UNIVERSITY of NICOSIA

Year 2

Course Title	**Veterinary Reproductive Biology and Genetics**				
Course Code	**VET-201**				
Course Type	Required				
Level	Undergraduate				
Year / Semester	Year 2/ Semester 1 (Fall)				
Teacher's Name	**Course Lead:** Dr. Catalina Cabrera **Contributors:** Dr. Konstantinos Voskarides Dr. Marios Christoforou				
ECTS	6	Lectures / week	4	Tutorials / week	2
Course Purpose and Objectives	The main objectives of the course are: • Develop expertise in male and female reproductive systems, hormonal regulation, and advanced reproductive technologies. • Recognize, diagnose, and ethically manage reproductive disorders in animals. • Acquire a deep understanding of genetic principles, mutation types, and modes of inheritance to promote animal health and breeding programs. • Apply genetic knowledge to optimize breeding strategies, reduce disease risks, and enhance desirable traits in animal populations. • Gain practical skills in reproductive evaluation, genetic diagnostics, and clinical decision-making for animal health and breeding advancement. • To gain knowledge on the use of the main Applied Reproductive Technologies (ART) utilized in domestic animals.				
Learning Outcomes	The following list provides the learning objectives that will be covered in the lectures, lab practical sessions and tutorials of each week: Week 1 **LOBs covered during lectures:** **Male reproductive biology** 1. Describe the development of the male reproductive systems. 2. Discuss the male reproductive tract organs and their function. 3. Describe the descent of the testicle. 4. Analyse the functions of each component of the male reproductive system in the production and transport of sperm.				

5. Describe the differences on the male reproductive system between species of domestic animals.
6. Explain the process of spermatogenesis, including the stages and hormonal regulation involved.
7. Discuss the feedback mechanisms that regulate male hormone production.
8. Discuss the importance of temperature regulation in the testes for spermatogenesis.
9. Understand the process of ejaculation and sperm transport.
10. Discuss the various methods and techniques used for evaluating male reproductive health and fertility in domestic animals.

Week 2

LOBs covered during lectures:

Female reproductive biology

11. Understand the anatomical structures of the female reproductive system, including the ovaries, fallopian tubes, uterus, and vagina.
12. Describe the functions of each component of the female reproductive system in the production and transport of ova (eggs) and support of pregnancy.
13. Explain the process of oogenesis and the formation of ova in the ovaries.
14. Describe the stages of folliculogenesis and the role of hormonal regulation in follicle development.
15. Identify and explain the role of key female reproductive hormones, including estrogen, progesterone, LH (luteinizing hormone), and FSH (follicle-stimulating hormone) and their changes throughout the cycle.
16. Describe the differences on the female reproductive system and cycle between species of domestic animals.
17. Understand the hormonal control of the female reproductive system, cyclicity, fertile period.
18. Note the length of estrous cycle and estrus in various species
19. Discuss the various methods and techniques used for evaluating female reproductive health and fertility in animals, including ultrasound imaging, cytology, and hormonal assays.

Laboratory Practical session:

Reproductive evaluation and Diagnosis. Introduction to breeding soundness evaluation

Week 3

LOBs covered during lectures:

Introduction to Male Reproductive Pathology

20. Define and differentiate between normal reproductive processes and reproductive pathology in male animals.
21. Understand the importance of studying reproductive pathology in veterinary medicine.
22. Identify and categorize the various causes of male reproductive disorders, including genetic, infectious, traumatic, and hormonal factors.

23. Discuss how environmental and nutritional factors can contribute to male reproductive problems.
24. Explain the impact of male reproductive disorders on fertility and overall animal health.
25. Explore the diagnostic methods used to evaluate male reproductive disorders, including physical examination, imaging (e.g., ultrasound, radiography), and laboratory tests (e.g., semen analysis).
26. Discuss the importance of obtaining a detailed reproductive history when diagnosing male reproductive pathology.
27. Learn about the management and treatment options available for male reproductive disorders, including medical, surgical, and supportive care.
28. Understand the ethical considerations and decision-making process involved in the treatment of these disorders.

Tutorial 1: Reproductive clinical cases

Week 4

LOBs covered during lectures:

Introduction to Female Reproductive Pathology

29. Define and differentiate between normal female reproductive processes and female reproductive pathology.
30. Understand the importance of studying female reproductive pathology in veterinary medicine and its impact on animal health.
31. Identify and categorize the various causes of female reproductive disorders, including genetic, infectious, inflammatory, and hormonal factors.
32. Describe the characteristics and clinical signs of common female reproductive disorders, such as ovarian abnormalities (e.g., cysts, tumors), uterine conditions (e.g., pyometra, uterine infections), and mammary gland diseases.
33. Explain the impact of female reproductive disorders on fertility, pregnancy, and overall animal health.
34. Discuss the role of environmental and nutritional factors in the development of female reproductive problems.
35. Explore the diagnostic methods used to evaluate female reproductive disorders, including physical examination, imaging (e.g., ultrasound, radiography), and laboratory tests (e.g., hormone assays, cytology).
36. Discuss the importance of obtaining a detailed reproductive history when diagnosing female reproductive pathology.
37. Learn about the management and treatment options available for female reproductive disorders, including medical, surgical, and reproductive technologies.
38. Understand the ethical considerations and decision-making process involved in the treatment of these disorders.

Farm visit - Practical session 1: Estrous cycle determination, female reproductive evaluation, introduction to the ultrasonography of the reproductive tract

Week 5

LOBs covered during lectures:

Reproductive Technologies in Domestic animals

39. Learn about the management and treatment options available for female reproductive disorders, including medical, surgical, and reproductive technologies.
40. Understand the ethical considerations and decision-making process involved in the treatment of these disorders.
41. Discuss the applications of hormone therapy in synchronizing estrus, inducing ovulation, and managing reproductive disorders.
42. Discuss detection and monitoring of behavioral and physical signs of estrus (heat) in various animal species and methods used to aid on the detection.
43. Describe the methods and protocols for synchronizing estrus in herds or groups of animals using hormonal and non-hormonal methods.
44. Explain the principles and techniques of artificial insemination in different species.
45. Discuss the advantages and limitations of AI in improving reproductive efficiency and genetic selection.
46. Introduce advanced reproductive technologies such as in vitro fertilization (IVF), embryo transfer (ET), and cloning.
47. Discuss the applications, challenges, and ethical considerations associated with these advanced techniques.

Farm visit - Practical session 2: Male reproductive evaluation, sperm evaluation and processing.

Week 6

LOBs covered during lectures:

48. Explain the process of fertilization, including sperm-egg interaction and the formation of a zygote.
49. Describe the events that occur during early embryonic development, from cleavage to blastocyst formation.
50. Discuss the process of implantation and the establishment of the placenta in different species.
51. Understand the various types of placentation (e.g., diffuse, cotyledonary, zonary) and their significance in different domestic animals.
52. Introduce methods for diagnosing pregnancy in domestic animals, including physical examination, ultrasonography, and hormone assays and their limitations.
53. Explore common pregnancy-related disorders and complications in domestic species, such as fetal resorption, mummification, and hydrops.

54. Discuss the impact of maternal nutrition and health on pregnancy outcomes.
55. Compare and contrast the reproductive physiology and pregnancy characteristics in different domestic species (e.g., cattle, horses, dogs, cats, swine).
56. Develop an understanding of the species-specific factors affecting pregnancy management and evaluation.

Farm visit - Practical session 3: Determination of pregnancy and pregnancy length and diagnosis of reproductive statues by ultrasonography.

Week 7

LOBs covered during lectures:

Mutation types

57. Define the terms mutation and polymorphism.
58. Describe the different mutation types.
59. Explain the implications of the different mutation types on the function of the gene product.
60. Describe genotype/phenotype correlation and provide examples.

Modes of inheritance

61. Describe autosomal recessive and autosomal dominant inheritance and provide clinical examples.
62. Outline the role of consanguinity in autosomal recessive disorders.
63. Explain the role of germline mosaicism and de novo mutations.
64. Explain X-linked recessive and dominant inheritance.
65. Describe mitochondrial inheritance and provide relevant examples.

Chromosomes and cytogenetic techniques

66. Describe the fundamental principles of conventional cytogenetics: appearance, structure, and classification of chromosomes.
67. Describe the biological basis of sex
68. Outline the various cytogenetic and molecular cytogenetic methodologies and applications in clinical practice.
69. Describe the significance of syntenies and of DNA sequence conservation.

Single gene disorders

70. Define genotype and phenotype.
71. Define the inborn errors of metabolism giving examples.
72. Define the terms penetrance, expressivity, and genetic heterogeneity, providing examples.
73. Define triple repeat disorders and anticipation.
74. Define sex-limited inheritance and phenocopies.
75. Describe key single-gene disorders in animals.

Week 8

LOBs covered during lectures:

Epigenetics

76. Outline the epigenetic mechanisms.
77. Define genomic imprinting and describe key imprinting disorders.
78. Define X-inactivation and briefly discuss its clinical relevance.

Chromosomal aberrations

79. Describe the numerical and structural chromosomal abnormalities, their inheritance, segregation, and pathogenicity.
80. Outline the clinical features of the common chromosomal disorders including autosomal trisomies, sex chromosome aneuploidies and structural abnormalities.

Cancer

81. Explain cancer as a microevolutionary process.
82. Define oncogenes and describe how they contribute to the development of neoplasia.
83. Explain how the different types of tumour suppressor genes prevent the development of neoplasia.
84. Outline the types of DNA repair genes which, when mutated, lead to cancer predisposition.

Population genetics

85. Explain the Hardy-Weinberg law/equilibrium and outline those factors that may disturb this equilibrium.
86. Describe the use of the Hardy-Weinberg law to estimate the carrier frequency of autosomal recessive disorders.
87. Explain the term mutation-selection equilibrium and describe the use of the Hardy-Weinberg law to estimate the new mutation rate in autosomal dominant disorders.
88. Explain the terms founder effect, genetic drift, and heterozygote advantage.

Week 9

LOBs covered during lectures:

Multifactorial inheritance

89. Describe the multifactorial model of inheritance.
90. Outline the role of genetic factors in the aetiology of key common medical conditions such as diabetes mellitus, congenital heart disease and hip dysplasia.
91. Define heritability and recurrence risks.

Single genes in animals breeding

92. Describe how coat colour is inherited in animals and the role of epistasis.
93. Describe the genetics of the following traits in animals: carpet wool, prolificacy in sheep, polledness, muscular hypertrophy in cattle and sheep, dwarf poultry.
94. Outline the genes for sexing in chickens.

Relationship and Inbreeding

95. Describe the inbreeding coefficient.
96. Describe the general expression for relationship and inbreeding.

97. Describe the base population and inbreeding in populations.
98. Describe inbreeding depression.
99. Describe the hybrid vigour.

Selection within populations

100. Describe estimated breeding values and accuracy of selection.
101. Describe how to predict a candidate's breeding value for a trait.
102. Describe the selection for more than one trait.
103. Describe the importance of inbreeding and genetic drift.
104. Describe sire-reference schemes.
105. Describe marker-assisted selection (MAS) and genome-wide selection (GWS).

Week 10

Tutorial 1: Mendelian genetics - Pedigree analysis
- Solve genetic problems involving pedigree analysis**.**

Tutorial 2: Population genetics
- Calculate allele and genotype frequencies.
- Apply Hardy-Weinberg equilibrium.
- Understand the importance of mutation-selection equilibrium and of selection coefficient.

Week 11

LOBs covered during lectures:

Immunogenetics, pharmacogenetics

106. Outline the genetic characteristics and the clinical significance of the major histocompatibility complex (MHC).
107. Describe the main principles of pharmacogenetics, giving relative examples.

Genetic sequencing

108. Outline the main techniques used in molecular genetic diagnosis including Sanger DNA sequencing, MLPA and Next Generation Sequencing.

Gene cloning and recombinant proteins

109. Describe the basic principles of gene cloning and the production of recombinant proteins.

Genetically engineering/ transgenic and animal cloning

110. Describe methods of genetic alterations in animals.
111. Describe the production of transgenic animals.
112. Describe the use of animal cloning.
113. Describe transgenic animals in genetic improvement.

Week 12

LOBs covered during lectures:

Review sessions

	114. Demonstrate comprehensive understanding of reproductive anatomy and hormonal regulation in males and females. 115. Identify and categorize common reproductive disorders and their treatments. 116. Explain the significance of estrus synchronization and reproductive technologies. 117. Describe fertilization, implantation, pregnancy diagnosis methods, and pregnancy-related complications. 118. Compare reproductive physiology across domestic species and recognize species-specific factors influencing pregnancy management. 119. Demonstrate a clear understanding of key genetic terms, mutation types, and their functional implications. 120. Identify and differentiate between various modes of genetic inheritance, providing clinical examples. 121. Explain the role of epigenetics, chromosomal aberrations, oncogenes, and tumor suppressor genes in genetic diseases and cancer. 122. Apply the Hardy-Weinberg equilibrium to estimate carrier frequencies and mutation rates and discuss population genetics concepts. 123. Summarize multifactorial inheritance, traits in animal breeding, inbreeding concepts, and modern genetic techniques succinctly.		
Prerequisites	None	Required	None
Course Content	**Lecture Topics:** • Developmental anatomy of reproductive organs • Male genital organs • Female genital organs • The reproductive tract in carnivores, pig, ruminant and horse • Spermatogenesis and spermatozoa structure • Estrous cycle • Oocyte development • Fertilization and pregnancy • Embryo maternal recognition • Applied reproductive techniques (ART) • Production of transgenic animals • Population genetics in closed farms and inbreeding control • Single gene traits in selected species • Selection within populations • MAS and GWS selection • Closed vs open nucleus breeding schemes		
Teaching Methodology	Lecture based learning and laboratory practical sessions		
Bibliography	1. Introduction to Veterinary Genetics, 3rd Edition, Frank W. Nicholas 2. Pathways to pregnancy and parturition, 3rd Edition, P.L. Senger 3. Introduction To Veterinary Genetics NICHOLAS 4. Comparative Reproductive Biology SCHATTEN 5. Arthur's Veterinary Reproduction and Obstetrics NOAKES		

Year 2

	6. Canine Reproduction and Neonatology GREER
Assessment	Final examination 60% Coursework. 30% Participation 10%
Language	English