

# **The University of Zambia**

## **School of agricultural sciences**

### **2015 Full year courses exams post graduate**

<b>Course code</b>	<b>course Title</b>
1. AGA 6020	Endocrine system and Hormone metabolism
2. AGA 6132	Ruminant nutrition and race management
3. AGA 6132	Vitamins and mineral metabolisms
4. AGA 6142	proteins and Amino Acids metabolism
5. AGA 6601	Biochemical techniques and instrumentation
6. AGC 6322	plant protection
7. AGC 6820	communication skills
8. AGE 6062	production economics
9. AGE 6091	Institutional and behavioral economics
10. AGE 6122	Agricultural policy Analysis
11. AGE 6231	quantitative Analysis of agricultural policies
12.AGS 6512	Soil survey and Digital soul mapping
13. AGS 6122	soil classification and land evaluation
14.AGS 6232	soil amendment and fertilizer technology
15.AGS 6411	soil Microbiology
16.AGS 6512	crop water requirements



**THE UNIVERSITY OF ZAMBIA**  
**FACULTY OF AGRICULTURAL SCIENCES**  
**DEPARTMENT OF ANIMAL SCIENCE**

**FINAL EXAMINATION QUESTIONS - 2014/15**

**COURSE:** AGA 6012 ENDOCRINE SYSTEM AND HORMONE METABOLISM  
**DURATION:** THREE (3) HOURS

**INSTRUCTIONS:** CAREFULLY READ INSTRUCTIONS FOR EACH SECTION  
WRITE THE NUMBER OF EACH ATTEMPTED QUESTION

**SECTION A**

**INSTRUCTIONS:** ANSWER ALL QUESTIONS IN THIS SECTION

**QUESTION ONE**

A. Briefly describe the following terms as used in endocrinology of domestic animals; **[10]**

- i. Endocrine
- ii. Osteoclasts
- iii. Para-follicular cells
- iv. Antagonist
- v. Releasing Factor(s)

- B. With respect to domestic animals;
- i. Briefly discuss the endocrine role of the placenta. **[4]**
  - ii. Draw and label the common structure that steroids share. **[3]**
  - iii. Why is the pancreas considered to be both an endocrine and exocrine gland? **[1]**
  - iv. Describe the feedback mechanisms regulating hormone synthesis? **[2]**

**QUESTION TWO**

With regard to the adenohypophysis,

- i. Use a diagram to describe the hypothalamo-hypophyseal system. **[5]**
- ii. Name the hormones synthesized by the adenohypophysis. **[5]**
- iii. What are the secretory cells involved in the synthesis of hormones? **[5]**
- iv. Describe the regulation of synthesis of adenohypophyseal hormones. **[3]**
- v. Why would you or would you not administer these hormones orally. **[2]**

## **SECTION B**

**INSTRUCTIONS:      ANSWER ANY TWO QUESTIONS IN THIS SECTION**  
**QUESTIONS CARRY EQUAL MARKS (20)**

### **QUESTION THREE**

- A. Often the environment influences body functions and three vital organs of the body are involved. Discuss how these three levels of integration ensure endocrine control takes place. **[6]**
- B. Describe what a receptor is, its location in relation to a cell, and name the functionally important segments of the receptor. **[10]**
- C. Discuss how receptor function is regulated. **[4]**

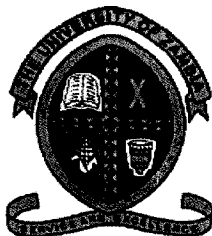
### **QUESTION FOUR**

- A. With the use of a diagram, discuss the endocrine role of the adrenal cortex. **[6]**
- B. Explain the relationship between Iodine availability and goitre. **[4]**
- C. State the factors involved in thyroid hormone transport. **[3]**
- D. Discuss the role of enzymes in the two-cell two-gonadotropin theory. **[6]**
- E. What is the rate-limiting step in the steroidogenic process? **[1]**

### **QUESTION FIVE**

- A. With the use of examples, describe how the coordination of body functions is undertaken by chemical messengers. **[6]**
- B. The original understanding was that chemical messengers are synthesized by a gland and act on target cells at sites located away from the secretory gland. Discuss what other “crine” factors have since been used to better explain “endocrine” function. **[6]**
- C. Discuss the hormones, organs and processes involved in calcium metabolism. **[6]**
- D. How does the synthesis of steroid hormones differ from that of peptide (protein) hormones? **[2]**

**END OF EXAMINATION**



**THE UNIVERSITY OF ZAMBIA  
SCHOOL OF AGRICULTURAL SCIENCES  
DEPARTMENT OF ANIMAL SCIENCE**

**2014/2015 END OF THE YEAR FINAL EXAMINATIONS**

**AGA 6102 – RUMINANT NUTRITION AND RANGE MANAGEMENT**

**INSTRUCTIONS**

Answer **any five** questions from both sections

Write your answers for questions in each section in a separate booklet

Read the questions carefully before attempting them

All questions carry equal marks (20 Marks each)

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**SECTION A - RUMINANT NUTRITION**

**QUESTION ONE**

You have fed weaner calves with Rhodes grass hay. Describe how the carbohydrate components of the grass are digested in a ruminant animal. Show the depth of your knowledge of ruminant digestion by mentioning how the final products of this type of digestion are formed, absorbed and utilised.

**(20 marks)**

**QUESTION TWO**

(a) List down and explain the importance of saliva in ruminant digestion

**(4 Marks)**

(b) Poultry manure is a cheaper source of protein in ruminant feeding. Describe how the manure provides proteins to a ruminant animal.

**(8 marks)**

(c) In an event that there is inadequate supply of readily digestible carbohydrates, explain the possible end result of the nitrogen contained in the poultry manure.

**(8 Marks)**

**QUESTION THREE**

Define the following metabolic disorders and explain how they are caused, and also how they can be prevented;

(i) Ruminal acidosis

**(4 Marks)**

(ii) Ketosis

**(4 Marks)**

(iii) Bloat

**(4 Marks)**

(iv) Urea toxicity

**(4 Marks)**

(v) Liver abscess

**(4 Marks)**

## SECTION B- RANGE MANAGEMENT

### QUESTION FOUR

Rangeland degradation consists of a reduction in the quantity or nutritional quality of the vegetation available for grazing. The prospect of increased rangeland degradation is common to all dry land areas. In particular, the deterioration is more advanced in semi-arid and sub-humid areas than in arid areas.

- (a) What are the characteristics of these range lands? (4 marks)
- (b) Outline the importance of rangelands in Zambia (6 marks)
- (c) What are the causes of rangeland degradation in Zambia? (4 marks)
- (d) What measures should be carried out to improve the productivity of rangelands in Zambia? (6 marks)

### QUESTION FIVE

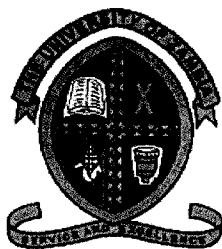
- (a) Define an ecosystem (3 marks)
- (b) What are the components of an ecosystem in rangelands (6 marks)
- (c) Draw a diagram to show energy flow in an ecosystem (6 marks)
- (d) What are ecosystem goods and services? Explain and give examples (5 marks)

### QUESTION SIX

- (a) In range management it is important to carry out a natural resource inventory. In natural resource inventory mention the six types of plant attributes that are commonly measured. (6 marks)
- (b) The following data of two desirable browse species Moringa and Leucaena was collected from 12 quadrants from grazing area in Central Province. Each quadrant was 10 meters x 10 meters.

Quadrant No.	1	2	3	4	5	6	7	8	9	10	11	12
Number of moringa plants	2	0	5	3	11	0	1	12	0	3	9	4
Number of Leucaena plants	3	1	1	0	0	0	2	0	0	1	0	1

- (i) Calculate
  - (a) The frequency of moringa and of Leucaena (6 Marks)
  - (b) The density per hectare of moringa plant and of Leucaena (10 marks)
- (ii) - Which of the two has better results in terms of frequency and density (4 marks)



**The University of Zambia  
School of Agricultural Sciences  
Department of Animal Science**

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**COURSE:** AGA 6132: Vitamins and Mineral Metabolism

**DATE:** 9<sup>th</sup> July 2015    **TIME** 14:00 HOURS

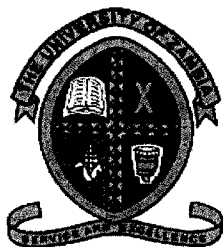
**TIME ALLOWED:** THREE (3) HOURS    **TOTAL MARKS:** 100

**INSTRUCTIONS:** Answer any five (5) questions as each question carries 20 equal marks.

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1. A). Explain how fat soluble vitamins are mobilized from dietary sources in the Gastro-Intestinal Tract to be transported to storage sites in farm animals (10 Marks)?  
B). Why are fat soluble vitamins supplied on periodic bases while that of water soluble vitamins are basically on daily basis (4 Marks)?  
C) What are trace mineral elements and why are they potentially toxic when used in animal diets (6 Marks)?
2. A).With the help of a diagram, explain the role of Vitamin A in the prevention of Night Blindness in farm animals (10 Marks)?  
B).What are the other metabolic functions of Vitamin A when included in animal diets (4 Marks)?  
C). What are the key dietary sources of Vitamin A for grazing animals and how are these resources mobilized for utilization by the said animals (6 Marks)?
3. A). Explain the importance of Niacin in the metabolism of carbohydrates, lipids and proteins (6 Marks)?  
B). How is the role of Niacin related with that of Vitamin A in the restoration of sight in farm animals (2 Marks)?  
C). Apart from dietary sources, explain in detail how Niacin is mobilized for metabolism within animal tissues (8 Marks)?  
D). How is the metabolism of Niacin related with that of Thiamin in the metabolism of carbohydrates, lipids and proteins (4 Marks)?

4. A). Explain the role and importance of Vitamin K in blood clotting (8 Marks)?  
B). What are the other metabolic functions that have been associated with Vitamin K in animal metabolism (6 marks).  
C). Explain the metabolic relationship between Vitamin E and Selenium in the prevention of lipid peroxidation and exudative diathesis (6 Marks)?
5. A). What are the key metabolic functions of Iron in different animal tissues (10 Marks)?  
B). What are the main sources of Iron in animal diets and how are these elements mobilized from the gut for storage and subsequent utilization by animal tissues (6 Marks)?  
C). What are the main storage forms of Iron in farm animals (4 Marks)?
6. A). Minerals present a diverse group of individual elements with specific functions and yet they are divided into only two groups consisting of Macro and Trace elements. In general terms, explain the importance of minerals in animal nutrition (10 Marks)?  
B). How does the function of Minerals differ from that of Vitamins (4 Marks)?  
C). Explain how you would determine dietary essentiality of an element as a nutrient in animal metabolism (6 Marks)?



**The University of Zambia  
School of Agricultural Sciences  
Department of Animal Science**

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**COURSE:** AGA 6142: Proteins and Amino Acids Metabolism

**DATE:** 22<sup>nd</sup> June 2015    **TIME** 09:00 HOURS

**TIME ALLOWED:** THREE (3) HOURS      **TOTAL MARKS:** 100

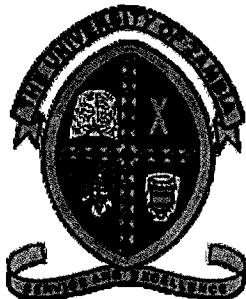
**INSTRUCTIONS:** Answer any five (5) questions as each question carries 20 equal marks.

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1. A). Using a diagram, demonstrate the formation of a peptide bond between the amino acids Serine and Glycine (4 Marks)?  
B). Name and draw the structures of three basic amino acids that are known to have pH buffering capacity in cellular fluids (6 Marks)?  
C). Explain the steps required for one to determine the amino acids sequence in a protein molecule (10 Marks)?
  
2. A). Name and explain the characteristics of at least four (4) chemical reactions that are known to take place at the  $\alpha$ -amino group of amino acids (10 Marks)?  
B). How can these reactions be exploited in the determination of amino acids protein composition and sequences (4 Marks)?  
C). What are the key enzymes and co-enzymes involved in the trans-amination and oxidative de-amination reactions of amino acids and how are these reactions important in the metabolism of amino acids (6 Marks)?
  
3. A). What are synthetic amino acids and how can these amino acids assist in meeting protein requirements in non-ruminants (6 Marks)?  
B). Why has the use of synthetic amino acids been limited to only a few ones like DL-Methionine and L-Lysine (4 Marks)?  
C). Why is it important to balance up the supply of amino acids in animal diets (10 Marks)?

4. A). Explain the limitations of using Crude Protein to estimate protein requirements in diets meant for Ruminants (4 Marks)?
- B). In olden days, it was believed that ruminants do not have a requirement for dietary proteins. What are the merits and de-merits of such a statement in modern day protein metabolism (6 Marks)?
- C). How would you ensure a high producing ruminant has an adequate supply of all essential amino acids to meet its requirements for increased Production (10 Marks)?
5. A). Using your knowledge of amino acids metabolism, explain the catabolism of amino acids Threonine, Glycine and Serine through which their Carbon skeletons are converted to yield energy in the TCA cycle (10 Marks)?
- B). Explain the routes for the biosynthesis of Glutamate and Glutamine from  $\alpha$ -keto acids (4 Marks)?
- C). What is the importance of the above reactions as far as metabolism of amino acids in farm animals is concerned (6 Marks)?
6. A). Explain how dietary proteins are mobilized for cellular uptake in the non-ruminant digestive system (8 Marks)?
- B). What is the importance of Ammonia generated from oxidative de-amination of  $\alpha$ -amino acids during their catabolism in animal tissues (6 Marks)?
- C). Explain how the metabolism of amino acids is regulated between the Tri-carboxylic Acid (TCA) Cycle and the Urea Cycle as may be influenced by cellular energy levels (6 Marks)?

START 14:07



**THE UNIVERSITY OF ZAMBIA  
SCHOOL OF AGRICULTURAL SCIENCES**

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**2015 MID YEAR EXAMINATIONS**

**COURSE : AGA 6601- BIOCHEMICAL TECHNIQUES AND  
INSTRUMENTATION**

**DATE : MONDAY, 02 MARCH 2015 14:00 HOURS**

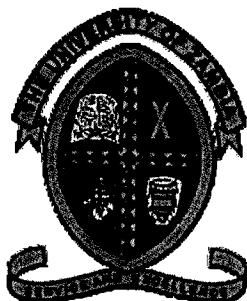
**DURATION : 3 HOURS**

**INSTRUCTIONS : ANSWER ANY FIVE QUESTIONS**

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1. Mention and explain the important factors to consider on laboratory samples under the following headings:
  - i. Sampling
  - ii. Sample Storage
  - iii. Preparation for Analysis(20 marks).
2. In evaluation of chemical composition of feeds, outline the types of analyses that should be carried out and the importance of carrying out these analyses (25 marks).
3. Mention and explain any five Specialized Analytical Instrumentation methods and where they are normally applied (20 marks).
4. What are the basic principles involved in chromatography and what are the different types of chromatography that can be used in food/feed analysis. (20 marks).
5. Explain how immunoassays can be used in food/feed analysis. (20 marks).
6. What is the importance of vitamin analysis in feeds? To be quantitated by most methods, vitamins must be extracted from feeds. What treatments are commonly used to extract the vitamins? (20 marks).

THE END



**THE UNIVERSITY OF ZAMBIA  
SCHOOL OF AGRICULTURAL SCIENCES**

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**2015 MID YEAR EXAMINATIONS**

**COURSE : AGA 6601- BIOCHEMICAL TECHNIQUES AND  
INSTRUMENTATION**

**DATE : MONDAY, 02 MARCH 2015 14:00 HOURS**

**DURATION : 3 HOURS**

**INSTRUCTIONS : ANSWER ANY FIVE QUESTIONS**

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**THE END**

**Final Examination 2014/15 Academic Year****Venue: VLT3**[illegible]



**THE UNIVERSITY OF ZAMBIA**  
**SCHOOL OF AGRICULTURAL SCIENCES**  
**DEPARTMENT OF PLANT SCIENCE**  
**POST GRADUATE EXAMINATION**  
**COURSE AGC 6820: COMMUNICATION SKILLS**  
**FINAL EXAMINATION**

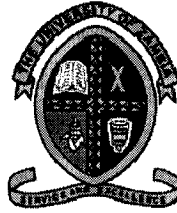
**DATE: Monday 22<sup>nd</sup> June 2015    TIME: 09:00-12:00 Hours    Venue: VLT 3**

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**Instructions:** Answer five (5) questions only

1. Give examples of illustrations in a Scientific or technical paper and describe how they can be made more effective.
2. Discuss the components of a typical communication process model.
3. What is communication? Using relevant examples differentiate between social and business communication.
4. Using relevant examples describe communication flow within organisation from the perspective of a middle manager.
5. What is a team in an organisation? Describe the various stages of team development.
6. Discuss the importance of an agricultural 'EXPO' to the stakeholders. What are some of the challenges encountered by the organisers of such events?

**END OF EXAMINATION**



THE UNIVERSITY OF ZAMBIA  
DEPT. OF AGRICULTURAL ECONOMICS & EXTENSION  
2015 ACADEMIC YEAR EXAMINATIONS  
AGE 6091 INSTITUTIONAL AND BEHAVIOURAL ECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: INSTRUCTIONS: ANSWER ALL QUESTIONS.

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**Question 1**

Several development challenges negatively affect the performance of agriculture and agribusiness sectors in Sub-Saharan Africa. Identify and elaborate on the main technical and institutional challenges faced by smallholder farmers and how weak institutions affect market performance.

[25 Marks]

**Question 2**

A large number of broad explanations have been propounded for the mixed and disappointing results of market liberalization and structural adjustment (or market led) policies in the agricultural sectors of most African countries including Zambia. Identify and clearly explain the arguments that have been propounded to explain the failure of liberalization policies.

[25 Marks]

**Question 3**

A number of closely related strands of economic literature or schools of thought are classified as part of the body of literature of New Institutional Economics (NIE). Some of these schools of thought include the following: **the economics of imperfect information; transaction-costs economics; moral hazard and agency theory; property rights; and incomplete-contracts theory.** Clearly explain significant aspects of each of these schools of thought. Use relevant examples from agriculture/rural development to illustrate your explanations.

[25 Marks]

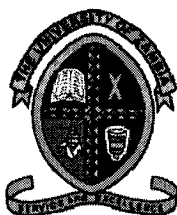
**Question 4**

The Institutional Analysis and Development (IAD) framework presents a suggested framework for the analysis of institutions in the agricultural development context. List and discuss the 4 elements of the "action domain" and then illustrate the applicability of this framework by showing how you will use it to study the *market for maize* in Zambia or any other commodity of your choice in the country.

[25 Marks]

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END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA  
DEPT. OF AGRICULTURAL ECONOMICS & EXTENSION  
2015 ACADEMIC YEAR EXAMINATIONS  
AGE 6091 INSTITUTIONAL AND BEHAVIOURAL ECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: INSTRUCTIONS: ANSWER ALL QUESTIONS.

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[25 Marks]

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END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA  
SCHOOL OF AGRICULTURAL SCIENCES  
2015 ACADEMIC YEAR EXAMINATIONS  
AGE 6122: AGRICULTURAL POLICY ANALYSIS  
ANSWER: ALL QUESTIONS; MARKS: AS INDICATED; TIME 3 HOURS

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1. i) Give two justifications for studying policy incidence (4 Marks).  
  
ii) Illustrate using a clearly labelled diagram, the differential size and distributional welfare effects of a market quota and producer subsidy (a target price and deficiency payments) on the following: producers, consumers, tax payers and the government (12 Marks).  
  
iii) Comment on the dead weight losses of the two policies. How can the social cost of each policy be approximated? (8 Marks)  
  
iv) What do you understand by the term surplus transformation curve? (6 Marks)
2. i) Contrast the subject of political economy theories from that of economics of public choice? 6 Marks  
  
ii) Discuss Nominal Protective Coefficiency, Effective Rate of Protection and Domestic Resource Cost as measures of Competitiveness (9 Marks).  
  
iii) By using the Agricultural Policy of Zambia as an example, discuss the steps involved in a country's policy formulation process (15 Marks).
3. i) Discuss the three (3) major broad objectives (and trade-offs) that governments are trying to further through interventions in the agricultural sector (6 Marks).  
  
ii) Discuss the three categories of constraints that limit the ability of policy-makers to realize all the three objectives discussed in 3a (6 Marks).  
  
iii) Discuss the differences between monetary and fiscal policies (6 Marks).
4. i) What is the role of monitoring policy impacts (MPI) in the cycle of policy formulation and implementation? Contrast MPI with policy evaluation (6 Marks).  
  
ii) Define and contrast Partial Equilibrium Framework and General Equilibrium Framework for Policy analysis (6 Marks).  
  
iii) What do you understand by the term quantitative policy analysis? Discuss using a mathematical model (10 Marks).

END OF EXAMINATION

**The University of Zambia**  
**School of Agricultural Sciences**  
**2014/15 Academic Year First Semester**  
**Final Examinations**

**AGE 6231: Quantitative Analysis of Agricultural Policies**

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**TIME: THREE HOURS**

**INSTRUCTIONS: THERE ARE FIVE QUESTIONS IN THIS EXAM. ANSWER ALL QUESTIONS.**

1. Sadoulet and de Janvry categorize rationales for government intervention into classes – efficiency-oriented and non-efficiency-oriented.
  - a. (2 points) List two efficiency oriented rationales for government intervention
  - b. (2 points) List two non-efficiency oriented rationales for government intervention
  - c. (6 points) Why do we need quantitative policy analysis?

2. Assume that the individual's utility function is given by the following function.

$$U = S^2 F^2$$

where  $S$  is shelter and  $F$  is food.

- a. (4 points) Derive the individual's Marshallian demand curves
  - b. (4 points) Calculate own-price elasticities for shelter and food
  - c. (2 points) Derive the indirect utility function
3. Please answer the following questions about the **homogeneity of Marshallian demand functions**.
  - a. (2 points) State the homogeneity property of Marshallian demand functions in words.
  - b. (3 points) What is the intuition behind this (homogeneity) property?
  - c. (5 points) If there are two goods, then the homogeneity property of Marshallian demand functions can be stated in elasticity form as:

$$\xi_{i1} + \xi_{i2} + \eta_i = 0$$

where  $i$  indexes the good ( $i=1, 2$ ),  $\xi_{ij}$  is the price elasticity of demand for good  $i$  with respect to the price of good  $j$ ; and  $\eta_i$  is the income elasticity of demand for good  $i$ . Suppose you estimated the following single-equation Marshallian demand function for beef:

$$\ln q_{beef} = 4.015 - 0.359 \ln p_{beef} + 0.087 \ln p_{chick} - 0.095 \ln income$$

where  $\ln$  denotes the natural log,  $q_{beef}$  is the per capita quantity demanded of beef,  $p_{beef}$  is the beef price,  $p_{chick}$  is the chicken price, and  $income$  is per capita income. Prices and income are in nominal terms.

- i) What hypothesis would you test to check if the estimated Marshallian demand equation satisfies homogeneity? State the null and alternative hypotheses.
- ii) Use the estimated coefficients in the equation for  $\ln q_{beef}$  above to say something about the homogeneity assumption for the model.
- iii) Explain your application of the elasticity form of the homogeneity property in i) and ii) above to the equation for  $\ln q_{beef}$

4. Consider the following demand system for the US meat sector.

Table 1. Elasticities and budget shares for the meat demand system

	$\ln \underline{P}_m$	$\ln \underline{P}_d$	$\ln \underline{P}_c$	$\ln \underline{Y}$	$\underline{w}_i$
$\ln Q_m$	-1.00	0.30	0.50	0.20	0.30
$\ln Q_d$	2.00	-0.50	-2.00	1.5	0.50
$\ln Q_c$	0.60	1.50	-0.10	1.00	0.20

where the index  $i = \{m=\text{meats}, d=\text{dairy}, c=\text{cereal}\}$ ;  $\ln Q_i$  and  $\ln P_i$  are natural logs of quantity per capita and price of commodity  $i$ , respectively;  $\ln Y$  is natural log of per capita income; and  $w_i$  is budget share for commodity  $i$ .

For each of the following properties, give the formula, state the number of equations and show whether or not it holds for the above system.

- (3 points) Engel aggregation
  - (7 points) Cournot aggregation
5. A farmer is considering growing wheat (WHT), sorghum (SOR), and/or cotton (COT). His farm records indicate returns to each of these activities over the past five years as indicated in Table 1.

Table 2. Historical returns (\$/ha)

Season	WHT	SOR	COT
1	50	57	89
2	50	46	67
3	38	45	20

- Write the formula for and compute the following
  - (3 points) the mean returns
  - (10 points) the matrix of deviations from mean returns
- (4 points) Write out algebraically the MOTAD model that could be used to generate solutions for an efficiency frontier.
- (3 points) Explain the objective function and each constraint in the MOTAD model in b.



**UNIVERSITY OF ZAMBIA**  
**SCHOOL OF AGRICULTURAL SCIENCES**

**UNIVERSITY END OF YEAR EXAMINATIONS: JUNE/JULY 2015**

**AGS 6115: SOIL SURVEY AND DIGITAL SOIL MAPPING**

**INSTRUCTION:** Answer all questions

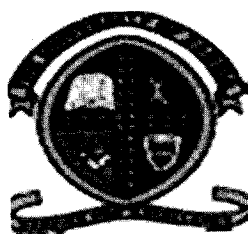
**TIME:** 3 Hours

**100 Marks**

- 
1. Explain the assumptions behind the interpolation of surfaces using
    - (a) Trend surface analysis (5 Marks)
    - (b) Splines (5 Marks)
    - (c) How would you check the quality of the predictions independently in splines and trend surfaces? (5 Marks)
  
  2. (a) Outline the main advantages of soil spectroscopy as opposed to wet chemistry. (8 Marks)
    - (b) Explain the underlying principles applied in the measurement of soil properties in spectroscopy. (8 Marks)
  
  3. You have been hired to map the spatial variability of soil lead contamination in part of Kabwe district in Zambia.
    - (a) Briefly describe three sampling patterns that you may use in soil sampling for this purpose. (12 Marks)
    - (b) What are the advantages and disadvantages of each of the sampling methods outlined in (a) above. (9 Marks)
    - (c) Which of the three methods is often used in practice and why. (7 Marks)

4. Given that there are five points that you wish to use to estimate the value of soil phosphorus (P) at a location that was not sampled. The known values of soil P are 30 ppm, 28 ppm, 24 ppm, 19 ppm and 31 ppm and that these points are 2 km, 1.5 km, 1.8 km, 3 km and 2.1 km respectively away from the point that is to be estimated.
- (a) Calculate the estimated value of soil P at the unsampled location assuming that the inverse distance interpolation (IDW) method is to be used. (6 Marks)
  - (b) What are the advantages of using the IDW method as opposed to global methods of interpolation such as trend surfaces? (6 Marks)
5. (a) What is a Digital Elevation Model (DEM) and why is it so often used in spatial analysis. (4 Marks)
- (b) What is plan and profile curvature and how do they differ? (8 Marks)
6. (a) How does the synthetic approach differ from the analytic approach in soil mapping? (6 Marks)
- (b) Why is it that neither the analytic nor synthetic approach is strictly adhered to in most soil survey projects? (5 Marks)
  - (c) What key considerations should be taken into account when locating field sampling points with the aid of a GPS? (6 Marks)

**END OF EXAMINATION**



**The University of Zambia,  
School of Agricultural Sciences**

**JUNE/JULY, 2015 EXAMINATIONS**

**AGS 6122: SOIL CLASSIFICATION AND LAND EVALUATION**

Time: 3 hours

Total marks: 100

**Instructions: Answer all questions.**

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Q1. Diagnostic and hard pan horizons are used to classify soils in the Soil Taxonomy.

a. Explain the difference between a diagnostic horizon and a genetic horizon **(3 marks)**

b. Which hard pan structures are likely to be associated with the following horizons? **(4 marks)**

i) Bs

ii) Ap

iii) Bx

iv) Bt

c. Why is it that most spodic horizons are found immediately below pale and bleached surface diagnostic horizons? **(3 marks)**

Q2. The USDA Soil taxonomy is one of the most widely used systems of soil classification

a. What is the role of Soil Taxonomy in agro technology transfer? **(5 marks)**

b. Explain the difference between the following pairs of taxonomic terms **(3 marks)**

i) Hyperthermic and Isohyperthermic soil temperature regime

ii) Frigid and isofrigid soil temperature regime

iii) Aridic and Xeric soil moisture regime

c. Among the 12 soil orders recognised in the USDA Soil Taxonomy, Entisols occupy about 16% of the earth's ice-free land surface, constituting the largest coverage among all soil orders. Why is it so? **(5marks)**

d. Distinguish between a sub-group and a great group and explain which factors are taken into consideration in identifying the two soil categories in the USDA Soil Taxonomy **(4 marks)**

Q3. What is the main soil property used to distinguish Ultisols from Alfisols? Inceptisols from Entisols? **(6 marks)**

Q4. Provide a hypothetical soil profile description for a soil that is classified in the humic Argixerolls subgroup **(8 marks)**

Q5. A good understanding of epipedons is important for the classification of soils.

a. What is changing in the following sequence of epipedons? (do not describe the epipedons; just describe the changes) **(8 marks)**

**Ochric----Umbric----Mollic----Histic**

b. Explain why an A horizon is not necessarily an epipedon. **( 2 marks)**

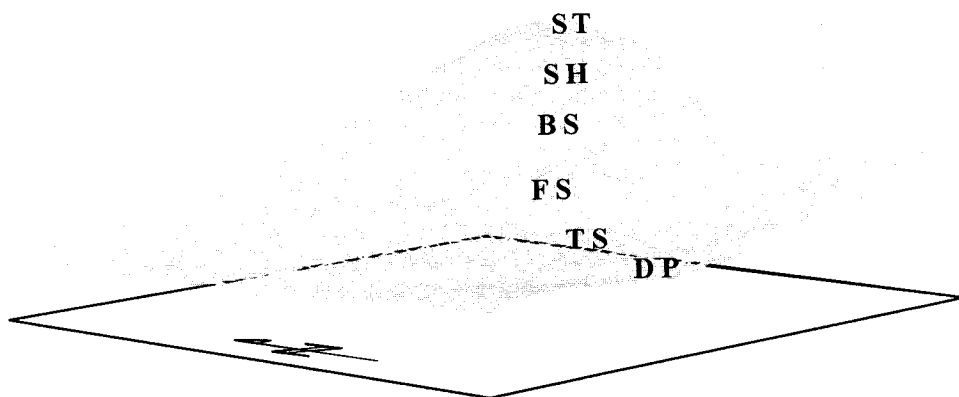
**Q6.** Why is it possible to have soils that are chronologically very old, yet pedologically they are still Entisols? **(10 marks)**

**Q7.** Land evaluation is the process of assessing and predicting the suitability of land for specific uses.

- a. Outline the FAO framework for land evaluation and the basis for its development **(5 marks)**
- b. What are the main weaknesses of the Zambian Land Capability Classification System? **(3marks)**

**Q8.** Pedology is the study of the morphology and genesis of soils, while geomorphology is the study of the morphology and genesis of the surface of the earth. Why is an understanding of geomorphology important to achieve an understanding of pedology? Provide an example **(10 marks)**

**Q9.** The figure below is a graphic expression of a natural landscape with different topographic positions represented by different letters. Examine it carefully and answer the questions that follow.



- a. In which topographic position/s would you mostly expect to find the following:  
(Briefly explain your answers) **(10 marks)**
- i) Very shallow soils
  - ii) Very old soils
  - iii) Redoximorphic features
  - iv) Calcium Carbonates near the surface
  - v) high organic carbon
  - vi) an Ab horizon
  - vii) dominance of iron oxides in clay fraction
  - viii) Plinthite
  - ix) Saline soils
  - x) high water percolation
- b. The graphic expression above represents an important soil forming factor.  
Name that factor and explain why it is considered important in soil formation **(5 marks)**
- c. The paper by Bockheim et al (2002), 'Historical development of key concepts in pedology' presents important concepts that have proven to be useful in the field of pedology. One such concept is the catena concept. What is a catena and what is the main driving force in its role in soil formation? **(6 Marks)**

**END OF EXAM**

UNIVERSITY OF ZAMBIA

School of Agricultural Sciences

UNIVERSITY END OF YEAR EXAMINATIONS—JUNE/JULY, 2015

AGS 6232: Soil Amendments and Fertilizer Technology

TIME: 3 Hours

MARKS: 100

**INSTRUCTIONS:** ANSWER ALL QUESTIONS. WRITE LEGIBLY AND DEMONSTRATE LOGICAL DEVELOPMENT OF THE ANSWERS.

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1. An economic combination of organic residues and chemical fertilizer is not just complementary ( $2 + 2 = 4$ ) but actually synergistic ( $2 + 2 > 4$ ). Explain the synergistic effect of the combination of organic and inorganic fertilizers on soil productivity. [10]
2. a). Describe the major soil constraints to soil productivity on saline and sodic soils [8]  
b). Show the reaction of gypsum in reclaiming saline and sodic soils **and** describe the improvements in soil properties that result from this reclamation. [10]  
c). A sodic soil with a CEC of  $18 \text{ cmol}(+) \text{ kg}^{-1}$  and bulk density of  $1340 \text{ kg m}^{-3}$  has an exchangeable sodium percentage (ESP) of 24 in the top 45 cm. If it is desired to reduce the ESP to 6 % in the top 30 cm in the soil, calculate the amount ( $\text{kg ha}^{-1}$ ) of gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) that should be applied to reclaim this soil. [10]
3. a). Organic matter such as compost or manure applied to soil is known to mitigate some of the adverse effects of soil acidity. Can this soil amendment entirely eliminate the need to apply agricultural lime to ameliorate soil acidity? [3]  
b). Using relevant chemical reactions describe how agricultural lime reacts with an acid soil **and** explain why gypsum is not considered a liming material. [4]

- d). Exactly 0.5 g of material claimed to have lime properties was treated with 25 cm<sup>3</sup> of 1.0 N HCl after which the excess acid was back-titrated with 1.0N NaOH and a titre of 13.5 cm<sup>3</sup> was obtained at the neutralization end point. A blank without the sample was similarly treated and a titre of 23.5 cm<sup>3</sup> was obtained. Calculate the CCE or NV of this sample. [10]
4. a). Provided with ammonium sulphate (21 % N and 24 % S), urea (46 % N, triple super phosphate (46 % P<sub>2</sub>O<sub>5</sub>) and muriate of potash (60 % K<sub>2</sub>O), calculate the amounts of each of these straight fertilizers you would need to prepare one ton of a bulk blended fertilizer of grade 20 : 10 : 5 plus 10 % S. [10]
- b). Explain the rationale for the manufacture of controlled nutrient-release fertilizers and describe the ways that are used to produce such products [10]
- c). Describe advantages that bulk blended fertilizers have over chemically blended fertilizers. [10]
5. a). A fertilizer importer quotes you the following prices: 3-12-12 for \$125 per ton and 20-10-10 for \$230 per ton. Given that straight fertilizers urea, KCl and single superphosphate (20 % P<sub>2</sub>O<sub>5</sub>) cost ZK 195.00, 220.00 and 300.00 per 50 kg bag, respectively on the local market determine which of the two imported fertilizers would give the best value for money. Take \$1.00 = ZK 7.30. [10]
- c). Why are farmers not convinced to buy and use more lime on acid soils that clearly show limited productivity? [5]

**END OF EXAMINATION PAPER**



## UNIVERSITY OF ZAMBIA

### FIRST HALF EXAMINATIONS –FEBRUARY 2015

#### AGS 6411: SOIL MICROBIOLOGY

**Time:** Three (3) Hours

**Marks:** 100

**Instructions:** Answer all Questions

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1. Soil provides the most complex biological community with extensive diversity exhibited by metabolic activities, morphologies, genetics and life histories of organisms. The loss of soil biodiversity presents a subsequent reduction in the myriad of biological processes that are important for the maintenance of soil fertility. With the introduction of climate smart approaches to the management of soils, many technologies have been introduced across the world. Bearing in mind the importance of soil biology, briefly discuss giving examples, the potential impacts of the following:
  - a. Conservation farming [5 marks]
  - b. Global warming [5 marks]
  - c. Increased use of inorganic fertilizers [5 marks]
  - d. Mulching [5 marks]
2. Soil respiration is a biological measure of the carbon dioxide released in the soil from microbial decomposition of organic matter. Assuming a titre of **0.1** and an incubation **period of 7 days of a 100 g of soil** , calculate the amount of respired carbon dioxide-carbon given the following information on three soils: [15 marks]

Sample	Amount of 0.1 M HCl consumed (ml)	
	Phenolphthalein Color Shift	Methyl orange Color Shift
Blank	7.0	2.0
Liempes Soil	7.3	8.3
UNZA Field Station Soil	1.8	5.3
Msekera Soil	1.2	7.1
Mufulira Soil	1.4	5.7

- b. Assuming a **bulk density of  $1.5 \text{ g/cm}^3$**  and a soil depth of **20 cm**, calculate the amount of carbon respired during a season of **110 days** at the UNZA Field Station and Liempe farm if they are **10 and 520 ha** in size, respectively. **[10 marks]**
3. The interaction among the different forms of nitrogen in the atmosphere, soils, plants, and animals constitutes the nitrogen cycle. Nitrification and denitrification are microbial processes that both result in the transformation of nitrogen in the soils. Compare and contrast the following with respect to these two processes:
- Substrate(s) required for this transformation **[2 marks]**
  - Steps and enzymes/ enzyme systems of the transformation **[15 marks]**
  - Metabolic characteristics, as far as oxygen utilization and energy production, of the microorganisms involved **[5 marks]**
  - Agronomic significance of the process **[3 marks]**
4. The use of biological inoculants in crop production has been shown to improve crop performance and subsequent yields. Explain how you can **demonstrate** improved **performance** of crops inoculated with fungal and bacterial inoculants. Show how your demonstration will address changes in soil quality, nutrient uptake and in yield. **[10 marks]**
5. Lignin is the second most abundant plant material which makes up about 10-30% of the total plant material. Answer the following questions related to lignin biosynthesis, its attributes and decomposition:
- Indicate / state the steps involved in lignin biosynthesis, mentioning the substrates, enzymes, and products along the pathway **[15 marks]**
  - What are the characteristics of lignin and how do they influence its decomposition **[10 marks]**
  - Discuss the roles and limitations of the following groups of fungi in lignin decomposition: **[10 marks]**
    - White-rot fungi
    - Brown-rot fungi
    - Soft-rot fungi

-End-



## UNIVERSITY OF ZAMBIA

### SECOND HALF EXAMINATIONS –JUNE 2015

#### AGS 6512: CROP WATER REQUIREMENTS

**Time:** Three (3) Hours

**Instructions:** Answer all Questions

**Marks: 100**

**Paper I (Theory)**

**Question 1:** Photosynthesis provides plants with assimilates that can be used for growth. Explain the roles of the following in the process of photosynthesis:

- a) Rubilose Bisphosphate Carboxylase Oxygenase (RUBISCO) [2 marks]
- b) Phospholenol Pyruvate carboxylate (PEP Carboxylase) [2 marks]
- c) Kranz Anatomy [2 marks]
- d) Photorespiration [2 marks]
- e) Calvin Cycle [2 marks]

**Question 2:** Msekera Research Station is located at Latitude 20°. This location is 1,016m above sea level with a measured number of sunshine hours ( $n$ ) of 5.9 for the month of December. Using the data provide in the attached tables and assuming  $P_m = 20\text{kg CH}_2\text{O ha}^{-1}\text{H}^{-1}$ , answer the following questions:

- a) Determine the Photosynthetically Active Radiation (PAR) on a very clear day during this month [2 marks]
- b) What are the daily gross photosynthesis rate of crop canopies on i) a very clear and ii) an overcast day during this month? [4 marks]
- c) Calculate the maximum gross biomass production rate (bgm) for a crop grown during this month [9 marks]
- d) If the maximum respiration rate (rm) is only a quarter of the maximum gross biomass production rate, determine the maximum net biomass production rate (bnm) [5 marks]

**Question 3:** Light is an important component in the photosynthesis process in biomass production in crop growth.

- a) Using a light response curve, describe the relationship between light and photosynthesis for the crop groups I & II. Indicate limiting factors resulting in light saturation [4 marks]
- b) Based on optimum temperatures, explain the major differences and examples of crops in Crop groups I & II [4 marks]
- c) Explain how daytime air temperature can be used to determine the suitability of a crop for a particular area [2 marks]

**Question 4:** Briefly define each of the following terms

- a) Harvest index [4 marks]
- b) Green canopy cover [4 marks]
- c) Crop coefficient [4 marks]
- d) Tau [4 marks]
- e) Effective porosity [4 marks]

**Question 5:** AquaCrop model can be used to simulate different plant growth scenarios of annual crops under rainfed and irrigated conditions.

- a) Briefly describe four ways the model can be useful in real life [12 marks]
- b) Briefly explain how root zone moisture affects biomass production [6 marks]
- c) Explain why normalized water productivity (WP\*) is preferred in the model than the water productivity (WP) [4 marks]

**Question 6:** A maize crop was grown under irrigation on a 50 ha field and an irrigation schedule developed based on the table below during the growth stages (I – IV):

	I	II	III	IV
Days	25	30	30	38
ET <sub>o</sub>	8.9	9.4	8.8	7.6
K <sub>cb</sub>	0.4	0.75	1.15	0.85
K <sub>s</sub>	0.5	0.8	1.0	0.5

- a) Calculate the total seasonal water requirement of the crop in (i) mm and (ii) m<sup>3</sup>/ha [10 marks]
- b) Calculate the seasonal Transpiration (Tr) and Evaporation during growth season [8 marks]