Indoor Environmental Control for Animal Facilities

Description

The scope of the course is to convey the fundamentals of controlling the indoor environment of animal facilities. Psychometrics are used to define the indoor air parameters of interest, energy and mass balance equations describe the interactions between the facility shell, the animal heat losses (i.e., sensible, latent and total) and the indoor environment parameters such as temperature, relative humidity and air velocity. Sensors and automation techniques are analyzed in terms of supporting the control of indoor microenvironment, whereas techniques and technologies for the reduction of GHG resulting from animal facilities are explained.

Learning objectives

Students completing this course will be able to:

- Use energy and mass balance equations to describe the thermal, vapour and CO_2 exchanges between an animal facility and the outdoor environment
- Appreciate the significance of building thermal insulation and thermal mass
- Understand the thermal physiology of animals and their reaction under harsh environmental conditions
- Calculate required ventilation rates for all four seasons and select appropriate systems
- Comprehend the importance of cooling systems and their integration in controlling the indoor environment of an animal facility
- Explain the role of integrated Advanced Sensor/Actuator/Control Systems for achieving the appropriate indoor environmental conditions of livestock houses.
- Comprehend the main environmental pollutant emissions from livestock buildings and the main mitigation and adaptation techniques and technologies

WEEK	LECTURES
1ST	Psychrometric chart - (Panagakis)
2ND	Energy and mass balance equations for mechanical ventilation systems - (Panagakis)
3RD	Energy and mass balance equations for natural ventilation systems - (Panagakis)
4TH	Thermal functioning of the facility shell - (Panagakis)
5TH	Animal thermoregulation - (Panagakis)
6TH	Heat stress descriptors - (Panagakis)
7TH	Alleviation of heat stress – (Panagakis)
8TH	Advanced Sensors for Automation in Precision Livestock Farming (Arvanitis/Loukatos)
9TH	Advantages and Disadvantages of Automation Techniques in Precision Livestock Farming (Arvanitis/Loukatos)
10TH	Reduction of GHG and ammonia emissions - (Bartzanas)
11TH	Mitigation and adaptation techniques and technologies in view of climate change (Bartzanas)
12TH	Examples & exercises - (Panagakis)
13TH	Examples & exercises – (Arvanitis/ Bartzanas/Loukatos)

Assignments – indicative

1. Assessment of temperature distribution within a facility wall (Panagakis)
2. Evaluation of heat stress risk based on pertaining descriptors (Panagakis)
3. Estimation of ventilation rates throughout a year (Panagakis)
4. Sensors and Actuator Systems Adjustments for Livestock Premises Regulation of Environmental Factors through Advanced Control Techniques (Arvanitis/Loukatos)
5. Estimation of GHG and ammonia emissions in a typical Greek livestock farm (Bartzanas)

Exams, marking and student assessment

Assignments: 70%, Written exam(s): 30%