THE UNIVERSITY OF ZAMBIA

UNIVERSITY OF ZAMBIA EXAMINATION PAPERS (1986)

AGRICULTURE

1. Anatomy and Physiology — AGA 210/VMA 200

2. Basic Principles of Nutrition — AGA 320

3. Applied Nutrition — AGA 320

4. Animal Genetics and Breeding — AGA 332

5. Beef,Dairy,Sheep and Goats production — AGA 450

6. Poultry and Pigs production and Animal Health — AGA 450

7. Animal Health and Enviromental Physiology — AGA 561

8. Advanced Animal Breeding and Reproductive Physiology — AGA 562

9. Managemental practices as they affect the Quantity and quality Animal Products and by products — AGA 563

10. Animal Nutrition — AGA 564

11. Advanced Livestock and Poultry Management — AGA 565

12. Agricultural Botany — AGC 211

13. — AGC 232

14. Forage Crops — AGC 342

15. Plant Pathology — AGC 351

16. Plant Pathology (Supplementary) — AGC 351

17. Crop Science VI (Field Crops Production) — AGC 460

18. — AGC 460

19. Plant Breeding — AGC 472

20. Horticulture — AGC 481

21. Advanced Aspects of Crop Production — AGC 591

22. ADVANCED ASPECTS OF HORTICULTURE — AGC 594

23. — AGC 595

24. Advanced Plant Breeding — AGC 596

25. Fundamentals of Agriculture Economics — AGE 310

26. Fundamentals of Agriculture Economics — AGE 310

27. Production Economics — AGE 421

28. Agricultural Marketing and Policy — AGE 432

29. Farm Management Principles — AGE 561

30. Agriculture Prject Planning and Appraisal — AGE 562

31. Accountancy and Records — AGE 563

32. Extension Records — AGE 563

33. Statistics and Experimental Design — AGG 311

34. Statistics and Experimental Design (Supplementary) AGG 311

35. Agricultural Mechanization — AGM 322

36. Farm Structures (Supplementary) — AGM 431

37. Agricultural Mechanization — AGM 540

38. Agricultural Mechanization — AGM 541

39. Land Surveying and Earth Moving — AGM 542

40. Irrigation and Drainage Engineering — AGM 543

41. Fundamentals of Soli Science — AGS 210

42. Fundamentals of Soil Science (Supplementary) — AGS 210

43. Soil Physics , Irrigation and Drainage — AGS 321

44. Soil Physics , Irrigation and Drainage (Sup) — AGS 321

45. Soil Science — AGS 432

46. Soil Chemistry Fertility & microbiology (Supp) — AGS 432

47. Land Evaluation and Improvement — AGS 541

48. Land Evaluation and Improvement (Supp) — AGS 541

49. Soil Science — AGS 552

50. Advanced Soil Physics — AGS 553

51. Advanced Aspects of Soil Physics (Supp) — AGS 553

52. Soil Science (Supp/Def) — AGS 554

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS

1.   The Coordination of an animal's responses to its internal and
      external environments is the function of the nervous and
      endocrine systems. Give a brief account on the differences and
      similarities between these systems and to some detail describe
      the functions and modes of secretion of gonadotropic hormones in
      a female domestic animal.   (20 points)

2.   Both animal husbandry and animal health technology have one
      factor in common, to increase animal production. One of the
      products is milk. Give a brief description of the structure of
      the mammary glands in a named domestic animal and discuss the
      factors that influence galacto poiesis i.e. maintenance of
      lactation. Do these factors also influence the milk yield?
      Please explain.   (20 points)

3.   In order for an animal to maintain itself, be active, grow and
      produce, energy is required. This energy is derived from food.
      Show, using your knowledge of Anatomy and physiology how a named
      monogastric domestic animal obtains and processes its food in order
      for it to obtain energy required for the above named functions.

                                                         (20 Points)

4.   Describe the structure of the primary female organ, in named
      domesticated animal. How does such an animal indicate that
      it is ready for copulation?   (20 points)

5.   Both internal and external environments are very important as
      factors influencing the health and production of our domesticated
      animals. Temperature is one of these factors and for proper
      functioning the animal's body temperature has to be within a
      constant range. Describe how pigs maintain this constant range
      of temperature.   (20 points)

6. Write short notes on five of the following:-

    (a) Factors of Growth:

    (b) The functional structure of the mammalian lung.

    (c) The composition of blood.

    (d) Central Nervous system

    (e) Types of epithelium.

    (f) Structure of the skin.   (20 points)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL THE QUESTIONS INDICATED. <u>READ QUESTIONS VERY CAREFULLY</u>
AND ANSWER ALL COMPONENTS OF THE QUESTIONS.

1. (a) With the aid of appropriate flow charts differentiate
carbohydrate digestion and absorption between ruminant and
non-ruminant animals in the different parts of the digestive
tracts.

   (b) What problems would arise if these anaimals (ruminant
versus non-ruminant) were given excessive amounts of
soluble carbohydrates in the ration?   (20 points)

2. The urea cycle is important in nitrogen metabolism.

   (a) Briefly discuss why this is so?

   (b) List two species of animals which have a <u>non-functional urea</u>
cycle and state <u>why</u> and also <u>how</u> they excrete nitrogen. (20 points

3. Given/the that gross energy (GE) of a sheep's diet was determined to
be 4000 kcal/kg of diet.

   (a) With the help of a flow chart partition the utilization of
this gross energy by the animal.

   (b) Coincisely outline how the various components of the gross
energy are determined.   (20 points)

4. Riboflavin, Pantothenic acid and Pyridoxine are all water soluble
vitamins.

   (a) List the differences or similarities in the metabolic
functions or reactions they are involved in, in the animal.

   (b) What characteristic symptoms would you expect if there was
a deficiency of each of these vitamins (riboflavin,
pantothenic acid and pyridoxine) and what natural sources
would prevent the deficiency from occuring.   (20 points)

5. Answer part a and either b or c only.

    (a) The kidney is a very critical organ in the regulation of
         electrolytes. Substantiate this statement as regards to
         sodium (Na), Potassium (K) and chlorine (D) metabolism.

    (b) How is it that the deficiency symptoms of vitamin D (1,25-
         Dihydroxycholecalciferol) are similar to those of calcium
         deficiency?

         OR

(c) (c) Why is iron supplementation to the ration so critical for
          the pig at different stages of growth?

                                                      (20 points)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

   EACH PART TO BE ANSWERED IN A SEPARATE ANSWER BOOK

1.   (a)   Briefly describe the proteins of Wheat and Maize, emphasizing on qualitative and quantitative aspects.

   (b)   Make a comparison between Soybean meal and Cotton seed meal as sole protein supplements in broiler rations.   (15 points)

2.   (a)   Urea feeding during the dry season is a popular practice on Zambian commercial beef farms. Describe the practice indicating potential risks and explaining, how one would avoid such risks and achieve maximum benefits from this practice.

   (b)   Rancidity, mold growth and high temperatures can reduce the feeding value of animal protein sources. Briefly explain how each of these conditions reduces the feeding value of these protein sources.   (20 points)

3.   Ensiling is a method of preserving harvested nutritious roughages such that nutrients are not lost as would normally occur. Briefly describe the sequence of changes that occur in the process that leads to a stable preserved mass. What precautions would one take to ensure the production of good quality silage.   (15 points)

/2.........

AGA 320

PAPER II

PART II

APPLIED NUTRITION

TIME: ONE AND HALF HOURS

ANSWER: ALL THE QUESTIONS GIVEN. READ THE QUESTIONS VERY CAREFULLY

1.   (a)   Would you expect the nutrient requirements of an animal
to be different for maintenance, growth or fattening?
Explain your answer with special reference to energy and protein
requirements.

    (b)   Enumarate the factors which influence the plane of nutrition
of a breeding cow and discuss each with respect to how good
or proper management can optimize production.   (15 points)

2.   With the information given below, design a 100 kg ration to feed
weanling pigs (5-10kg liveweight).

Ingredients	DM %	DE kcal/kg	CP	CF %	COMPOSITION Ca	P	NaCl
Maize polishings	93	3100	12	2	0.08	0.5	-
Maize bran	89	2500	10	10	0.14	1.1	-
Sorghum grain	89	3600	9	2	0.04	0.3	-
Soybean cake	89	3300	45	6	0.30	0.7	-
Sunflower cake	93	3000	46	11	0.40	1.0	-
Sodium Chloride (NaCl)	-	-	-	-	-	-	60
Limestone	-	-	-	-	36.0	-	-
Dicalcium Phosphate	-	-	-	-	23.0	18.0	-
Vitamin-Mineral premix							
Nutrient Reqts of piglets Nutrient concentration/kg diet		3500	22	3	0.8	0.6	0.2

Limitations, (a)   1% Vitamin-mineral mixture to be included

    (b)   Minimum crude fiber 3% per kg of diet

    (b)   Why would it be poor management to feed the same ration
(for weanling pigs) to finishing or fattening pigs? (20 points)

AGA 320

PAPER II

PART II

APPLIED NUTRITION

3. In animal nutrition, depending on the production function we are
    interested in, we formulate rations for animals such that we have
    optimal feed utilization to minimize feed costs. Thus monitoring food
    intake becomes critical. What factors affect feed intake and how
    can you manipulate these factors in order to maximize your feed
    utilization (Illustrate your answer with figures or diagrams
    where applicable)?   (15 points)

END OF EXAMINATION

ANIMAL BREEDING AND ARTIFICIAL INSEMINATION

TIME: THREE HOURS

ANSWER: ALL FIVE QUESTIONS. ANSWERS TO SECTION ONE AND TWO MUST
          BE IN SEPARATE ANSWER BOOKS.

SECTION ONE

ANIMAL BREEDING

1.   (a)   On a given farm, a farmer has two breeds of pigs, Largewhite
           (L W) and Landrace (L R). Average litter size for each
           of the two breeds were 8 and 12, respectively.   10 cross-
           breed sows (LWxLR) gave the following litter sizes
           8, 7, 9, 6, 12, 5, 14, 8, 8, 13.
           What is the percent heterosis resulting from the crossing
           of the two breeds?

     (b)   If hemophelia (sex-linked recessive) has a frequency of
           10 per 1000 males in a population which is believed to be
           in Hardy-Weinberg equilibrium what is the proportion of
           carriers among the normal females?   (20 marks)

2.   I magine you are a dairy farmer.   The previous year you
     collected data on milk yield per day of the first lactation (see
     the table below). If this year you want to select 20% of your
     best animals as parents of the next generation   (Selection
     intensity = 1.4) / the herd average for milk yield per day is 10 litres,

     (a)   What is the estimate of heritability (h^2) of milk yield
           per day in this herd?

     (b)   What is the expected response to selection?

     (c)   What is the expected new herd milk yield average per day?

     (d)   What is the expected minimum repeatability value of milk
           yield per day in this herd?

Table 1 milk yield per day in litres

Sure	Dam	Progemy		
		1	2	3
1	1	12	13	12
	2	8	9	8
	3	11	8	9
2	1	7	8	12
	2	7	9	12
	3	13	12	10
3	1	12	10	11
	2	12	10	9
	3	8	7	10

(20 marks)

3. Discuss the effects of inbreeding and cross breeding on the
    genetic constitution of a population for a low heritable trait
    and for a high heritable trait of your own choice.

(20 marks)

/3.........

SECTION TWO

ARTIFICIAL INSEMINATION

4. (a) What is puberty? Briefly describe factors that influence the age at puberty in a named domestic animal.

    (b) Describe the signs of oestrus in a cow and indicate the time when artificial insemination may be carried out in order to achieve the best results,   (20 marks)

5. You have been appointed the Animal Husbandry officer in charge of Artificial Insemination Services in Zambia. How would you

    (a) Plan the organisation of these services

    (b) Evaluate the success of these services among cattle in your region   (20 marks)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS FROM SECTION 1 - 4

SECTION I

1.   Describe the different poultry management systems indicating the advantages and disadvantages of each one.

(20 marks)

SECTION 2

HEALTH

2.   Not long ago there were reports of an outbreak of Corridor Disease in some parts of Zambia.
      What is the cause of the disease and what are the symptoms, diagnosis and control of it.

3.   You were invited to a Poultry Farm where you witnessed over 50% of the 8 week old chicks suffering from Infectious Bursal Disease otherwise known as Gumboro Disease. How is the disease transmitted, what are the symptoms and what advice would you give to the farmer.

SECTION 3

SHEEP, GOATS AND RABBITS

4.   Given a flock of fifty sheep to manage, outline as comprehensively as you can, how you would manage them profitably.

5.   What would you consider to be the current constraints to sheep and goat production in Zambia? If you had the power to do so, what changes would you effect, to improve on the present situation?

AGA 450

SECTION 4

BEEF AND DAIRY

6. (a) Discuss what cconstitutes "Good Hay"

    (b) Differences in chemical composition of cereal grains and how it
         affects utilization by ruminants

                                                        (10 points)

7. (a) The nutritive needs of the mature beef cow can vary for
         a large number of reasons. Indicate what they are:

    (b) The year round productive needs of the beef cow can be divided
         into four distinct nutritional periods. Discuss these periods. (5 p

8. Discuss quality milk production and why it is so important to the
    dairy industry.   (5 points)

9. Outline a program for raising dairy calves from birth to ten months of
    age.   (10 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCT. 1986

AGA 450

BEEF AND DAIRY

PAPER I

TIME: THREE HOURS

ANSWER: ALL QUESTIONS IN THIS SECTION IN A SEPARATE BOOKLET

1

SECTION I

1.   Discuss factors which affect animal utilization of pastures and
     forages in the context of the following:

   (a)   What is good hay or pasture?

   (b)   The role of implants and/or additives in a pasture or forage
         feeding program and give the names, roles and responses
         expected for any "three" implants or additives.   (10 points)

2.   Calving heifers at two years of age or three years of age is a
     management decision made by the producer. Briefly and with listing of poin
     where possible discuss how the
     /decision might be made in the following context:

   (a)   advantages and desadvantages of calving heifers at two years
         of age versus three years of age

   (b)   The potential role of creep feeding calves in your decision

   (c)   How a preconditioning program might fit into a two or three
         year 1st calving situation.   (15 points)

3.   Quality milk production is extremely important to the dairy
     industry.

   (a)   Indicate the reasons from an industry point of view .

   (b)   What factors must be considered in maintaining quality milk.
         production?   (20 points)
     Briefly
4.   /define, describe or explain the following:-

   (a)   Major vitamins and minerals required by cattle

   (b)   NPN (non protein nitrogen) use and limitations with cattle

   (c)   corrective matings with cattle

   (d)   net energy

   (e)   milk fever

(f)   Heritability

(g)   Price spread in buying and selling cattle.

(h)   Servicing capacity of 2 and 3 year old bulls

(20 marks)

AGA 450

SECTION II

Answer all questions on this section in a separate book

1. You have just started a commercial rabbitry with an initial stock of fifty adult female Californian White rabbits and five adult males.
   Indicate in detail how you would proceed to house, feed, breed, market and otherwise manage your rabbitry commercially. (10 points)

2. Outline how you would feed a female dairy goat from birth through weaning, growth, breeding, gestation, parturition and lactation - till it weans off its own kid. Where appropriate indicate the approximate age of the goat at the various stages of management.

   (15 marks)

3. A prospective farmer has come to you for guidance on what breed of sheep to choose for a commercial sheep farm. What factors would you advise that he takes into account in deciding what breed of sheep to introduce to his farm?

   Provide some detail as to why you think the factors you would advise him/ner to take into consideration are important. (10 points)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ANSWER ALL QUESTIONS FROM THIS SECTION IN A **SEPARATE** ANSWER BOOK

1. Describe all the important factors affecting hatchability of fertile eggs. (20 Marks)

2. Brooding is a very important phase in poultry management. Outline the known management proceedures during this phase (10 Marks)

3. Write briefly on the following:-
   (i) culling proceedures in layers
   (ii) sex indentification of Day old chicks
   (iii) cage system of poultry management. (15 Marks)

4. Distinguish between the following:-
   (i) Hen Housed and Hen-day egg production
   (ii) Broiler and capon
   (iii) Laying intensity and laying persistency.
   (iv) Sexual maturity and precocious laying (15 Marks)

AGA 4506

PAPER II

ANIMAL HEALTH

Answer all questions in a separate book.

1. You have been made the manager of an Intensive Poultry Production Unit on a farm in Lusaka. List any 10 common poultry diseases you might encounter and indicate what preventive or therapeutic measures you will use to solve each one of them.   (20 Marks)

2. Health is the state that results from a successful adjustment of body form and function to forces tending to disturbe them. Please discuss
                                                              (20 Marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-SESSIONAL EXAMINATIONS - MARCH. 1986

AGA 561

ANIMAL HEALTH AND ENVIRONMENTAL PHYSIOLOGY

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS.

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1. (a) Design and draw in detail a pig house for one boar, ten sows and their followers, for a farm in Lusaka.

    (b) Indicate the advantages and disadvantages of your particular design.

    (20 points)

2. (a) What environmental factors affect poultry production and how do poultry respond to these factors?

    (b) Discuss the criteria you would take into account in deciding where to locate a poultry farm in Zambia

    (20 points)

3. (a) What clinical signs and postmortem lesions would you expect to see in an outbreak of Aspergillosis in a flock of young chicken?

    (b) Indicate how you would differentiate Aspergillosis from other poultry diseases with which it may be confused. List your differentials and indicate how they differ from Aspergillosis?

    (c) How would you control an outbreak of Aspergillosis?

    (20 points)

4. You have been called to a pig farm that is experiencing high mortalities in the young piglets from birth till about one month of age.
    You observe that management is poor in all aspects.
    You also observe that the young piglets are running a whitish diarrhoea, are week, dull, cold and dehydrated.

/2

4. Continued

On opening up some recently dead piglets you observe that the intestines are inflamed and hemorrhagic. In a few young piglets that died within a few days after birth, in addition, there are pinpoint hemorrhages around the heart.

(a) What questions would you ask to help you arrive at a diagnosis?

(b) Based on the history given above, what is your Tentative Diagnosis?

(c) Indicate in details what advice you would give the farmer to stop the mortalities and to prevent more deaths in the future. (20 points)

5. For each of the following diseases in the left column, please list the information required in the right column.

(i) Mange   (a) Major species affected
(ii) Senkobo   (b) Causative agent
(iii) Foot and Mouth
      Disease   (c) Mode(s) of transmission
(iv) Lampy skin disease (d) Preventive measure(s)
(v) Orf   (e) Treatment(s)
                                    (20 Points)

6. (a) What are the major modes of transmission of Tuberculosis in cattle?

(b) Describe the clinical signs and post mortem lesions you would expect to see in a cow with advanced generalized tuberculosis.

(c) An unusually high proportion of cattle originating from the Southern Province of Zambia show evidence of Tuberculosis at slaughter. Taking into account the epidemiology, economics and public health aspects of Tuberculosis, - if you had the power to do so, what would you do about this apparent problem? (20 Points)

END OF EXAMINATION

AGA 562

ANIMAL BREEDING AND REPRODUCTIVE PHYSIOLOGY

TIME: THREE HOURS.

ANSWER: QUESTION ONE AND ANY OTHER TWO QUESTIONS FROM
           SECTION ONE AND ANSWER ALL QUESTIONS IN SECTION
           TWO.

SECTION ONE

ANIMAL BREEDING

1.(a)   In short horn cattle Red coat colour is incompletely
         dominant to White coat colour, producing Roan colour
         when the two types of animals are crossed. If in a
         large rondomly mating population of 4000 cattle 40
         have white coat colour and the population is assumed
         to be in Hardy-Weinburg equilibrium, calculate the
         following:-

         (i)   The frequency of the Red and White colour
                 alleles.
         (ii)   The genotypic frequencies.
         (iii)   The number of animals with Roan coat colour.
         (iv)   The phenotypic frequency of the Red colour.

                                                       (12 ma

   (b)   In a large swine breeding operation the following
         data was obtained on daily post weaning growth rate:

         - Heritability of post weaning growth rate = 0.5
         - Population mean post weaning growth rate   = 500 gms/
         - Mean of the selected sows to be
            Parents of the next generation   = 700 gms/day
         - Selection Intensity   = 1.00
         - Phenotypic variance of the trait = 10000 gms^2/day
         - Mean of the offsprings of selected
            parents   = 600 gms/day.

(Question 1.(b)(i) contd.)...

(i) Predict using three different methods the genetic gain per generation that can be realised by a swine breeder based on the above information.

(ii) Determine the Probable Breeding Value (PBV) of future generation after selection.

(iii) Determine the Estimated Transmitting Ability (ETA) of the next generation.   (13 marks)

2.   Briefly write about the following:

(i)   Most Probable Producing Ability (MPPA)
(ii)   Repeatability of a trait
(iii) Epistasis
(iv)   Heterosis
(v)   Genetic slippage   (25 marks)

3.   Describe the different types of Genotype X Environment (GE) interactions - illustrating how you could test for the existence or absence of a GE interaction and comment on the significance of any TWO of them.   (25 marks)

4.   Discuss the different methods of evaluating dairy sires to be selected for AI service.   (25 marks)

SECTION TWO

REPRODUCTIVE PHYSIOLOGY

5. What do you understand by Oestrus synchronisation. Discuss how this could be of any use to the farmer at Galaun Farm.

(10 marks)

6. Infertility has been a problem of many cattle farmers in the country what are the possible causes of this and how can it be controlled in herds of cattle.

(15 marks)

END OF EXAMINATION

MANAGEMENTAL PRACTICES AS THE AFFECT THE QUALITY AND

QUANTITY OF ANIMAL PRODUCTS AND BY PRODUCTS

TIME: THREE HOURS

ANSWER: ALL FIVE QUESTIONS. THE QUESTIONS CARRY EQUAL MARKS.

1.   (a)   Why is it important to control milk hygiene?

     (b)   Qualify the statement - "antimicrobial residues in milk are of
           public health and economic importance".

     (c)   What do you understand by milk adulteration?

     (d)   How is milk adulteration routinely verified? - Give examples.

2.   Give a brief account of each of the following:-
     (a)   Thaw rigor - how it comes about and its importance.

     (b)   Water holding capacity of meat - definition and importance.

     (c)   Meat tenderization

     (d)   Stunning - reasons why animals meant for slaughter have to be
                       stunned and methods commonly used to stun food animals

     (e)   Marbling

3.   (a)   Describe three common courses of damage to hides and skins
           (under ranching conditions), other than parasitic infestation,
           fungal and viral infections (of the skin).

     (b)   What preventive measures would you recommend to a farmer to cut
           down the economic loss (to his ranching enterprise) resulting from
           the damage to hides and skins by the three factors you have
           described in 4(a)?

4.   Discuss how the following can affect milk yield:-
     (a)   "steaming up"
     (b)   Pregnancy
     (c)   Fear and excitement prior to milking.
     (d)   Strong maternal instinct, common among indigenous cows.

5.   Pale soft Exudative (P.S.E.) meat is a serious economic problem if pig
     meat is to be sold fresh because of its pale and watery appearance whi'
     tend to put off descriminating consumers. In view of the above statement,
     what advice can you offer to an upcoming piggery cooperative as
     regards short and long term solutions to the problem of P.S.E. meat?

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS IN THIS SECTION IN A SEPARATE BOOKLET.

SECTION I

RUMINANTS

I. It has been stated that "pregastric fermentation is not without
    its disadvantages". Discuss this relative to nutrient
    fermentation in the rumen and end products passing to the lower
    digestive tract.   (8 points)

2. In terms of energy yield per mole of various volatile fatty
    acids the following figures have been cited: acetate - 10 ATP
    net, propionate - 17 ATP net: and butyrate - 25 ATP net.
    How would you go about increasing ATP yield in the ruminant by
    manipulation of the rumen environment.   (8 points)

3. There has been recent interest in the concepts of by-pass protein
    and protected lipids in ruminant feeding. Discuss the implications
    of these concepts and where they might play a role assuming them
    to be economically feasible.   (7 points)

4. Discuss, define or describe very briefly the following:

    (a) urea toxicity   (f) Hardware disease
    (b) Co: Mo interrelationship   (g) low level antibiotic feeding
    (c) Grass tetary   (h) nitrogen retention
    (d) Rumensin   (i) net energy
    (e) Fat soluble vitamins   (j) cobalt - Vit B_{12} (20 points)

5. Outline in detail the utilization of urea and protein by
    ruminants.   (10 points)

6. The following are "so called" metabolic disorders (1) Bloat
    (2) Acidosis (3) milk fever (4) Ketosis. Select any two (2)
    of these and discuss them relative to rumen function and /or
    ruminant performance.   (6 points)

AGA 564

7. The following are implants or additives which are potentially available to improve animal performance i.e gain and/or feed efficiency.

   (1) Synovexs (2) Ralgro (3) MGA (4) Synovex H

   Select any two (2) and discuss their use.   (6 points)

8. There are many factors which can contribute to food intake regulation in ruminants. Outline those, in your opinion, which are of most significance.   (5 points)

BONUS QUESTION

9. If you were to enter an MSc program what areas do you think you would most benefit from further training - based on your interests and on your BSc program of UNZA.   (5 points)

/3......

AGA 564

MONOGOSTRIC NUTRITION

SECTION II

[All Question must be answered] in a separate booklet

1. Concisely describe the following:

   (a) The processing techniques/of blood and bones for feeding to pigs and poultry.

   (b) The functions of manganese and pantothenic acid in pigs and poultry. What are the consequences of their dietary deficiency?   (20 points)

2. (a) Contrast the steps followed in linear programming and manual methods of ration formulation for broiler breeder layers.

   (b) Formulate a 45% protein concentrate for pigs from the following information:

      (i) One tonne capacity

      (ii) Cottonseed cake to be restricted to 30% of the total vegetable protein inclusion.

      (iii) The ingredients to incorporate are:

	% PROTEIN	% RESIDUAL OIL
SOYBEANCAKE	48	6.5
COTTONSEED CAKE	40	9.0
FISHMEAL	66	18.8

   What feeding recommendations would you make to the concentrate user when the maximum residual oil stipulation is 4%?   (20 points)

END OF EXAIONATION

LIVESTOCK AND POULTRY MANAGEMENT

TIME: TWO AND HALF HOURS

ANSWER: ALL QUESTIONS   (EACH SECTION SHOULD BE ANSWERED IN A
           SEPARATE ANSWER BOOK)

SECTION I

ANIMAL BREEDING MANAGEMENT

1   (a)   What does an animal breeder need to know in order to
            estimate the change in breeding value (V) for a specific trait
            when selection is applied on a different trait.   (10 points)

     (b)   Distinguish between selection criteria and selection methods
            and   describe the different selection methods indicating
            the importance of each one in the improvement of different
            animal traits.   (20 points)

SECTION II

HEALTH

1.   What considerations would you take into account in determining
      vaccination schedules for farm livestock?
            What are some of the problems that may arise as a result
            of improper vaccination?   (20 points)

2.   Briefly outline the causes of dystocia in cattle. Indicate in
      detail how you would proceed to deliver a calf with unilateral
      shoulder flexion resulting in dystocia.   (20 points)

SECTION III

MANAGEMENT AND NUTRITION

1.   Discuss the possible alternative development paths of livestock
      in the Cropped Tropical Lowlands of Africa, using Zambia as a
      model.   (30 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-SESSIONAL EXAMINATIONS MARCH, 1986

AGC 211

AGRICULTURAL BOTANY

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS.   ILLUSTRATE YOUR ANSWERS
         WHEREVER POSSIBLE.
         ALL QUESTIONS CARRY EQUAL MARKS.

1. The data in the table below shows percentage of maize
    and soybean roots at various soil depths.

Depth (cm)	Percentage of roots at Various depths	
	Maize	Soybean
5	7	22
10	14	50
15	24	15
20	17	6
30	15	3
40	8	2
50	6	1
60	4	1
Below 60	5	0

(a) What conclusions would you make from these data?

(b) How would this information influence inter-row
     cultivation and why?

(c) Would early and late interrow cultivation have
     the same effects on roots and, therefore,
     yield?

2. (a) What is tillering? Discuss how environmental
         factors may affect tillering.

    (b) Is tillering always necessary? Justify your
         reasoning.

AGC 211

3. Briefly discuss the following:-

    (a) Flower morphology and plant breeding.

    (b) Structure of grass and legume seed.

    (c) Importance of crop growth stages to agricultural production.

    (d) Leaf structure and photosynthesis.

4. Discuss the growth of fruits in relation to:-

    (a) Patterns of growth (give examples).

    (b) Processes involved in increase in size.

    (c) Influence of seed development on fruit growth.

5. Suppose you are given data on leaves of a plant (e.g. maize) which show differences in the shape, size and structure of leaves from the bottom to the top of the plant. Discuss the various possible causes that might account for differences in:-

    (a) Shape

    (b) Size

    (c) Structure

6. A farmer brings to you whole-plant (roots, shoot and inflorescence) specimens of various crops. He does not know which specimen is maize, wheat, oats, barley, or rye. Discuss the various morphological characteristics you would use to differentiate these specimens.

TIME: THREE HOURS

ANSWER: Any FIVE questions. All questions carry equal marks

1.   (a)   Explain the structure, functioning and economic importance
           of the mouth parts of order hemiptera.

     (b)   Describe the hemipterous and other insect pest problems of
           citrus and discuss the possible integraton of chemical and
           non chemicals methods of control under Zambian conditions.

2.   (a)   Describe the major insect pest problems of stored grain
           products faced by small scale farmers in Zambia.

     (b)   Suggest the methods for the control of those pests.

     (c)   Briefly suggest a strategy for the control of /the larger
           grain borer if and when it enters into Zambia from
           Tanzania.

3.   (a)   Briefly discuss the status of six commonly observed insect
           pests of cotton in Zambia.

     (b)   Explain the importance of insect scouting on cotton and
           give economic thresholds   for major insect pests.

     (c)   What are the commonly practiced methods for the   control/of major insect and
           how/such practices can be improved under Zambian conditions?

4.   (a)   Discuss the mechanism of insect resistance to insecticides.

     (b)   How/did diamond backmoth of cabbage (Plutella xylostella)
           develop   resistance to commonly used insecticides in
           Zambia?

     (c)   What methods would you suggest to manage diamond backmoth of cabbag
           as well as other insect pests   of cabbage.

2.   AGC 222

5.   (a)   Discuss the practice of biological control of insects with
              predators and parasites

      (b)   Explain the effectiveness and economics/with special of biological control of insect
              reference to biological control of potato tuber moth in
              Zambia.

6.   Describe the philosophy of insect pest management and discuss the
      need and/the major components.

END OF EXAMINATION

PLANT PHYSIOLOGY FOR AGRICULTURAL STUDENTS

TIME: THREE HOURS

ANSWER: All questions

1.   Briefly define or explain the following terms:-

   (a)   Zeatin

   (b)   Aleuron

   (c)   After-ripening

   (d)   Critical day length

   (e)   Leghaemoglobin

   (f)   Thylakoid

   (g)   Glycolate

   (h)   Double-dormancy

   (i)   Root cap.

   (j)   Active transport.   (10)

2.   Identify the plant growth hormone most likely involved in control
      of the following growth process./ Give One answer for each part.

   (a)   Cell division, differentiation of the vascular system.

   (b)   Vegetative bud dormancy, seed dormancy

   (c)   Stomatal closure, reduction in plant height

   (d)   Increase in internode length, replacement of vernalization
          requirement.

   (e)   Delay of leaf senescence, stimulation of tissue growth in
          culture.

   (f)   Stimulation of leaf abscision, affects protein synthesis.

   (g)   Inhibition of axillary bud growth, delay of leaf abscision.

   (h)   Induction of fruit ripening, causes leaf epinasty.

   (i)   Parthenocarpic fruit development, stimulation of elongation
          of Avena coleoptiles

   (j)   Stimulates fruit set and hydrolytic enzymes.   (10)

3. Give a logical explanation to account for each of the following:

(a)   Wilson found that in the presence of light and absence of carbon dioxide (CO_2), Ribulose bisphosphase (RUBP) increased, while phosphoglycerate (PGA) decreased.

(b)   When the coleoptile of a grass seedling (Avena) is excised (cut), it fails to bend towards the unilateral light stimuli.

(c)   Seeds of cotton   soaked in sulfuric acid before planting.

(d)   Winter wheat grows well vegetatively, but fails to flower and produce seed in Zambia.

(e)   Seeds of tomato failed to germinate when planted soon after removal from the fruit.

(f)   Root hair formation and root branching are anatomically completely different phenomena.

(g)   Mrs. Banda tightly sealed a bottle in which she had placed some seeds and water. A fews hours later,
the bottle exploded   (10)

4. Write short notes on FOUR of the following:

(a)   Physiological germination

(b)   Epigeal and Hypogeal germination

(c)   Absorption and Action Spectrum.

(d)   Scarification and Stratification

(e)   Emmerson enhancement effect and Hill's reaction.   (20)

5. Kranz leaf anatomy is unique in C_4 plants. Illustrate the structure and discuss its significance and how it functions in photosynthesis. (20)

6. Legumes are effective in biologically fixing the ab.   nitrogen (N_2)/ from the atmosphere. Discuss the infection process and how the fixed N_2 becomes available to the plant   (20)

7. Discuss the factors that affect photosynthesis and, where possible contrast between C_3 and C_4 plants.   (10)

END OF EXAMINATION

AGC 342   (FOR GRADUATING STUDENT ONLY.

FORAGES

TIME: THREE HOURS.

INSTRUCTIONS: YOU ARE REQUIRED TO ANSWER QUESTION I.
                YOU MUST ANSWER ANY FOUR(4) OF THE REMAINING
                QUESTIONS.

---

1.   Discuss the visits the class made to the Miller and
     Galloun farms.

2.   Discuss the re-seeding of ranglands.

3.   Discuss the use of additives in making silage.

4.   Discuss the advantages of rotational grazing, as compared
     to continuous grazing of irrigated pastures.

5.   Compare the effect of over-grazing and of under-grazing
     of pastures on: (assume a mixture of lucerne and buffelg

     a.   forage plant longevity.
     b.   forage yield.
     c.   live-weight gains peranimal, per ha, per annum.

6.   Discuss moisture levels of lucerne that would enable safe
     storage as

     a.   hay (baled).
     b.   silage.
     c.   haylage.

END OF EXAMINATION

AGC 342

FORAGES

TIME: THREE HOURS.

INSTRUCTIONS: Answer Question I (value 30%)

Answer any four of questions 2,3,4,5, and 6
(value 20% each).

1.   Assume that you are hired as a farm manager on a large
commercial farm. Previous pasture management has
been inadequate. Your first assignment is to
re-establish a good pasture (lucerne and buffelgrass),
and to introduce management practices that will maximize
ALL of the benefits that could be anticipated from a good pasture
system and from proper grazing practices. Describe how
you would carry out your assignment.

2.   Discuss the principles that determine the procedures
used in making high quality:

(a)   hay, and
(b)   silage.

3.   You are to deliver a lecture on the digestion
process in the ruminant. Prepare an outline for
such a lecture (with headings) including brief notes
that will call your attention to the
points you feel are important to discuss.

4.   Discuss the renewed interest in, and emphasis on,
forage production in advanced farming systems.

5.   Discuss the concept of a grassland system of
      agriculture that will be suitable for

      (a)   the Zambian commercial farmer, and

      (b)   the Zambian small (subsistance) farmer.

6.   Contrast pasture management with range management.

END OF EXAMINATION

AGC 342/VMA 232
FORAGES

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

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1.   Describe/discuss:

   a.   seedbed preparation for forages.
   b.   stand establishment for stargrass.
   c.   stand establishment for lucerine.

2.   Compare the management practices applied to pastures of Rhodesgrass with stargrass pastures. Base your comments on the differences between the species and also what was seen at the Miller and Galloun farms.

3.   Compare hay with silage as:

   a.   preparation procedures.
   b.   risks.
   c.   use.
   d.   value as feed.

4.   Discuss management of an irrigated pasture:

   a.   assume the species is lucerine.
   b.   assume the species is stargrass.

5.   Describe the concept and objectives of the farming system identified as a Grassland Agriculture.

END OF EXAMINATION

UNIVERSITY MID-SESSIONAL EXAMINATIONS MARCH, 1986

AGC 351

PLANT PATHOLOGY

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS.
ILLUSTRATE YOUR ANSWER WITH SUITABLE DIAGRAMS
WHERE EVER POSSIBLE.
ALL QUESTION CARRY EQUAL MARKS

1.   Describe with examples the types of spores and their
dispersal in Plant pathogenic fungi

2.   Outline the classification of commonly used fungicides
and describe their uses with emphasis on major crop
diseases in Zambia.

3.   Classify the major diseases of wheat, briefly describe
their symptoms and mention the life history and control
of stem rust (Puccinia graminis)

4.   Describe the symptoms, dissemination, and control of
major virus diseases of following crops:
(a)   Tobacco
(b)   Maize
(c)   Groundnuts
(d)   Potato

5.   Discuss the symptoms, economic importance and general
methods of control of major bacterial diseases of crops
in Zambia.

6.   Write notes on the following:-
(a)   Acervulus   (d)   Haustorium
(b)   Pycnidium   (e)   Rhizomorphs
(c)   Clestothecium   (f)   Plasmodium.

END OF EXAMINATION

TIME: THREE HOURS

ANSWER:: Question No. 1 and any other four questions. Each question
          carries 20 points

1.   (a)   Explain what is meant by "selectivity". Give examples of
           various forms of selective action of herbicides.

     (b)   A maize field has a weed history of an abundance of wild
           sunflower (Helianthus sp), Rottboellia exaltata, and foxtail
           (setaria sp.). What weed control program would you prescribe
           for such a field?

2.   Compare and contrast the potentials and limitations of irrigated and
     rainfed wheat.

3.   (a)   What is "Appropriate Technology"? Give one axemple for
           large scale farming and one for small scale farming to show
           how .such   technology can be adopted.

     (b)   How would you mechanize/for the production of groundnuts on
           a small scale farm ˙ using ˙ technologies available in
           Zambia?

4.   (a)   Compare and contrast the seedbed requirements for maize and
           sorghum.

     (b)   How/should the new maize varieties developed at Mount Makulu
           increase maize productivity   in Zambia?

5.   (a)   The potential for crop production among small scale farmers
           is immense and yet it remains under exploited. Explain why.

     (b)   The Zambian population must diversify its eating habits. How
           could indigenous crop plants/be fitted into this program?

/2.......

6. (a) Of the four important oil crops grown in Zambia which one would you /consider to have the highest potential for expansion among small scale farmers? Give reasons.

   (b) Why is soyabean a preferred rotation crop for irrigated wheat?

END OF EXAMINATION

AGC 472

PLANT BREEDING

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS.   ALL QUESTIONS CARRY EQUAL MARKS.

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1. (a)   Explain the Hardy-Weinberg equilibrium and its implication in breeding cross-pollinated crops.

    (b)   A sample of 100 individuals from a population is made up of 4 AA, 32 Aa and 64 aa genotypes for a certain trait. Show by calculation whether this population is in Hardy-Weinberg equilibrium for the trait.

    (c)   "Plant breeding is both an art and a science." Discuss this statement.

2. Write short notes on any five

    (a)   The nearest neighbour analysis

    (b)   Meiosis in plant breeding

    (c)   In breeding in self and cross-pollinated crops.

    (d)   Stratified mass selection

    (e)   Progeny tests in breeding cross-pollinated crops.

    (f)   Protandry and protogyny in flowering plants.

    (g)   Single seed descent breeding method.

ANSWER EITHER 3 OR 4

3. (a)   Outline step by step the procedure of utilizing cytoplasmic - male sterility system in maize for the production of single and double cross hybrid seed:

    (b)   You have been appointed plant breeder to initiate a breeding program for the improvement of pumpkins in Zambia. Prepare a systematic plan of research to be followed during the next five years. (Pumpkins are cross-pollinated).

4. You are assigned the task of initiating a plant breeding program of developing high yielding maize varieties to fit various agro-ecological zones of Zambia. Describe step by step the procedure you would follow.

5 Answer in brief any four
   (a) Discuss the significance of plant introduction and domestication as a breeding method in view of the present food situation in Zambia.
   (b) The backcross breeding method in self-pollinated crops.
   (c) Define heritability and discuss the significance of heritability estimates in plant breeding.
   (d) Describe centers of diversity of crop plants and their value to plant breeding.
   (e) Explain the dominance and over dominance theories of heterosis.

6. (a) List and briefly discuss the objectives of breeding soybeans and sorghum in Zambia.
   (b) It has been observed that soils in the northern Province of Zambia have high concentrations of aluminum and this situation is hindering rain-fed wheat production in the area. If you were given the task of developing wheat varieties with resistance to aluminum toxicity using Induced mutations, how would you proceed to do that (assume resistance to aluminum is simply inherited).

END OF EXAMINATION

HORTICULTURAL SCIENCE

TIME: THREE HOURS

ANSWER: QUESTION NO. 1 (COMPULSORY) AND ANY OTHER **FIVE** QUESTIONS.

ALL QUESTIONS CARRY EQUAL MARKS

1. (a) What is the horticultural definition of plant propagation?

   (b) Discuss the histological basis for initiation of root primordia in cuttings **and illustrate** by means of a simple sketch the location of origin of root initials.

   (c) What do you understand by the term incompatibility in stock/scion combinations?

   (d) List **four** symptoms of stock/scion incompatibility.

   (e) Name **three** theories that have been advanced to explain the fundamental causes of incompatibility and discuss, very briefly, the one that you consider most appropriate.

2. (a) What do you understand by the term "**plant growth regulator**"? Based on chemical structure and physiological similarities, what are the main groupings and their source of synthesis in plants.

   (b) Discuss, with specific examples, the use of plant growth regulators in the production of fruit crops.

3. Write short notes on any **five** of the following:-

   (a) Biennial or Alternate bearing

   (b) IAA (Indoleacetic Acid)

   (c) Double Dormancy

   (d) Plant Juvenility

   (e) Climacteric

   (f) Bridge Grafting

/2.,.....

AGC 481

4. (a) Upon graduation from the University of Zambia, you have been hired by a Company that wishes to commercially grow citrus fruit (oranges, lemons and grape fruit) in Zambia

Discuss how you would proceed to establish a nursery and have grafted plants ready for planting at a permanent site.

(b) What management practices would you suggest to ensure production of apples at the University Nursery?

5. A market gardener wishes to grow potatoes for the local market.

(a) What advise would you give the person relative to:

(i) Soil and soil preparation

(ii) Manures and Soil Improving Crops

(iii) Fertilizer practices

(iv) Planting including seed and seed rate.

(v) Other crop husbandry practices to bring the crop to maturity.

(b) What measures should this grower adopt for long term (more than three months) storage of potatoes?

6. (a) The production of vegetable seeds has been proven feasible in Zambia and could be a source of foreign exchange.

Discuss how you would produce seed of the onion cultivar 'Texas Early Grano'.

(b) The mango (Mangifera Indica) is an important tree fruit crop in Zambia. Discuss the factors currently limiting the expansion of mango fruit production for export from Zambia and state how improvements can be accomplished.

/3 ......

AGC 481

7. A grower who lives just outside Lusaka planted seeds of
the pea cultivar "Dark Skin Perfection" during the latter
part of November. The person found that many seedlines
died after germination and what remained looked
chlorotic and eventually produced a light crop of peas
of inferior size and quality.

(a)   Discuss what could have caused the failure of
this crop.

(b)   What advise would you give this grower to success-
fully grow peas for the fresh market?

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: Question No. 1 and any other four questions. Each question
carries 20 points.

1.   Zambia's
/   highest crop yields are not/as good as they could be.
theoretical maximum yields for maize and soybean are 30 ton ha^{-1} . For example the
and 14 tons ha^{-1} respectively. Explain giving at least three
factors responsible for the lower yields currently achieved.

2.   (a)   The general use of crop mixtures developed out of the
belief that/cooperation might occur. Explain with
examples the conditions under which cooperation and competition
may occur in   crop mixtures.

   (b)   Clean cultivation is not necessary and perhaps not even
desirable. Discuss the pros and cons of this statement.

3.   How would you describe a good canopy? Discuss three possible
ways of improving light distribution in a canopy.

4.   (a)   Define the term "agricultural drought" and distinguish
between "agricultural drought" and "meteorological drought."

   (b)   What do you understand by the "buffering effect of soils"
with respect to dry spells?

5.   Discuss the conditions under which yield may be limited by the
"source" and by the "sink". Give examples.

6.   Explain how physical environmental factors may influence plant growth
and development. Give examples.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - JULY, 1986

AGC 593

POST HARVEST TECHNOLOGY

TIME: THREE HOURS

ANSWER: All question

1. Give a logical explanation to account for the following observations:

    (a)   Unripe, green bananas placed in the same storage chamber with ripening tomatoes, quickly turned yellow and ripened.

    (b)   Apples store longer when placed in air-tight or tightly sealed storage chambers.

    (c)   In bread baking, the dough continued to rise and to increase in volume.

    (d)   A can of processed fruits had both ends extended.

    (e)   Pectin was added during the processing of jelly.   (10)

2. (a)   Vegetables lost their green colour and turned/yellow under prolonged storage. What are the factors that cause this loss in colour? Illustrate the pathways leading to yellow and colourless compounds.   (10)

    (b)   Write short notes on Two of the following:
          (i)   Climacteric fruit.
          (ii)   Hypobaric storage.
          (iii)   Deodorizing.   (10)

3. Apples and tomatoes are abundant this year. Discuss how you would process ONE of these into an acceptable product. (20)

4. A new company in Lusaka has started processing fruits and vegetables. Unfortunately, they are experiencing problems with browning discoloration after peeling and cutting the fruits and vegetables, and have no idea of the cause. How would you explain the cause and mechanism of this browning and offer solutions to prevent it?   (20)

5. Discuss the malting and brewing process. Indicate the problems that are associated with beer on-the-shelf and offer solutions.   (20)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: Question No. 1 (Compulsory) and any other FOUR questions.
          All questions carry equal marks

---

1. (a) **Define a clone?**

    (b) Discuss the anatomical basis for initiation of root
         primordia in stem cuttings and illustrate by means of a
         sketch the location of the origin of root initials.

    (c) What do you understand by the term incompatibility in stock/sci
         combinations?

    (d) Discuss the theories advanced to explain the fundamental
         causes of incompatibility and suggest the one that you
         consider appropriate.

2. (a) Discuss the physical environmental factors controlling
2.   flowering in plants.

    (b) What is the evidence. that would support hormonal control
         of flowering?

    (c) How / could the role of plant hormones in sex determination be
         exploited by a cucumber and pumpkin breeder?

3. Write short notes on any five of the following:
    (a) Maleic hydrazide (MH).
    (b) Biennial bearing
    (c) Training fruit trees
    (d) Seed dormancy in vegetable crops
    (e) Fruiting spurs
    (f) Centres of origin of cultivated fruit plants.

4.   Discuss fully the effects of temperature on the growth and development of pumpkins and watermelons.

5.   The production of vegetable seeds in Zambia has the potential of earning valuable foreign exchange. Discuss fully how you would proceed to produce certified seed of the onion cultivar "Texas Early Grano".

6.   (a)   What are Plant Growth Substances?

      (b)   Discuss the practical uses of plant growth substances in the production of horticultural crops.

END OF EXAMINATION

AGC 596
ADVANCED PLANT BREEDING

TIME: THREE HOURS.

ANSWER: FIVE Questions. All questions carry equal marks.

1. a)   What do you understand by variety stability?

    b)   How can you breed stable varieties?

    c)   Below is mean yield data in Kg/ha of three
         bambara groundnut varieties at four locations
         representative of the main agro-ecological
         zones of Zambia.

Variety	Locations			
	1	2	3	4
UNZA-B1	4.0	3.0	1.0	1.5
UNZA-B2	6.0	4.0	3.0	1.0
UMTALI-7	2.0	1.0	3.0	0.5
Total	12.0	8.0	7.0	3.0

Apply the Eberhart and Russel method to compute the
stability parameters and compare the stability of the
three varieties.

2.   Discuss the application of biotechnology and chromosome manipulation techniques in plant breeding.

3.   Write short notes on five of the following:

   a.   Somaclonal variation.
   b.   Nurse crop.
   c.   honeycomb selection method.
   d.   synthetic varieties.
   e.   plasmid.
   f.   single seed descent breeding method.

ANSWER EITHER 4 or 5

4.   a.   What do you understand by first degree statistics in biometrical genetics.

   b.(i) Discuss the North Carolina Design 1 (NC_1) mating design for estimating genetic variances.

   (ii)   Give a complete ANOVA table for one environment and progenies not blocked in sets.

   (iii) Using ANOVA table, show how you can derive the variance components

   (iv)   Give formulae for calculating estimates of additive and dominance genetic variances.

5.   You have been appointed a breeder to initiate a plant breeding research program on Pearl millet (a cross-pollinated crop) to develop open-pollinated and hybrid varieties to fit the various agro-ecological zones of Zambia. Outline the type of breeding program you would follow.

6.   a.   You are asked to develop an ideotype for
            sorghum. With your knowledge of plant
            physiology what would be your sorghum
            ideotype?

      b.   If you were to actually initiate a breeding
            program to develop your ideal sorghum plant, list
            and briefly discuss the type of pre-selection
            studies you would have to do before you start
            your breeding program.

END OF EXAMINATION

AGE 310 (GRADUATING STUDENTS)

FUNDAMENTALS OF AGRICULTURAL ECONOMICS

PAPER I

TIME: THREE HOURS.

ANSWER: QUESTIONE ONE, TWO, AND THREE ARE COMPULSORY.
         YOU CAN OPT FOR ANY OTHER TWO QUESTIONS.

MARKS: AS GIVEN BELOW.

---

1. Assume the following production alternatives A to G to
    produce a constant output Y (only two inputs required,
    other things held constant).

	A	B	C	D	E	F	G
Input X_1	2	3	4	5	6	7	8
Input X_2	10	7	5	4.6	4.3	4.1	4.0

Illustrate your answers to the following questions
graphically.

a)   Explain the "law of diminishing marginal rate of
     substitution" on the basis of these data.

b)   Assume the following per unit prices for the two
     inputs:

     $P_{X1} = 2. - K$
     $P_{X2} = 4. - K$

     which alternative will be the least cost combination
     to produce the wanted output Y?

c)   Suppose the producer considers a budget of K30. -
     for the production of Y. Which alternative(s)
     can be realized with this budget?   (20 marks)

/2...

2. Assume the following cost data for a purely competitive
    producer.

Total output	AFC	AVC	ATC	MC
1	60.00	45.00	105.00	
2	30.00	42.50	72.50	40
3	20.00	40.00	60.00	35
4	15.00	37.50	52.50	30
5	12.00	37.00	49.00	35
6	10.00	37.50	47.50	40
7	8.57	38.57	47.14	45
8	7.50	40.63	48.13	55
9	6.67	43.33	50.00	65
10	6.00	46.50	52.50	75

Assume further three different market prices:

$P_1 = 55. - K$
$P_2 = 40. - K$
$P_3 = 30. - K$

a) Apply the MR - MC rule and answer the three
    following questions for each of the three prices:

    -   should he produce?
    -   if so, what amount?
    -   what profit, or loss will be realized?

b) Graph the four cost curves and explain graphically
    your arithmetical results. Specifically, explain
    why MC cuts both AVC and ATC at their minimum poi

                                            (25 marks)

3.   a)   Explain briefly the concepts of price elasticity
and income elasticity of quantity demanded. Giv
the two modes of calculating the price elasticit
coefficient $E_{d(p)}$ with respective formulas, and
explain why the midpoint formula is considered t
be more meaningful.

b)   For the 1986/87 budget a reduction in excise tax
on beer and soft drinks has been announced.
Comment on this reduction the Daily Mail from
6th February, 1986 forcasted a "big dent in
government coffers". Discuss this statement.
Base your discussion on the following (estimated)
figures for soft drinks.

Original data (before tax reduction):

Ex-factory price per bottle	67.5 ngwee
Including 35% excise	17.5 ngwee
sales per day	100,000 bottl

New data (after tax reduction):

Ex-factory price per bottle	62.5 ngwee
Including 25% excise	12.5 ngwee

Assume two different price elasticities of
quantity demanded.

1. $E_{d(p)} = 2$

2. $E_{d(p)} = 6$

What are the respective results in terms of government
tax revenues?   (25 marks)

4.   Draw a circular flow model of a pure free market economy
Explain.   (15 marks)

5. Following is an example of a typical production function
    of an individual producer, other factors of production
    held constant.

Input X_1	TPP (Y)	MPP
0	0	
1	1	1
2	5	4
3	9	2
4	11	1
5	12	-1
6	11	

Draw the TPP-curve as well as the MPP-curve, explain the
"law of diminishing returns", and indicate the section
where it is only applicable.   (15 marks)

6. Which are the five fundamental questions facing any
    economic system? Explain the reasoning of each of
    them.   (15 marks)

7. Explain the "law of equimarginal utility" and discuss
    the underlying assumptions of this "concept of consumer
    behaviour".   (15 marks)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS AS INDICATED BELOW.

SECTION I

(Answer question one and one other from this section)

1. Given the following economic system

$Y = C + I + G + X - M$

$C = 50 + .8Yd$ — Consumption function

$T = 10 + .1Y$ — Tax function

$G = 40$ — Government expenditure

$I = 30 - 50i$ — Investment function

$X = 20$ — Exports

$M = 5 + .2Y$ — Imports

$Y_F = 320$ — Full employment output

(a)   Derive the equilibrium equation for Y.

(b)   If $i = .15$ what is the state of the government budget?

(c)   Is the government pursuing an expansionist, passive or deflationary policy? Explain.   (28 marks)

2. What do you understand by the following concepts:

(a)   Multiplier

(b)   frictional unemployment

(c)   crowding out effect.

(d)   value added.   (18 marks)

3. Do you think that the major tool of fiscal policy should be changes in government spending or changes in taxation? Justify your position.   (18 marks)

/2.......

AGE 310   Paper II

4.   What are the basic determinants of investment? Explain the
relationship between the interest rate and level of investment?   (18 m

SECTION II

(answer two questions from this section)

5.   (a)   What is meant by the term inflation? Distiquish between
"demand-pull' and 'cost-push' inflation.

(b)   Explain the relationship between inflation and unemployment. (18 m

6.   What are the major phases of a business cycle? How do seasonal
variations and secular trends complicate measurement of the
business cycle?
(18 marks)

7.(a) Discuss the characteristics and functions of money.

(b)   Briefly discuss the theory behind the keynesian demand for
money.
(18 marks)

8.   Monetary policy is not always effective as an instrument in
achieving full-employment. Explain carefully and fully when
and why this is so.
(18 marks)

SECTION III

(Answer one question from this section)

9.   Explain some of the arguments in support of the use of tariffs,
quotas and other trade barriers in developing countries. (18 marks)

10.   How do tariffs affect the welfare of importers and exporters and
how do these effects depend on the elasticities of supply and
demand?
(18 marks)

11.   How would the devaluation of the kwacha help in solving Zambia's
balance of payments difficulties?
(18 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - JULY 1986

AGE 310 (FOR GRADUATING STUDENT)

FUNDAMENTALS OF AGRICULTURAL ECONOMICS

PAPER II

TIME: THREE HOURS.

ANSWER: FIVE QUESTIONS AS INDICATED BELOW.

SECTION I

(Answer question one and five and any other two)

. Given the system

$$Y = C + I + G + X - M.$$
$$C = 50 + .20 \ Yd \quad - \text{Consumption Function.}$$
$$T = 10 + .1Y \quad \quad - \text{Tax function.}$$
$$G = 40 \quad \quad \quad - \text{Government expenditure.}$$
$$I = 30 - 500 \ i \quad - \text{Investment.}$$
$$X = 20 \quad \quad \quad - \text{exports.}$$
$$M = 5 + .2Y \quad \quad - \text{Imports}$$

(a) Solve the equilibrium equation of Y.

(b) If the rate of interest is 15 percent by how much must government expenditures (G) be changed to produce equality between exports and imports.

(c) What is the equilibrium value of Y, Yd, and I?

(30 points)

(a) Explain the different phases of a typical business cycle verbally and illustrate graphically.

(b) Explain the different types of unemployment, and comment on the economic and non-economic costs of unemployment.

(15 points)

Explain how the economy's performance is measured by the Gross National Product (GNP). Compare the expenditure approach to GNP with the income approach to GNP.

(15 points)

/2....

4.   (a)   What is the difference between cost-push and demand-pull inflation?

     (b)   Who loses from inflation? Why?

     (c)   How can government combat the two types of inflation in (a)?   (15 points)

5.   Compare and contrast fiscal and monetary economic policies.   (25 points)

6   (a)   Discuss the characteristics and functions of money.   (15 points)

     (b)   What instruments can the central bank use to control supply of money?   (15 points)

SECTION II
(Answer ONE question)

1.   Utilizing a demand-supply diagram, show and explain the economic effects of a tariff, and of a quota. (15 points)

2.   Give the arguments for and against for protection of infant industries.   (15 points)

3.   What effect has had/the devaluation of the Kwacha on the Zambian economy. What in your view were the economic reasons for introducing the auctioning system?
                                                  (15 points)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: Question one, two and three are compulsory.

            You can opt for any other two questions.

MARKS   As given below.

1.   (a)   Explain briefly the concepts of price elasticity and income
           elasticity of quantity demanded. Give the two modes of
           calculating the price elasticity coefficient $E_{d(p)}$ with
           respective formulas, and explain why the mid-point formulas
           is considered to be more meaningful.

     (b)   For the 1986/87 budget a reduction in excise tax on beer and
           soft drinks has been announced. Commenting on this reduction
           the Daily Mail from 6th February, 1986 forcasted a "big dent
           in government coffers". Discuss this statement. Base your
           discussion on the following (estimated) figures for soft
           drinks.
           Original data (before tax reduction):

           Ex-factory price per bottle   =   67. 5 ngwee
           including 35% excise   =   17. 5 ngwee
           sales per day   100,000 bottles

           New data (after tax reduction):
           Ex-factory price per bottle   =   62. 5 ngwee
           including 25% excise   =   12. 5 ngwee

           Assume two different price elasticities of quantity demanded:
           1. $E_{d(p)}$ = 2

           2. $E_{d(p)}$ = 6

           What are the respective results in terms of government tax
           revenues?   (25 marks)

2. Assume the following cost data for a purely competitive producer.

Total output	AFC	AVC	ATC	MC
1	60.00	45.00	105.00	> 40
2	30.00	42.50	72.50	> 35
3	20.00	40.00	60.00	> 30
4	15.00	37.50	52.50	> 35
5	12.00	37.00	49.00	> 40
6	10.00	37.50	47.50	> 45
7	8.57	38.57	47.14	> 55
8	7.50	40.63	48.13	> 65
9	6.67	43.33	50.00	> 75
10	6.00	46.50	52.50	

Assume further three different market prices

$P_1 = 55. - K$

$P_2 = 40. - K$

$P_3 = 30. - K$

(a) Apply the MR - MC rule and answer the three questions:
-   should he produce?
-   if so, what amount?
-   What profit, or loss will be realized?

(b) Graph the four cost curves and explain graphically your arithmetical results. Specifically, explain why MC cuts both AVC and ATC at their minimum points.   (25 marks)

3. Assume the following production alternatives A to G to produce a constant output Y (only two inputs required, other things held constant). Illustrate your answers to the following questions graphically!

	A	B	C	D	E	F	G
INPUT X_1	2	3	4	5	6	7	8
INPUT X_2	10	7	5	4.6	4.3	4.1	4.0

(a) Explain the "law of diminishing marginal rate of substitution" on the basis of these data.

(b) Assume the following per unit prices for the two inputs:

$P_{x1} = 2. - K$

$P_{x2} = 4. - K$

which alternative will be the least cost combination to produce the wanted output Y?

(c) Suppose the producer considers a budget of K 30. - for the production of Y. Which alternative(s) can be realized with this budget?   (20 marks)

4. Following is an example of a typical production function of an individual producer, other factors of production held constant.

input x_1	TPP (Y)		MPP
0	0	>	1
1	1	>	4
2	5	>	4
3	9	>	2
4	11	>	1
5	12	>	-1
6	11		

Draw the TPP-curve as well as the MPP-curve, explain the "law of diminishing returns", and indicate the sections where it is only applicable.   (15 marks)

5. Explain the "law of equimarginal utility" and discuss the underlying assumptions of this concept of "consumer behaviour".

(15 marks)

6. Draw a circular flow model of a pure free market economy. Explain!   (15 marks)

7. Which are the five fundamental questions facing any economic system? Explain the reasoning of each of them.   (15 marks)

END OF EXAMINATION

The University of Zambia

University Mid-Sessional Examinations - March 1986

AGE 421

Production Economics

Time: Three hours
Answer All questions
Marks   100 total

I. Multiple Choice. Circle the letter in front of each answer that is
   correct. One or more answers may be correct for each question.
   There are 24 correct answers out of the possible 48 answers.
   Correct answers are worth one mark each (24 possible). One point
   will be subtracted for each wrong answer circled.

   1. A production function:

a   Relates to a specific production process and state of technology.
b   Depicts output resulting from the production process during a given
    unit of time.
c   The shape of the production function describes the change in
    output as increasing amounts of fixed factors are added to a set
    of variable factors.
d   When a production function is graphed as a continuous "curve", the
    implication is that variable inputs and outputs are both perfectly
    divisible.

   2. With regard to Marginal Physical Product,

a   It is always increasing in Stage I production.
b   It is always decreasing in Stage II production.
c   It is always a positive amount in Stage II production.
d   It is always greater than average physical product in Stage II.

   3.   With regard to Average Physical Product,

a   While it at first increases and then decreases, it always remains
    a positive amount.
b   When it is at its highest point, average total cost will be at its
    lowest point.
c   The manager will not find his most profitable output level where
    it is higher than marginal physical product.
d   Where it is decreasing, marginal cost will also be decreasing.

   4. With regard to Stage II of the production function,

a   It begins where the marginal physical product starts to decrease.
b   It ends where the slope of total physical product is 1.0.
c   Both marginal physical product and average physical product are
    decreasing.

d   It begins at the output level represented where a line drawn from
    the origin becomes tangent to the total physical product.

5. Regarding total fixed costs of production:

a   In a short run situation, their value need not be known in order to
    make a decision regarding what output level is the most profitable.
b   They arise from the use of fixed input factors in the production
    process in the long run period.
c   If averaged, based on output level, their cost is still positive in
    Stage III of the production function.
d   They are included in the calculation of marginal cost.

6. Regarding marginal cost:

a   It is calculated as the additional cost of adding one more unit of
    variable input to the production process.
b   The manager should try to operate when at the lowest point on the
    marginal cost curve.
c   It will always flow through the lowest point on the average
    variable cost curve when depicted graphically.
d   The sum of individual producers' marginal cost curves results in
    the demand curve facing producers in the total market situation.

7. With regard to the value of the marginal product:

a   It refers to the money value of the marginal unit of product
    produced and sold.
b   When equated to the price of the variable input factor, it gives
    the manager a decision criterion for finding the most profitable
    input and output level.
c   It is always a decreasing value in Stage II of the production
    function.
d   It is calculated by multiplying the marginal physical product
    times the price of the variable input being used.

8. When marginal cost is equal to marginal revenue:

a   Maximum net return is achieved and is always a positive amount.
b   Marginal cost is increasing while marginal revenue is decreasing.
c   Average total cost is usually at a minimum.
d   Net returns are maximized.

9. Two variable inputs are in a least cost combination if:

a The marginal rate of substitution between them is equal to the slope of the isocost line.
b They are combined at a point falling on the expansion path.
c. The marginal rate of substitution between them is decreasing.
d The combination is on an isoquant where output is equal.

10. With regard to the expansion path:

a It will always be a straight line but does not necessarily begin at the origin.
b There is a different one for each variable input price ratio.
c It connects points of least cost combinations and is also one of the isoclines.
d The expansion path formula sets the ratio of variable input prices equal to the value of marginal product ratio.

11. The production possibility schedule:

a Expresses the maximum output available to the manager from a limited set of inputs.
b Is a convenient method to conmpare two production functions simultaneously when assuming some limited input levels.
c Its slope is determined by the marginal rate of factor input substitution.
d Represents a complementary relationship between the two enterprises if the marginal rate or product substitution between them is positive.

12. The revenue maximizing combination of outputs occurs when:

a The marginal rate of product substitution of Y1 for Y2 is equal to the inverse product price ratio.
b The slope of the isorevenue line is equal to the slope of the production possibility schedule.
c Total variable costs are minimized on the production possibility schedule.
d Outputs are in a complementary relationship to each other.

II. Problems (20 marks)

1. Given the production function: $Y = 50 + 1.1X_1 - .003X_1^2$

    a. Calculate level of X where Stage III production begins?

    b. Calculate level of X most profitable if $PX = K1$ and $PY = K8$

2. Given the production function: $Y = 60X_1 - 2X_1^2 + 40X_2 - X_2^2$
   and $PX_1 = K6$, $PX_2 = K2$, $PY = K3$.

   a. At what input combination will maximum output be achieved?

   $X_1 = $ _____ $X_2 = $ _____

   b. What is the MRS of X_2 for X_1 when $X_1 = 3$ and $X_2 = 4$?

   _____

   c. Is the combination $X_1 = 3$ and $X_2 = 4$ on the expansion path?

   _____ Yes   _____ No   How do you know? _____

   _____

   d. If $X_1 = 12$, what will be the value of X_2 if the point is on the expansion path?   _____ X_2

   e. What is the input combination that maximizes net return?

   $X_1 = $ _____ $X_2 = $ _____

III. Depict and describe the relationship between the long run average cost curve and the short run average total cost curve. Of what use are these to the manager? (10 marks)

IV. What situation might a manager use the concept of "net present value" to assist him in decision making? What is it? How is it calculated? How is it used as a criterion for decision making? (10 marks)

V. Describe the conditions necessary to make the most efficient economic use of two variable inputs in the production of two product outputs. (8 marks)

VI. Cash flow analysis: What is it? What are its uses? (8 marks)

VII. How can a manager use subjective probabilities in improving his decision making in risky situations. Illustrate if possible. (10 marks)

VIII. Describe briefly the difference between any five of the following: (10 marks)

   a. Inflection point and the point of diminishing returns
   b. Fixed input factor and variable input factor.
   c. Ridge lines and isoclines.
   d. Isoquants and production possibility schedules.
   e. Competitive and complementary enterprise relationship.
   f. Joint products with fixed proportions and joint products with variable proportions.
   g. Expected values and salvage values.
   h. Compounding and discounting.
   i. Internal rate of return and the discount rate.
   j. Capital and credit.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS -- OCT., 1986

AGE 432

AGRICULTURAL MARKETING AND POLICY

TIME: THREE HOURS

ANSWER: Questions one, two, and three are compulsory.

You can opt for any other two questions.

MARKS: As given below.

1.   One approach to improve profitability of farming is to increase farm revenue by employing a price stabilization policy. This can be done by a buffer stock scheme.

(a)   Explain the principal working of a buffer stock scheme and its major objectives, advantages, and risks.

(b)   Assume the following price-quantity schedule:

P (K/bag)	Q (1,000 bags)
14	30
13	40
12	50
11	60
10	70
9	80
8	90
7	100
6	110
5	120
4	130
3	140
2	150

AGE 432

Suppose the following situation:

Quantity supplied in year 1 = 80,000 bags
Quantity supplied in year 2 = 40,000 bags
Equilibrium price estimated by buffer stock = 11.-K

Assume further the buffer stock to take 20,000 bags off the market in year 1 and sell them in year 2. Compare the respective effects on farmers' revenue with and without interference of the buffer stock scheme.

Explain your results verbally and graphically! (30 marks)

2. (a) Cooperatives and marketing boards are two types of marketing enterprises. Compare the functioning of those two and discuss their respective relative advantages.

(b) Discuss in this context which role NAMBOARD could performe in the near future after its monopoly status has been abolished. (20 marks)

3. Profitability of farming can be improved by government activities which attempt to reduce farmers' production costs.

(a) Elaborate on the various measures which can be employed to reduce costs of production.

(b) Explain verbally and graphically the principal working of a subsidy given for a specific input (e.g fertilized) on a per unit basis, other things assumed constant. Discuss in this context the impact of the elasticity of quantity supplied. (20 marks)

4 (a) Briefly describe the performance and situation of the agricultural sector in Zambia (the then Northern Rhodesia) just before independence was achieved.

(b) How did the first and second National Development Plan reflect this situation? What were the main consequences with regard to agricultural and rural development? (15 marks)

AGE 432

5.   (a)   Give the main objectives of agricultural policies in sub-subaran Africa and comment briefly on each.

     (b)   Countries with a dominating traditional agricultural sector are said to be caught in a vicious circle of poverty. Explain and refer to the Zambian situation.   (15 marks)

6.   (a)   Define the term "marketing margin" and discuss its various components.

     (b)   Marketing efficiency can be evaluated with regard to technical and economic aspects. Explain and illustrate with an example of a Zambian marketing institution.   (15 marks)

7..   (a)   Elaborate on the various marketing functions and emphasize the specific requirements due to the nature of agricultural products.

     (b)   One approach to analyse marketing systems is the institutional approach. Briefly describe this approach and explain what is meant by a "marketing channel".

                                        (15 marks)

END OF EXAMINATION

UNIVERSITY EXAMINATIONS - JUNE, 1986

AGE 552

AGRICULTURAL EXTENSION EDUCATION

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

MARKS: 100; QUESTION ONE, TWO, THREE, FOUR: EACH 20 QUESTION FIVE, SIX: EACH 10

1. In which ways are "target groups" involved in the "bottom-up" problem-solving approach to agricultural extension?

2. Characterize the basic ideas of the Training & Visit - system of agricultural extension.

3. What is a "package"-approach to agricultural extension? Give also one illustrative example.

4. Can you think of an agricultural innovation that is likely to be easily adopted by small-scale farmers? Give reasons for your choice, i.e. low complexity, high visibility, low costs, etc.

5. Give one illustrative example each of a method-demonstration and a result-demonstration.

6. What are the advantages of the campaign-approach.

END OF EXAMINATION

AGE 552
AGRICULTURAL EXTENSION EDUCATION

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

MARKS: 100; QUESTIONS ONE, TWO, THREE, FOUR: EACH 20;
          QUESTION FIVE, SIX: EACH 10.

1. In which ways are "target groups" involved in the "bottom-
    up" problem-solving approach to agricultural extension?

2. Give an example for local customs which affect the daily
    work of both male and female extension staff.

3. Give reasons why farmers are reluctant to adopt innovations
    presently being promoted by local extension organizations
    in Zambia. Are farmers really as ignorant and conservative
    as officials claim? Give also alternatives to the progressive
    farmer strategy.

4. Discuss the importance of using group methods in traditional
    societies. Show also the difference between result - and
    method-demonstration and the importance of careful planning
    preparation.

5. Give an example of a package programme: the role of input
    supply and credit and marketing, and how these link up
    with extension.

6. Discuss the importance of control procedures and the
    application of the training - and - visit system.

END OF EXAMINATION

AGE 561
FARM MANAGEMENT (PRINCIPLES)

TIME: THREE HOURS.

ANSWER: QUESTION ONE, WORTH 50 MARKS IS COMPULSORY,
CHOOSE FROM THE REMAINING QUESTIONS TO CREATE AN
EXAM WORTH 100 MARKS.

1.   Interpret and evaluate the attached multiple
regression equation. This Cobb-Douglas production
function "explains" the dependent variable, the value
of total farm output (K), of small scale hybrid maize
growers in the Eastern Province.

   (a)   Economic Interpretation;
   Discuss the economic logic of the variables.
   Calculate and discuss the marginal products of
   the inputs.

   50 marks   Fertilizer cost K11.6 per bag in the year under
   consideration, consider the producers economic
   rationality given this information.

   (b)   Statistical Interpretation;
   Discuss multicollinearity as a problem in
   agricultural economic research.
   Discuss, goodness of "fit", tests of significance,
   appropriateness of functional form.

2.   There are two major econometric works describing small
scale agriculture in Zambia: Discuss the objectives,
methodologies, and major findings of the works of

20 marks Doris Dodge and Andrew Tench.

3.   Discuss the purposes to which the Cobb-Douglas
20 marks production function are usually put. Discuss the
          advantages and disadvantages of this functional form.

4.   Based on the farm management survey designed in this
          course develop a set of hypotheses relevant to the
          issue of agricultural development in Zambia. Discuss
30 marks the relevant statistical tests. Relate these hypotheses
          to the literature on peasant agriculture.

5.   Discuss the proceedures for designing an effective farm
          management survey from the point of view of sample
10 marks error, measurement error, bias in sample selection.

          . . . .

                    END OF EXAMINATION

SQUARED MULTIPLE CORRELATION 0.79393
MULTIPLE CORRELATION 0.89103
ADJUSTED SQUARED MULT. CORR. 0.73897
RESIDUAL MEAN SQUARE 0.113343
STANDARD ERROR OF EST. 0.336665
F-STATISTIC 14.45
NUMERATOR DEGREES OF FREEDOM 4
DENOMINATOR DEGREES OF FREEDOM 15
SIGNIFICANCE (TAIL PROB.) 0.0000

NO.	VARIABLE NAME	REGRESSION COEFFICIENT	STANDARD ERROR	STAND. COEF.	T- STAT.	2TAIL SIG.	TOL- ERANCE	CONTRI- BUTION TO R-SQ
	INTERCEPT	5.71718	0.854272	10.194	7.86	0.000		
126	LOGTOTFR	0.495283	0.202266	0.422	2.45	0.027	0.463637	0.08237
69	LOGTOTAH	0.683185	0.234870	0.470	2.91	0.011	0.525267	0.11624
67	LOGAGE	-0.660000	0.222242	-0.364	-2.97	0.010	0.914482	0.12116
132	LOGHMAZE	0.203196	0.136135	0.199	1.49	0.156	0.776539	0.03061

THE CONTRIBUTION TO R-SQUARED FOR EACH VARIABLE IS THE AMOUNT
BY WHICH R-SQUARED WOULD BE REDUCED IF THAT VARIABLE WERE
REMOVED FROM THE REGRESSION EQUATION.

where logtotfr = Ln of fertilizer applied to all farm operations (bags)
      logtotAh = Ln of cropped land (ha)
      logage   = Ln of the age of the house hold head
      loghmaze = Ln of the years experience growing Hybrid maize. (yrs)

CORRELATIONS

	LOGFAMLA 103	LOGTOTFR 126	LOGTOTAR 69	LOGANHIR 106	LOGOXUSE 66	LOGAGE 67	LOGANSEL 109	LOGHMAZE 132	LOGTOTVA 99
LOGFAMLA 103	1.000								
LOGTOTFR 126	0.419	1.000							
LOGTOTAR 69	0.226	0.667	1.000						
LOGANHIR 106	0.429	0.413	0.156	1.000					
LOGOXUSE 66	0.576	0.402	0.506	0.489	1.000				
LOGAGE 57	0.220	0.127	0.178	0.120	0.019	1.000			
LOGANSEL 109	0.196	0.479	0.370	0.128	0.381	-0.110	1.000		
LOGHMAZE 132	0.693	0.393	0.149	-0.028	-0.064	0.241	0.362	1.000	
LOGTOTVA 99	0.159	0.767	0.716	0.229	0.477	-0.179	0.497	0.346	1.000

NUMBER OF CASES READ 24
CASES WITH DATA MISSING OR BEYOND LIMITS 4
REMAINING NUMBER OF CASES 20

SUMMARY STATISTICS FOR EACH VARIABLE

	VARIABLE	MEAN (NATURAL LOGS)	STANDARD DEVIATION	COEFFICIENT OF VARIATION
103	LOGFAMLA	1.01937	0.53410	0.523957
126	LOGTOTFR	2.33331	0.56080	0.240346
69	LOGTOTAR	0.77258	0.45374	0.587301
106	LOGBNWIT	-1.35418	1.91173	-1.411730
66	LOGBXUSE	0.45055	0.33920	0.752862
67	LOGAGE	3.61693	0.36342	0.100477
109	LOGANSEL	-1.11687	1.79675	-1.608734
132	LOGHWAZE	1.05926	0.64383	0.607807
99	LOGTOTVA	6.22911	0.35895	0.105786

VALUES FOR KURTOSIS GREATER THAN ZERO INDICATE DISTRIBUTIONS
WITH HEAVIER TAILS THAN THE NORMAL DISTRIBUTION.

9.3.

AGE 561

R
E
S
I
D
U
A
L

Y

.700

.525

.350

.175

0.00

-.175

-.350

5.00   5.25   5.50   5.75   6.00   6.25   6.50   6.75   7.00   7.25

PREDICTD

N=   20
COR=-.35E-8

	MEAN	ST.DEV.	REGRESSION LINE	RES. VS.
X	6.2291	.5871	X=-.695E-9*Y+ 6.2291	.36389
Y	63E-10	.29913	,Y=-.180E-9*X+ 1..E-8	.09445
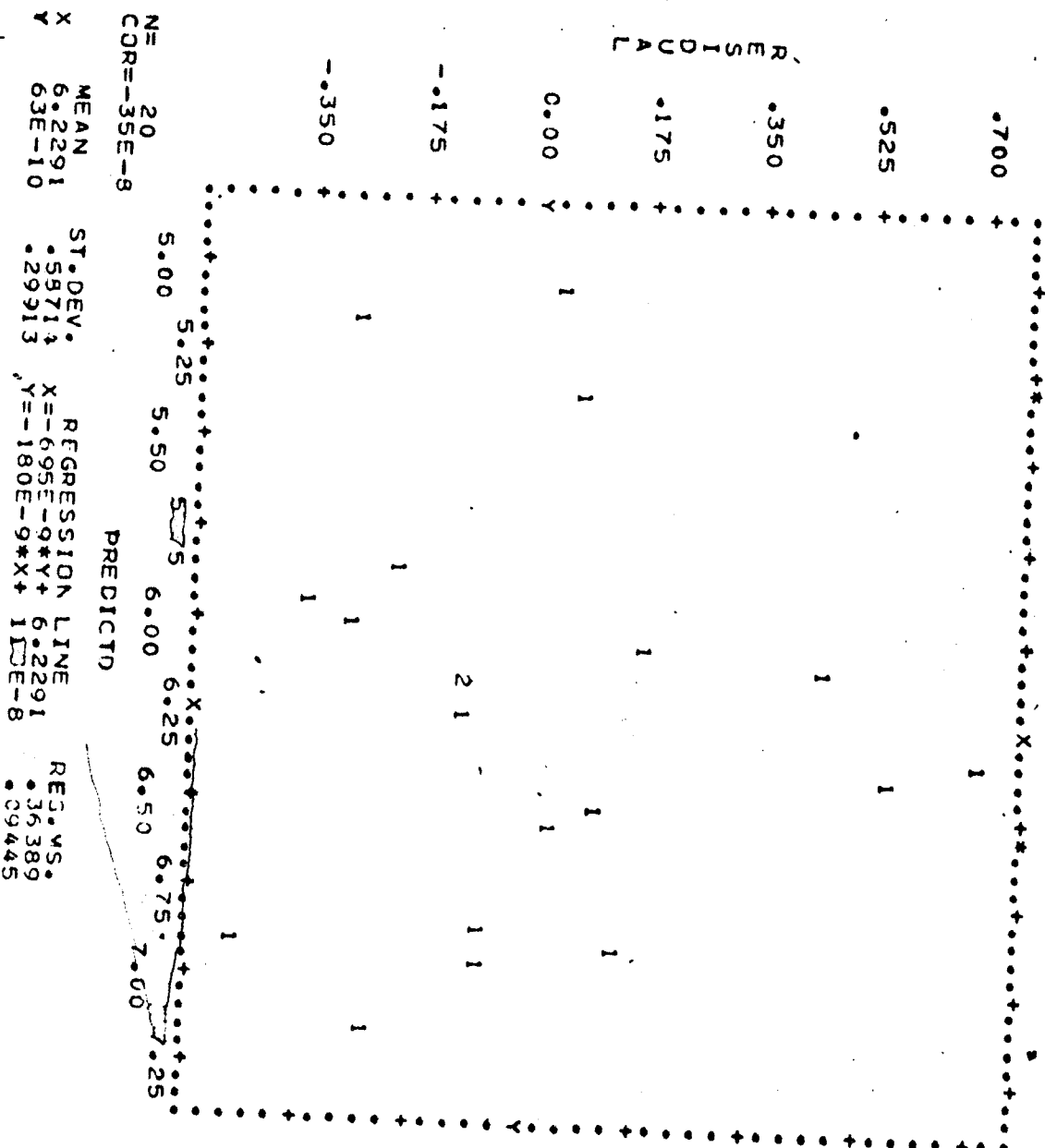
The University of Zambia

University Mid-Sessional Examinations - March 1986

AGE 562

Agricultural Project Planning and Appraisal

Time: Three hours.
Answer: All questions (Note choices with #6 and #8)
Marks: 100 total.

----

1. Projects require planning and planning requires projects. Discuss.
   (12 marks)

2. Discuss the sources of tangible benefits in agricultural projects.
   (12 marks)

3. Once financial prices for costs and benefits have been determined
   and entered into project accounts the analyst estimates the
   economic value of a proposed project to the nation as a whole.
   Discuss the necessary steps the analyst takes in order to do this
   and indicate the reason(s) why each step is necessary. (14 marks)

4. Discuss the use of shadow prices in project analyses. What are
    they? Why is it necessary to use them? When is it necessary to
    use them? How are they used? (12 marks)

5. In measuring project worth, discounted measures are preferred to
   undiscounted measures. Discuss the use of "net present worth" and
   "net benefit investment ratio" in some detail. How are they
   interrelated? When are they used? How are they applied? What
   are their advantages and disadvantages? (14 marks)

6. Creating a national development plan involves the development of
   several component pieces and then fitting them together. These
   pieces include a macroplan, sectoral plans, and individual project
   plans. Choose one of these three pieces and discuss it. (10 marks)

7. Discuss why the goals in national development plans are rarely
   achieved. (10 marks)

8. Briefly discuss four of the following: (16 marks)

   a. Social opportunity cost of capital
   b. Crossover discount rate
   c. Switching value.
   d. Sensitivity analysis.
   e. Declining real burden of debt service
   f. Farm budget aggregation
   g. Net benefit increase
   h. First year return

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: QUESTION (1) OR (2) worth 40% and three (3) others each
          worth 20% each.

1.   From the following annual data prepare a cash analysis then
     set up; a trading account, and a balance sheet then prove the
     accounts.

     The farm represents a dairy and beef operation.

			VALUATIONS	
			OPENING	CLOSING
Feed	K. 200,000			
Veterinary	K. 20,000	Dairy cattle	K. 140,000	160,000
Pesticides	K. 5,000	Young stock	K. 30,000	40,000
Wages	K. 10,000	Machinery	K. 200,000	250,000
Fertilizer	K. 10,000	Beef cattle	K. 140,000	100,000
Machinery bought	K. 50,000			
Private Drawings	K. 30,000			

Sales

Dairy	K. 300,000
Cull cows	K. 4,000
Beef	K. 200,000

     At the beginning of the year the D.B.Z. owed the farmer K. 22,000
     at the end they owed him K. 24,000

2.   Discuss the advantages and disadvantages of Gross Margin
     analysis. What recommendations would you make to a farm with the
     following enterprises. What other information is required.

     This is a mixed crop and animal enterprise.

INPUTS		OUTPUTS	
Crop variable costs	K. 128,350	Crop sales	K. 631,380
Animal variable costs	K. 625,460	Animal sales	K. 901,660
Total	K. 753,810		K.1,533,040

Common costs	
Wages	K. 286,240
Farmers labour	K. 20,000
Total	K. 306,240

AGE 563

Machinery and power	K.	367,640
Overheads	K.	104,120
Total	K.	471,760
Total common costs	K.	778,000
Total costs	K.	1,531,810
Managerial income	K.	1,230

Crop costs and revenues

Ha.	Crop	Revenue	Total Variable costs
200	Seed maize	K. 134,210	K. 26,370
300	Maize	K. 171,790	K. 33,140
65	Potatoes	K. 73,760	K. 8,090
40	Tobacco	K. 251,620	K. 60,750
Total		K. 631,380	K. 128,350

Animal costs and revenues

Average Number	Animal	Revenue	Total variable costs
70	Dairy	K. 383,150	K. 211,200
60	Beef	K. 52,510	K. 20,210
-	Pigs	K. 466,000	K. 366,580
Total		K. 901,660	K. 597,990

3. Break even points provide useful knowledge about farm operations. Use this concept to show how a farmer might decide between hiring his neighbour to do some plowing or to buy some additional equipment himself. Using the same concept illustrate how a farmer would calculate the break even weight gain for a herd of beef cattle.

4. Illustrate the method of calculating the appropriate feed intensities for two beef herds, one continous and the other intermittent.

5. Define and disucss;

   (a)   Partial budgets

   (b)   Internal rate of return

   (c)   Opening and closing evaluations

   (d)   Methods of calculating depreciation

6. A linear programming matrix includes the following; Production, selling, purchasing and transfer activities. Define these and explain how they are incorporated into the matrix.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-SESSIONAL EXAMINATIONS - MARCH, 1986

AGE 565

EXTENSION RESEARCH

TIME: THREE HOURS

ANSWER: ALL EIGHT QUESTIONS

MARKS: ACHIEVABLE: 100, QUESTIONS 1-6 CARRY 10 MARKS,
    QUESTIONS 7 AND 8 CARRY 20 MARKS

AIDS: NAN LIN, FOUNDATIONS OF SOCIAL RESEARCH; POCKET
   CALCULATOR

Question 1, 10 marks

Assume you are working with the Adaptive Research Planning
Team in Central Province as an extension research
specialist. The following problem is assigned to you:
"What are the effects of demonstration plots on farmers'
fields on small-scale farmers' adoption of crop
rotations?"
Deduce from the problem and formulate five hypotheses
You may be very specific

Question 2, 10 marks

LINTCO wants to obtain information about the area cotton
farmers plan to plant with cotton during the 1986/87
season. Lists with the names of the almost 40 000 cotton
farmers of the previous season are available. The
researcher who has been commissioned to survey a sample of
cotton farmers decided to select 800 farmers by systematic
sampling. What procedures does he follow?

Question 3, 10 marks

There are no lists of farmers available in Kuluka District
to select a random sample of 125 farm households for a
survey on the effects of a couple of Field Days the
Extension Service held during the growing season 1985/86.

AGE 565

Question 3 continued

The District Agricultural Officer, from census data and marketing records, got the following data on the farm households in his District:

24 % female headed households

76 % use hoe cultivation,

20 % have access to oxen power

 4 % have access to tractors,

32 % sell less than 5 bags of maize annually to the Cooperative Marketing Union,

40 % sell 5 to 15 bags,

28 % sell more than 15 bags.

Assume that the D.A.O. wanted to apply quota sampling with independent controls to evade the problem of non-availability of a reliable sampling frame, and he also wanted to do the fieldwork quickly to reduce memory errors. Give the numbers of farm households for the quota controls in the quotas assigned to each of the five interviewers the D.A.O. plans to employ.

Question 4. 10 marks

The Provincial Agricultural Officer in Eastern Province wants to have information on ox-drawn equipment available to emergent commercial farmers in Katete District. He is attaching special emphasis to farmers' experiences with tool bars. Estimates run to one in twenty oxen farmers who may have such experience. From Government funds K 3.500 can be made available for a survey.

Assume you are entrusted with this survey. You know from previous surveys: subsistence for enumerators is K 24 per day, mileage is K 0.60 per km, piece rate per interview is K 8. The enumerator can do three interviews per day and he will cover 45 kms per day on average.

What sample size would you propose?

AGE 565

Question 5 10 marks

Coffee growing has been encouraged in Zambia primarily to
fulfil the internal demand and finally to attain exportable
surpluses. This has prompted the Zambian Government to
involve small farmers into coffee growing as a cash crop.
Special extension staff has been provided to teach farmers
and advise them on all technical matters concerned with
coffee production. One such technical matter is pruning
of coffee trees which needs much skill. To teach pruning
to farmers in the most efficient ways Extension Services
plan to use two different audio-visual teaching aids:

(1)   drawings in black ink showing how to prune trees plus
       written text;

(2)   colour slides which have been taken in farmers'
       coffee gardens plus tape.

What type of research design would you propose to test the
effectiveness of the two different teaching aids?

Question 6 10 marks

A foreign donor agency offers to sponsor a District
Development Programme in one of the more remote rural
Districts of Zambia. To be able to plan their activities
more carefully the expatriate Programme staff does a survey
among villagers to find out about people's felt needs.
Personal interviews are used to collect the data.
Among the questions asked the following two could also be
found:

Question A: Preventive medicine has been found to be of
             utmost importance for rural welfare. Do you
             feel you need a Rural Health Centre in your
             village so that doctors and nurses could take
             preventive measures?

Question B: Could you, please, tell me something about
             problems you are facing in this village?

Comment on the wording and on the content of the two
questions.

Re-phrase questions if you feel it is necessary.

AGE 565

Question 7. 20 marks

In a number of developing countries experience showed that farmers were much more inclined to adopt new techniques and practices if they attended demonstrations together with their spouses. During an evaluation of the Lima Crop Extension Programme in 1983/84 researchers tried to find out whether this also would be true for Zambia. The following table was established:

Adoption of manure in maize production, small-scale farmers in Chibili District, 1983 / 84

	Demonstrations attended by farmer alone	farmer and spouse	
tried and adopted manure	5	35	40
tried manure, but did not yet adopt	7	11	18
did not try manure and did not adopt	22	0	22
	34	46	80

What do the table data tell us about the hypothesis implied above? Do we accept or reject the hypothesis?

Formulae: $\chi^2 = \sum \left[\frac{(fo - fe)^2}{fe} \right]$

df = (number of columns -1) (number of rows - 1)

Question 8. 20 marks

This file contains data obtained from a survey on extension exposure of LIMA farmers in Potauke District, Eastern Province, 1984/85

AGE 565

Farmer no.	Variables			
	Number of Visits	Others attend	Advice discussed	More Visits
1	0	0	0	1
2	2	2	0	1
3	1	0	0	1
4	0	0	0	1
5	3	1	1	0
6	4	1	1	0
7	0	0	0	1
8	2	1	0	1
9	4	1	1	0
10	4	1	1	0

Information from the codebook:

Variable	Category/Dimension	Code
Number of visits from an extension worker in the last four weeks	absolute number	no code
Are visits attended by other farmers?	no yes sometimes	0 1 2
Is the advice of the extension worker discussed with the family members?	no yes	0 1
Would you like to see the extension worker more often?	no yes	0 1

Choose any two variables you may like from the data file and analyze their relation with one another. Draw up a cross-break table for the purpose. Significance tests and percentages need not to be calculated.

TIME: THREE HOURS

ANSWER: ALL QUESTIONS. ALL QUESTIONS ARE EQUAL VALUE.
         QUESTION 1 AND 2 OFFER A CHOICE - DO EITHER A OR B OF EACH.

1.   Answer either part a or part b.

   a.   Compare the strength and weaknesses of the
         Latin Square and Randonized complete Block
         designs.

   b.   Discuss the main factors to consider in
         determining appropriate sizes and shapes of
         plots.

2.   Answer either part a or part b.

   a.   Assume that five sources of dietary Fe are
         to be tested for their effectivity at keeping
         baby pigs healthy (as measured by rate of
         gain). The weekly costs of these sources are:
         A(K2.00), B(K2.50), C(K0.50), D(K3.85), and
         E(K7.22).

      i.   Suggest an experimental design for this
            experiment.

      ii.   Set up the ANOVA table, showing the d.f.
            for the sources of variation.

      iii. If you were a swine producer, what outcome
            for this statistical analysis would you
            prefer? Explain why.

   b.   Discuss suitable experimental designs (complete
         with ANOVA tables and d.f. for the sources
         of variation) for the following field
         experiments. Suggest suitable plot sizes.

/2........

AGG 311

(Question 2 continues)

    i.   Twenty four varieties of Wheat (for grain yield).

    ii.   Three levels of cultivation (deep, medium, and shallow) as measured by yield of carrots.

    iii. Eight fertilizer treatment combinations (2 levels of each of N, P, and K) as measured by maize yield.

    iv.   Ten pasture mixtures (simulated grazing).

3.   A pasture experiment (small plot, simulated grazing) was done. The treatments, their mean yields, and Duncan's multiple range test notation follows:

Treatments	Mean Yields	Duncan's
A	3.5	cd
B	8.9	a
C (control)	5.5	bc
D	2.0	d

The sums of squares for the ANOVA are as follows:
Columns= 87, Treatments= 156, Total= 309, Rows = 54.
The Table values for $F_{0.05}$ and $F_{0.01}$ were found to be 5.762 and 9.784, respectively.
The $LSD_{0.01}$ was calculated to be 3.220 $LSD_{0.05}$ was 2.112

a.   Complete the ANOVA.

b.   Discuss and interpret

c.   Do you have any criticism to offer concerning this experiment? Explain your answer.

AGG 311

4.   a.   Distinguish between regression and correlation analyses.

    b.   In wheat, stem diameter and straw strength may be related.

        i.   Explain why a researcher might be interested in this relationship.

        ii.   If "r" for this relationship = 0.92 (highly significant), what could you conclude from this, and how could you use this information, as a plant breeder?

5.   In the following part explain if the differences in yield that are seen can be tested for significance, using the "t" test. If your answer is "yes" describe briefly how. If your answer is "no" explain how you could test these differences.

    a.   Three varieties of maize are grown in adjacent plots at ten sites near Mbala.

    b.   Two varieties of wheat are grown in adjacent plots at fourteen sites near Goldon Valley.

    c.   Two varieties of soyabeans are grown in single plots. Variety A was grown at nine sites north of Lusaka. Variety B was grown at eleven sites west of Lusaka.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-SESSIONAL EXAMINATION. MARCH, 1986

AGM 211

AGRICULTURAL MECHANIZATION I

TIME: THREE HOURS

ANSWER: EACH SECTION IN /SEPARATE ANSWERING BOOKS.

USE: RULER ,CALCULATOR.   ANSWER ALL QUESTIONS.

SECTION I
(48 Marks)

1. An electrical lead nominated 1000w at 250v, is connected to a mains 100m distance. A $2mm^2$ cupper wire is used of 0.017 microhm/m^3 resistivity. The mains voltage is 220v. Calculate:

    (a) The percentage of the voltage drop out of the source voltage

    (b) The actual load voltage

    (c) The fuse size to protect the circuit if class Q2. is used   (16 marks)

2. (a) Explain, why the commercial connections are in parallel?

    (b) Explain the difference between overloading the wires and overloading the source.

    (c) What are the switchgear typs?

    (d) What is the difference between alternators and generators?   (16 Marks)

3. Draw the following circuits:

    (a) Battary charger circuit

    (b) Petrol engine ignition circuit

    (c) Ground interruptor circuit   (16 marks)

/2

AGM 211

SECTION II

(52 Marks)

4. A tractor with four wheel drive is pulling a load of
3000 N. The velocity is 7 2 Km/hour. Diameter of
all wheels is 1 8m.
  - What power is necessary to pull the load?
  - What is the number of revolution per minute
    for each wheel?   (8 marks)

5. (a) - Make a simple sketch of a vernier callipers and
       put names to the different parts
       - Give the producer how to read the vernier
         callipers.   (6 marks)

   (b) - Draw (exact) a part of an M 20x2.5 bolt.
       - At what diameter approximately would you
         drill a hole for M20?
       - To how many revolutions per minute do you
         set the drilling machine if the maximum
         cutting-speed is 40m/minute in this case
         (use the found diameter, previous question)
                                         (8 marks)

   (c) - Draw the arc-welding circuit.
       - Give a discription of the process in the
         arc and the temperature level, current and
         voltage drop.
       - Give three functions of the slag.   (6 marks)

6. (a) - What is the composition of mild steel?
       - Mention five different applications of
         mild steel.
       - Is it easy to harden, weld and turn?

   (b) - Give a brief discription of the hardening
       process.

   (c) - What is an alloy?
       -

AGM 211

- Give four elements to make an alloy and give the influence they have on the material properties. (16 marks)

7. (a) -Give the principle objects for the farm workshop.
- Which factors do you consider before starting building a new workshop

(b) What is the advantage of wood as a building material?
- Why should wood be seasoned?

(8 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCT. 1986

ACM 322

AGRICULTURAL MECHANIZATION II

TIME: THREE HOURS

ANSWER: ALL QUESTIONS, EACH SECTION IN A SEPARATE BOOK

SECTION ONE

1. (a) Discuss, with the aid of P-V diagram, the actual petrol cycle

   (b) A six-cylinder, 4 stroke diesel engine of 100mm cylinder bore and 125 mm position stroke. The engine develops 72 Kw at 2500 r.p.m. The mechanical losses was found to be 12KW at the same speed. The fuel used is 39 KJ/L. Calculate:
      (i)   Engine indicated power
      (ii)   Indicated mean effictive pressure
      (iii) fuel consumption if the thermal efficiency is 30%.

      (18 marks)

2. (a) What is the high heat value of a fuel?

   (b) Calculate the air/fue ratio and the weight of combustion products of 12 litters of a diesel fuel, $C_{16} H_{30}$, with 20% excess air. Diesel specific gravity is 0.833.

      (18 marks)

3. (a) Describe briefly some of the measures undertaken by the manufactures to boost engine output.

   (b) What is engine knock? and what are its possible causes?

   (c) What do you understand by the term tuning as applied to engines?   (14 marks)

SECTION TWO

1. (a) What are the aims of Agricultural Engineering?

   (b) Changes in Agricultural Engineering as a subsystem cause changes in the society as a whole. Discuss briefly:
      (i)   influence on yields and costs
      (ii)   influence on employment
      (iii) changes in labour-load.   (10 marks)

/2.........

2. (a) ~~Which factors~~ influence the physical working power of man.

    (b) Give a definition for task-time and what elements are
         incorporated in the task-time.   (9 marks)

3. (a) What are the aims of tillage

    (b) Discuss the advantages and disadvantages of zero-tillage
         systems.   (8 marks)

4. (a) The yield of which crops are most effected by weed growth,
         crops with a long or a short growing period. Explain
         and give examples

    (b) Discuss two ways of determining the amount of small weeds
         in a field.   (7 marks)

5.(a) Make sketches of a handdriven penutskeller.

    (b) Which factors influence the breaking-percentage in
         shelling.   (8 marks)

6. Which demands have to be made on a farm building.   (8 marks)

END OF EXAMINATION

AGM 431   (FOR GRADUATING STUDENTS)
FARM STRUCTURES

TIME: THREE HOURS.
ANSWER: ALL QUESTIONS.

1.   How many corrugated iron sheets are required for a poultry
       house 8m wide and 17m long with a gable roof (inclinatio
       on both sides = 19°).
       Sin 19°= 0.33, cos 19° = 09.5 and tan 19° = 0.35.
       Effective covering width of sheets = 72 4 mm, length
       of sheets available: 2, 2.5, 3, 3.5, 4, and 5 meter.
                                        (30 marks)

2.   What are the advantages and disadvantages of loose - housir
       system of keeping diary cattle?   (12 marks)

3.a.   What are the main advantage of preparing a "bill of
       quantity" for a certain building?

  b.   If you want to know how much cement and sand you need for
       plastering a building, how are you going to calculate it?
                                        (16 marks)

4.   How does the temperature and humidity affect the possible
       storage time of sowing seeds?   (12 marks)

5.   Make a design of a laying house for 160 hens. Indicate
       how you arrived at area, number of nest boxes, perches...et
       Give plane and cross-section.   (30 marks)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

1.   What are the effects of soil on building design?   (10 marks)

2.   What are the types of shade devices?   (10 marks)

3.   What is the best orientation of buildings in Zambia
     and Why?   (10 marks)

4.   With the aid of the rainfall intensity duration curve,
     show how the rainfall affects the surface drainage system.   (10 marks)

5.   What are the structure systems? Which would you recommend for
     farm buildings?   (10 marks)

6.   What is meant by building conseptual systems?   (10 marks)

7.   Make a design for Poultry house to keep 1000 birds.   (10 marks)

8.   Calculate the foundation demensions under a 40 cm wall, if the
     load is 7.5 ton/m (including the foundation), and the soil
     bearing capacity is 1.5 Kg/cm^2.   (10 marks)

9.   What are the window types? which type is recommended for a
     diary cattle house?   (10 marks)

10. Draw flemish bond wall pattern.   (10 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – JULY, 1986

AGM 540

AGRICULTURAL MECHANIZATION IV

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

Answer each section in a separate book

SECTION I

1. (a) Write a classification system for the internal combustion engines.   (4 marks)

    (b) How would you determine the n value of a thermodynamic process?   (4 marks)

    (c) With the aid of the performance curve, discuss an engine torque, power and specific fuel consumption changes with with the engine speed.   (4 marks)

    (d) What is meant by a presistant engine? Show that graphically.   (4 marks)

2. (a) Draw the four main thermodynamic processes on T-S diagram, discussing the changes   (5 marks)

    (b) A0.25 Kg of air is taken through a constant volume process. Conditions at the beginning of adiabatic compression are 95 KN/m^2 and 40°C. The compression ratio is 6;1.
    The highest temperature attained in the cycle is 1630°C

    Calculate:

    (i)   The heat supplied to the cycle.
    (ii)   The thermal efficiency
    (iii) The work done during the cycle /Kg of air
           (Assum; K= 1.4 and C = 0.717 KJ/Kg.K)   (12 marks)

3   (a) Draw the Brony brake, and show how it is used to determine an engine power.   (7 marks)

    (b) A More's test was conducted on a four cylinder diesel engine. When running at full load, all cylinders in the brake power was 60.6 KW. The measured brake power, in KW when each cylinder's injector was cut off in turn and the load reduced to bring the engine back to its original speed were as yollows:

/2......

I	2	3	4
43.2	42.1	42.7	44.2

Calculate:

(i) Indicated power of the engine

(ii) The thermal efficiency of the engine. (10 marks)

SECTION II

1. (a) Discuss the "tied-ridging" tillage system.
   Give a discription, the advantages and disadvantages and
   discuss tools needed. (6 marks)

   (b) Discuss the different principles for repressive weed
   control. Give examples of tools. (5 marks)

   (c) Give 5 important effects of the presence of crop residues
   on the soil surface. (5 marks)

   (d) What is the effect on the yield of crops with a long and
   crops with a short growing period of repeated mechanical
   weed control Explain and give examples. (3 marks)

2. (a) To characterize a distribution pattern distinctive numbers
   used. One of them is the Irregularity figure:

$$r = 100 \sqrt[8]{\left(\frac{\bar{d}}{20}\right)^8 + \left(\frac{d_{max}}{40}\right)^8}$$

   Explain the meaning of $\bar{d}$ and dmax.
   Make a sketch of the diagram relating $r, \bar{d}$ and d_{max}. (6 marks)

   (b) A spray has a $\bar{x}_{32}$ of 110 μ. How big is the area
   which can be covered with 1.5 liter of liquid. (2 marks)

3. (a) Threshing can be established by different actions.
   Describe three of them and give an example of a (part of a)
   machine using this action. (4 marks)

   (b) Describe and sketch the principle of a maize picking machine
   Also of the device for the removing of the bracts covering
   the maize. (8 marks)

AGM 540

(c) Discuss drying of agricultural produce as a preserving m
method; what is the aim of drying, which factors are
important in this treatment and give an explanation

(8 marks)

(d) Which criteria are used to judge a dryer or drying system.

(3 marks)

END OF EXAMINATION

AGM 543
IRRIGATION AND DRAINAGE ENGINEERING

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

. . . .

1.(a)

3 marks

A flat area is drained by parallel drain lines spaced 24 m apart and 300 m long. If the drainage coefficient is 12.5 mm/day, what will be the flow at the outlet end of each drain?

(b)

5 marks

If the field in (a) above is 8 ha in size, what will be the size of the main (clay pipe) at the outlet of the field? Slope of the main is 0.15; for clay pipe, n=0.011.

(c)

12 marks

How many drains will it take to drain a swamp that contains an estimated 1235 ha-mm of water in five days? The diameter of the drain tubing is 150 mm (n=0.016). The drain slope is 0.25%.

2.   Given the following data for the soil profile of
an irrigated field which consists of two horizons.

			A horizon	B horizon
(i)	mass basis moisture contents (%)			
	wilting point		10	25
	field capacity		28	38
	saturation		40	47
(ii)	bulk density (g/cm^3)		1.15	1.35
(iii)	thickness of horizon (cm)		40	80
(iv)	initial volumetric moisture content (%)		15	35

6 marks   (a)   Calculate the amounts of hygroscopic water,
plant available water and gravity water
(cm) for each horizon.

4 marks   (b)   Plot the resultant moisture content of the
profile if 15 cm of water are added. Assume
that the A-B horizon interface does not
impede flow and that drainage from the B
horizon is not impeded.

4 marks   (c)   Assuming that a shallow rooted crop is being
grown on the field (therefore consider only
the A horizon as the soil moisture reservoir),
how long will it take to deplete the
reservoir to 25% of capacity if the the
Evapotranspiration (ET) rate is 6mm/day and
the A horizon is initially at field
capacity?

3 marks   (d)   How much water (mm) will have to be applied
at that time if the irrigation is 65%
efficient?

3 marks   (e)   If a rainfall of 15mm occurs on the 5th day,
how soon thereafter will irrigation be
required? (assume 80% of the rainfall
infiltrates and irrigation is provided when
the reservoir is at 25% of capacity).

3.(a)

8 marks

A 24-ha field of potatoes is to be irrigated, at a rate not to exceed 1 cm/hr, with a sprinkler system. The root zone is 90 cm deep. The available moisture holding capacity of the soil is 17 cm/m depth. The water application efficiency is 70%. The field is to be irrigated when 45% of the available moisture capacity is depleted. The peak rate of moisture use is 5mm/day. Determine the:

(i)   net depth of application per irrigation
(ii)   depth of water to be pumped in cm
(iii) irrigation period or days to cover the field
(iv)   area to be irrigated per day.

(b)

12 marks

(i)   Determine the required capacity of a sprinkler system to apply water at a rate of 20 mm/h. Two 186-m sprinkler lines with 16 sprinklers each at 12 m spacing on the line and 18 m spacing between lines are required.

(ii)   Allowing 1 hour for moving each 186-m sprinkler line described above, how many hours would be required to apply a 80-mm application of water to a square 16.2 ha? How many 10 hr-days are required?

4.(a)   Prove the following statements:

8 marks   (i)   "To double the quantity of water flowing
                    over an overflow-type control structure,
                    the depth must be increased only 1.6
                    times."

          (ii)   "To double the quantity of water flowing
                    through a submerged orifice-type of control
                    structure, the effective head, h, must be
                    increased four times the original head."

  (b)   Consider a farm irrigation ditch having the
12 marks following dimensions: bottom width, 0.5m; side
          slopes of 1.5 horizontal to 1 vertical; depth of
          water, 0.40m. If the bottom of the ditch has a
          uniform slope of 1 metre per kilometre, what will
          be the mean velocity of flow and flow rate?
          Use n= 0.020.

5.   What is meant by the "total energy head" of a
2 marks   flowing fluid?

          A farmer wishes to pump water at a rate of 250 litres
          per second from a river to an irrigated farm over a
          distance of 3 kilometres through a 35 cm diameter
          pipe. The gauge pressure at the suction side of the
          pump is 490.5 KPa and the pipe pressure at the
          discharge side, 30 m above the pump level is
          atmospheric. Determine:
3 marks   (a)   the velocity head developed by the discharge
15 marks (b)   the power of the pump motor for 80%
                  efficiency, given that the friction factor
                  (f) for the pipe is 0.005.

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END OF EXAMINATION

AGS 210   (FOR GRADUATING STUDENT)

FUNDAMENTALS OF SOIL SCIENCE

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

1.   Explain how "volcanism and tectonism" are processes of
      landscape renewing.

2.a. Define soil permeability.

  b. Develop Darcy's equation.

  c. Give values of permeability for sandy, loamy, and clayey soils

3.   Discuss the major stages in soil development.

4.   Discuss the role of micro organisms in nitrogen cycling.

5.   What is the effective CEC of a soil, and how does it differ
      from that determined by the ammonium acetate procedure?

6.   What minerals are important in determining soil properties
      and why?

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCT. 1986

AGS 210

FUNDAMENTALS OF SOIL SCIENCE

TIME: THREE HOURS

ANSWER: ALL questions. Each question is worth ten marks

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1. (a) Define and give each time three examples of igneous, metamorphic and sedimentary rocks.

   (b) Explain the rock cycle

2. (a) Name one 1:1 (diphormic) and one 2:1 (triphormic) clay minerals.

   (b)) Draw simple diagrams to illustrate their structure, naming the structural units included and explaining the origin of surface charge on the clay minerals.

3. For any three plant nutrient elements, explain why a determination of soil pH may provide important information regarding their availability.

4. Given the following data:

Soil type	(g/cm^3)	Moisture held (g/100g) at pressure in bars			
	B. density	15	0.3	0.1	0.01
A	1.7	3	5	7	25
B	4.2	9	23	36	50

   (a) Plot the moisture characteristic curves for the soils and indicate the corresponding textural classes

   (b) Assuming that the active root zone for a particular crop is 50cm deep, compute the available water in the two soils and express the results in percent by volume and in mm of water depth.

/2.....

5. Discuss the main <u>biological</u> phases of the Nitrogen Cycle
    in the Soil/Plant/Atmosphere System, namely ammonification,
    nitrification, denitrification, fixation and immobilization.
    Indicate their importance in soil fertility.

6. Using the following profile description and analytical
    data:
    (a) Name and define the diagnostic horizons present.
    (b) What is the likely to be dominant clay mineral   in this
         soil.
    (c) In what major stage of development can this
         soil be situated
    (d) Classify this soil (highest level only)
         according to the U.S. Soil Taxonomy and the
         FAO legend.

    (d) Evaluate the physical and chemical attributes
         of this soil and discuss its general
         agricultural value.

<u>Remark:</u>

Profile description and analytical data will be made available at the
time of examination.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY SUPPLEMENTARY/DEFERRED EXAMINATIONS - DECEMBER 1986

AGS 210

FUNDAMENTALS OF SOIL SCIENCE

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS. EACH QUESTION IS WORTH TEN MARKS.

1.   Make a table with the different classes of minerals,
      their characteristic chemical component and give two
      examples of each class.

2.   Discuss soil pH under these headings:

      (a)   Active vs. reserve acidity.   (3)

      (b)   Soil pH measured using 0.01 $\underline{M}$ $CaCl_2$
            vs. that measured using water.   (4)

      (c)   Importance of pH to plant growth.   (3)

3.   (a)   How is the N content of soils related to the
            C content?   (4)

      (b)   Discuss what happens to this relationship when
            a crop residue is worked into the soil.   (6)

4.   (a)   Develop the equation for soil permeability
            measurement.

      (b)   Calculate the permeability through a soil sample
            of 10 cm diameter and 4 cm thick. A permanent
            layer of 5 cm water is on top of the soil. At
            the bottom of the sample a flow of 1 dm^3 per hour
            is measured.

5.   Set up the calculations to find the following:

(a)   m.e. of exchangeable Ca/100g of soil if an
        extract of 6g of soil, made up to 100 cm^3,
        is found to contain 25 ppm.   (4)

(b) NH_4^+ holding capacity((in g/100g) of a soil
        with CEC of 20. (Atomic weights:
        N = 14, H = 1).   (2)

(c)   the total organic matter in a soil if 8g of
        the soil is extracted and the solution made up
        to 200 cm^3 volume. This final extract contains
        30 mg C/100 cm^3.   (4)

6.   A soil profile has at the same time all the characteristi
        of a Vertisol and the diagnostic features of an Alfisol.

(a)   Define the necessary characteristics to classify a
        soil as Vertisol.
(b)   Define the diagnostic horizons and other necessary
        properties of an Alfisol.
(c)   What is the final classification of the soil?
        Justify your choice. Give the corresponding
        name(s) according to the FAO legend.
(d)   What broad differences could their in generally
        be with the agricultural value between Alfisols
        and Vertisols.

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                    END OF EXAMINATION

UNIVERSITY MID-SESSIONAL EXAMINATIONS - MARCH 1986

AGS 321
SOIL PHYSICS, IRRIGATION AND DRAINAGE

TIME: THREE HOURS.

ANSWER: Any three questions from each section.

            All questions carry equal marks.

            Don't forget to write appropriate units whenever needed.

MAX. MARKS: 60.

SECTION I

1.(a)   A saturated soil was exposed to drying for 10 days. Assuming a profile thickness of 100cm and no drainage, show graphically and explain

         (i)   Rate of water loss as a function of time.
         (ii)   Depthwise distribution of water (approx.) for 0,2,5 and 10 days after the start of drying.

  (b)   Name the processes responsible for soil aeration, conditions under which these processes operate and forces responsible for causing the flow in these processes.

2.(a)   Assuming that temperature at the soil surface
         equals the mean temperature at the beginning, show
         for a period of 24 hours the temperature at 0 and
         30 cm depths, as a function of time. Use same graph
         for both the depths. Also give reasons for any
         differences in graphs for the two depths.

  (b)   Briefly discuss the factors affecting and practices
         to control wind erosion.

3.(a)   Discuss the role of irrigation during different
         seasons of Zambia.

  (b)   Rank the following group of approaches for
         scheduling irrigation in order of preference and
         give reasons for the same. Assume no lack of
         instruments, money or techniques available.

         (i)   Soil water indicators and measurements.
         (ii)   Plant and water indicatorsand measurements.
         (iii) Meteorological approaches.

4.(a)   Briefly describe the types of sprinklers and
         indicate conditions under which different kinds
         shall be most suitable.

  (b)   Briefly discuss the factors affecting drainage
         requirement of a given area.

SECTION II

5.   Using the data from the table below calculate:

  (a)   Millimeters of water loss per unit area
        during the total period.
  (b)   Rate of water loss and express in appropriate
        units.
  (c)   Volume of water lost per hectare.

Soil layer (cm)	Percent water (g/100g) at		Bulk density (g/cm^3)
	Day 0	Day 10	
0-20	30	10	1.0
20-50	30	20	1.5

6.   Assume that the upper surface of mercury in the
       reservoir of both tensiometers is 30 cm above the
       soil surface. Using the data in the table below
       calculate:

  (a)   Pressure/matric potential around the tensiometer
        cup.
  (b)   Total soil water potential for both the points.
  (c)   Indicate the direction of flow.

Tensiometer cup depth below surface (cm)	Mercury height in capillary tube (cm)
10	5
100	10

7.(a)   For a 50cm thick surface soil layer with hydraulic conductivity of 0.1 cm/sec, when a water column of 50 cm is ponded at its top and water table is just touching its bottom, calculate the volume flow rate of water through an area of 1 m^2.

(b)   A sample of moist soil having a wet mass of 990g and a volume of 600 cm^3 was found to have a dry mass of 900g. Assuming particle density of **2.5**g/cm^3, calculate

   (i)   Bulk density,
   (ii)   Porosity,
   (iii)   Saturation percentage,
and   (iv)   Air filled porosity.

8.   Assuming 10 hectare field area, water use rate of 5 mm/day, safe depletion of 50 mm, irrigation efficiency of 50%, water source 10m below the field level, pumping system efficiency of 75% and irrigation system working 10 hrs/day, calculate for each irrigation:

   (a)   Appropriate irrigation interval.
   (b)   Depth of irrigation water to be applied per unit area.
   (c)   Volume of water needed for the whole field.
   (d)   Volume of water required to be pumped per hour.
   (e)   Brake horse power of the engine.

END OF EXAMINATION

AGS 432   (FOR GRADUATING STUDENTS)

SOIL CHEMISTRY AND FERTILITY

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

1.   Draw a simple diagram to illustrate the structure of a 2:1 (trimorphic) clay mineral, naming the structural units. Describe how permanent charge develops on this mineral and outline its significance in soil.

2.   Using a different nutrient ion each time to illustrate your answer, explain how the solubility product principle and the chelate stability constant govern nutrient availability in soil.

3.   Describe how you would proceed to diagnose nutrient deficiency in a field, emphasizing procedure and factors you would consider.

4.   Describe relative forms of soil acidity and discuss their relative importance.

5.   How can a rhizobium innoculation be carried out in practice?

6.   Which processes contribute to the movement of nutrients in the soil and what is their relative importance in relation to certain specific ions?

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

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1. What advantage do K_2CO_3 or K_2O have over KCl as a potassium fertilizer for K deficient acid soils in high rainfall areas?

2. Nitrogen is an important plant nutrient. Describe the microbiological and other processes that involve mineral nitrogen (NO_3^-, NH_4^+) in the soil leading to a discussion on the efficient use of nitrogen fertilizers.

3. Comment upon or explain the statement. The sample preparation procedure should always be described in full when soil pH values are reported.

4. Discuss the relationships between the surface area of soil minerals and the physical and chemical properties of soils.

5. By what mechanisms are soil particles bound together to form peds?

6. In what ways does organic matter contribute to soil fertility and productivity?

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – OCT., 1986

AGS 432

SOIL CHEMISTRY AND FERTILITY

TIME: THREE HOURS

ANSWER: **SIX** questions. All question carry equal marks.

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1. (a) Define "chelation" and describe how this may affect soil development.

    (b) For one nutrient element, describe how "chelation" enhances its availability to plants

2. (a) Discuss the composition, properties and uses of the principal fertilizers derived by chemical synthesis from atmospheric dinitrogen

    (b) Compare and contrast the advantages/disadvantages of organic manures and mineral fertilizers in relation to Zambian agricultural development.

3. What is a symbiotic relationship? Give accounts of two examples of symbiotic relationships important in soil science.

4. (a) Why is soil acidity particularly severe in the Luapula, Northern and North western provinces of Zambia?

    (b) Explain the properties you would concern yourself with if you were asked to assess the suitability of a piece of land in this area for production of a legume crop.

5. After 20 years of maize-growing with ammonium sulphate as fertilizer the pH of the A horizon of a sandy soil drops from 7.0 to 5.5. Why? Would an equally large shift be expected in a loam variety of the same soil given the same treatment?

6. Discuss the relative importance of the four processes which facilitate bringing nutrient ions into contact with the absorbing surfaces of plant roots. Emphasize how the importance of these four mechanisms would be altered by soil texture, ion type and plant species.

7. (a) Explain the differences between specific and non-specific adsorption of anions in soils, giving examples of each type. -

   (b) The adsorption of cadmium in soil can be described by the Langmuir equation giving the plot below;
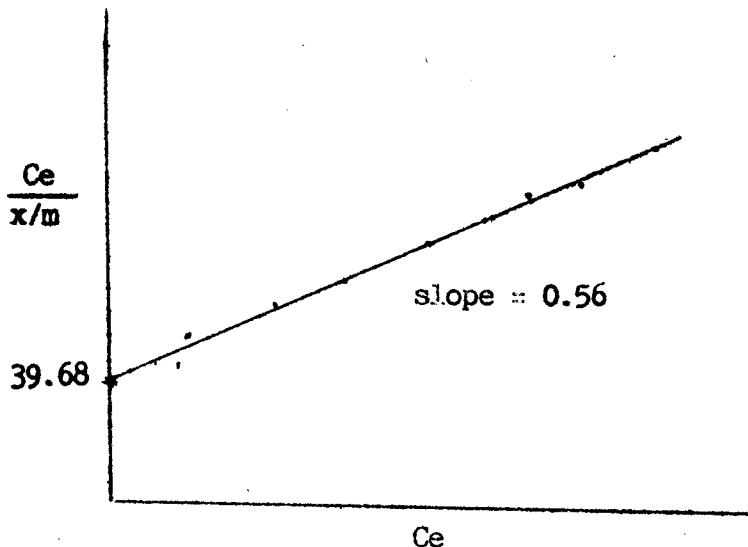
   Derive the values and units of the Langmuir capacity b and affinity k terms if x/m is expressed in mole Cd/g soil and Ce in mole/dm^3.

8. It is desired to reduce the exchangeable sodium percentage (ESP) of a sodic soil to 5% by replacing it with calcium. Calculate how much gypsum (Kg/ha) would have to be added if the soil has a CEC of 10 meq/100g soil and contains 4 meq sodium per 100g soil. Assume a depth of 20cm.

AGS 541
LAND EVALUATION AND IMPROVEMENT

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS.

ALL QUESTIONS CARRY EQUAL MARKS.

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1. The chemical properties of Katito soil series of Mbala are given below. Assess the suitability of this soil for maize production and justify your answer.

KATITO SOIL DATA

Depth cm	Org.C.%	CEC me/100g clay	pH KCL	% BASE SAT. NH_4OAc	% AL SAT.
0-10	1.2	12	4.2	11	69
10-20	0.95	10	4.2	7	80
20-46	0.66	8	4.2	8	77
46-77	0.44	6	4.4	10	73
77-123	0.28	6	4.2	14	60
123-143	0.24	6	4.2	3	88

2. Calculate the total readily available moisture in Choma soil series using the following data. Make some assumptions and interpret your result.

CHOMA SOIL DATA

Depth cm	BULK DENSITY g/cm^3	$1/3$ Bar Water %	15 Bar Water %
0-19	1.63	7.0	2.0
19-31	1.61	8.3	2.2
31-72	1.66	7.4	6.0
72-125	1.54	10.3	7.5
125-185	1.64	12.6	9.1
185-200	1.55	19.8	9.6

3.   Using the graph paper given and the data below,
      calculate the length of the growing season in
      Solwezi and discuss the implications of growing
      short and long duration maize varieties. Assume
      a soil with a total readily available moisture of
      100 mm.

SOLWEZI AREA DATA

	J	A	S	O	N	D	J	F	M	A	M	J
Rainfall(mm)	0	1	1	51	193	283	294	236	240	65	4	0
Pan Evaporation (mm)	110	160	169	200	123	114	115	96	116	122	107	92

4.   Discuss the basic principles, applications and
      limitations of the Zambia Land capability classification
      system.

5.a. Distinguish between multiple and compound land
      utilization types. Give examples.

  b. Describe a common land utilization type in Southern
      Province in terms of its key attributes.

6.a. Discuss the 4 major kinds of land qualities.

  b. What factors would you consider in selecting land
      qualities for assessment of land suitability?

7.   How is the level of management expected to influence
      the suitability of land for a specific land utilization
      type? Give examples.

END OF EXAMINATION

AGS 551
ADVANCED SOIL GENESIS, CLASSIFICATION AND SURVEY

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

1.a. Discuss the likely influence of Basalt parent material on soil composition in a tropical environment with more than 1000mm of annual rainfall and another with 600mm of annual rainfall.

b. Explain the important processes of soil formation in the genesis of a spodic horizon. Make any assumptions.

2. A soil in Mbala is classified as "Clayey, Kaolinitic, Isohyperthermic, Typic Haplustox." Discuss in detail its chemical and physical properties and the climate associated with it.

3. Explain the main management problems of the following soils:

    a. Durargid.
    b. Quartzipsamment.
    c. Paleaquult.
    d. Acrustox.
    e. Cryaquept.

4. Given below is organic carbon distribution in the top 100cm of an Oxisol. Calculate the amount of Organic carbon in Kg/m^3 and decide whether or not on the basis of this criteria alone this Oxisol qualifies to be a Humox.

Depth	Org. C.%	Bulk density gcm^{-3}
0 -13	5.45	0.89
13 - 30	4.06	0.93
30 - 58	3.55	0.89
58 - 88	3.25	0.93
88 -100	1.04	1.16

5.a. Explain how differential thermal analysis is used in identification of minerals.

  b. Compare and contrast the properties of organic matter and sesquioxides. What is the significance of these properties in soil behaviour.

6. Discuss the main limitations in classifying soils according to Soil Taxonomy.

7. Given a farm of 600 hactares, suggest and justify a type of soil survey and how you would go about doing it.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-SESSIONAL EXAMINATIONS - MARCH 1986

AGS 552
SOIL SCIENCE V

TIME: THREE HOURS.

ANSWER: ALL Questions. All questions carry equal marks.
         (For questions subdivided in (a) and (b) marks
         are indicated on a total of 10).

1.   What is meant by the profitability of fertilization
     and how can this be determined.

2.   Which soil characteristics are particularly influenced
     by the organic matter content and in what way.

3.   Discuss the different aspects related to the
     evaluation of soil testing methods.

4.   Plants can be subject to certain stress situations
     during the growing season. How can fertilization
     help the plant overcome these situations.

5.   Compare the efficiency of the different N-fertilizers.

6.   Certain characteristic symptoms may indicate a
     particular nutrient deficiency in the field. Which
     ones do you know?

7.   a.   Discuss some of the main aspects of sugar
            cane fertilization (7 p.)

      b.   Which technique forms the basis of modern
            sugar cane fertilization (3 p.)

8.   Which are the different existing possibilities
      regarding the reclamation of saline and sodic
      soils.

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END OF EXAMINATION

AGS 553
ADVANCED SOIL PHYSICS

TIME: THREE HOURS.
ANSWER: ALL QUESTIONS.
MARKS: ALL QUESTIONS CARRY EQUAL MARKS.
NUMERICAL DATE: WILL BE HANDED TO THE CANDIDATES FOR QUESTIONS
                 1 and 4b.

1.   Calculate the stock of soil water and express the
      result in mm.

2.   Discuss the determination of moisture tension of soils
      under controlled vapour pressure conditions.

3.a. Based on the Continuity and Darcy equations
      demonstrate how soil evaporation can be calculated.

  b. How does the presence of a plane of zero flux influence
      the calculation.

4.a. Compare the Universal Soil Loss Equation (USLE) with
      the Soil Loss Estimation Model for Southern Africa
      (SLEMSA).

  b. Calculate according to both methods the erosivity of
      a given storm.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - JULY 1986

AGS 554

ADVANCED IRRIGATION AND DRAINAGE

TIME: THREE HOURS.

ANSWER: ALL QUESTIONS. All questions carry equal marks
         and Part (a) and (b) within a question have equal
         marks.

1.(a)   Define the most commonly used criterion and explain
         the different systems based on this criterion to
         evaluate sodicity hazard of irrigation water.

  (b)   Give a brief account of the physical factors to be
         considered for selection of land for irrigation.

2.(a)   Show graphically the relative (i) crop growth rate
         when soil water content changes from saturation to
         PWP and (ii) depthwise water removal by plant roots
         when the whole profile is at field capacity and when
         the upper part of this profile is drier as compared
         to its lower part.

  (b)   When is the water management technique used to
         increase water intake rate of a given soil?
         Also discuss the various practices of this technique.

3.   Discuss the various crop management and cultural
         practices which can be used to reduce irrigation
         requirement.

4. Write in detail the information needed for successful irrigation management for sugarcane crop and citrus orchard.

5. Estimate the most appropriate drain spacing for the conditions given below.

> Irrigation interval of 10 days; percolation losses of 25mm/irrigation; drainable pore space of 0.05; maximum permissible water table height of 1m below the surface; drain level of 1.8m below the surface; drain pipe diameter of 0.2m and impervious layer situated 9.5m below the surface.

6.(a) Using the data given below, calculate the drawdown at a distance of 50m from the well. Aquifer with hydraulic conductivity of 10m/day and saturated part thickness of 120m; well having 0.6m diameter, influencing up to 500m distance and being pumped @ 1500m^3/day.

(b) For a 100 ha field; water use rate of 10mm/day; safe depletion of 10cm; irrigation efficiency of 50%; water source 10m below the field level; pumping system efficiency of 50% and the irrigation system working 20 hrs/day, calculate

   (i)   Appropriate irrigation interval.
   (ii) Irrigation depth per unit area.
   (iii) Volume of water needed for one irrigation and to be pumped per hour.
   (iv) Brake horse power of the engine.

END OF EXAMINATION