

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURE SCIENCES
POST GRADUATE EXAMINATIONS
2016/2017 EXAMS

AGC	6111	PLANT PHYSIOLOGY
AGC	6125	SUSTAINABLE AGRICULTURE
AGC	6211	PLANT BREEDING METHODS
AGE	6222	INTERNATIONAL TRADE
AGE	6231	QUANTITATIVE ANALYSIS OF AGRICULTURE POLICIES
AGG	6811	BIOSTATISTICS IN AGRICULTURE
AGN	6111	ADVANCED METABOLISM
AGN	6511	ADVANCED MATERNAL AND CHILD NUTRITION
AGS	6211	PLANT NUTRITION
AGS	6221	APPLIED SOIL CHEMISTRY
AGS	6311	APPLIED SOIL PHYSICS
AGS	6411	SOIL MICROBIOLOGY



UNIVERSITY OF ZAMBIA
School of Agricultural Sciences
DEPARTMENT OF PLANT SCIENCES
M.Sc. Agronomy Programme
AGC 6111- Plant Physiology. Final Examination

Date. 12th May 2017

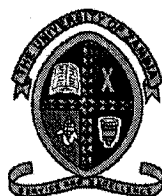
Time 09:00 to 12:00 hrs

INSTRUCTIONS

Answer ANY 5 (FIVE) questions.
Duration- 3 (three) hours

-
- 1) Briefly describe glycolysis and the role of oxidative pentose phosphate cycle in respiration.
 - 2) Describe the Relative growth rate in plants and the essential elements used in its computation.
 - 3) Describe the following;
 - a. Light extinction coefficient
 - b. Conversion factor.
 - c. Circadian rhythms
 - 4) Describe stress in plants and with the aid of diagram(s) describe plant response to increasing stress.
 - 5) Describe the following:
 - a. The different C4 photosynthetic systems and
 - b. Environmental factors that reduce nitrogen fixation capacity of leguminous plants.
 - 6) Discuss the mass and sensory pigments in plants.

END OF EXAMINATION



UNIVERSITY OF ZAMBIA

School of Agricultural Sciences

DEPARTMENT OF PLANT SCIENCES

M.Sc. Agronomy Programme- First term. FINAL EXAMINATION

AGC 6125- Sustainable Agriculture

Date. 24th May 2017

Time 09:00 to 12:00 hrs
~~14:00 to 16:30 hrs~~

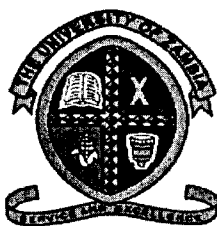
INSTRUCTIONS

Answer ANY 4 (FOUR) questions.

Duration- ~~2 and half~~ hours
3 hours

-
- 1) Discuss the following;
 - a. Outline at least 4 climate mitigation strategies.
 - b. Briefly describe the Life Cycle Assessment method of sustainability.
 - c. Human activities that contribute to environmental degradation.
 - 2) Describe ecosystem services and relate them to climate adaptation strategies.
 - 3) Briefly describe;
 - i. Agricultural biodiversity and agro ecosystem,
 - ii. Five threats posed by transgenic crops,
 - iii. Four issues critical to success of agricultural diversification.
 - 4) Discuss conservation farming in terms of the principles and component technologies.
 - 5) Briefly describe the four dimensions of a Sustainable Assessment of Food and Agriculture system.
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END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

Examinations for Master of Science in Plant Breeding and Seed Systems

AGC 6211: PLANT BREEDING METHODS

First Half 2016/2017 academic year

DATE: Wednesday May 24th 2017, AM.

TIME: THREE HOURS

Answer five questions only. All Questions Carry Equal Marks

1.0 Write short notes on the following:

(20 marks)

- a) Merits and demerits of Pedigree Selection Method
- b) Progeny test
- c) What do you understand by the terms “Non preference” and “antibiosis” in the mechanisms of insect resistance in plants
- d) Participatory Plant Breeding
- e) Single Seed Descent Breeding Method

2.0 a) What do you understand by the term clonal degeneration and how do you control it?

(5 marks)

b) What are the various sources of genetic variation within vegetatively propagated Crops?

(5 marks)

b) List and discuss **two** Breeding Methods you would apply to use the variation created through **hybridization** in improving vegetatively propagated crops such as cassava.

(10 marks)

3.0 *Triticum turgidum* (AABB genome) or wild emmer wheat and *Aegilops tauschii* (DD genome) are the progenitors of cultivated bread wheat and they are found in the **Anatolian Plateau (Turkey)** where these species are considered to have originated. However recent species exploration studies have also discovered the presence of *Aegilops tauschii* in the **Gobi desert**, the driest desert on earth. This finding has excited wheat breeders because it indicates that these *Ae. tauschii* species must be highly drought tolerant.

Clearly explain how the wheat breeders would go about exploiting the drought tolerance traits in the Gobi desert *Ae. tauschii* species in breeding for drought tolerance in bread wheat. **(20 marks)**

- 4.0 A graduate student studying the effect of mechanically varying the leaf angle of pearl millet leaves on light penetration in the crop canopy has shown that a leaf angle of about 45° to the stem allows the most light penetration in the crop canopy and has a significant effect on Radiation Use Efficiency (RUE) in pearl millet. If you were to embark on genetically changing the plant architecture of pearl millet (a cross pollinated crop species), through plant breeding,

Clearly explain how you would carry out your breeding program to develop an open pollinated (OPV) pearl millet variety with improved RUE. **(20 marks)**

- 5.0. A wild plant of the Compositae family (cross pollinated species) called *Vernonia galamensis* has been found to have oil of excellent quality for use in jet engines. Literature reports great variation for seed oil content in this plant.

Supposing you have been employed to improve the oil content of this plant using the population improvement approach and you chose the half-sib family selection method

- a) Clearly explain how you could carry out this breeding approach in detail. **(10 marks)**
- b) Suppose from other studies of the genetics of Vernonia oil content in the seed the following estimates have been obtained:

$$h^2_{bs} = 0.81$$

$$\text{Phenotypic variance, } \sigma^2 = 36.0$$

$$\text{The selection intensity to be used was } 5\%, i = 2.063$$

- i. Estimate the response to selection for half-sib using the formula:

$$R_s = (0.50) i \sigma h^2 \quad \textbf{(5 marks)}$$

- ii. Suppose the average oil content of vernonia is around 30.5 grammes/kg seed, What % response are you expected to get using the half-sib family selection with one cycle of selection? **(5 marks)**

- 6.0. Discuss in detail the application of invitro mutagenesis in the improvement of clonal crops such as cassava **(20 marks)**

- 7.0. a) What is hybrid vigour and how is it expressed in plants? **(10 marks)**

- b) If resistance to a certain disease in a cross pollinated crop is controlled by dominance gene action, i.e, its showing heterotic response. How would you attempt to exploit that in your improved variety? **(10 marks)**

- 8.0 From studying the genetics of **oil** and the micronutrient, **zinc** content in sunflower (a cross pollinated crop), it was found that the most important gene action for both traits is **Dominance gene action, i.e they show heterotic response**. A simple correlation analyses between the parameters; oil content, zinc content and yield showed a highly significant correlation between oil content and yield, but non significant correlation between oil and zinc and between zinc and yield as shown in Table 1 below.

Table 1. Correlation matrix of oil, zinc and yield in sunflower

Parameters	OIL	ZINC	YIELD
OIL	-	0.124 ^{ns}	-0.732 ^{**}
ZINC	0.124 ^{ns}	-	0.276 ^{ns}
YIELD	-0.732 ^{**}	0.276 ^{ns}	-

What do these results mean with regards to the improvement of these three traits in sunflower?
(20 marks)

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

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

2016/17 Msc AGRICULTURAL ECONOMICS MID YEAR EXAMINATION

COURSE: 2016/17 INTERNATIONAL TRADE MID YEAR EXAMINATION

CODE: AGE 6222

DATE: 12/05/17 AM: 09-12hrs

DURATION: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

1. Discuss in details the **Gravity Model** of International Trade (10 Marks)
2. What do you understand by the term i) **Opportunity Cost** (4 Marks) ii) **Comparative Advantage** (4 Marks) iii) **Absolute Advantage** (4 marks)
3. Suppose that in the U.S. 10 million roses can be produced with the same resources as 100,000 computers. Suppose also that in Mexico 10 million roses can be produced with the same resources as 30,000 computers. Using the concept of **Comparative Advantage**, **show through calculations** and **discuss** how the two countries can benefit from trade (10 Marks)
4. a) Contrast **Richardian model** from the **Heckscher-Ohlin model** (8 Marks)
b) Critically analyse two weaknesses of the **Heckscher-Ohlin model** (8 Marks)
5. What are the assumptions of the **Specific Factors Model** of International Trade (8 Marks)
6. Given the assumptions mentioned in question 5, show graphically and explain, how the Economy's Allocation of Labour and Production Possibility Frontier are determined (18 Marks)
7. What do you understand by the term **Patterns of Trade**? (3 Marks)
8. What do you understand by the term **Terms of Trade**? (3 Marks)
9. What would happen to general welfare of the Zambia's Economy if its Terms of Trade increases against the World? Discuss (6 Marks)
10. a) Suppose Zambia has a demand function $P = 140 - Q$ and supply function $P = 60 + Q$, What is Zambia's autarkic price? (3 Marks). What is Zambia's import demand curve? (3 Marks) What does **Autarky** mean? (2 Marks)

b) Suppose Zambia places a tariff of $t = 20$ on each unit of imports. What is tariff-ridden Zambia import demand (in terms of **Foreign price**)? (6 Marks)

The University of Zambia
School of Agricultural Sciences
2016/17 Academic Year First Semester
Final Examinations

AGE 6231: Quantitative Analysis of Agricultural Policies

TIME: THREE HOURS

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

1. (7 points) In no more than half a page, explain why we need quantitative policy analysis.
2. (8 points) Empirical studies of consumer demand for various food items and agricultural products have used the following functional forms (among others):
 - a. $x_i = \alpha + \beta p_i$
 - b. $\ln x_i = \alpha + \beta \ln p_i$
 - c. $x_i = \alpha + \beta \ln p_i$
 - d. $\ln x_i = \alpha + \beta p_i$

For each functional form (a. through d.),

- i. What is the interpretation of β (in words)?
 - ii. What is the price elasticity of demand? Show your work.
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 ($i=1, 2$), ξ_{ij} is the price elasticity of demand for good i with respect to the price of good j ; and η_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
$\ln \underline{Q}_m$	-1.00	0.30	0.50	0.20	0.30
$\ln \underline{Q}_d$	2.00	-0.50	-2.00	1.5	0.50
$\ln \underline{Q}_c$	0.60	1.50	-0.10	1.00	0.20

where the index $i = \{m=\text{meats}, d=\text{dairy}, c=\text{cereal}\}$; $\ln \underline{Q}_i$ and $\ln \underline{P}_i$ are natural logs of quantity per capita and price of commodity i , respectively; $\ln \underline{Y}$ is natural log of per capita income; and \underline{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) Homogeneity
 - (2 points) Engel aggregation
 - (5 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 1. Historical returns (\$/ha)

Season	WHT	SOR	COT
1	50	57	89
2	50	46	67
3	52	50	18
4	54	56	46
5	38	45	20

- (12 points) Compute
 - the mean returns, and
 - the returns variance-covariance matrix for the three activities.
- (5 points) Write out algebraically the quadratic programming model that could be used to generate solutions for an efficiency frontier.
- (8 points) Write out algebraically and explain the objective function and each constraint in a MOTAD model of this problem.



UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

FINAL EXAMINATIONS FIRST HALF OF 2016 ACADEMIC YEAR

COURSE: AGG 6811: BIostatistics in Agriculture
DURATION: THREE (3) HOURS
TOTAL MARKS 100

INSTRUCTIONS: **IN SECTION ONE (1):** Answer question one (1) and any one of the remaining questions in this section.

IN SECTION TWO (2): Answer all the questions in this section.

FOR ALL STATISTICAL TESTS: USE 5% LEVEL OF SIGNIFICANCY.

ANSWERS FOR SECTION ONE AND SECTION TWO SHOULD BE IN SEPARATE ANSWER BOOKS.

SECTION ONE (1)

QUESTION 1

Given the following data, from a study of milk yield from different Batoka dairy cows, give a full analysis and interpretation of these data. Test the hypothesis that the production of the cows was the same (20 points).

COWS	Milk Yields (litres/milking) over a period of five days				
Cow A	62.7	69.3	67.1	66.0	63.8
Cow B	68.2	58.3	62.7	66.0	57.2
Cow C	59.4	55.0	66.0	61.6	53.9
Cow D	40.7	35.2	42.9	44.0	38.5

QUESTION 2

- a) From your understanding of the Research Process, outline steps in executing a research activity. (15 points).
- b) What types of reasoning are employed on research? (5 points).

QUESTION 3

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

- a) Characteristics of Factorial Experiments.
- b) Uses of Analysis of Covariance.
- c) Error Control.
- d) Simple effects and main effects in a factorial experiment.

SECTION TWO (2)

QUESTION 4

A master's student carried out a maize variety trial in Lusaka district, with the intention of introducing a new variety in the district. Three varieties were included in the trial, in a Completely Randomized Experimental Design, namely: A, B, and O. Varieties A, and B came from CYMMIT while variety O was a local variety (control). Does the following maize yield data provide evidence for introducing a new variety, if so which one? (20 points).

<u>VARIETY</u>	<u>YIELD</u>							
A	25	23	20	24	27			
B	25	28	28	24	23	22		
O	20	21	18	20	21	21	16	19

QUESTION 5

A Masters student collected the following data from nine (9) maize plants, which were randomly selected from a maize field, to study relationships.

Grain Yield (gm)	83	78	76	70	87	89	80	77	89
Plant Height (m)	1.0	1.2	1.3	1.2	1.0	1.1	1.0	1.3	1.1
Number of cobs	2	1	2	1	2	2	2	1	2

- Determine the simple relationships between these three variables. **(6 points)**.
- Determine partial relationship between these three variables. **(8 points)**.
- Determine whether the simple relationships are significantly different from zero. **(6 points)**.

QUESTION 6

Briefly:

- Describe Multivariate Analysis. **(4 points)**.
- Describe multivariate Analysis of Variance. What is it used for? How does it differ from Analysis of Variance? **(4 points)**.
- Describe Multivariate Regression Analysis and state what it is used for? **(4 points)**.
- Describe Canonical Correlation Analysis and state what it is used for? **(4 points)**.
- Describe Factor Analysis and the two common types of Factor Analysis? **(4 points)**.

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND NUTRITION

2016 / 2017 ACADEMIC YEAR MID - YEAR EXAMINATION

COURSE: AGN 6111
Advanced metabolism

Date: 17th May, 2017

Time: 09 00 – 12 00 hours

Duration: THREE (3) HOURS

Venue: DRGS I

INSTRUCTIONS TO CANDIDATES:

- 1. This paper consists of Section A and Section B. Answers to each section should be in separate booklets**
 - 2. Please read the guidance for each section carefully; Answer ALL questions**
 - 3. Each question is allocated marks shown in parenthesis**
 - 4. All ten (10) questions in section A are compulsory and contain four (4) marks each.**
 - 5. All questions in Section B carry fifteen (15) marks each**
-

SECTION A

Section A has a total of **ten (10)** questions and each question carries **4 marks**

Answer **ALL** questions in this section

You should take about **one (1)** hour for this section; allow about **five (5)** minutes for each question

NB: Answer questions 1 to 5 in this section (Section A) in one booklet and questions 6 – 10 in a separate booklet

1. Explain, with the use of a simple diagram, how transamination reactions in muscle contribute to glucose synthesis in the liver. (4 marks)
2. Under what dietary circumstances do ketone bodies become an important fuel for the brain and how does this occur? (4 marks)
3.
 - a. Summarise the role of NPY neurons in the regulation of food intake. (2 marks)
 - b. Explain how cholecystokinin contributes to the regulation of food intake. (2 marks)
4. State **three (3)** factors which influence BMR and explain the influence they have. (4 marks)
5. Compare the metabolic fate of pyruvate in red blood cells with that in an aerobic muscle cell. (4 marks)

6. Describe **four (4)** differences in the movement of non-haem and haem iron containing foods in the alimentary system from consumption to the inside of the enterocytes (4 marks)
7. High levels of homocysteine are a risk factor for cardiovascular diseases, strokes, thrombosis and degenerative diseases.
- a. Name **two (2)** vitamins whose metabolism can result in the formation of homocysteine. (1 mark)
- b. What defect in the metabolic pathways can lead to the accumulation of homocysteine? (3 marks)
8. Some minerals are found in the soils of particular regions and crops that are grown there are rich in these minerals.
- a. Name **two (2)** such minerals that are found in the soil and can be found in crops. (1 mark)
- b. For each of the minerals you have stated in 8.(a), indicate **one (1)** deficiency that can arise from a lack of consumption of that mineral and **one (1)** corresponding symptom of that deficiency (3 marks)
9. A class of drugs known as proton pump inhibitors influence absorption of some minerals and vitamins in the human body. Answer the following:
- a. Name **one (1)** vitamin and **one (1)** mineral that are influenced by these drugs (1 mark)
- b. For each of the mineral and vitamin you have named in 9. (a), briefly describe how the rate of absorption is affected by these drugs. (3 marks)

10. Name **two (2)** minerals and **two (2)** vitamins of your choice and for each of the four nutrients, state its major excretory route or organ. **(4 marks)**

SECTION B

There are four (4) questions - Answer **ALL** questions in this section

Each question carries 15 marks.

Answer **questions 1 and 2 in one booklet** and **questions 3 and 4 in another booklet.**

You should take about two (2) hours for this Section; each question should take about 30 minutes.

1. Compare and contrast fat and carbohydrate as sources of energy in man. Include a consideration of the size and site of stores, and summarise the circumstances leading to their deposition. **(15 marks)**

2. Summarise the metabolic processes that take place AFTER a meal, when a person enters a period of prolonged fasting. You should refer to fat, carbohydrate and protein metabolism. **(15 marks)**

3. Discuss the absorption and transport of vitamin B12 in the human alimentary system. In your discussion, include how the Vitamin B12 is released from a named food matrix in which it is bound and give an example of such a food component that is rich in Vitamin B12 **(15 marks)**

4. Zinc, calcium and other minerals have numerous functions in the body. **Figure 1** is from a zinc absorption related research study that was conducted in Malawi on children that were admitted to a hospital for tuberculosis (on treatment) and some for minor injuries. The children were on a maize – soy diet. Answer the following questions related to zinc.

- a. Describe in your own words the conclusion you would draw from figure 1. (3 marks)
- b. What is the relationship of phytate and zinc in this zinc story? (2 marks)
- c. Discuss any three (3) factors that influence the absorption of zinc in the human body. (15 marks)

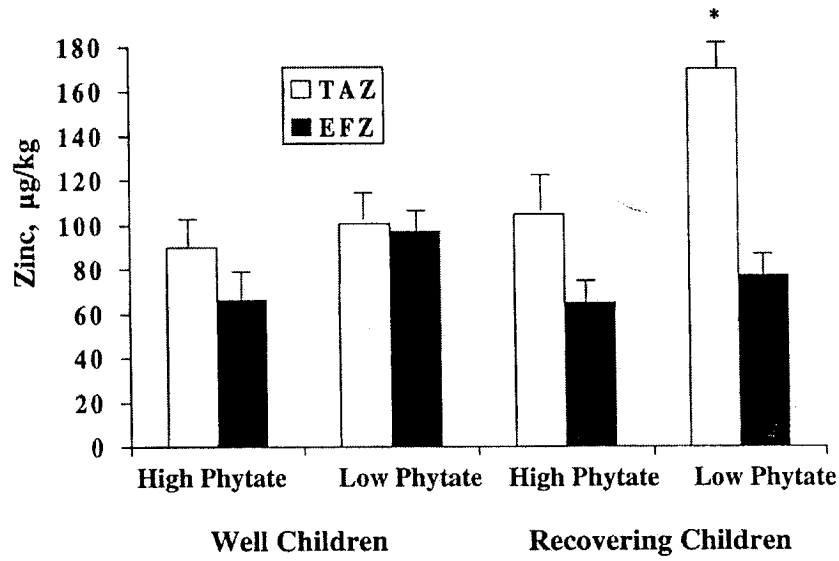


Figure 1: A comparison of total absorbed zinc (TAZ) and endogenous faecal zinc (EFZ) in either well or recovering Malawian children receiving either a high or a low phytate diet

END

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURE SCIENCE
DEPARTMENT OF FOOD AND NUTRITION SCIENCES**

**COURSE: AGN 6511: ADVANCED MATERNAL AND CHILD NUTRITION
EXAMINATION 2016/2017 ACADEMIC YEAR.**

DATE: MAY, 2017

TIME: 09:00-12:00 HOURS (3 Hours)

VENUE: DRGS

INSTRUCTIONS: READ QUESTIONS CAREFULLY BEFORE ANSWERING. QUESTIONS ARE ORGANIZED INTO TWO SECTIONS. SECTION A COMPRISES SHORT-ANSWER QUESTIONS FOR 40 MARKS: SECTION B CONTAINS LONG-ANSWER QUESTIONS FOR 60 MARKS. TOTAL: 100 MARKS. ANSWER EACH QUESTION ON A SEPARATE PAGE WITH EACH PAGE CLEARLY MARKED WITH YOUR STUDENT NUMBER.

SECTION A: 40 MARKS: Choose Four (4) out of the Five (5) Questions Below:

As a human nutritionist, you may be required to play a role of a counsellor, below are five situations in which your advice may be required, pick four situations and advise the client accordingly.

1. Briefly counsel a pregnant woman with regard to maternal outcomes arising from inadequate intake, with specific reference to macronutrients (10 Marks).
2. Briefly explain the concerns associated with pregnancy during the adolescent period (10 Marks).
3. Briefly discuss the dangers associated with experiencing insulin inefficiency that may arise during the late stages of pregnancy? (10 Marks).
4. You are at a referral health facility with access to relevant equipment for assessing nutritional status, identify one method you would use to determine nutritional status and explain its advantages (10 Marks).
5. What do you understand by the following terms?
 - a. Nutritional status and nutrition surveillance (5 Marks).
 - b. Clinical assessments and anthropometric measurements (5 Marks)

SECTION B: 60 MARKS – Choose Three (3) out of the (4) Questions Below:

1. You are posted as a Public Health Nutritionist at Ministry of Health in the Policy Unit, explain to your colleagues:
 - a. Types of supplementation programmes that would be useful for supporting women before and during pregnancy. *(15 Marks)*.
 - b. Two supplements that are not routine for pregnant women in Zambia, and discuss their advantages *(15 Marks)*.
2. You are at the Provincial officer in charge of approving research protocols, and you are responsible for briefing students on some of the research conducted in the province, explain to them why:
 - a. Mixed results for supplementation such as iron and folic acid may be obtained. *(15 Marks)*; and
 - b. Dietary practices among pregnant women may not be evaluated in most trials *(15 Marks)*.
3. Avoiding conditions that lead to stunting allows for promoting optimal outcomes throughout the life cycle. Provide an explanation for each of the two questions below:
 - a. Can stunting be reversed? *(15 Marks)*.
 - b. Is short maternal stature a risk factor to maternal and child health? *(15 Marks)*.
4. Short maternal stature increases the risk of small for-gestational-age and preterm births. Discuss problems associated with small for-gestational age and preterm babies *(30 Marks)*.

THE UNIVERSITY OF ZAMBIA
UNIVERSITY MID YEAR EXAMINATIONS – MAY 2017

AGS 6211
PLANT NUTRITION

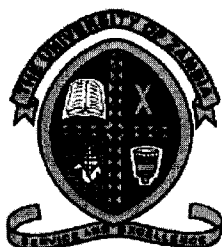
TIME: 3 Hours

Marks: 100

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

1. Define the following:
[10 Marks]
 - a. Ion uptake synergism [2 Marks]
 - b. Metabolism [2 Marks]
 - c. Mycorrhizae [2 Marks]
 - d. Photosynthesis [2 Marks]
 - e. Apoplast [2 Marks]
 2. With the help of a diagram describe the type of cells found in a root cross section.
[20 Marks]
 3. The Casparian strip and the Plasmalemma are very important barriers in the transport of solutes and ions. Describe how effective these barriers are and how they are overcome to allow ion uptake. **[20 Marks]**
 4. The plant CEC is important in the ion uptake by plants. Discuss how the CEC develops in the plant and how it affects ion uptake. **[20 Marks]**
 5. Discuss the mechanisms involved in the nutrition of iron of different types of plants growing in soil conditions with sub-optimal supply of iron. **[10 Marks]**
 6. Discuss the function, level of availability in the soil, deficiency symptoms and sources of the following nutrient elements: **[20 Marks]**
 - a. Nitrogen. [4 Marks]
 - b. Phosphorus [4 Marks]
 - c. Zinc [4 Marks]
 - d. Molybdenum [4 Marks]
 - e. Sulphur [4 Marks]
-

END OF EXAMINATION



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

FIRST HALF UNIVERSITY EXAMINATIONS 2017

AGS 6221: APPLIED SOIL CHEMISTRY

TIME: 3 hours

MARKS: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS AND SHOW ALL LOGICAL STEPS IN DEVELOPING THE ANSWER

1. a). Explain the differential stability (resistance to weathering) that is exhibited by minerals [6]
b). Why can the same mineral exhibit different shades of colour e.g. milky quartz, rose quartz etc. ? [4]
c). Given that a soil containing 36 % clay, 33 % silt and 20 % sand has a measured CEC of $28.6 \text{ cmol kg}^{-1}$, determine the probable clay mineral type. [5]
d). Describe the fundamental characteristics of colloids that make them the most chemically active component of a soil AND list the important soil colloids. [5]
2. a). Determine the CEC of an Oxisols from Agro-ecological Region III of Zambia that contains 63 % clay (predominantly Kaolinite), 10 % sesquioxides, 10 % sand, 12.3 % silt and 4.7 % humus. [10]
b). Show that a soil in a 1 ha plot with an average dry bulk density of 1300 kg m^{-3} in the profile and a CEC of $25.0 \text{ cmol kg}^{-1}$ can retain (adsorb) an equivalent of 1020 x 50 kg bags of muriate of potash fertilizer (60 % K_2O) in the top 20 cm of the soil. [15]
3. a). If a hectare of vegetables is irrigated with $10,000 \text{ m}^3$ of water containing 3.5 g of salt per litre; calculate the quantity of salt in ton ha^{-1} that would be introduced into the soil. [5]

- b). Estimate the EC ($\mu\text{S cm}^{-1}$) of a soil extract whose chemical composition upon analysis is 4.0 mg Ca^{2+} , 1.2 mg Mg^{2+} , 2.34 mg K^{+} and 0.3 mg Na^{+} per litre. [5]
- b). A soil profile requires 800 mm of water to completely saturate it. Given that that an irrigation water has a conductivity of 108 mS m^{-1} and that a field of maize to which it is intended to be applied, suffered a 50 % reduction in yield at a soil saturation extract conductivity of 6 dS m^{-1} (i.e. the crop salt tolerance), calculate the additional amount of water to add in order to maintain the salt balance. [10]
4. a). Calculate the activity of CaSO_4 in a water sample containing 15 mM Ca^{2+} , 50 mM Na^{+} , 30 mM Cl^{-} , 200 mM SO_4^{2-} and 10 mM HCO_3^{-} . [10]
- b). Given that amorphous $\text{Fe}(\text{OH})_3$ with $\text{pK}_{\text{sp}} = 37.5$ is the substance that controls the activity of Fe in soil, show that citrus grown on a calcareous soil ($\text{pH} \approx 8.5$) would exhibit iron deficiency symptoms. [5]
- c). Explain using appropriate equations the reaction of agricultural lime in an acid soil. [5]
5. a). Given that the diffusion coefficient of P in a wet soil as $5 \times 10^{-9} \text{ cm}^2 \text{ s}^{-1}$, calculate how long it will take the ion to diffuse from fertilizer placed 5 cm away from the seed. [5]
- b). If evapotranspiration (ETc) measurements showed that a crop of maize transpired $6.0 \times 10^9 \text{ g}$ of water per season per ha and that the average concentration of Ca in the water was 10 ppm, how much Ca would have been transported to the plant root surface? [5]
- c). Why is there often poor correlation between soil test values and crop response to applied fertilizer meant to address the problem of nutrient deficiency identified by the soil test? [5]

END OF EXAMINATION PAPER



UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF SOIL SCIENCE

AGS 6311: APPLIED SOIL PHYSICS

MID-YEAR FINAL EXAMINATIONS FOR 2016/2017

ANSWER ALL 4 QUESTIONS

TIME: 3 hours

MARKS: EQUAL MARKS FOR ALL QUESTIONS.

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- Q1.** Water movement into the soil, its storage within the soil and its escape or movement out of the soil or into a water table are all governed and depend on its energy.

Explain this energy, its source or sources and when and the conditions under which its various components operate or are effective.

Use infiltration, redistribution and drainage of rain as your example or illustration.

- Q2.** Poiseville's law is widely used in descriptions of water flow in soil physics.

The equation is derived from the general water flow equation which itself is derived from Darcy's equation.

Describe the process used to arrive at Poiseville's equation giving the assumption made at each stage and why.

- Q3.** Explain what flow nets are? Flow nets are based or derived from stream lines and water potential lines.

Explain and describe flow nets. How does one draw them?

What do we use flow nets for?

- Q4.** Water, air and all fluids move by diffusion and or mass flow. Explain what mass flow is and what diffusion is. How do these terms apply to air flow in soils?

What is the importance of these two processes and when is one more important than the other?

END



UNIVERSITY OF ZAMBIA

FIRST HALF EXAMINATIONS – MAY 2017

AGS 6411: SOIL MICROBIOLOGY

Time: Three (3) Hours

Marks: 100

Instructions: Answer all Questions

1. The practice of Conservation farming relies on the application of the principles of crop residue retention, seeding and input application in fixed planting stations, nitrogen-fixing crop rotations and reduced but precise doses of mineral fertilizer. In general, farming systems such as this one have been observed to improve soil chemical and physical properties thus resulting in increased crop yields. Explain how you would demonstrate an improvement (or lack of) in soil microbiological properties due to the practice of conservation farming.
 - a. Explain what you would be measuring [5 marks]
 - b. How would be measuring it (them) [10 marks]
 - c. How you would be making the interpretations and arriving at conclusions. [5 marks]
2. In soil ecological interactions, some organisms exist only because they rely on other organisms. Give two examples of relationships in which at least one microorganism would not be able to exist without the other basing on the following:
 - a. The nature of the relationship [3 marks]
 - b. The actual benefits derived or losses incurred [7 marks]
 - c. How can determine whether the relationship is mandatory or not [10 marks]
3. Explain how the process of the formation of the symbiosis for nitrogen fixation would be affected if the following were deliberately excluded:
 - a. Flavonoids [5 marks]
 - b. Nod factors [5 marks]
 - c. Rhicadhesins [5 marks]
 - d. Lectins [5 marks]
4. Explain the constituents/ members and roles of each of the following in nutrient cycling in the soil.
 - a. Cellulase enzyme system [6 marks]
 - b. Nitrogen enzyme complex [4 marks]
 - c. White-rot fungi [10 marks]
5. Agronomically, explain why a co-inoculation of Rhizobium and Mycorrhiza to a legume in an acid soil would have a synergistic rather than an additive effect [20 marks]

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