

## **COURSE OUTLINE**

### **DEPARTMENT OF ANIMAL SCIENCE**

#### **OBJECTIVES**

The course introduces students to a study of the basic principles of Animal Nutrition. The students will also be exposed to an understanding of the applied aspects of livestock nutrition and practical feeding at the farm level in the different animal production systems. Students are also offered the opportunity to develop practical skills in measuring nutritive value of feeds through digestibility trials, chemical and biochemical assays and in viva and in vitro methodology.

#### **COURSE ORGANIZATION**

Lectures: 52 x 1 hour (Semster 1 and 2)

Practicals: 16 x 6 hours (Semster 1 and 2)

Field Visits: 2 x 6 hours (Semester 2)

Assignments: 4 essays  
4 short answer types  
Seminar/Tutorials

Tests: Individual Lecturers will give short test at the end of the sections they teach.

Term Test: At end of Semester 1

Final exam: 1 x 3 hours (at end of Semester 2)

#### **COURSE ASSESSMENT (GRADING)**

(i) Continuous assessment (30% of Final Grade)

Students will be assessed through semesters 1 and 2 on their performance at the practicals, essays, assignments and term tests.

Weighing of marks for continuous assessment

Essays 10

Practicals 30

Short Answers 20

Term Tests 40

100

Final Grade

Continuous assessment semester 1: 15%

Continuous assessment semester 2: 15%

30%

(ii) Final Examination: 70%

100%

#### **LECTURES**

SEMESTER I: WEEK 1-6

SECTION I: THE ANIMAL AND ITS FOOD (10 LECTURES)

- (i) Classification of Animal Feeds:  
Dry Forage and roughages, pastures, range plants, silages. Energy contributing feeds, protein supplements, mineral and vitamin supplements, feed additives.
- (ii) Composition of feeds:  
Water, dry matter, organic constituents, inorganic constituents.
- (iii) Analysis of feeds:  
Proximate analysis scheme, Van Soest and Moore Systems.
- (iv) Digestion and Absorption of nutrients:  
-in monogastrics and ruminants.
- (v) Voluntary feed intake: WEEK 6: 28/04-2/05/97 (Dr LR. Ndlovu)  
Chemostatic, thermostatic, and Lipostatic theories. Sensory appraisal. Physical and physiology factors.

#### SEMESTER 1 Week 7-8

##### Section II: Digestibility of Feedstuffs (6 lectures)

- (i) - measurement of dry matter, organic matter, NDF digestibilities in viva, in vitro (Tilley and Terry), gas production technique and using enzymatic methods.
  - Validity and limitations of digestibility coefficients,
  - Factors affecting digestibility
  - Indicator method, Nylon bag method, mobile nylon bag technique.
- (ii) Kinetics of digestion and Passage: WEEK 8: 16/5/97:(Dr L.R. Ndlovu)  
Flow rates, rumen evacuation technique, Use of marker to estimate passage rate, Continuous dosing with chromium-mordanted straw.

#### SEMESTER 1: WEEK 9-13:

##### Section III Evaluation of feeds-: ENERGY COMPONENT (10 lectures)

- (i) Bioenergetics and Partitioning of feed energy:  
Demand for Energy, Gross energy (GE), Bomb calorimetry, partitioning of feed energy, Digestible Energy (DE), Metabolisable Energy (ME), Factors affecting ME of feeds, Heat Increment (HI), Energy retention.
- (ii) Calorimetry and Respirometry:  
Direct calorimetry, indirect calorimetry and respiratory exchange. Measurement of energy retention - carbon and nitrogen balance, comparative slaughter.
- (iii) Energy Systems:  
Total Digestible Nutrients (TDN), Starch Equivalent (SE), Metabolisable Energy (ME), Net Energy (NE). The new ME/NE system. Comparison of the systems. Energy Systems for ruminants and monogastrics.
- (iv) Efficiency of utilisation of metabolisable energy (EUME):  
EUME for maintenance, fattening, growth, lactation, fermentation patterns and EUME.

## SEMESTER 2 WEEK 1-5:

Section IV Evaluation of Protein. CP. DCP and True Protein.(10 lectures)

(i) Evaluation of protein:

Crude protein, digestible crude protein, true protein.

(ii) Protein quality for monogastrics:

Protein efficiency ratio, gross protein value, protein replacement value, nitrogen balance, biological value, chemical score.

(iii) Protein quality for ruminants:

Importance of rumen microbes, Metabolism of nitrogenous material in rumen. Rumen degradable protein. Undegradable protein. Factors affecting degradability. Non-protein nitrogen (NPN). Evaluation of protein for ruminants. Estimation of microbial synthesis and supply to the small intestines. Protein systems.

## SEMESTER 2 WEEK 6-9:

Section V Metabolic role of the Micro-nutrients (Vitamins and Minerals) (6 lectures)

(i) Vitamin nutrition:

Structure, physiological and metabolic role of the fat soluble and water soluble vitamins. Requirements and deficiency diseases.

(ii) Mineral Nutrition:

Physiological and metabolic role of the macro, micro, and trace minerals. Requirements, deficiency diseases. Micronutrients interactions.

## SEMESTER 2: Week 10-13

Section VI Feeding standards and Ration Formulation (8 lectures)

(i) Nutrient requirements for maintenance growth, reproduction and production for ruminants and non-ruminants.

(ii) Formulation of rations for ruminants and non-ruminants, principles, techniques and methods (manual/computer based).

(iii) Practical and field trip to a stockfeed manufacturing company.

## RECOMMENDED TEXT BOOKS

Animal Nutrition by McDonald, Edwards and Greenhalgh 5th Edition.

Improved Feeding of Cattle and Sheep by Whittemore and Elsley.

Nutrition of the Chicken by Scott, Nesheim and Young.

Animal Foods of Central Africa by Topps and Oliver.

Nutritional Ecology of the Ruminant by Peter J. Van Soest.

Protein Nutrition in Ruminants by Orskov

## NUTRITIONAL BIOCHEMISTRY

### 2.0 PRACTICALS

#### INSTRUCTIONS TO STUDENTS

The practical classes are an essential component of the Nutritional Biochemistry Course and a complement to the learning of principles, concepts and theory at the lectures. Practical exercises on analytical

techniques, animal experiments are part of your training as Animal Scientists and Nutritionists. It is also a training in good work methods. Develop good working habits by setting about your experiments in a systematic and intelligent manner. Students are expected to prepare themselves adequately before appearing for the practicals. Read the instructions in the practical handouts and get an understanding of what you will be doing at the practical sessions.

Remember student numbers have increased and we are working with limited facilities both in the Animal House and Nutritional Biochemistry Laboratory. Please co-operate in the sharing of facilities and equipment. Be conscious of the cost and difficulties in obtaining chemicals, reagents, materials, glassware and equipment and therefore the USE of these should be in a reasonable and sensible manner. **DO NOT WASTE REAGENTS.** If you are in doubt on procedures or use of equipment, consult a Demonstrator or one of the Technicians in attendance.

Take your practicals seriously and put in your best effort for full benefit from the practical course.

**ALWAYS KEEP YOUR WORK PLACE TIDY.**

Attendance at practical class is compulsory.

**ASSESSMENT**

**IMPORTANT:**

Each student must keep a **PRACTICAL RECORD BOOK**. All raw data and calculations must be entered in the record book. Demonstrators are authorised to check the records from time to time.

Practical work will be assessed on the reports submitted on each of the practicals or a series of practicals as indicated by the instructors.

The grades earned are part of your continuous assessment marks.

**REPORTS**

Practical reports should be presented in a neat and concise manner and to the following forms:

Title of Experiment

Objectives

Materials and methods (be brief and refer to practical handouts)

Results (tabulated and described where necessary)

Discussion

References (use Journal of Animal Science Style)

All practical reports are to be handed in by dates stipulated by the instructors. Late submissions will not be accepted.

**AS 530**  
**Animal Nutrition and Metabolism**  
**Lecture Schedule**

[http://animalscience.ag.utk.edu/courses/530\\_schedule\\_heitmann.htm](http://animalscience.ag.utk.edu/courses/530_schedule_heitmann.htm)

<b>Lecture</b>	<b>Subject</b>
1	Introduction and overview
	<b>Developmental Physiology:</b>
2	Comparative gastrointestinal morphology
3	Development of ruminant GIT
4	Development of non-ruminant GIT
5	GIT hormones and enzymes
6	GIT hormones and enzymes
7	Nutrient digestion
8	Nutrient Absorption
	<b>Animal Growth:</b>
9	Neural and skeletal growth
10	Muscular and adipose tissue growth
11	Effect of age on tissue growth
12	Effect of nutritional status on growth
13	Growth and nutrient requirements
14	Compensatory growth
15	Water use and metabolism
16	<b>EXAM</b>
	<b>Energy and Carbohydrates:</b>
17	Structure and classification
18	Nomenclature
19	Digestion and absorption
20	Fermentation and VFA production
21	Specific tissue requirements
22	Glycogen metabolism
23	Glycolysis and HMP
24	Oxidative metabolism
25	Gluconeogenesis
26	<b>EXAM</b>
	<b>Lipids:</b>
27	Nomenclature and classification
28	Triacylglycerols, phospho- and glycolipids
29	Sterols, isoprenoids, lipoproteins
30	Digestion and absorption
31	Mitochondrial and peroxisomal oxidation

32	Lipogenesis
33	Ketogenesis
34	<b>EXAM</b>
	<b>Proteins and Amino Acids:</b>
35	Classification of proteins
36	Classification of amino acids
37	Nitrogen and amino acid metabolism
38	Nitrogen and amino acid metabolism
39	Nitrogen and amino acid metabolism
40	Nitrogen and amino acid metabolism
41	Protein quality measurement
42	Protein quality measurement
43	Availability of protein and amino acids
44	<b>EXAM</b>
	<b>Minerals:</b>
45	Classification of minerals
46	Metabolism, function, and deficiencies
47	Metabolism, function, and deficiencies
48	Metabolism, function, and deficiencies
49	Metabolism, function, and deficiencies
50	Mineral toxicities
51	Requirements affected by growth and physiological status
	<b>Vitamins:</b>
52	Classification of vitamins
53	Metabolism, function, and deficiencies
54	Metabolism, function, and deficiencies
55	Metabolism, function, and deficiencies
56	Dietary source and feed processing effects on availability
57	Dietary source and feed processing effects on availability
58	<b>EXAM</b>

## Course Syllabus

Topics Covered	Sessions
<b>Developmental Physiology of the Digestive Tract:</b> Evolutionary development of ruminant and non-ruminant digestive tracts with comparative reference between species. Age related changes in digestive tract hormones and enzymes. Nutrient digestion and absorption.	8
<b>Animal Growth:</b> Neural, skeletal, muscular, and adipose tissue growth as affected by age and nutritional status. Effects of component growth on nutrient requirements. Compensatory growth.	6
<b>Water:</b>	1
<b>Energy and Carbohydrates:</b> Structure, classification, nomenclature, and metabolism of carbohydrates. Animal energetics. Dietary measures of energy utilization.	9
<b>Lipids:</b> Structure, classification, and nomenclature of lipids. Lipid transport and metabolism. Essential fatty acids.	7
<b>Proteins and Amino Acids:</b> Classification and metabolism of nitrogen and amino acids. Protein quality measurement. Dietary sources and feed processing effects on availability.	9
<b>Minerals:</b> Classification, metabolism, functions, deficiencies, and toxicities of major and trace minerals. Mineral requirements as affected by physiological status and growth	7
<b>Vitamins:</b> Classification, metabolism, functions, deficiencies, and toxicities of vitamins. Dietary sources and feed processing effects on availability.	