



**UNIVERSITY OF SALAHADDIN- ERBIL**  
**DEPARTMENT OF ANIMAL RESOURCES**  
**COLLEGE OF AGRICULTURAL ENGINEERING SCIENCES**

**Subject: RUMINANT NUTRITION**

**Course Book – 3<sup>rd</sup> YEAR**

**Ass. Prof. Dr. Nawzad M. Aziz** (Theoretical)

**Ass. Prof. Dr. Suzan M. Muhamad** (Theoretical)

**Ass. lec Mr. Adnan Hamasaed** (Practical)

**Ass. lec Mrs. Mahabad I. Saeed** (Practical)

**Academic Year: 2021-2022**

# Course Book

<b>1. Course name</b>	<b>RUMINANT NUTRITION</b>
<b>2. Lecturer in charge</b>	<b>Dr. Suzan Muhamad Nur Muhamad                      BSc, MSc, PhD</b> <b>Dr. Nawzad Muhammad Aziz                                      BSc, MSc, PhD</b>
<b>3. Department/ College</b>	<b>Animal Resources/ Agricultural Engineering Sciences</b>
<b>4. Contact</b>	<b>Mail: <a href="mailto:Suzan.Muhamad@su.edu.krd">Suzan.Muhamad@su.edu.krd</a> Tel.07504135247</b>
<b>5. Time (in hours) per week</b>	<b>Theory: 2</b> <b>Practical: 3</b>
<b>6. Office hours</b>	<b>Monday, Wednesday ( 8.5 to 12 AM.)</b>
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<b>Dr. Suzan Muhamad Nur                      BSc, MSc, PhD</b> <b>Dr. Nawzad Muhammad Aziz                      BSc, MSc, PhD</b> <b>Ass. Lecturer Adnan Mama Saed (Practical)</b> <b>Ass. Lecturer Mahabad I. Saeed</b>
<b>9. Keywords</b>	
<b>10. <u>Course overview:</u></b>	
<p>Proper nutrition is essential for the health &amp; productivity of all animals and is the basis of successful production systems.</p> <p>Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume.</p> <p>Nutrition is the study of how the body uses the nutrients in feed to sustain life and for productive purposes. Nutrition is a very complicated science. We must study the nutrients themselves and also look at how animals consume, digest, absorb, transport, metabolize, and excrete them.</p> <p>Feeds and feedstuffs are chemically complex mixtures of substances that contain the nutrients an animal need. The digestive tract breaks down those complex materials to their constituent parts so the nutrients can be absorbed and metabolized by the body. Breakdown of food by the digestive system in preparation for absorption is called digestion (The physical, chemical, and enzymatic means the body uses to render a feedstuff ready for absorption) and is accomplished in three ways:</p> <ol style="list-style-type: none"> <li><b>1-</b>The physical or mechanical actions of chewing (mastication) and muscular action of the digestive tract (peristalsis).</li> <li><b>2-</b>The chemical action of hydrochloric acid (HCl), which is used by stomach to denature proteins and bile that is used in the small intestine to help digest fats.</li> <li><b>3-</b>The action of enzymes, which increase the speed of the breakdown of the chemical bonds in foods by the addition of a water molecule (hydrolytic enzyme).</li> </ol>	

Enzyme (proteins capable of catalyzing reactions associated with a specific substrate) Enzymes can be produced by the digestive tract and accessory organs (liver, pancreas), or by microorganisms living in symbiosis with the animal. Enzymes are biological catalysts that speed the rate at which a particular reaction reaches equilibrium. Many enzymes are found in the system and are needed for faster and more efficient digestion. The type of digestive system an animal has dictates what the animal can successfully use as feed. The more complicated the feed (like forage), the more complicated the digestive tract. Thus, the ruminant system is designed to retain feed for several days, which is a long time compared to the few hours that a feed is held in a carnivore's simple tract.

General concept of how to use the correct chemical analysis and benefit from Proximate Analysis of feedstuff - general guidance on how to use nutrition lab., repetition in chemical analysis, Sampling of feedstuffs for analysis and how to save samples before analysis, Determination of Moisture , Ash, Silica, Crude fat, Crude fiber, Crude Protein, and calculating the proportion of soluble carbohydrates in food samples and making rations for farm animals.

### **11. Course objective (Theory):**

- 1- Define nutrition and understand the reasons for studying nutrition.
- 2- Describe the general uses of nutrients in the body.
- 3- Describe the methods of the breakdown of food.
- 4- Classify digestive systems according to stomach type of diet consumed.
- 5- Describe the steps of digestion.
- 6- Explain the importance of the complex stomach of the ruminant and its benefits to the animal.
- 7- Feeding Standards for maintenance, growth, reproduction and lactation.

### **12. Student's obligation**

Students should attend the lectures (theory and practical) and participate in all quizzes during the course, also monthly examination and homework with reports required.

### **13. Forms of teaching**

The forms of teaching include data show, power point also white board for explaining the subjects which needs more explanation and mathematical solutions.

<p><b>14. Assessment scheme</b>                  Theoretical (65%) + Practical (35%)                  Theoretical (65%)                  15% (Monthly Examination) 50% (Final Examination)</p>	
<p><b>15. Student learning outcome:</b>                  During this semester the student should learn the reasons for studding ruminant nutrition, and how nutrients are used in the animal body, methods of breakdown of feeds in the animal digestive system. Also learn how digestive systems are classified according to stomach type of diet consumed, steps of digestion. In addition, the importance of complex stomach of the ruminant and its benefits to the animal. Finally, the student will learn feeding standards for maintenance, growth, reproduction, lactation and ration formulation.</p>	
<p><b>16. Course Reading List and References:</b>                  1- Animal Nutrition (2011). Mc Donald, P.; R. A. Edwards; J. F. D. Greenhalgh; C. A. Morgan; L. A. Sinclair, and R.G. Wilkinson. 7th ed. Prentice Hall.                  2- Feeds and Feeding (2004). Perry, T. W.; A. E. Cullison and R. S. Lowery. 6th ed. Prentice-Hall, New Jersey.                  3- Feeds &amp; Nutrition Digest (1990). Ensminger, M. E.; J. E. Oldfield, and W. W. Heinemann. 2nd ed. Ensminger Publ. Co.                  4- Introduction to Animal Science (2006). Damron, W.S.,3rd ed. Pearson, Prentice Hall.                  5- - Chemical composition and nutritional value of feed materials in Iraq (1978). Kazim Ali Khawaja, ElhamAbdullah al-Bayati, Samir Abdul Ahad Mate.</p>	
<b>17. The Topics:</b>	<b>Lecturer's name</b>
Introduction Animals and its Food.	<p><b>Dr. Suzan M Nur Muhamad                  &amp; Dr. Nawzad M. Aziz</b></p>
Composition of Plant and Animal, Water, Dry matter and its composition.	
Carbohydrates Classification of carbohydrates, Monosaccharide's, Disaccharides, Polysaccharides & Lignin.	
Digestion and Metabolism of Carbohydrates	
Proteins, nucleic acids and other nitrogenous compounds. Digestion and Metabolism of Proteins.	
Lipids Classification of Lipids, Fats, glycolipids, Phospholipids, Waxes & Steroids Digestion and Metabolism of Lipids.	

Energy metabolism	
Vitamins, Minerals Fat and water-soluble vitamins Function of minerals, Trace and Major elements	
Classification of Digestive Systems	
Enzymes, Digestion in mammals	
Microbial digestion in ruminants and other herbivores	
The Nutrient Requirements (energy and protein) of Animals, Feeding standards for: Maintenance, growth	
The Nutrient Requirements (energy and protein) of Animals, reproduction, lactation.	
Ration Formulation	
<p><b>18. Practical Topics</b></p> <p>1- Proximate analysis of feedstuff, General on how to use nutrition laboratory, some notes on an analysis of micronutrients, Repetition in the laboratory, Laboratory equipment and glassware used in the laboratory of nutrition.</p> <p>2- Sampling for analysis by the food as well as how to take samples.</p> <p>Conditions to be met to obtain a representative sample, Sampling and Preparation of samples for analysis of feed.</p> <p>3- Determination of Dry Matter (DM) or moisture: Principle /Equipment/Calculations. The objective of estimating moisture</p> <p>4- Ether Extract (EE) (Crude Fat) Determination</p> <p>5- Determination of Ash.</p> <p>6- Estimate silica: - A general knowledge about silica. Prepare the extract of the ash samples to estimate dietary silica, Procedure. Calculations to estimate with some examples.</p> <p>7- A visit to the feed factory: In order to inform students the feed ingredients as well as how to make pellets.</p> <p>8- Crude Fiber Determination (CF)</p> <p>9-Crude Protein Determination (C.P)</p> <p>10- Determination of Nitrogen Free Extract (NFE)</p>	<p>Mr. Adnan HamaSaed &amp; Mrs. Mahabad I. Saeed</p>

## **19. Examinations:**

### **Q1. Compositional:**

**A- What are the principles of ruminant nutrition?**

**Answer:**

- 1- Ruminants are adapted to use forage because of microbes in their rumen.**
- 2- To maintain ruminant health and productivity, feed the rumen microbes, which in turn will feed the ruminant.**
- 3- Ruminant nutritional needs change depending on age, stage of production, and weather.**
- 4- Adequate quantities of green forage can supply most —if not all—the energy and protein a ruminant needs.**
- 5- Forage nutritional composition changes depending on plant maturity, species, season, moisture, and grazing system.**
- 6- Supplementation may be necessary when grass is short, too mature, dormant, or if animal needs require it (i.e., high-producing dairy animal).**
- 7-Excessive supplementation may reduce the ability of the rumen microbes to use forage.**

**B- what is main classification of Carbohydrates?**

**Answer:**

**Carbohydrates are classified into three main classes:**

**A/Monosaccharides**

**B. Disaccharides: They give two monosaccharide units on hydrolysis, which may be the same or different. For example,**

- 1. Lactose (milk sugar) which hydrolyses into two molecules of glucose and galactos.**
- 2. Sucrose (found in most plants, cane and beet sugar) which hydrolyses into two molecules of glucose and fructose:**
- 3. Maltose it is obtained from the hydrolysis of starch. Which hydrolyses into two molecules of glucose.**

**C/ Polysaccharides**

**C- What is The Role of Rumen Microorganisms?**

**Answer:**

- 1-Production of cellulase (to break down fiber-rich plant material)**
- 2- Synthesis of volatile fatty acids (used as energy by the animal)**
- 3- Synthesis of vitamins**

#### **4- Synthesis of microbial protein**

**D- Why the rumen pH near neutral (6-7)?**

**1- Continuous absorption of VFA through the rumen wall.**

**2- Buffered by bicarbonate and phosphate ions in saliva.**

**E- The composition of feeds often expressed on a DRY MATTER BASIS (DM), why? which allows a more valid comparison of nutrient content.**

**F- When Feeding livestock concentrate, we must increase grain slowly over a few days? To allow microorganism to adaptation in the rumen to a new feed.**

**Q2/ Indicate whether each statement is true ( T ) or false ( F ). In order for a statement to be true, it must be completely true. Then correct the false statements. 1-( F )**

**The cell walls of plants and animals are highly cellulose. (PLANTS)**

**2-( F ) Fructose is a Disaccharide found in ripe fruits and honey. (Monosaccharide's)**

**3-( F ) Glycogen is a common component of many feeds. ( not a common)**

**4-( F ) Water is not most important nutrient in nutrition. Keeps animal cool carries nutrients throughout the body. ( Most)**

**5-( F ) Macro-minerals include Iron, Zinc, Copper, Manganese, Selenium, Iodine, Cobalt and Molybdenum. ( Micro-minerals)**

**6-( F ) Enzymes are carbohydrates capable of catalysing reactions associated with a specific substrate. ( Proteins)**

**7-( F ) Carnivores (animals that eats a diet of only plant materials). (Herbivores)**

**8-( F ) Omasum of a cow is the fourth part of its stomach which is called true stomach. (Third)**

**9- ( F ) Animals consume water at 1 to 2 times the amount of dry food consumed.(3-8)**

**10-( F ) If animal water requirements are not met, feed intake will increase. (Decrease)**

**11-( F ) Saponification is a measure of fats degree of unsaturation. (Iodine number)**

**12- ( F ) Vitamins are organic substances required by animals in very large amounts for regulating various body processes.( Very small)**

13-( F ) Oesophagus, gather and chew feed using tongue and teeth. ( mouth)

14-( F ) In the Small intestine, bacterial activity, water absorption and waste storage. (large intestine)

15-( F ) Pancreatic Secretions pH = 2-3. (7.2- 7.8)

Q3. Complete the following sentences with missing words:

- 1- Cattle, sheep and goats have ability to convert plant carbohydrates and proteins into available NUTRIENTS for human use, making otherwise UNUSABLE land productive.
- 2- Polysaccharides usually regarded as important source in animal nutrition which include STARCH, CELLULOSE, HEMICELLULOSE.
- 3- Bile made in liver, stored in GALL bladder, active in the SMALL intestine, emulsifies FAT to AID in digestion.
- 4- Reticulum is honeycomb lining, no SECREASION, and collects HARDWARE(WIRE &NAILS).
- 5- Abomasum (true gastric stomach), produce proteolytic ENZYMES and HCl which cause pH decrease from 6 to 2.5, denature-PROTEIN, kills BACTERIA, dissolve MINEARLS.
- 6- Microorganisms in the rumen include BACTERIA, PROTOZOA and FUNGI.
- 7- Lignin is not a true carbohydrate. It contains too much CARBON, the H and O are not in the right proportion, and some NITROGEN usually is present.
- 8- Water percentage produced by complete oxidation of Glucose 60%, Fat 107% and Protein 45%.
- 9- The majority of the true protein, and non-protein nitrogen compounds (NPN), entering the rumen is broken down to AMONIA, which bacteria require for synthesizing their own body PROTEIN.

## 20. Extra notes:

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

## 21. Peer review

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*

ئەم كۆرسىۋوكە دە بىت لە لايە ن ھاوہ ئىكى ئە كادىمىيە وە سە ىر بىرئىت و ناوہ رۆكى بابە تە كانى كۆرسە كە پە سە ند بىكات و جە ند ووشە يە ك بنووسىت لە سە ر شىاوى ناوہ رۆكى كۆرسە كە و واژووى لە سە ر بىكات. ھاوہ ل ئە و كە سە يە كە زانىارى ھە بىت لە سە ر كۆرسە كە و دە بىت پلە ي زانستى لە مامۇستا كە مئتر نە بىت.