end of the course the student will be able to:

Knowledge</td></tr>
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	1. Describe meiotic division and compare and contrast with mitosis 2. Explain how meiotic division contributes to genetic diversity 3. Explain non-disjunction in meiosis and the clinical implications 4. Outline meiosis in the presence of chromosomal translocations and explain the clinical implications 5. Compare and contrast gametogenesis in the male and female 6. Describe fertilization and outline the main events in embryonic development before implantation of the embryo 7. Outline key early events in cell fate specification in the developing embryo 8. Discuss clinical applications of extracorporeal embryonic development 9. Discuss preimplantation genetic testing/ diagnosis and outline the main techniques currently used 10. Outline the process of implantation of the embryo 11. Outline the events of the second week of embryonic development including the formation of the bilaminar germ disc 12. Outline gastrulation and the formation of the definitive germ layers and list their derivatives 13. Discuss how embryonic folding is a key event in the developing morphology of the embryo and consider the emergence of embryonic axes (dorsoventral and anteroposterior) 14. Discuss the formation and evolution of the different cavities (e.g. chorionic, amniotic) during the development of the embryo and foetus 15. Outline key events in the development of the placenta 16. Explain the basis of chorionic villous sampling and amniocentesis in the context of prenatal diagnosis 17. Define the terms malformation, deformation, disruption, sequence and association and use these terms appropriately when describing congenital anomalies 18. List the common types of congenital anomalies and their incidence 19. Explain, with examples in specific systems, the consequences of failure of certain embryonic structures to regress 20. Define teratogens, explain their mode of action with examples and relate the action of key teratogens with specific malformations in the various organs 21. Demonstrate, with examples in the different systems, the link between genetic conditions and congenital malformations and identify disturbance of normal molecular regulation where relevant 22. Relate key events such as the development of the cardiac tube, looping and septation to the formation of the heart chambers and outflow tract and the configuration of the adult heart 23. Provide a brief outline of the development of the vasculature 24. Outline foetal circulation and describe the adaptations taking place at birth 25. Explain how disturbed development leads to septal, outflow tract and valvular defects and discuss their functional implications

	26. Define the three layers of the cardiac wall and corresponding vascular layers and correlate the structure of cardiomyocytes and cells of the conducting system with cardiac function 27. Outline the development of the respiratory system focusing on tracheo-bronchial development, branching morphogenesis and alveolar maturation 28. Describe tracheo-oesophageal and lung malformations and correlate with disturbance in development 29. Describe the histology of the airways and alveoli putting emphasis on relating structure with function 30. Discuss the role of surfactant-producing cells and consider clinical correlates 31. Explain how embryonic folding leads to the formation of the primitive gut tube and how foregut, midgut and hindgut are defined 32. Outline the development of the liver, gallbladder and pancreas as derivatives of the primitive gut tube 33. Relate physiological herniation and intestinal rotation to the adult configuration of the intestines 34. Give a brief outline of the development of gastrointestinal function during pregnancy 35. Describe the process of establishing the gut microbiome from birth to adulthood and its importance. 36. Describe the significance of the enteric nervous system (also referred to as the second brain) – the brain-gut connection 37. Describe the basis of the main congenital gastrointestinal anomalies including defects of the body wall, abnormal rotation, hepatic and pancreatic malformations, hindgut defects, and defects of the enteric nervous system. 38. Define the four layers of the gastrointestinal tract and outline their function 39. Relate the types of epithelium and the cellular characteristics of epithelial cells in the different parts of the gastrointestinal tract with function and discuss clinical correlates 40. Describe the histological structure of the liver focusing on the hepatic lobule and relate cellular morphology to hepatic function 41. Describe the histology of the exocrine and endocrine pancreas and relate cellular characteristics to pancreatic function 42. Outline the development of the urinary system including the pronephros, mesonephros and metanephros with emphasis on the interaction between the developing kidney and collecting system 43. Discuss the development of renal function of the foetus during pregnancy 44. Describe the main malformations of renal development with relevant molecular correlates and defects of bladder development 45. Outline the histology of the kidney and urinary system and correlate renal function with the structure of the nephron and the collecting ducts 46. Outline the process of gonadal differentiation and development of the gonads

	47. Describe the development of the genital ducts and external genitalia in both male and female 48. Describe the main defects in the development of the uterus, vagina and male genitalia 49. Describe the histology of the ovaries and testes and correlate the cell types with gametogenesis 50. Describe the histology of the fallopian tubes, uterus and vagina considering functional correlates and explain how the cellular structure of the uterus changes in a cyclical fashion in preparation for embryo implantation 51. Discuss clinical correlates of cervical histology 52. Outline the development of the pharyngeal arches and their derivatives and discuss the implications of disturbed development 53. Briefly outline the process of neurulation and correlate disturbance with the main types of neural tube defects 54. Consider the mechanism of neural tube defect prevention using folic acid supplementation 55. Explain the origin of the neural crest and its contribution to embryonic development 56. Discuss the consequences of disturbance of the molecular regulation of neural crest development 57. Briefly outline events that follow closure of the neural tube including the formation of the three primary brain vesicles (forebrain, midbrain and hindbrain) and the spinal cord and relate the development of secondary brain vesicles with structures of the adult brain 58. Describe the different cell types in the central nervous system and understand the basic organisation of the spinal cord, cerebrum and cerebellum, correlating with function 59. Describe the structure of nerves of the peripheral nervous system (including spinal nerves) and relate to function 60. Discuss the process of myelination, its significance for function and provide examples of disturbance of this process 61. List developmental anomalies of the central nervous system other than neural tube defects and broadly relate to disturbance of normal development and molecular dysregulation 62. Briefly outline the process of somitogenesis and the developmental roles of the sclerotome, myotome, dermatome and syndetome 63. Outline the key events underlying the development of the axial and appendicular skeleton and contrast the process of endochondral and intramembranous ossification 64. Explain the correlation between spinal nerves and the vertebral column as well as the segmental nature of innervation of muscle groups and the skin 65. Discuss clinical correlates of the segmental innervation of dermatomes and myotomes

	66. Discuss the developmental and molecular basis of skeletal dysplasias and apply these principles to achondroplasia 67. Describe the histology of bone, cartilage and tendons and relate to function 68. Describe the histology of peripheral muscle and relate to function 69. Describe the histological components of the skin and relate to function ***Skills*** 70. Identify main histological components of different tissues on sections/ illustrations 71. Interpret basic QFPCR peak patterns in prenatal diagnosis 72. Describe the categorization of drugs in terms of their potential use in pregnancy 73. Identify congenital malformations depicted in images/ illustrations ***Professional competencies*** 74. Discuss ethical considerations relating to the manipulation of pre-implantation embryos 75. Consider the roles of different health professionals and scientists in assisted reproductive techniques and pre-implantation genetic testing 76. Discuss the significance of basic research involving animal models in medicine 77. Discuss rare/orphan congenital diseases and comment on the lack of research funding and interest by pharmaceutical companies 78. Discuss the rationale of the use of drugs in pregnancy considering both maternal and foetal safety 79. Discuss the global burden of congenital anomalies and contrast with other causes of neonatal morbidity and mortality around the world 80. Discuss the folic acid paradigm in the context of a global strategy for the prevention of congenital malformations		
Prerequisites	None	**Required**	None
Course content	• Meiosis, gametogenesis and unbalanced gametes • Preimplantation biology • Key events of general embryology • Extraembryonic development • System-specific embryology and congenital anomalies • Teratogenesis • Structure of differentiated cells and functional correlates		
Teaching methodology	Lectures – normally two face-to-face, three on-line p/week Tutorials – two case-based learning small group sessions, two expert-led class discussions/debates		

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<tr><td></td><td>Flipped classroom activities

Community and/or hospital and/or laboratory visits each week, relating to the case of the week

Student centred learning/self-study</td></tr>
<tr><td>Bibliography</td><td>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>T.W. Sadler</td><td>Langman’s Medical Embryology</td><td>14th</td><td>Wolters Kluwer</td><td>2019</td><td>978-1496383907</td></tr>
<tr><td>Wojciech Pawlina</td><td>Histology: A text and atlas</td><td>8th</td><td>Lippincott Williams and Wilkins</td><td>2018</td><td>9781496383426</td></tr>
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Recommended 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>Schoenwolf, Bleyl, Brauer and Francis-West</td><td>Larsen’s Human Embryology</td><td>6th</td><td>Elsevier</td><td>2020</td><td>9780323696043</td></tr>
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<tr><td>Assessment</td><td>The course will be assessed at the end of Semester 1 with a Summative Final Examination consisting of Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).</td></tr>
<tr><td>Language</td><td>English</td></tr>
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