THE UNIVERSITY OF ZAMBIA

SCHOOL OF AFRICULTURAL SCIENCES

POST GRADUATE EXAMINATION 2009-2011 FIRST AND SECOND SEMESTER

1. AGA 6012- Endocrinology and metabolism
2. AGA 6101- Animal energetic and energy metabolism
3. AGA 6111- Non ruminant digestion and metabolism
4. AGA 6122- Ruminant digestion and metabolism
5. AGA 6142- Protein and amino acid metabolism
6. AGA 6601- Biochemical techniques and instrumentation
7. AGC 6112- Plant physiology
8. AGC 6121- Agro-climatology and physiology of yields
9. AGC 6162- Horticulture
10. AGC 6432- Biometrical genetics and plant breeding
11. AGC 6452- Molecular genetics and biotechnology
12. AGC 6462- Molecular genetics and biotechnology
13. AGC 6552- Weed science
14. AGC 6611- plant breeding and seed systems
15. AGE 6062- Production economics
16. AGE 6091- Institutional and behavioural economics
17. AGE 6222- International trade theory and policy
18. AGE 6231- Quantitative analysis of agricultural policies
19. AGE 6311- Seed agribusiness
20. AGG 6132- Soil plant water relations
21. AGG 6141- Plant nutrition
22. AGG 6211- Biostatistics
23. AGS 6432- Soil amendments and fertilizer technology
24. AGS 6442- Soil mineralogy
25. AGS 6532- Soil conservation
26. AGS 6622- Soil survey and aerial photo interpretation

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AFRICULTURAL SCIENCES

POST GRADUATE EXAMINATION 2009-2011 FIRST AND SECOND SEMESTER

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28.AGS 6232- Soil amendments and fertilizer technology
29.AGS 6311- Applied soil physics
30.AGS 6411- Applied soil chemistry
31.AGS 6411- Soil microbiology
32.AGS 6431- Soil microbiology
33.AGS 6432- Soil amendments and fertilizer technology
34.AGS 6532- Soil conservation
35.AGS 6612- Soil and water conservation
36.AGS 6715- Agroclimatology.

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2009/2010 ACADEMIC YEAR, SECOND SEMESTER
FINAL EXAMINATIONS

AGA 6012
ENDOCRINOLOGY AND METABOLISM

TIME ALLOWED: THREE HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

Q1.

Breier et al. (1986) conducted a study on the somatotrophic axis in young steers, particularly looking at the influence of nutritional status on the pulsatile release of growth hormone (GH) and circulating concentrations of insulin-like growth factor-I (IGF-I). The researchers found, among others, the following results:

1) Peak height of GH: High nutrition (group 1) 9.2±3.5 ng/mL; Medium nutrition (group 2) 19.5±4.1 ng/mL; Low nutrition (group 3) 23.8±10.8 ng/mL.
2) GH pulses occurred episodically throughout the day and night in all animals.
3) During realimentation, plasma GH concentrations decreased in groups 2 and 3 towards the range of the Control (group 1) animals.
4) Feeding at 1.8% DM of liveweight/d (group 2) did not alter plasma IGF-I concentrations but feeding at 1% DM of liveweight/d (group 3) caused a significant decrease in plasma IGF-I levels.
5) Realimentation resulted in progressive increase of IGF-I concentrations to the range of Control animals within one week.
6) An apparent relationship between weight gain and IGF-I concentrations was observed during the last week of differential feeding ($r = 0.677$).

Discuss in detail the above findings, considering all the hormonal changes and possible metabolic processes during the period of the nutritional insult and realimentation.

Q2.
Describe physiological mechanisms through which thyroid hormones affect the basal metabolic rate (BMR) of an animal.

Q3.
Blood Calcium is maintained within narrow limits.
a) Why is this necessary?
b) How is blood Calcium controlled?

Q4.
Pineal gland is associated with reproduction.
a) What is its postulated mechanism in reproduction?
b) Female and male reproductive functions are initiated by apparently similar hormones. Contrast and distinguish hormonal control of puberty in male and female.
c) With a sketch, describe mechanisms and control of Estrus.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2010 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGA 6101: ANIMAL ENERGETICS AND ENERGY METABOLISM

TIME : THREE (3) HOURS
INSTRUCTIONS : ATTEMPT FIVE QUESTIONS
THE QUESTIONS CARRY EQUAL MARKS
ANSWER THE TWO PARTS IN SEPARATE ANSWER BOOKS

Part I

1. Identify the class of lipids that is of greatest importance as a source of metabolic energy and describe how (in general terms, without outlining complete specific pathways) they are broken down to yield the universal carrier of energy, ATP.

2. Distinguish between the following:
   a. Homopolysaccharides and heteropolysaccharides
   b. Glycolipids and glucolipids
   c. Substrate level phosphorylation and oxidative phosphorylation
   d. Deamination and transamination
   e. Basal energy needs and maintenance energy needs

3. Explain the following:
   a. Conditions that promote use of amino acids as sources of metabolic energy.
   b. The central role of α-keto glutarate in amino acid catabolism.

Part II

4. Feed intake is critical in the supply of nutrients to meet needs for various metabolic activities. Outline animal and environmental related factors and how they tend to affect feed intake in animals.

5. What is appetite and how is it regulated by the central nervous system and the periphery organs based on the nutrient metabolic status of the animal?

6. What is homeorhesis and how is nutrient homeostatic nutrient partitioning disrupted in the presence of a coordinated physiological response such as pregnancy or lactation?

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2010 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGA 6111: NON RUMINANT DIGESTION AND METABOLISM

TIME : THREE (3) HOURS
INSTRUCTIONS : ATTEMPT FIVE QUESTIONS
THE QUESTIONS CARRY EQUAL MARKS
ANSWER THE TWO PARTS IN SEPARATE ANSWER BOOKS

Part I

1. Name and explain how the various secretions from different segments of the digestive tract assist with the digestion, absorption and excretion of feed materials in non-ruminants.

2. The liver is termed the cleaning house of dietary nutrients after being absorbed from the gut. Explain how the liver accomplishes this important task and what are the other functions of the liver?

3. Explain the main sources of proteins in non-ruminants and how these are digested and metabolized to perform different functions in the body.

Part II

4. Explain the chemical role of water in the digestion of food outlining the chemical reactions where it is involved.

5. Explain the differences in feeding objectives, and resultant feeding methods, between broilers and layers.

6. Explain the following:

    a. The role of sodium in the digestion of fats.
    b. The role of vitamin D in bone development.
    c. Signs of hyperglycemia.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SECOND SEMESTER EXAMINATIONS – APRIL, 2010

AGA 6122 – RUMINANT DIGESTION AND METABOLISM

TIME: 3 HOURS

INSTRUCTIONS: ANSWER FOUR (4) QUESTIONS, TWO FROM EACH SECTION IN SEPARATE ANSWER BOOKS.

SECTION A

1. What is rumen motility and how does this process facilitate the fermentation of feed resources and subsequent mobilization of products from the rumen?

2. The fermentation process in ruminants is said to be accomplished by interactions of a wide range of microbial species. Explain the interactions of various microbial species in the rumen in the degradation of fibrous feed materials. How do these interactions assist in the generation of required end products? How does rumen fermentation compare with hind-gut fermentation

3. All animals depend on glucose as the main energy metabolite in the blood and yet in ruminants, most of the dietary glucose is converted to volatile fatty acids in the rumen. Explain how the ruminant animal meets its energy metabolic and milk synthesis requirements.

SECTION B

4. Discuss the adequacy of the theory of digestible crude protein as relates to ruminants.

5. You have the following information for an Angoni cow:

    a. weight 300kg
    b. Eating per day:
        Dry matter intake (DMI) = 3% of body weight
        CP of feed is 15.556%
        3.6kg digestible carbohydrates (CHO)

    c. Producing 0kg milk/day
    d. 70% of the feed CP is degraded in the rumen
    e. 50% of undegraded CP is amino acids
    f. 179g of microbial CP synthesized/kg of digested CHO

g. Amino Acid (AA) content of microbial CP = 70%
h. Digestibility of AA in small intestine = 85%
i. Digestibility of undegraded AA in the small intestine = 10%
j. Digestibility of microbial CP in the intestines = 78%
k. Protein used for maintenance is calculated as:
(metabolic weight of animal in kg) x 2.2g
Endogenous fecal CP = 33.33% of DMI x 12.5g
The total endogenous fecal CP is calculated as Total DMI x 12.5g
l. True digestibility of feed CP in the whole digestive tract = 80%
m. The utilization of absorbed AA and eventually mobilized AA in the intermediary protein synthesis = 80%

Study the figure showing the pathways for protein during protein metabolism in ruminants and answer questions 1 – 20.

1. Intake of CP
2. Degraded CP
3. Undegraded CP
4. Microbial CP
5. Recycled CP = PBV in the Nordic system
6. Absorbed amino acids from microbial protein
7. Absorbed amino acids from undegraded protein
8. Total absorbed amino acids = AAT in the Nordic system
9. Protein in milk (kg milk x 32)
10. Endogenous fecal nitrogen = digestive enzymes that are excreted.
Total maintenance requirement (total maintenance endogenous)

Endogenous fecal CP related to maintenance

Endogenous urinary CP related to maintenance

Endogenous fecal CP related to production
= DM for production x 12.5
Total endogenous fecal CP (maintenance + production)

11. Endogenous urinary protein=Maintenance protein that is not endogenous fecal protein

12. Undigested microbial CP

13. Protein synthesis needed for milk production and maintenance

14. Proein that can be stored in body reserves

15. Absorbed amino acids not utilized for protein synthesis

16. Truly undigested feed protein

17. Total excretion of CP in feces

18. Absorbed non amino acid CP from microbial protein

19. Absorbed non amino acid CP from undegraded protein

20. Excretion of CP in urine

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2010/11 ACADEMIC YEAR SECOND SEMESTER FINAL EXAMINATIONS

AGA 6142: PROTEIN AND AMINO ACID METABOLISM

TIME : THREE (3) HOURS
INSTRUCTIONS : ATTEMPT FOUR QUESTIONS
THE QUESTIONS CARRY EQUAL MARKS
ANSWER THE TWO PARTS IN SEPARATE ANSWER BOOKS

Part I (Answer any two questions)

1. Explain the importance of acid/base properties of amino acids in the analysis and separation of protein molecules.

2. What do you understand by stereochemistry of amino acids and how has it affected the use of synthetic amino acids in the animal feed industry?

3. Explain how the active groups on the α-carbon and in the side chains affect reactions of amino acids with other compounds. How are these reactions used in the identification and quantification of amino acids moieties?

Part II (Answer both questions)

4. Discuss Nitrogen Balance and Net Protein Utilization as measures of protein quality indicating the advantages and limitations of each.

5. Define the following and explain their significance in protein nutrition:
   a. Amino acid antagonism.
   b. Maillard reaction.
   c. Factor 6.25 used in determining protein content.
   d. Thomas-Mitchell equation.
   e. The concept of protein quality.

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF ANIMAL SCIENCE

MASTER OF SCIENCE IN NUTRITION

COURSE:AGA 6601 BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION

FINAL EXAMINATION FIRST SEMESTER, NOVEMBER 9TH 2010
EXAMINER: Drinah Banda Nyirenda, PhD/Senior Lecturer
TIME: THREE (3) HOURS

ANSWER ALL QUESTIONS

Question 1 (20 marks)

a) Give the principles that chemically distinguish monosaccharides, oligosaccharides, and polysaccharides. **(6 marks)**

b) Demonstrate your understanding by explaining how solubility characteristics can be used in an extraction procedure to separate monosaccharides and oligosaccharides from polysaccharides. **(4 marks)**

c) Four different values of fiber content for maize bran were reported on percent dry weight basis: 46.0, 8.9, 40.2 and 11.9 using different methods of fiber analysis.
   i) Indicate which method fits with each value **(3 marks)**
   ii) Justify your answer by listing the constituents measured by each method. **(3 marks)**

Question 2 (20 marks)

a) Calcium can be quantified by gravimetric analysis, EDTA complexometric titration, and redox titration. Briefly discuss the principles involved in each of these techniques . **(10 marks)**

b) Define the abbreviations ZABS, FDA, USDA, and EPA, and give one example for each, of what they do and or regulate relevant to food analysis. **(4marks)**

c) By way of examples differentiate "standard deviation" from "coefficient of variation"; and "standard error of the mean" from "confidence interval"; "linear regression" from "correlation coefficient ". **(6 marks)**

Question 3 (20 marks)

a) Explain and contrast the principle(s) (not procedures) involved in determining the fat content of a product **by four (4)** of the following methods:
   i) Soxhlet
   ii) Babcock
   iii) Refractive index
   iv) Mojonnier
   v) Detergent
   (8 marks)

b) Indicate for each method selected above, the type of sample and why it would be the appropriate method for analysis. **(4 marks)**

c) To help characterize a fat sample: Peroxide value; TBA number; and the value from the test for conjugated dienes and trienes can be used . With respect to the results of tests in (b) above:
   i) What do the results of these tests tell you about a fat sample? **(4 marks)**
   ii)Differentiate these three tests as to what chemical is being measured.
   (4 marks)

Question 4 (20 points)

a) As an analyst, you are given a sample of condensed soybean solubles to analyze and determine whether it is reduced to the correct concentration. By gravimetric means, you find that the concentration of solids is 26.54%. The laboratory standard reads 28.63%. If the starting volume was 1000 liters at 8.7% solids, and weight is 8.5kg per liter, how much more water must be removed? **(10 marks)**

b) For three (3) of the following four (4) techniques listed:
   i) Dialysis
   ii) Addition of ammonium sulfate
   iii) Heating to high temperature
   iv) Affinity chromatography

   Identify the principle by which it can be used to separate proteins within a protein solution (e.g., precipitation, adsorption, size, charge) and very briefly explain how the separation process works. **(10 marks)**

Question 5: (20 marks)

a) A dehydrated precooked velvet bean was analyzed for crude protein content in duplicate using the Kjeldahl method. The following data were recorded:

Moisture content = 8.0%
Weight of sample no. 1 = 1.015g
Weight of sample no. 2 = 1.025g
Normality of HCL used for titration = 0.1142
mL HCl used for sample no. 1 = 22.0 mL
mL HCl used for sample no. 1 = 22.5 mL
mL HCl used for reagent blank = 0.2 mL

Calculate crude protein content on both wet and dry weight basis of the velvet bean, assuming velvet bean protein contains 17.0 percent nitrogen.
(10 marks)

b) In amino acid analysis, a protein sample hydrolyzed to individual amino acids is applied to a cation-exchange column. The amino acids are eluted by gradually increasing the $_{p}H$ of the mobile phase. Answer the following:
   i) Describe the principles by which ion-exchange chromatography operates. **(5 marks)**
   ii) Differentiate anion- versus cation-exchangers. **(5 marks)**

END OF AGA 66601 FINAL EXAMINATION

UNIVERSITY OF ZAMBIA

School of Agricultural Sciences

Department of Crop Sciences

MSc Agronomy Programme- First Semester Final Examinations

AGC 6112: PLANT PHYSIOLOGY

Date 9 November 2010 **Time 09:00 to 11:30 hrs**

INSTRUCTIONS

1. Answer ANY 4 (FOUR) questions.
2. All questions carry equal marks.
3. Duration- 2.5 (two and half) hours.

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1. Can you account for the apparent lower yield performance of nitrogen- fixing plants compared to non nitrogen- fixing plants. **[25 marks]**

2. What is carbohydrate partitioning and explain its importance to plant productivity. **[25 marks]**

3. Explain growth and differentiation as components of plant development. **[25 marks]**

4. What are auxins and explain their effects in plant development. **[25 marks]**

5. Differentiate between biotechnology and genetic modification of organisms as tools for improving yield. **[25 marks]**

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

School of Agricultural Sciences

Department of Crop Sciences

MSc Agronomy Programme- First Semester FINAL EXAMINATION

AGC 6121: AGRO CLIMATOLOGY AND PHYSIOLOGY OF YIELD

Date November 17th 2010 **Time 09:00 to 12:00 hrs**

INSTRUCTIONS

1. Answer **ALL** questions.
2. Each section should answered in a **SEPARATE** booklet
3. Duration **3** (three) hours.

Section A

Question 1 ***(20 marks)***

Briefly define each of the following terms used in Agroclimatology

a) Dewpoint temperature;
b) Solar constant;
c) Emissivity;
d) Planentary boundary layer;
e) Tropopause.

Question 2 ***(20 marks)***

Given the following meteorological data as measured on 10 January 2010 in Mbala (Northern Zambia) located at 08°51'S and at 1384 m above sea level:

Maximum temperature	28°C
Minimum temperature	24°C
Maximum relative humidity	80 %
Minimum relative humidity	68 %
Actual sunshine hours	4.9 hours
Sunset hour angle (w_s)	1.527 radians
Extraterrestrial radiation (Ra)	50 MJ m^{-2} day^{-1}

Determine

a) Saturation vapour pressure (e_s)
b) Actual vapour pressure (e_a)
c) Solar radiation (R_s)
d) Clear-sky solar radiation (R_{so})
e) Net short wave radiation (R_{ns})

Question 3

The depletion of the solar energy and associated processes in the earth's atmosphere results in a temperature profile around the earth: ***(20 marks)***

a) What are the three distinct and very important sources of heat energy typical of the earth's atmosphere;
b) What are the constituents of the atmosphere that take a significant part in absorption of solar radiation;
c) There has been significant level of consensus amongst scientists that there has been a global precipitation change on Earth. What are these agreed changes according to IPCC (2001)?

Section B

1. Write short notes on any three of the following
    i. Leaf area index;
    ii. Stress syndrome;
    iii. Leghemoglobin;
    iv. Light extinction in plant canopies.
2. Give detailed description of Genetic and Physiological approaches of improving plant yield.

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

School of Agricultural Sciences

Department of Crop Science

MSc Agronomy Programme- First Year Final Examinations.

AGC 6162: HORTICULTURAL SCIENCE

Second Semester- 2009/2010

Date 15th April 2010 **Time 09:00 to 12:00 hrs**

INSTRUCTIONS

1. **ANSWER FOUR** Questions
   a. Question 1 is **COMPULSORY**
   b. Answer Q. 1 and **ANY THREE (3)** questions.
2. Duration- Three (3) Hours.

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1. The following is a model of carbohydrate partitioning in Peaches (*Prunus persica*) a deciduous fruit type.

   a) Young non fruiting tree Frame›root=leaves› laterals.
   b) Young fruiting trees Leaves›frame=fruit›laterals›roots
   c) Mature tree. Leaves›fruit›frame›laterals›roots.

   Suggest the differences that would be observed in partitioning patterns of an evergreen species such as Avocado (*Persea americana*)? **[25 marks]**

2. Describe commercial production of mango (*Mangifera indica*). In your answer include varieties, and environmental conditions also highlight the concept of holistic management. **[25 marks]**

3. Disease identification is critical in propagating plants. Briefly describe three (3) common methods of indexing plants. **[25 marks]**

4. Using specific examples describe the use of one common growth enhancer used in horticulture. In your answer include general effects, commercial formulations, **[25 marks]**

5. Give brief explanation of the following;
    a. Advantages of pruning fruit trees;
    b. Two common pests of Citrus trees;
    c. What are the general causes of variability in clones. **[25 marks]**

END OF EXAMINATION

UNIVESITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

CROP SCIENCE DEPARTMENT

UNIVERSITY EXAMINATIONS

AGC 6432 BIOMETRICAL GENETICS AND PLANT BREDDING APRIL 2010

INSTRUCTIONS

Answer Question No. 1 and any other THREE. Points for each question are indicated in brackets.

TIME: 3 hours

Q.1 A bean breeder wants to find out if epistasis is involved in the expression of resistance to Angular leaf spot. He crosses two varieties; the susceptible variety (Kabulangeti=P_1) and the resistant (Mexico 54=P_2). Some of the F_1 seeds were selfed to F_3. Four F_3 plants were randomly selected and each crossed to P_1, P_2 and F_1 (testers). The Average angular leaf spot scores of the progenies resulting from these crosses, planted in three replications are given in the table below.

Hybrids	Replication 1	Replication 2	Replication 3
L1 x P1	8.3	8.2	8.0
P2	4.1	3.9	4.0
F1	6.0	6.1	6.3
L2 x P1	7.4	7.0	7.1
P2	3.2	3.8	3.3
F1	4.0	5.8	5.0
L3 x P1	6.7	6.1	6.4
P2	2.9	2.9	3.4
F1	5.0	5.9	4.9
L3 x P1	5.6	5.0	5.2
P2	5.1	5.3	5.0
F1	4.7	4.9	4.8

Tasks

1. Confirm the presence or absence of Epistasis gene action in the expression of resistance to Angular Leaf spot in this population.
   Note: All essential steps must be shown
2. Estimate the Additive and Dominance genetic variances

Q. 2 Define selection (5 points). How is selection measured? (6 points) How would you improve selection in breeding for disease resistance? (8 points)

Q. 3 List the procedures that you know that are used in estimating stability parameters. (5 points) Describe in details any one of them. Use an illustration. (15 points)

Q.4 Explain the three sources of genetic variation and give their significance in plant breeding (20 points)

Q.5 Write short notes on the following: (5 points each)

a. Relationship between selection differential and selection intensity
b. The term 'Phenotype'
c. Similarities between diallel mating and North Carolina Design II
d. Homeostasis

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

Examinations for Master of Science in Plant Breeding and Seed Systems

AGC 6451: PLANT BREEDING METHODS
First Semester 2010/2011 Academic Year

DATE: Tuesday November 2nd 2010, AM. **TIME: THREE HOURS**

Answer five questions only. All Questions Carry Equal Marks

1.0 Write short notes on the following:

a) Exsitu Conservation
b) Somaclonal variation in Crop Improvement
c) The value of Multilocation Trials
d) Participatory Plant Breeding
e) Show how Scaling Test C which is given as [$C = 4F_2 - 2F_1 - P_1 - P_2$] was derived

2.0 a) Genetic variation is described as fixable and Non Fixable. Discuss these types of genetic variation and their application in crop Improvement

b) Discuss the essential requirements for an effective Indirect Selection Method for yield

ANSWER QUESTION 3.0 COMPULSORY QUESTION

3.0 Plant Physiologists have established that Abscisic Acid (ABA) is a drought signal in plants. ABA is produced in the roots at the onset of water stress. It is transported via the xylem from roots to the leaves and detected by stomatal guard cells which effect stomatal adjustment (or closure of the stomata) to reduce moisture loss from the plant through transpiration. ABA, hence acts as a signal from the roots to alert the rest of the plant, that there is danger of drought looming on the horizon for the plant to prepare itself by reducing moisture loss through closure of the stomata.

A drought tolerant plant will rapidly produce more ABA in response to moisture stress and thereby conserve water by closing the stomata compared to a drought susceptible plant.

Plant physiologists have developed a rapid non-destructive invivo ABA assay method for cultivated crops which involves collecting plant sap from the xylem cells at the base of the stem of a plant using a syringe under suction pressure and quickly analyzing the sap for concentration of ABA.

Suppose you have just been appointed Maize Breeder by the new Seed Company Bio Source Ltd. to develop **OPV** and **hybrid** maize varieties that will have **high yield potential** and **drought tolerance** for Zambia using the ABA assay approach and applying the S_1 Family Selection Breeding Method.

Clearly and comprehensively elaborate your Breeding Programme to develop OPV and Hybrid maize varieties with drought tolerance and high yield potential.

4.0 a) What do you understand by the term Response to Selection
b) What are the Factors that affect the response to selection
c) In the first year of a population Improvement Breeding Program in Maize, there was a drought, and so the Breeder decided to select primarily for husk cover (length of husk extension beyond the tip of the ear) that season. The mean of 250 families was 2.5 cm. The Breeder selected the best families, which have a mean of 3.1 cm. After recombining the selected families, he noted that the average for the improved population was now 2.8 cm. Assuming that the initial population still has a mean of 2.5 cm that year, what was the realized heritability for this trait?

5.0 Discuss some important achievements of plant introduction. Discuss the merits and demerits of Plant Introduction as a Breeding method

6.0 a) What is Inbreeding Depression and hybrid vigor?
b) Plant Breeders have come to value the exploitation of hybrid vigor or Heterosis in Crop improvement. Clearly discuss the process involved in the Single Cross hybrid Varieties of Sorghum.

7.0 a)The use of Doubled Haploids in Plant Breeding is becoming a very exciting Plant Breeding approach. Discuss its application in Self and Cross pollinated Crops.

b) What is the potential of the Doubled Haploid Method in Breeding of Vegetatively propagated Crops?

----------END OF EXAMINATION----------

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2010-2011 ACADEMIC YEAR SECOND SEMESTER
FINAL EXAMINATIONS

AGC 6452 MOLECULAR GENETICS AND BIOTECHNOLOGY

TIME: 3 HOURS

INSTRUCTIONS: ANSWER **FIVE** QUESTIONS

1. Discuss various plant tissue culture techniques and their applications to production of non-transgenic and transgenic crop plants.

2. Discuss the biology and applications of *Agrobacterium tumefaciens* and *A. rhizogenes* in the construction of transgenic crops.

3. Explain the essential features of typical cloning vectors that you would use for gene addition and gene subtraction strategies with specific examples of how these strategies have been applied in plant biotechnology.

4. Analyse the principles and uses of marker-assisted selection (MAS) in plant biotechnology and explain why in spite of high expectations, MAS technology has not been widely applied in breeding programmes in Zambia.

5. Explain the principles, advantages and limitations of AFLPs, ISSR and ESTs as molecular markers.

6. Discuss the principles and applications of somatic hybridization, embryo rescue and anther culture in plant biotechnology.

7. Analyse the scientific and social controversies that have led to near paralysis in the adoption of recombinant DNA technology in Zambia.

8. Distinguish between transcriptomics and proteomics with regards to underlying principles and applications in plant biotechnology.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

2009-2010 SECOND SEMESTER FINAL EXAMINATIONS

AGC 6462 MOLECULAR GENETICS AND BIOTECHNOLOGY

TIME: 3 HOURS

INSTRUCTIONS: ANSWER **QUESTION 1** AND ANY OTHER **FOUR QUESTIONS**. YOU MAY USE DIAGRAMS TO ENHANCE YOUR ANSWERS.

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1. The following fragment of a plant gene sequence is provided for you to investigate its functions in maize.

```
001 cctcctctcc cgtcctatcc atccggcacg cccagcatcc atccactcct cccctgctcc
061 ggctccggct ccggctccgc catgggcctt tcaacagttt actccccggc cggaccgcgc
121 ctcgtgccgg cccctctcgg ccgctgccgc tctgcccagc cccgccgccc gcgccgagcc
181 ccgctcgcca ccgtccggtg ctccgtcgac gccaccaagc aggcgcagga tggcgtggcg
241 acggcggtcg cgacggaggc gccggcgtcg cggaaggagt gcttcggggt cttctgcacc
301 acctacgacc tcaaggcgga ggacaagacc aagtcgtgga ggaagctagt gaatgttgct
361 gtgtcaggcg cggccgggat gatatcaaat cacctgctgt tcaaactcgc ttctggtgag
421 gttttcggac aagaccaacc aatagcactt aagctactcg gctcagaaag atcgtttcaa
481 gccctcgaag gtgtagctat ggaactggag gactcgctgt atccactgct gagggaagtc
541 agcattggca tagatcctta cgtggtcttt caagatgtag attgggccct tcttattggc
601 gctaagcccc gaggtcccgg catggagcga gctgcgctac tggatatcaa tggccaaatc
661 tttgctgacc aggggaaagc acttaatgcg gtcgcctcgc ggaacgacga agtcttagtt
721 gtcggaaatc cctgtaacac taatgcgctg atttgtttga aaaatgcccc aaacataccg
781 gcaaaaaact ttcatgcatt gacgaggttg gatgaaaata gagcaaagtg ccagctggca
841 ctaaaagcag gtgtatttta tgacaaagta tcaaacgtga ctatttgggg gaaccattcg
901 acgactcagg ttcctgattt cttgaatgcc aaaattgatg gaagaccagt gaaagaagtc
```

Design a strategy to silence the expression of the gene by the RNA interference (RNAi). Your strategy should clearly explain or outline:

(A) The type and features of DNA vectors of your choice,
(B) The types of in vitro gene constructs you would use,
(C) The appropriate enzymes and
(D) The subsequent analyses that you would do to determine if your plantlets no longer express your gene.

2. Summarize ANY THREE of the following:
   (A) Application of plant growth regulators in plant tissue culture.
   (B) Ti-plasmid
   (C) Somatic hybridization and its applications in crop plant research.
   (D) Embryo rescue.

TURN OVER

3. Distinguish between gene addition and gene subtraction strategies in plant biotechnology and using specific examples explain the challenges of each strategy as applied to your provided example.

4. Discuss marker assisted selection (MAS) as a strategy for plant breeding and provide reasons why MAS strategies have not been widely applied in Zambian agricultural research.

5. Compare and contrast conventional Polymerase Chain Reaction (PCR) and reverse transcription PCR (RT-PCR) and explain their uses in site-directed mutagenesis and plant gene expression analysis.

6. Compare and contrast plant transformation by the *Agrobacterium tumefaciens* and the biolistc methods.

7. Discuss the principles, uses and challenges of RADPs, RFLPs and simple sequence repeats (SSRs) molecular markers in plant molecular genetics.

END OF EXAMINATION

The University of Zambia
School of Agricultural Sciences
Department of Crop Science

AGC6552: Weed Science
Final Examination 2009/2010

Date: Monday, 19th April, 2010 **Time: Three (3) hours**

INSTRUCTIONS: ANSWER FIVE QUESTIONS

Q1. Write an essay on the availability and fate of herbicide in the soil. (20 marks)

Q2. Write briefly on the following:

a. Weed problem as a social problem. **(5 marks)**
b. IWM. **(5 marks)**
c. Success of weed is based on what aspects of plant growth. **(5 marks)**
d. Herbicides absorption. **(5 marks)**

Q3. Write an essay on the role played by genetic variation in weeds. **(20 marks)**

Q4. Write an essay on cultural weed control. **(20 marks)**

Q5. Briefly discuss the following:

a. Assessment of herbicide effects. **(5 marks)**
b. Biological control of weeds. **(5 marks)**
c. Growth inhibitors and their role in weed control. **(5 marks)**
d. Knapsack calibration. **(5 marks)**

(20 marks)

Q6. Write an essay on mechanical weed control **(20 marks)**

END OF EXAMINATION AND GOOD LUCK

University of Zambia

School of Agricultural Sciences
First Year Examination for Master of Science in Plant Breeding and Seed Systems

AGC 6611
Second Semester 2010/11

Date: 4th May 2011..... .....Time: 09 00 hrs

Instructions: Answer any six **Total marks: 100%**

1	Seed of a released variety is carefully multiplied by seed growers. During the different stages of seed multiplication and seed testing, the seed is checked for conformity to set standards. Seed lots that are satisfactory are certified for sale. However, the certified seed lot may be sold over a range of time and may deteriorate in its viability while in storage before it is sold. Discuss factors that may cause seed deterioration in storage highlighting how this can be avoided. **[10 Marks]**
2	There is interdependence between various components of the seed value chain. Please explain the interdependence of training, breeding, marketing and farmer. **[10 Marks]**
3	Most countries in southern Africa have opted for a variety release system that involves independent testing and formal release of candidate varieties. Distinguish the two systems and justify their choice. **[10 marks]** of variety release

4	Seed certification may be based on minimum standards or truth in labelling. Compare the two systems pointing out the advantages and disadvantages of each system. **[10 Marks]**
5	Assume you are a farmer on a farm whose total arable area is 500m x 500m (25ha). In your district every farmer grows maize during the country's only rain season. Your farm has adequate irrigation to cover the whole farm. Much of your arable land was grown of maize during the previous rain season. Your application to Felomu Seed Company to grow maize seed during the following rain season has been approved. Amongst the conditions for seed production is not to plant maize after maize on the same land and distance isolation of 200m. Assume that your neighbours may plant maize as close as the boundaries. Discuss how you would still succeed in multiplying one variety of seed maize for Felomu Seed Company indicating the maximum area (ha) you can multiply maize seed under each option. **[10 Marks]**
6	What is the relevancy and procedure of conduction the following seed quality tests for seed certification. a) Moisture content: b) Other seeds count c) Purity analysis d) Germination capacity e) Vigour **[10 Marks]**
7	Contrast the testing of Distinctness, Uniformity and Stability (DUS) and Value for Cultivation and Use (VCU) for the purpose of release. **[10 marks]**

-END-

The University of Zambia
School of Agricultural Sciences
2009/2010 Academic Year Second Semester
Final Examinations
AGE 6062: Production Economics
Time: Three (3) Hours

Instructions: There are four questions in this exam. Answer all.

1. Answer the following questions as concisely as possible.
   a) Sune Carlson contends that four forces interact to effectively determine the actions of profit-maximizing firms. Briefly discuss the four forces.
   b) Briefly explain why agricultural economists study production economics
   c) Compare and contrast polynomial production functions and von Liebig's Law of the Minimum

2. Sally Street has a small business in which she clears red cedar from pasture land. She operates as a price taker. The prevailing price for clearing cedars is $20 per acre. Her costs are given by

$$C(q) = 0.1q^2 + 10q + 50$$

where q is the number of acres Sally chooses to clear.

   a) Derive the average variable cost, fixed cost, and marginal cost
   b) How many acres should Sally clear to maximize profit?
   c) Calculate Sally's profit.
   d) Derive her supply curve.
   e) What is the elasticity of her supply curve at equilibrium?
   f) What is the minimum price of q at which she will operate in the short run?

3. Consider the following production function:

$$q(x_1, x_2) = 100x_1 - 2x_1^2 + 50x_2 - x_2^2$$

   a) Determine if the function is strictly concave.
   b) Derive the expansion path.
   c) Derive the factor demand for x_1.
   d) Determine the impacts of changes (comparative statics) in the price of x_1 on x_1, the price of x_2 on x_1, and the price of output on x_1.
   e) Derive the isoquant equation.

4. Given the following production function

$$q(x) = 3x^2 - \frac{1}{2}x^3$$

In which x is the number of workers employed. The price of output q is P = 75 and the cost of hiring a worker is r = 100.

a) Assume that the objective of a private firm is to maximize returns to the fixed factors of production. Derive the optimal number of workers for a private firm.

b) Assume that the objective of a cooperative is to maximize the average output $\left[\frac{q(x)}{x}\right]$ per worker. What is the optimal number of workers for the cooperative with this production function?

c) Which firm employs more workers? Will this generally be the case? Explain.

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2009/2010 ACADEMIC YEAR SECOND SEMESTER EXAMINATIONS
AGE 6091 INSTITUTIONAL AND BEHAVIOURAL ECONOMICS

TIME: THREE (3) HOURS

INSTRUCTIONS: This examination has Sections A and B. Answer both sections according to the instructions in each section

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SECTION A:

You are requested to **answer all the questions in Section A** that are based on the extract from the case study on animal health services.

Question A1

Present the main elements of the IAD framework. Which of these elements are discussed in the text below? Which are not?

[10 Marks]

Question A2

You are requested to discuss how you might structure contractual arrangements and/or delivery systems for animal health services in an African country with which you are familiar. Show clearly how the attributes of the service described below influence your recommendations. In addition also consider other salient factors, besides the attributes of the service you would need to take into account in devising an appropriate delivery system.

[30 Marks]

[Total Section A: 40]

Extract from the case study on animal health services (Kirsten et al. 2009: Ch 11)

Characteristics and attributes of animal health services

It is useful to discuss the economic characteristics and attributes of animal health services to help define the distribution of responsibilities between the public and the private sector, since these services can be carried out/delivered both by government veterinary staff (completely or partly free of charge) or by private veterinarians (usually at cost). Broadly speaking, the spectrum of animal health services includes preventive and control/inspection programmes and the treatment of sick animals. The most important tier of the animal health service structure is

the field animal health service, which is in direct contact with producers, animals and their products. The work done at the village, farm, herd/flock and individual animal levels is decisive for any animal health programme.

Animal health care services can typically be classified as private or public goods, depending on who receives the benefits (Leonard, 1993). At one extreme are purely private goods, which (i) only benefit the animal owner receiving the service: (ii) can be enjoyed exclusively by that owner (the exclusion principle): and (iii) when provided, exclude somebody else from that service at that particular time (the rival principle). For example, clinical treatment for a wound or worms would qualify as a pure private good because the treatment benefits only the owner of that animal: nobody else benefits; and the treatment excludes other farmers from the services of the veterinarian at that time. In contrast, services like quarantine and meat inspection are pure public goods as they do not directly benefit the owner of the animal and do not exclude other producers from that service.

As a rule, the higher the private benefit, the more justified it is to have the beneficiary pay for the service directly and to transfer the service to the private sector. Public sector management of private good services is justified if economies of scale are an important consideration or if sophisticated expertise or equipment is needed. In such cases, the services should be financed through direct payment from the beneficiaries and not from general revenue.

Pure public good services typically involve market failures, externalities, or moral hazards and should be managed by the public sector (although subcontracting to private operators is always possible) and financed by the general public revenue. Activities such as meat inspection approximate a purely public service and should therefore be financed and managed by public resources. Other examples of pure public goods would include veterinary public health and prevention; control or eradication of major epidemic livestock diseases that have the potential to affect the national economy through high production losses; losses in export trade or food insecurity at a national level. Individual farmers, particularly poor and marginalized farmers and private animal-health providers, are relatively powerless to protect themselves from these diseases, which require a national or even international approach for their control. This also includes the prevention and control of zoonotic diseases and other food-safety issues that could cause substantial public-health concerns in communities. The control of tsetse fly that transmits cattle trypanosomiasis is one important example.

Between these extremes, there is a continuum of diseases and animal health concerns with varying public and private attributes. Brucellosis, for example, is a classic zoonotic disease with high infection rates in rural populations. It frequently affects whole families in a short time, causing severe disability and family crisis, because most of the wage earners will be sick simultaneously. If medical treatment is sought or available, the disease results in significant economic loss to individuals and countries. There is a clearly recognized public good in controlling this disease in livestock, the only source of infection for humans. Brucellosis species cause abortion and decreased lactation in female cattle or small ruminants, so prevention is clearly a private good for livestock owners. Both individual owners and the public sector could have obligations to pay the costs of controlling this disease.

One important aspect of animal health service delivery that complicates the decision on who should provide or pay for the service relates to the externalities produced by these services. Externalities are spillover effects from production or consumption of a given service. Market operations may be ill equipped to allocate resources optionally where externality exists. Typically therefore, either too little (in the case of a positive externality), or too much (in the case of a negative externality), is produced or consumed in the absence of a price mechanism to determine the value of these externalities. A vaccination for control of epidemics is an example of a service with a positive externality. Controlling the spread of foot and mouth disease or rinderpest in a given region checks the spread to other regions. Also, cattle dips built for the treatment of ticks and tick-borne diseases (especially East Coast fever in East Africa), produce predominantly private benefits. However, if participation is low, the population of ticks resistant to the acaricide may increase and pose a threat to all farmers, including those participating in the programme. Due to these externalities there is thus a public element in a dipping programme, suggesting the need for some state involvement.

An additional attribute of animal health services is the existence of economies of scale. This relates to the research and production of vaccines, veterinary drugs and supplies, and individual veterinary practices. All entail significant indivisible fixed costs, which reduce with the scale of operation and sales. The cost of input delivery is at times increased substantially as a result of widely dispersed farmers. Under such circumstances, natural monopolies enjoying economies of scale deliver the inputs at a comparatively lower cost. However, net welfare losses rather than gains arise from monopolistic market structures leading to a sub-optimal allocation of resources.

Furthermore the limited skills and knowledge of farmers about animal diseases and its diagnosis confirms a typical situation of information asymmetry, where one party is better informed about the details of a given transaction than the other, providing scope for opportunistic behaviour. An animal health service provider is capable of administering expired vaccines or drugs to an animal since the farmer is not able to evaluate the quality. Likewise, an animal health service provider can recommend a more costly course of therapy in order to realize higher returns from a transaction.

Based on this discussion, it follows that the roles of the private and public sectors in the delivery of animal health services are not so clear-cut. While recognizing the broad spectrum of animal health services and the varied economic characteristics of different animal health services, Gros (1994) points to the possible complementarities of the public and the private sector in the provision of animal health services. In addition, Gros (1994) observes that whereas most services can be classified as private goods, public goods or services that confer externalities, the original design of the animal delivery system, and the nature of most animal diseases in Africa mar this distinction somewhat. Most contagious diseases in Africa such as Foot and Mouth Disease or Rinderpest cannot be cured. However, vaccinations exist and the very fact that they are 'notifiable' diseases in some countries makes it mandatory that the animal health authorities and farmers are alerted in the case of an outbreak. Whereas the diagnosis of such a disease by an animal health specialist exhibits the rivalry principle, the control measures instituted, including vaccinations confer positive externalities on neighbouring farmers. According to Gros

(1994) therefore, some curative services in Africa assume a public good rather than a pure private good character. The above notwithstanding, some curatives such as treating a case of trypanosomiasis or a surgical intervention for delivering a calf by caesarean section exhibit pure private good characteristic since only the herd owner gets benefits and there are no externalities. This suggests a need to take the characteristics of the disease, the (intervention) technology needed for prevention and cure as well as the economic benefits flowing from the delivery of the service (all collectively referred to as the techno-economic characteristics of the activity/good) into account to inform the optimal delivery mode of animal health services.

SECTION B

Answer any three questions

Question B1

Explain the major academic contributions of Elinor Ostrom and Oliver Williamson that led to their selection as recipients of the 2009 Nobel Prize for Economics. Illustrate their impact on the agricultural economics discipline by describing an application of the work of **either** Ostrom **or** Williamson to an issue in African agricultural development.

[20 Marks]

Question B2

Discuss the importance and role of coordination in the utilization of natural resources, making reference to the various mechanisms for coordination in natural resource management. Discuss how different physical and technical characteristics of a resource would affect the appropriate management structure or system for natural resource management.

[20 Marks]

Question B3

You are a farmer who has just benefited from a redistributive land reform programme in a hypothetical country "Azania". Explain the view you would hold about the role of the state or any other organization in protecting property rights. In this light you are also asked to contrast the concepts "property rights" and "land reform". Are they reconcilable?

[20 Marks]

Question B4

Name and discuss the dimensions and incentive attributes of different contract enforcement institutions that are relevant in the market exchange of agricultural commodities.

[20 Marks]

Question B5

In light of the development challenges facing agriculture and agribusiness in Africa you are requested to illustrate the value of having an "institutional economics" perspective in finding real solutions to these challenges. Drawing on real examples, your answer should **both** highlight how weak institutions affect market performance **and** illustrate the importance of institutional change in improving the economic performance in African countries.

[20 Marks]

[Total Section B: 60]
Grand total [100]

The University of Zambia
School of Agricultural Sciences
2010/11 Academic Year First Semester
Final Examinations
AGE 6222: International Trade Theory and Policy

TIME: THREE HOURS
INSTRUCTIONS: ANSWER ALL QUESTIONS

1. Consider a Ricardian model with two countries, England and Zambia, producing two goods, wine and maize. Suppose the unit-labor requirements in wine production are: $a_{LW}^{Eng} = 1/3$ hour per liter, and $a_{LW}^{Zam} = 1/2$ hour per liter, while the unit-labor requirements in maize are $a_{LC}^{Eng} = 1/4$ hour per kg, and $a_{LC}^{Zam} = 1/2$ hour per kg.
   a) Which country has the absolute advantage in wine? … in maize? Explain.
   b) Which country has the comparative advantage in wine?... in maize? Explain.
   c) According to Ricardo, state how these two countries would take advantage of the potential benefits of trade?

2. If the liberalization of agricultural markets proceeds in the future, many countries may eliminate export subsidies to farm products. Use a partial equilibrium (supply and demand) diagram to depict the price and welfare effects of export subsidy elimination for corn. Assume that the country is small in international markets.

3. Suppose there are only two countries, the US and China producing and consuming clothing. Suppose in free trade China exports clothing to the US.
   a) At the free trade price, in which country is the supply of clothing greater than demand?
   b) At the free trade price how does world supply compare with world demand for clothing? (i.e., greater, less, or equal)
   c) If the US and China were in autarky rather than free trade, in which country would the price of clothing be higher?
   d) In moving from autarky to free trade would the price of clothing rise, fall or stay the same in the US?
   e) In moving from autarky to free trade would the price of clothing rise, fall or stay the same in China?
   f) Starting from free trade, if the US places a tariff on imports of clothing, how would the price of clothing change in the US?
   g) Starting from free trade, if the US places a tariff on imports of clothing, how would the price of clothing change in China?
   h) How would a tariff on US imports of clothing affect the amount of clothing produced in the US?
   i) How would a tariff on US imports of clothing affect the amount of clothing demanded in the US?

4. Does trade theory suggest that trade liberalization by a small importing country will make everyone in the country better-off? Why or why not? Explain briefly.

5. Explain the theoretical foundation of the countervailing duty policy employed in trade disputes and discuss how it may be used strategically to impede free trade.

The University of Zambia
School of Agricultural Sciences
2010/11 Academic Year First Semester
Final Examinations
AGE 6231: Quantitative Analysis of Agricultural Policies

TIME: THREE HOURS
INSTRUCTIONS: ANSWER ALL QUESTIONS

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

2. Assume that there are three categories of agricultural products that the consumer food and fiber expenditure can go towards. These categories are crops (C), livestock (L), and fiber (F). further assume that crop products include wheat (W), corn (N), and rice (R); livestock category includes meats (M) and dairy (D); and the fiber category includes cotton (T) and wool (O).
   a) If you were to estimate the demand for rice using the conventional method of utility maximization subject to the food and fiber expenditure constraint, what would be the total number of parameters to be estimated?
   b) After applying the general restrictions on demand, specify the number of parameters to be estimated. Specify the restriction and the number of parameter reduction by each restriction.
   c) Using a two-stage budgeting procedure, explain how you would estimate the demand for rice. What is this demand a function of (*specify the endogenous and exogenous variables*)? Specify the number of parameters to be estimated in the demand for rice equation as well as in the system using the two-stage budgeting procedure.
   d) Two-stage budgeting implies separability of preferences. Define the concept of separability and give the necessary condition for the utility function to be separable.

3. Consider the following demand system for the Zambian meat sector.

	$\ln P_m$	$\ln P_d$	$\ln P_c$	$\ln Y$	W_i
$\ln Q_m$	-1.00	0.30	0.50	0.20	0.30
$\ln Q_d$	2.00	-0.50	-2.00	1.50	0.50
$\ln Q_c$	0.60	1.50	-0.10	1.00	0.20

where W_i is budget share for commodity i; i = m for meat, d for dairy, c for cereal; and Q and P are quantity and price, respectively.

For each of the following conditions, give the formula and show whether the property holds for the above demand system. Specify the number of equations you need to write to check for each property.
   a) The Engel aggregation condition(s)
   b) The Cournot aggregation condition(s)
   c) The symmetry condition(s) for meats and cereals
   d) The homogeneity condition(s)

4. Stone's original work begins with the following equation:

$$\log q_i = \alpha_i + \eta_i \log x + \sum_{k=1}^{n} e_{ik} \log p_k$$

a) Show the steps that are taken to derive the following demand system

$$\log q_i = \alpha_i + \eta_i \log\left(x/P\right) + \sum_{k \in K} e_{ik}^{*} \log\left(p_k/P\right)$$

b) What is P (the deflator)? Give the formula to calculate P and specify what commodities it includes.

5. 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) Derive the individual's Marshallian demand curves
b) Calculate own-price elasticities for shelter and food
c) Derive the indirect utility function

UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2009/2010 ACADEMIC YEAR SECOND SEMESTER
FINAL EXAMINATIONS
AGE 6311: SEED AGRIBUSINESS
TIME: THREE (3) HOURS

INSTRUCTIONS: ANSWER BOTH QUESTIONS IN SECTION A AND ANY THREE OF THE FOUR QUESTIONS IN SECTION B. ANSWER EACH SECTION IN SEPARATE ANSWER BOOKS

Section A (40 points)

1. Forecasts affect decisions and activities throughout an organization
   a) State three examples of decisions that can benefit from forecasts. (**1.5 Marks**)
   b) List three elements of a good forecast (**1.5 Marks**)
   c) Compare and contrast judgmental and time series forecasts (**4 Marks**)
   d) Suppose you have time series observations of a variable of interest for the first five periods and would like to derive a forecast for the sixth period.

Period, *t*	1	2	3	4	5	6
Actual	40	42	42	44	43	?

   i) Determine the forecast for the sixth period using the three-period moving average (**4 Marks**)
   ii) Determine the forecast for the sixth period using exponential smoothing, assuming $\alpha = 0.1$. (**4 Marks**)

2. Palm Associates, a Lusaka-based business, has scarce resources of land, labor and capital, and would like to determine how to allocate these resources between two competing cropping enterprises – maize and sorghum. They have 20 hectares of land, 72 man-days of labor, and $300 of capital. Maize requires four man-days of labor and $5 (capital) per hectare. Sorghum requires two man-days of labor and $20 of capital per hectare. The company expects a gross margin of $80 per hectare for maize and $70 per hectare for wheat.
   a) Set up the following
      i) The primal model in algebraic and tableau formats. (**2 Marks**)
      ii) The dual model in algebraic and tableau formats. (**2 Marks**)
   b) Write out the syntax/code that you would use to solve the primal problem using the Generalized Algebraic Modeling System (GAMS). (**6 Marks**)
   c) Use the simplex method to solve the problem (**9 Marks**)
   d) What is the value of the objective function in the optimal solution? (**1 Mark**)
   e) What is the optimal quantity of each of the real and slack activity? (**5 Marks**)

Section B (60 points)

1. Strategic marketing plan integrates all business activities and resources logically to meet customer needs and to generate profit. Explain the strategic market planning process. (**20 Marks**).

2. Risk management is an important consideration in many seed agribusiness decisions today. Discuss this statement; highlighting the types of risks faced by seed agribusinesses and how they can be minimized **(20 Marks)**

3. a. Explain the critical decision making areas that a seed agribusiness manager has to focus on when carrying out the financial management function **(12 Marks)**
   b. There are various alternatives for financing a seed agribusiness, amongst which include equity and debt financing. Compare and contrast equity with debt financing **(8 Marks)**

4. Write short notes on the following:
   i. The functions of human resources management **(4 Marks)**
   ii. Seed agribusiness as a system or value chain **(3 Marks)**
   iii. Factors that affect location of a seed agribusiness **(5 Marks)**
   iv. Compare and contrast a limited company and a cooperative (**8 Marks**)

----------**END OF EXAM**----------

UNIVERSITY OF ZAMBIA

UNIVERSITY SECOND SEMESTER EXAMINATIONS-APRIL, 2010

AGG 6132: SOIL PLANT WATER RELATIONS

Time: Three (3) Hours **Marks**: 85
Instruction: Answer all Questions

Non-programmable calculators are allowed

1. Briefly define each of the following terms ***(20 marks)***
   a) Aeration porosity
   b) Soil water potential
   c) Surface tension
   d) Field capacity
   e) Infiltration rate

2. With the aid of a diagram describe the four points on the soil water characteristic curve (pF curve) that can be used to construct one using field and laboratory measurements ***(10 marks)***

3. A layered vertical soil column consists of a loamy textured soil (*L=25cm*) with a sandy textured soil (*L=75cm*) layer over it. The top of the column has water ponded at a constant height of 10 cm above it, and the bottom is open to the atmosphere. The hydraulic conductivity of the sandy layer is five times greater than the loamy layer. If the discharge is -13.75 cm^3/hr over a cross-sectional area of 100cm^2: Note: $dH_1+dH_2=110cm$ ***(15 marks)***

   a) Calculate the flux in (*i*) mm/day and (*ii*) m^3/day/ha
   b) Calculate the water potential (h) at the interface between the two layers (in cm)
   c) Calculate (***i***) the hydraulic conductivities of each layer and (***ii***) the effective hydraulic conductivity of the entire system (in mm/day)

4. Given the following soil moisture and hydraulic head measurements using a neutron probe and tensiometers in an irrigated maize field at the University Farm, ***(20 marks)***

	April 3		April 10	
Depth (cm)	H (cm)	θv (%)	H (cm)	θv (%)
10	-288.2	16.8	-458.2	7.5
30	-202.5	18.6	-275.5	15.9
50	-186.1	17.3	-205.0	16.2
70	-187.4	16.8	-202.5	16.7
90	-191.2	24.1	-206.2	24.2
110	-241.6	15.2	-242.8	15.5

determine:

a) The plane of zero flux during the measured period (cm)
b) The change in soil water storage during the measured period from the surface to the 90cm (m^3/ha)
c) The amount of water loss in the profile through (***i***) soil surface and (***ii***) depth below 110 cm

5. The following soil profile data was obtained from a representative soil profile from a winter maize field irrigated with an overhead (pivot) irrigation system in Mukushi Farm Block, Northern Zambia. ***(20 marks)***

Depth (cm)	Bulk Density (g cm^{-3})	Gravimetric Water Content (%)	
		Field Capacity	Wilting Point
0 – 10	1.71	17.3	4.4
10 – 23	1.67	14.4	2.4
23 - 63	1.58	13.2	3.4
63 - 100	1.52	19.9	5.3
100 - 183	1.59	14.2	4.0

a) Determine the available water-holding capacity (AWC) of the soil profile to a depth of 1 meter (mm/m)
b) Determine the depth of air in the entire profile when the soil water content is at field capacity
c) If 50mm irrigation is applied, how deep will the irrigation water penetrate the soil profile
d) What measures would you take in order to increase the available water-holding capacity of this soil

End of Exam

THE UNIVERSITY OF ZAMBIA

UNIVERSITY FIRST SEMESTER EXAMINATIONS – NOVEMBER 2010

AGG 6141
PLANT NUTRITION

TIME: 3 Hours Marks: 80

INSTRUCTIONS: **ANSWER ALL QUESTIONS AND WRITE LEGIBLY**

1. Define the following:

   a. Water potential [2 Marks]
   b. Osmosis [2 Marks]
   c. Chlorosis [2 Marks]
   d. Plant nutrition [2 Marks]
   e. Molybdenosis [2 Marks]

2. In terms of nutrient ion uptake there are two (2) well defined mechanisms.

   a. Define Mechanism I and Mechanism II. [4 Marks]
   b. Describe the characteristics of Mechanism I and Mechanism II. [6 Marks]

3. The appreciation of plasma membrane in the study of plant nutrition is important.

   a. With the help of a drawing describe the morphology of the plasma membrane. [8 Marks]
   b. Explain how some nutrient uptake selectivity takes place in the cell wall while most of the selectivity takes place in the plasma membrane. [4 Marks]
   c. What role is played by plant CEC in the nutrient uptake selectivity? [2 Marks]

4. There are different mechanisms involved in the control of ion concentration in the plant.

   a. Describe three (3) mechanisms which may be involved in the control of uptake rate of nutrients. [6 Marks]
   b. Describe two (2) Fe uptake control mechanisms in most plants. [4 Marks]
   c. How do grasses react to low Fe availability in the soil? [2 Marks]

5. The characteristics of ion uptake by roots are determined primarily by the transport across membranes. Describe the following:

   a. Physicochemical factors which control the rate of membrane transport. [4 Marks]
   b. Metabolic factors that affect ion uptake. [8 Marks]

6. In terms of ion interactions in the plant, what is
    a. Competition? [2 Marks]
    b. Synergism? [2 Marks]

7. Several elements have been found to be essential for the growth and development of higher plants.

    a. What is the micronutrient deficiency that is common in maize in Zambia and one clear symptom is dwarfism? [2 Marks]
    b. How would you distinguish chlorotic symptoms of sulphur from those of nitrogen? [2 Marks]
    c. List one (1) function of each of the following essential elements:
        i. Phosphorous [2 Marks]
        ii. Copper [2 Marks]
        iii. Calcium [2 Marks]
        iv. Sulphur [2 Marks]
        v. Chlorine [2 Marks]
        vi. Manganese [2 Marks]
        vii. Boron [2 Marks]

END OF EXAMINATION

UNIVESITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

CROP SCIENCE DEPARTMENT

UNIVERSITY EXAMINATIONS

AGG 6211 BIOSTATISTICS OCTOBER 2010

INSTRUCTIONS

Answer Question No. 1 and any other THREE. Points for each question are indicated in brackets.

TIME: 3 hours

Q.1 (a). As a new recruited agronomist you are requested, as your first assignment, to explain when to use the Youden Square Design, what it is and how to analyze the data obtained from such a design. Use a hypothetical example to illustrate your answer giving a comprehensive interpretation of the results from your example **(25 points)**

Q.1 (b). You are given information/data on drought occurrence in the last two centuries as follows:

	Drought	No Drought
1801-1909	4	45
1910-2010	14	42

The question poised is, 'are the summers of the current century significantly more prone to drought than the previous one?' Establish the basis of responding to this question substantively **(15 points)**

Q.2 Write short notes on the following: **(4 points each)**

a. Uses of Regression versus uses of Correlation analysis
b. Advantages of the Completely Randomized Design compared to those of the RCBD
c. Components of a Research proposal versus components of a Research Report
d. Importance of clear definition of a problem in research
e. Applications of Split-Plot Design

Q. 3 Given the following data from an experiment on diet effects on milk production in which a Latin Square Design was used, **analyze** the data and **indicate the efficiency** of this design over Randomized Complete Block Design. Four feeding diets A, B, C and D were used **(20 points)**.

		Cows			
		1	**2**	**3**	**4**
Periods of milking (each being three weeks long)	**1**	A=192	B=195	C=292	D=249
	2	B=190	D=203	A=218	C=210
	3	C=214	A=139	D=245	B=163
	4	D=221	C=152	B=204	A=134

Q. 4 In a study on productivity of potato the following data were obtained.

Fertilizer amount (kg/ha)	Yield (tons/ha)
0	18.34
100	19.56
200	20.15
300	20.99

Test the hypothesis that the change in yield was due to the increase in fertilizer rate. Draw conclusions from your analysis. **(20 points)**

Q.5 List the assumptions that must hold for Analysis of Variance to be used **(8 points)**. For two of these illustrate how you would test for their validity. **(12 points)**

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY SEMESTER EXAMINATIONS, APRIL 2010

AGS: 6432
Soil Amendments and Fertilizer Technology

TIME: 3Hrs MARKS: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS

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1. (a) Distinguish between industrial and biological nitrogen fixation [4]

   (b) Describe the cost elements that would be implicit in the local production of NH_3 using the Haber-Bosch process. [5]

   (c) Describe how H_2 is generated from coal and natural gas. Compare the yield of H_2 from each of these materials [5]

   (d) How much NH_3 would be produced from one ton of coal with a purity of 58%? [10]

2. (a) Describe the reaction of agricultural lime in acid soil [6]

   (b) Plant breeders can develop crops tolerant or resistant to all plant physiological conditions in acid soils. Is this a certain means to eliminate the need for lime and fertilizer? [6]

   (c) Why does organic matter ameliorate soil acidity? Does this effect eliminate the need for lime and fertilizer? [6]

   (d) i. Why should lime not be mixed with nitrogenous fertilizers? [3]
   ii. Why would such a mix be more acceptable with agricultural lime than with other forms of lime? [4]

3. Given that a sachet of Rhizobium inoculum costs K10,000 and it can treat 50kg of soyabean seed enough for 1 ha, work out the gross margin for using inoculums versus inorganic fertilizer for a crop yield of 2.5 ton ha^{-1}. Soyabean sells for \$420 ton^{-1}. [10]

4. Explain the basis for the myth that inorganic fertilizer destroys the soil and advance arguments to dispel it. [10]

5. (a) Discuss the merits and demerits of the Fertilizer Support Programme (FSP) as implemented in Zambia. [5]

   (b) In what specific ways could the FSP be reformed in order to make it efficient and effective? [6]

6. A soil with a bulk density of 1.3 gcm^{-3} tested 0.15 cmol K kg^{-1}. If the target yield of maize on this soil was 5ton ha^{-1}, calculate the deficit K if any that must be compensated for by applying iorganic fertilizer. How much D compound should be applied? [10]

7. Outline the process of production of single super phosphate. Calculate the amount of acid needed to produce 50% of partially acidulated phosphate rock. [10]

END OF EXAMINATION

UNIVERSITY OF ZAMBIA,

2010 SECOND SEMESTER EXAMINATIONS

AGS 6442

SOIL MINERALOGY

Marks: 100

Instructions: Answer all questions: **Time:** 3 hours

1. Define the following: **(10 marks)**

   a. Anhedral crystal
   b. Short range order mineral
   c. C2/m2/m2/m
   d. Sesquioxides
   e. [010]

2. Indicate whether the following statements are true or false. **(10 marks).**

   a. In the structure of the crystal $CaCO_3$, the carbon atom exists as a cation.

   b. The mineral $Al_2Si_2O_5(OH)_4$ has a lower CEC than the mineral $K_{0.3}Al_2(Al_{0.3}Si_{3.7})O_{10}(OH)_2$.

   c. A soil dominated by FeOOH and $Al(OH)_3$ in its clay fraction is more highly weathered than a soil containing $CaSO_4.2H_2O$ and $CaCO_3$ in its clay fraction.

   d. A mixture of 95 % gypsum and 5% quartz contains more calcium than pure dolomite.

   e. Smectites have higher specific surface areas and CEC than vermiculites.

   f. Cok_α radiation has shorter wavelength than Co k_β radiation.

   g. A 100 mg clay sample containing 40 % kaolinite will have a weight loss of more than 5 mg at 550°C when heated in a furnace.

   h. Montmorillonitic clays are not likely to be found in Oxisols.

Some useful Atomic masses: Ca=40, S=32, K=39, Na=23, Cl=35.5, O=16, C=12, Si=28, Al=27, H=1, Mg=24

3. Answer the following questions briefly and concisely. *(20 marks)*

   a) List the 7 crystal systems and describe their properties *(5 marks)*

   b) Minerals in soils are sometimes classified as primary or secondary minerals. Define these terms and give examples of three minerals that belong to each of these two classes. For each example give the name and chemical formula of the mineral. *(5 marks)*

   c) X-ray diffraction is a technique commonly used for identifying minerals. Describe what kind of information one can obtain about minerals using this technique. *(5 marks)*

   d) Silicates are an important group of mineral in soils. List the structural classes of silicate minerals and describe the arrangement of SiO_4^{4-} tetrahedra in any three of these classes. *(5 marks)*

4. An investor in the agro minerals industry wants to use some of the waste rock material generated at a gemstone mine. The waste rock contains high amounts of the mineral phlogopite ($KMg_3(Si_3Al)O_{10}(OH)_2$) which the investors wants to use as a source of magnesium and potassium. Answer the following questions: *(20 marks)*

   a) To which group of layer silicate minerals does phlogopite belong? *(2 marks)*

   b) Is phlogopite dioctahedral or Trioctahedral? Give reasons to support your answer. *(3 marks)*

   c) Draw a schematic diagram of the structure of phlogopite showing the planes in which all the elements in the formula of the mineral occur. *(7.5 marks)*

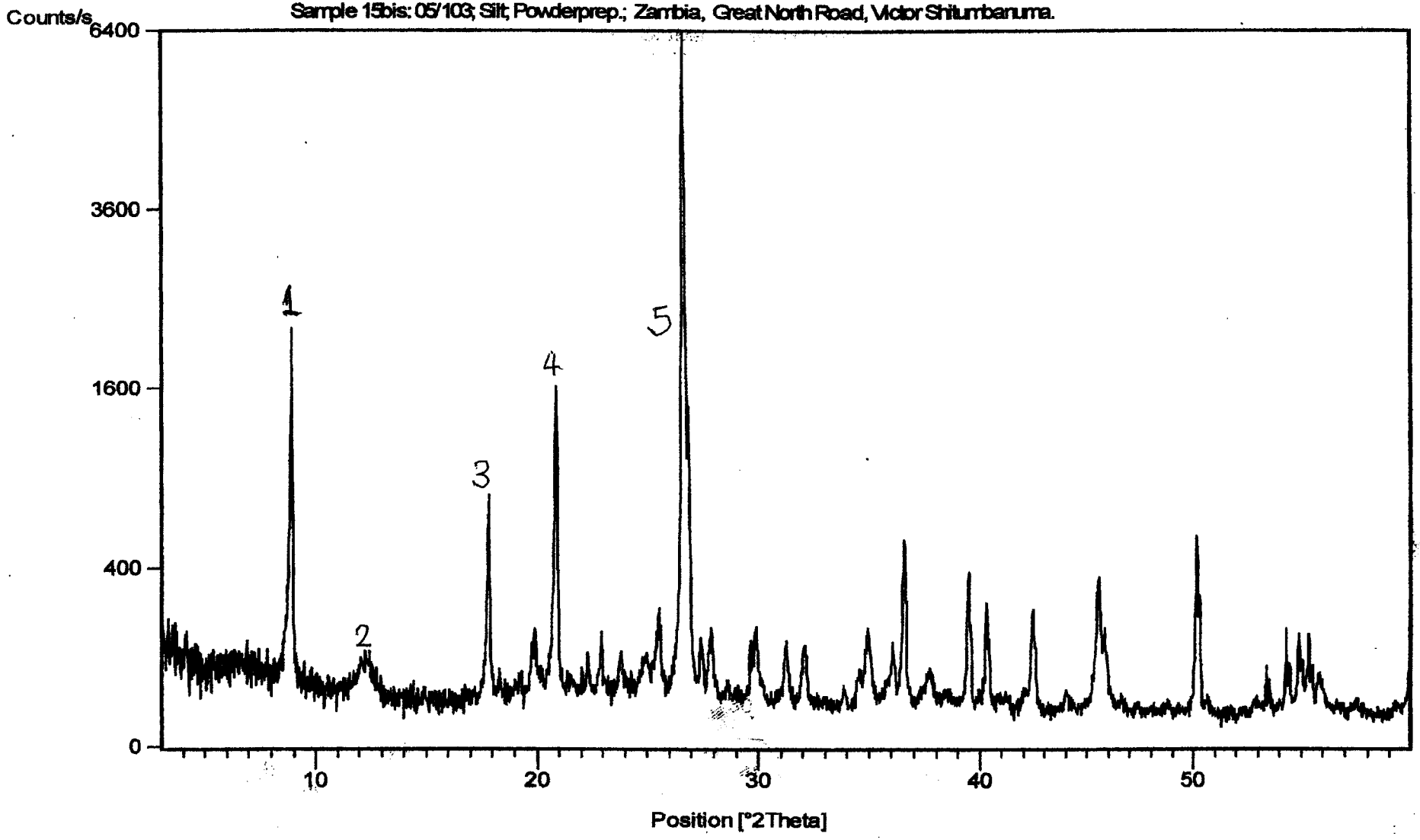
   d) Is phlogopite likely to expand and contract upon wetting and drying? Give reasons to support your answer. *(2.5 marks).*

   e) If the waste rock contains 65 % by weight phlogopite, calculate the amount of potassium and magnesium associated phlogopite in one metric tonne of waste rock. *(5 marks).*

5 Attached is an X-ray diffractogram of the silt fraction of a soil from a farm along the Great North Road in Lusaka. The soil sample was analyzed using an X-ray Diffractometer that emits Cukα radiation with λ=0.154 nm. Answer the following questions. *(25 marks)*

   a) Calculate the d-spacings corresponding to the peaks on the diffractogram labelled 1, 2, 3, 4 and 5. (*4 marks*)

   b) Identify the minerals responsible for the peaks labelled, 1, 2, 3, 4 and 5. Give the names and chemical formulas and reasons to support your answers *(4 marks*)



File: 05103P15.RD

Diffractogram of Silt Fraction.

c) Which of the minerals identified has the smallest sized crystals in the sample? Give reasons to support your answer. (***2 marks***)

d) If a TGA of 100 mg of silt fraction of this soil gives a weight loss of 2 mg at 550° C, and a chemical analysis of the silt shows a K content of 4 %, calculate the percentage content of the minerals you identified by X-ray diffraction analysis if they are assumed to be the only minerals present in the sample.
(6 marks)

e) Based on the mineralogical composition of the silt fraction do you expect this soil to be inherently fertile? Give reasons to support your answer. ***(4 marks)***

f) Assuming the CEC of vermiculite is 120 $cmol_c$/kg, that of smectite is 80 $cmol_c$/kg; that of mica or illite is 20 $cmol_c$/kg, that kaolinite is 10 $cmol_c$/kg and that organic matter is 200 $cmol_c$/1kg, what is the dominant layer silicate mineral present in the fine earth fraction of a soil with a CEC of 7.4 $cmol_c$/1kg soil, an organic content of 1.2 % and clay content of 36.3 % in its fine earth fraction. ***(5 marks)***

Some important prominent d spacing for common non layer silicate mineral in soils:

Quartz: 4.27 Å 3.34 Å Hematite 2.69 Å 2.51 Å Calcite: 3.04Å

6 Gypsum is an important agro-mineral which is used as a source of calcium and sulphur in crop production and as a soil amendment for reclaiming sodic soils. The unit cell parameters for gypsum are:

$a = 5.68$ Å, $b = 15.18$Å, $c = 6.28$ Å, $\alpha = 90°$, $\beta = 113° 50'$, $\gamma = 90°$

Answer the following questions: ***(15 marks***)

a) To which crystal system does gypsum belong? Give reasons to support your answer? ***(3 marks)***

b) Calculate the axial ratio of this mineral. ***(3 marks)***

c) Does gypsum have an open or closed crystal form? Give reasons to support your answer. ***(3 marks)***

d) At what 2θ value will the peak for the (100) spacing of gypsum occur on a diffractogram when the crystal is analyzed with Cukα that has $\lambda = 1.542$ Å. ***(3 marks)***

e) If a newly discovered deposit of gypsum in Siavonga District which has gypsum as the only source of sulphur contains an average of 13 % sulphur. What is the average grade or percentage of gypsum in this deposit? ***(3 marks)***

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
MSc. AGRONOMY – SOIL SCIENCE

UNIVERSITY SECOND SEMESTER EXAMINATIONS – APRIL 2010

AGS 6532
SOIL CONSERVATION

TIME: 3 Hours Marks: 100
INSTRUCTIONS: **ANSWER ALL QUESTIONS AND WRITE LEGIBLY**

1. Briefly describe:
   a. Three types of erosion and; [6 Marks]
   b. Factors that are considered in the Universal Soil Loss Equation (USLE). [6 Marks]

2. Given an area where small scale farmers practice soil conservation, list three practices under:
   a. Agronomic/biological measures [6 Marks]
   b. Soil management measures [6 Marks]
   c. Mechanical measures [6 Marks]

3. List five (5) simple technologies you would recommend to a small scale farmer to help reduce soil erosion and explain how effective each one of the technologies is in erosion control. [10 Marks]

4. Listed below are different forms of land degradation. Discuss the causes, the evidence of these types of degradation and how to correct (alleviate) the same:

   a. Salinization [3 Marks]
   b. Pollution [3 Marks]
   c. Nutrient imbalance [3 Marks]
   d. Loss of organic matter [3 Marks]
   e. Compaction [3 Marks]

5. Discuss two important socio-economic factors you think may have contributed to land degradation more evidenced by erosion in the Southern Province of Zambia. [10 Marks]

6. Examine the data in the attached Tables on soil properties under shifting cultivation (Chitemene) and compost mound (Fundikila) systems of the Northern Province of Zambia.

    a. Discuss the merits and demerits of each system as a strategy for reversing soil degradation and improving soil productivity. [10 Marks]

    b. What interventions with soil amendments and fertilizers would be appropriate to each system in order to improve soil quality and fertility? [10 Marks]

7. Tropical soils are different from soils from temperate.
    a. What is meant by the statement that "tropical soils are fragile" and how can this fragility be addressed? [10 Marks]

    b. Why are the tropical soils more acidic in nature? [5 Marks]

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

2010 SECOND SEMESTER EXAMINATIONS

AGS 6622

SOIL SURVEY AND AERIAL PHOTO INTERPRETATION

INSTRUCTIONS: ANSWER ALL QUESTIONS

TIME: THREE (3) HOURS **MARKS: 80**

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1. Since the 1980s Zambia developed a land capability classification system:

   a) Explain the main characteristics of this system. (5 marks)

   b) Explain the meaning of each of the following land capability classes in the Zambian system: (10 marks)

   C3w , S1d, Gw, C4d, and S2s

2. During an experimentation at UNZA Farm, the following data on soil organic matter (%) were collected from different mapping units as provided below:

   3.44, 3.60, 4.40, 3.20 and 5.84 (15 marks)

   a) Determine the coefficient or variation of the data.

   b) Calculate the standard deviation

   c) How good can this data be used for mapping?

   d) How can organic matter be increased in this soil mapping unit?

2. a) How useful would soil survey information be in fisheries? (4 marks)
   b) Explain the different approaches in soil surveying. (6 marks)

3. A soil is classified as an Ustox at suborder level. Answer the following questions:

   a) Describe the general characteristics of the soil. (5marks)

   b) Explain its main agricultural limitations. (5 marks)

4. a) What is a soil catena? (5 marks)

   b) What is soil variability? (5 marks)

5. a) How are air-photos used in soil survey? (5 marks)
   b) Explain what is involved in the field stage of a soil survey. (5 marks)

6. Explain the different levels of soil survey as used in Zambia (10 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

2010 SECOND SEMESTER EXAMINATIONS

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THE UNIVERSITY OF ZAMBIA

2010 SECOND SEMESTER EXAMINATIONS

AGS 6622

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