<table>
<tr><td>Course title</td><td colspan="5">Structure and function of the human body IV</td></tr>
<tr><td>Course code</td><td colspan="5">MD-205</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 2 / Semester 4 (Spring)</td></tr>
<tr><td>Teacher’s name</td><td colspan="5">Sridevi Parvathareddy</td></tr>
<tr><td rowspan="2">ECTS</td><td rowspan="2">11</td><td>Large Group Learning
per Week</td><td>Tutorials
per Week</td><td>Small group work
per Week</td><td>Laboratories
per Week
**Includes basic sciences laboratories and anatomy practicals</td></tr>
<tr><td>10</td><td>4</td><td>4</td><td>2</td></tr>
<tr><td>Course purpose and objectives</td><td colspan="5">Reproduction and Development
1. Describe the development of male and female reproductive organs, including the descent of testes and the role of masculinizing determinants in differentiation.
2. Identify and explain the major structural features of male reproductive organs, including their blood supply, lymphatic drainage, and innervation, and detail their functions in erection and ejaculation.
3. Describe the histology of the testes and ovaries, discussing their roles in spermatogenesis, oogenesis, and hormone production, along with the control of these processes by pituitary hormones.
4. Explain the male and female sexual response cycles, including arousal, orgasm, and resolution, highlighting physiological changes.
5. Describe female reproductive organs and their relationships with surrounding structures, detailing their blood supply, lymphatic drainage, and innervation.
6. Compare and contrast the development of secondary sex characteristics in males and females, along with the physiological changes during puberty.
7. Describe the anatomy of the hypothalamus and pituitary gland and their roles in sexual maturation during puberty.
8. Explain the physiological processes of the menstrual cycle from menarche to menopause and their effects on other body systems.
9. Describe the processes of ovulation, fertilization, and early embryonic development, including blastocyst implantation and the role of trophoblastic enzymes.
10. Discuss the role of the placenta in hormone production and the exchange of substances between maternal and fetal circulations, along with maternal physiological changes from early pregnancy to parturition.</td></tr>
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11. Outline the physiological changes occurring in the infant upon first breath and adaptations to extrauterine life.
12. Define physiological parameters in neonates and describe regulatory pathways for growth in children, emphasizing the hypothalamus and pituitary gland.
13. Identify mechanisms of ossification and bone growth and describe key developmental milestones up to the age of five, with discussions on assessing these milestones.

Endocrine system

14. Explain the differences between the endocrine and exocrine systems and describe the three tissue types contributing to the endocrine system: endocrine glands, endocrine organs, and endocrine-related tissues, with examples.
15. Discuss the principal characteristics of endocrine glands, outline the three classes of hormones based on chemical structure, and explain the mechanisms of action of hormones and their receptors.
16. Define the term "tropic hormone" and provide an example; describe the mechanisms and regulation of hormone secretion, including negative and positive feedback and feed-forward control.
17. Understand the significance of various patterns of hormone secretion, such as pulsatile, circadian, and menstrual cycles.
18. Identify the body's major endocrine glands, including their anatomical locations and structures, specifically detailing the hypothalamus and pituitary gland along with their functions and histological features.
19. Describe the hypothalamic-pituitary axis and outline the synthesis, regulation, and effects of key hormones associated with it.
20. Discuss the gross anatomy of the thyroid and parathyroid glands, their histological features, and relate their structures to their functions.
21. Explain the biosynthesis and regulatory mechanisms of thyroid hormones and parathyroid hormone (PTH), focusing on their roles in calcium and phosphate regulation.
22. Describe the anatomy and major histological features of the adrenal gland, including the cortex and medulla, and outline the hormones secreted by the adrenal cortex and medulla, their synthesis, and regulation.
23. Discuss the roles of various adrenal hormones in blood pressure regulation, homeostasis, and physiological stress responses.
24. Describe the gross anatomy and histology of the endocrine pancreas, including hormone synthesis and regulation of insulin and glucagon.
25. Outline the gross anatomy of the ovaries and testes and discuss hormone synthesis and regulation within these reproductive glands.
26. Understand the principles of radioactive decay and radiation physics applied to endocrine imaging techniques.

	27. Explain how nuclear medicine scans and PET scans are utilized to visualize endocrine gland function, hormone production, and to detect abnormalities in endocrine organs. **Immune System** 28. Identify and differentiate the structures and functionalities of antibodies, B cell receptors (BCR), T cell receptors (TCR), and major histocompatibility complex (MHC) molecules. 29. Explain the principles and diagnostic uses of techniques such as flow cytometry and ELISA. 30. Describe the pathways of antigen processing and presentation, including endogenous, exogenous, and cross-presentation mechanisms. 31. Summarize the genetic organization and mechanisms responsible for the diversity of BCRs and TCRs, including allelic exclusion and the role of RAG1/2 and TdT. 32. Describe the stages of B cell development and the differences between T cell-dependent and T-independent responses. 33. Outline key processes in T cell development, activation, and the role of costimulatory signals. 34. Discuss the clinical implications of manipulating immune components such as TRECs, Treg cells, and CTLA-4. 35. Define and characterize the various T-helper cell subsets and their roles within the immune response. 36. Assess how digital technologies influence the diagnosis and monitoring of the immune system and other body systems.
Learning outcomes	**Reproduction and Development** **<u>Theme 1: The development of the reproductive system in males and females</u>** 1. Describe the development of the male reproductive organs including the descent of the testes from the posterior abdominal wall into the scrotum. 2. Describe the development of the female reproductive organs. 3. Discuss how differentiation along male or female lines depends on the presence or absence of masculinising determinants. **<u>Theme 2: The male reproductive system</u>** 4. Describe and identify the major structural features of the male reproductive organs including the blood supply, lymphatic drainage, and innervation: testes, epididymis, vas deferens, seminal vesicles, prostate gland, bulbourethral glands (Cowper's glands), penis, urethra 5. Explain how these organs function in the process of erection and ejaculation. 6. Describe the histology of the testes and explain its functional relationship to spermatogenesis and hormone production.

7. Describe the process of gametogenesis and discuss the importance of meiosis in reproduction.
8. Describe the control of testosterone production and spermatogenesis by the pituitary hormones.
9. Explain the male sexual response model of arousal, orgasm, and resolution.

Theme 3: The female reproductive system

10. Describe and identify the female reproductive organs including their blood supply, lymphatic drainage, and innervation: ovaries, fallopian tubes, uterus, cervix, vagina, external genitalia (vulva)
11. Describe the relationship of the female reproductive organs to the rectum, bladder, and urethra.
12. Describe the histology of the ovary and explain its functional relationship to oogenesis and hormone production.
13. Explain the female sexual response cycle of arousal, orgasm, and resolution.
14. Describe the anatomy and histology of the breast, including the blood supply and lymphatic drainage.
15. Describe the physiology of lactation and discuss the importance of breastfeeding.

Theme 4: Puberty and beyond

16. Describe the development of the male secondary sex characteristics.
17. Describe the development of the female secondary sex characteristics.
18. Compare and contrast the events of puberty in males and females, including the hormonal events and the structural changes associated with them.
19. Describe the anatomy of the hypothalamus and pituitary gland and explain their role in sexual maturation in males and females during puberty.
20. Explain the physiology of the menstrual cycle from menarche to menopause and discuss the effects on other body systems.

Theme 5: Conception and pregnancy

21. Describe the process of ovulation, fertilisation, and the early development of the embryo.
22. Describe the process of blastocyst implantation and explain the role of trophoblastic enzymes.
23. Explain the role of the placenta in hormone production and in exchanges between the maternal and foetal circulation.
24. Describe the maternal physiological changes from early pregnancy to parturition.
25. Describe the sexual attitudes and behaviours prevalent nowadays among young people.

	26. Outline the main socio-cultural and economic explanations for teenage pregnancy. 27. Discuss the important social concerns that arise with teenage pregnancies at individual and societal levels. *Psychology* 28. Describe the biological mechanisms underlying sexual differentiation and reproductive behaviour. 29. Explain the impact of hormones on sex-specific behaviours. 30. Identify and discuss genetic disorders related to reproductive development and behaviour. 31. Examine the neuropsychological basis of maternal behaviour. *Medical Ethics* 32. Outline ethical and legal considerations for counselling and treatment of minors, with respect to consent, confidentiality and determination of best interests 33. Describe and practise the guidelines for adolescent patients' sexual and reproductive health care. 34. Identify challenges in ethical treatment of transgender children and adolescents. **Theme 6: The neonate** 35. Outline the physiological changes that occur in the infant at first breath. 36. Discuss the neonatal adaptations to extrauterine life. 37. Define the physiological parameters in the neonate. *Medical Ethics* 38. Outline key ethical and legal issues in neonatology 39. Describe challenges for clinical practice with reference to the concept of futility and the distinction between treatment and care of premature neonates **Theme 7: Early child development** 40. Outline the pathways that regulate growth in children and discuss the structure and role of the hypothalamus and pituitary gland in these processes. 41. Identify the mechanisms of ossification and bone growth. 42. Describe the key developmental milestones up to the age of five. 43. Discuss how these milestones can be assessed. **Endocrine system** **Theme 1: Introduction to the Endocrine System** 44. Explain the difference between endocrine and exocrine systems.

45. Explain the difference between the three different tissue types that contribute to the endocrine system: endocrine glands, endocrine organs, and endocrine-related tissues and provide examples of the three different tissue types.
46. Explain the principal characteristics/attributes of an endocrine gland.
47. Based on chemical structure, outline the three classes of hormones secreted by the endocrine system.
48. Explain the mechanism of action of hormones and of hormone receptors.
49. Explain what is meant by the term 'tropic hormone' and give an example.
50. Describe the general mechanism and regulation of hormone secretion, including the principle of negative and positive feedback and feed-forward control.
51. Explain the importance of patterns of hormone secretion – e.g., pulsatile, circadian (diurnal), menstrual.
52. List the body's major endocrine glands and briefly outline their anatomical location, structure.
53. Briefly outline the function of the body's major endocrine glands.

Climate and Health

54. Identify environmental exposure pathways through which climate change impacts human health, such as natural disasters, air quality, changes in water quality and quantity, food security and safety, heat stress, and vector-borne diseases
55. Evaluate how climate change may interact with other environmental changes, such as land degradation and biodiversity shifts, to affect health

Theme 2: Hypothalamus and Pituitary Gland

56. Describe the anatomical location, structure, and function of the hypothalamus.
57. Describe the anatomical location, structure and major histologic features of the pituitary gland, including the distinction between the 'anterior' and 'posterior' pituitary.
58. Describe the function of the hypothalamus and its role in the regulation of the endocrine system.
59. Describe the hormones secreted by the pituitary gland and their principal actions.
60. Describe the "hypothalamic-pituitary axis" and briefly outline the synthesis, regulation, storage, secretion, transport, target, mechanism of action, and effect of the key hormones associated with it.

Theme 3: Thyroid and Parathyroid Glands

61. Describe the gross anatomy of the thyroid gland and its major histologic features.

62. Describe the gross anatomy of the parathyroid glands, their major histologic features, and differentiate between principal and oxyphil cells.
63. Relate the histological structure of the thyroid gland to its function.
64. Briefly describe thyroid hormone synthesis, storage, secretion, mechanism of action, and regulation/feedback control.
65. Briefly describe parathyroid hormone (PTH) synthesis, storage, secretion, mechanism of action, and regulation/feedback control mechanisms, including the role of PTH in calcium and phosphate regulation.

Research Methods and Statistics

66. Explain how interviews are useful for explaining the experiences of people with diabetes

Theme 4: Adrenal Glands

67. Describe the gross anatomy of the adrenal gland, cortex, and medulla, including the major histologic features.
68. Briefly describe the hormones secreted by the adrenal cortex (mineralocorticoids, glucocorticoids, sex hormones) and their synthesis, storage, secretion, mechanism of action, and regulation/feedback control mechanisms.
69. Explain the roles of mineralocorticoids in blood pressure regulation, glucocorticoids in homeostatic functions, and sex hormones in male and female adrenarche.
70. Describe the hormones secreted by the adrenal medulla and briefly describe their synthesis, storage, secretion, mechanism of action, and regulation/feedback control mechanisms. Outline the role of the adrenal medulla in the body's response to physiological stress.

Theme 5: Endocrine Pancreas

71. Describe the gross anatomy of the endocrine pancreas and the histology of the pancreatic islets.
72. Briefly describe pancreatic hormone synthesis, storage, secretion, mechanism of action, and regulation/feedback control mechanisms.

Sociology

73. Discuss the social determinants of diabetes.
74. Describe the link between social exclusion and diabetes.
75. Explain how interviews are useful for understanding the experiences of patients with diabetes.

Medical Ethics

76. Address ethical considerations in the care of patients with diabetes and obesity
77. Describe key ethical implications of health promotion campaigns targeting obesity

78. Describe components of ethic al practice with (and effective counselling of) overweight or obese patients

Theme 6: Imaging Techniques in Endocrinology

79. Understand the principles of radioactive decay and radiation physics as applied to imaging techniques in the endocrine system.
80. Explain how nuclear medicine scans (e.g., thyroid scans with radioactive iodine) are used to visualize gland function, hormone production, and detect abnormalities in endocrine organs, such as thyroid nodules and tumors.
81. Describe the application of Positron Emission Tomography (PET) scans in studying endocrine glands by tracing metabolic processes using radiolabeled hormones or glucose.

Immune System

Theme 1: Antibody and BCR structure

82. Describe the structure of the antibody and differences between monoclonal and polyclonal serum, as well as effector functions of the five classes of antibodies.
83. Describe the basic concept of flow cytometry and ELISA and diagnostic applications.

Theme 2: TCR and MHC structure and antigen processing and presentation

84. Describe T cell receptor structure and outline the main differences between T cell and B cell receptors.
85. Describe the cellular distribution and structure of MHC class I and II molecules and discriminate MHC recognition by CD4 and CD8 T cells.
86. Outline the endogenous and exogenous pathways of antigen processing and presentation and cross presentation.
87. Explain the mode of inheritance of MHC, the variation MHC variation in a population and its significance.

Theme 3: BCR and TCR expression and diversity

88. Briefly outline the germline organization BCR and TCR genes, the role of RAG1/2 and terminal deoxy-nucleotidyl transferase (TdT) and allelic exclusion.
89. Outline the mechanisms involved in the generation of diversity of the immunoglobulin receptors and T cell receptors.
90. Describe TRECs (T cell receptor excision circles) and their clinical application.

Theme 4: B Cell Development and Activation

	91. Describe the major developmental stages of B cell development including mechanisms of central tolerance. 92. Compare and contrast T cell-dependent and T-independent B cell response. 93. Describe T-dependent B cell activation in a primary focus and in germinal centres. 94. Describe somatic hypermutation and how it leads to affinity maturation and antibody class switch recombination. 95. Define naive and memory B cells and briefly outline the characteristics of a secondary immune response. 96. Describe the characteristics of TI-1 and TI-2 antigens and the B cell response induced by each one of them. 97. Explain the ethical principles and cultural competencies for working with diverse patients, in terms of age and socioeconomic background. (Cultural Competence integrated with Medical Ethics). 98. Discuss and practise the ethical principles and cultural competencies for working with diverse patients, such as age and socioeconomic background. (Cultural Competence integrated with Medical Ethics). *Digital Healthcare* 99. Understand the impact of digital-technology measurements and analysis on diagnosing and monitoring of body systems **<u>Theme 5: T Cell Development and Activation</u>** 100. Describe the major events in T cell development and the site where they occur in the thymus as well as the role of the selection events. 101. Compare and contrast B and T cell development. 102. Describe the functions of Treg cells and explain clinical applications of their manipulation. 103. Describe the signals required for T cell activation. 104. Compare and contrast the role of positive (CD28) and negative (CTLA-4) costimulatory signals in T cell activation. 105. State the clinical applications of manipulation of CTLA-4. 106. Define clonal anergy. 107. Name the different T-helper cell subsets and defining characteristics. 108. Explain the ethical principles and cultural competencies for working with diverse patients, in terms of age and socioeconomic background. (Cultural Competence integrated with Medical Ethics). 109. Discuss and practise the ethical principles and cultural competencies for working with diverse patients, such as age and socioeconomic background. (Cultural Competence integrated with Medical Ethics).

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<tr><td></td><td colspan="3">Stream: Digital Healthcare
110. Understand the impact of digital-technology measurements and analysis on diagnosing and monitoring of body systems (reprductive, endocrine)</td></tr>
<tr><td>Prerequisites</td><td>None</td><td>Required</td><td>None</td></tr>
<tr><td>Course content</td><td colspan="3">Reproduction and Development Themes:
1. The development of the reproductive system in males and females
2. The male reproductive system
3. The female reproductive system
4. Puberty and beyond
5. Conception and pregnancy
6. The neonate
7. Early child development
Endocrine System Themes:
1. Introduction to Endocrine System
2. Hypothalamus and Pituitary Gland
3. Thyroid and Parathyroid Glands
4. Adrenal Glands
5. Endocrine Pancreas
6. Imaging Techniques in Endocrinology
The Immune System Themes:
1. Antibody and BCR structure
2. TCR and MHC structure and antigen processing and presentation
3. BCR and TCR expression and diversity
4. Cell Development and Activation
5. T Cell Development and Activation</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>Arthur F. Dalley,
Anne M. R. Agur</td><td>Moore’s Clinically oriented anatomy</td><td>9th Int’l Edition</td><td>Wolters Kluwer Health</td><td>2024</td><td>9781975209544</td></tr>
<tr><td>Sadler, Thomas</td><td>Langman’s Medical Embryology</td><td>15th Edition</td><td>Wolters Kluwer</td><td>2024</td><td>9781975180010</td></tr>
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	Pawlina, Wojciech	Histology: A Text and Atlas with correlated cell and molecular biology	9th Edition	Wolters Kluwer	2024	9781975181574

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Costanzo, Linda	BRS: Physiology	8th Edition	Wolters Kluwer	2023	9781976963467
Halliday, N.L. & Chung, H. M	BRS Gross Anatomy	10th Edition International	Lippincott Williams & Wilkins	2023	9781975181482

Assessment	• Final exam (80%) • Coursework (20%)
Language	English