

Course on **Mathematics of Nutrition and Modeling Anaerobic Fermentation and Fiber Digestion Dynamics**

Dr. David R. (Dave) Mertens, Ph.D.

Dr. Mertens is known nationally and internationally as an expert on the analysis of fiber in feeds, the maximum and minimum fiber requirements by dairy cows, and the mathematical modeling of the intake and digestion of fiber by animals. He refined the neutral detergent fiber method to be an AOAC Int. Official Method, developed the physically effective fiber system, and the corn silage processing scores used to assess kernel fragmentation. He has authored or co-authored over 300 papers in research journals and conference proceedings and five chapters in books on nutrition and forages. He has given invited presentations throughout the U.S. and numerous other countries. Dr. Mertens has received numerous national and local awards for his teaching and research. He grew up on a dairy farm in central Missouri and received his B.S. and M.S. degrees at the University of Missouri-Columbia and his Ph.D. from Cornell University. He taught at Iowa State University and the University of Georgia before becoming a Dairy Research Scientist at the U.S. Dairy Forage Research Center in Madison, WI in 1984. In 2010, he retired from federal service and started Mertens Innovation & Research LLC to continue his research and educational activities.

Modeling Anaerobic Fermentation and Fiber Digestion Dynamics

- Objectives of the Modeling Course - You should be able to:
 - Understand the mathematics of first-order compartmental systems based on Ideal Chemical Reactors
 - Convert biological concepts into an acceptable model structure that represents the concepts
 - Estimate first-order digestion and passage kinetic parameters
 - Develop simple and complex dynamic models of first-order compartmental systems for in vitro and in vivo observations
 - Use Vensim software to create and simulate dynamic models
 - Develop strategies for refining models and deriving new parameters
 - Compare model simulations to empirical data

Courses will be taught February 25-28, 2019 in the Department of Agricultural Sciences, University of Sassari. The courses are open to faculty, graduate students, and technical representatives of nutrition and biogas companies.

Course approach will be hands-on development of models using Vensim software for integration. There will be a list of references to provide background information for describing mathematical, statistical and modelling of ruminant and biogas fermentations. In addition to Dr. Mertens, several faculty members from Italian universities will give lectures on various aspects of mathematics and modeling.

Day	Plan of the lectures
February, Monday 25	<p>9.00-11.00 A.S. Alberto Atzori - Practical pre-course on the utilization of the software Vensim</p> <p>11.00-11.20 Coffe break</p> <p>11.20-11.30 Antonello Cannas - Presentation and introduction of the course</p> <p>11.30-13. D. Mertens - Relationships of mathematics and statistics to nutrition entities</p> <p>13.00-14.30 Lunch</p> <p>14.30-15.30 D. Mertens - Averages, variation, and linear relationships of nutritional entities</p> <p>15.45 Coffe break</p> <p>16.00-17.30 D. Mertens - Complex, nonlinear, logarithmic, exponential and asymptotic relationships</p>
February, Tuesday 26	<p>9.00-11.00 D. Mertens - Calculus, rate of change and nutrition</p> <p>11.00-11.20 Coffe break</p> <p>11.30-13.00 D. Mertens - Dynamics and kinetics of nutrition - Curve Peeling</p> <p>13.00-14.30 Lunch</p> <p>14.30-17.30 A. Cannas – Training on the calculation of degradation and passage rates with the sofware <i>GnG1 Degradation And Passage Rates</i> of L.O. Tedeschi http://nutritionmodels.com/gng1.html</p>
February, Wednesday 27	<p>9.00-11.00 D. Mertens –Systems of dynamic equations</p> <p>11.00-11.20 Coffe break</p> <p>11.30-13.00 D. Mertens - - Analytical and numeric solutions to dynamic systems</p> <p>13.00-14.30 Lunch</p> <p>14.30-15.30 D. Mertens – Exercises</p> <p>15.45 Coffe break</p> <p>16.00-17.30 A. Formigoni Estimation and utilization in modeling of nutritional</p>

	value of feeds of the indigestible NDF
February, Thursday 28	<p>9.00-11.00 D. Mertens – Update on the methodologies and interpretation of in vitro degradation and digestibility values</p> <p>11.00-11.20 Coffe break</p> <p>11.30-13.00 P. Berzaghi –The utilization of NIR fro the prediction of degration rates and digestibility of feeds</p> <p>13.00 End of the course</p> <p>Afternoon: informal meeting of Dave Mertens with students and researcher to discuss their research</p>