UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS OCT-NOV 1995

SCHOOL OF AGRICULTURE SCIENCE

1. Fundamentals of Animal Science ------------------ AGA 210
2. Ruminant Production------------------------------ AGA 322
3. Animal Science --------------------------------- AGA 383
4. Pig and poultry production --------------------- AGA 411
5. Environment management for Animal Production ---- AGA 432
6. Agriculture ------------------------------------ AGA 511
7. Applied Animal Reproduction -------------------- AGA 521
8. Animal Health ---------------------------------- AGA 542
9. Fundamentals of crop science ------------------- AGC 210
10. Plant prtection ------------------------------- AGC 312
11. Range management and forage production --------- AGC 322
12. Plant pathology ------------------------------- AGC 332
13. Crop production ------------------------------- AGC 383
14. Field Crop production ------------------------- AGC 411
15. Horticultural Science 1 ----------------------- AGC 422
16. Agricultural Entomology ----------------------- AGC 431
17. Plant Breeding -------------------------------- AGC 442
18. Advanced Aspects of Crop Production ----------- AGC 511
19. Advanced Plant Breeding ----------------------- AGC 521
20. Horticultural Science II----------------------- AGC 552
21. Post-Harvest technology ----------------------- AGC 572
22. Fundamentals of Macroeconomics ---------------- AGE 222
23. Statistics and Experimental Design ------------ AGE 311
24. Introduction to Agribusiness management -------- AGE 411
25. Introduction to Econometrics ------------------ AGE 442
26. Intermediate Agribusiness 1 Management --------- AGE 452
27. Agricultural Extension Education --------------- AGE 552
28. Intermediate Farm Management ------------------ AGE 562
29. Agricultural marketing and policy ------------- AGE 462
30. Intermediate Farm Management ------------------ AGE 562
31. Advanced Agricultural Policy ------------------ AGE 572
32. Statistics and Experimental Design ------------ AGE 311
33. Fundamentals of Soil Science------------------- AGS 383
34. Soil Fertility -------------------------------- AGS 421
35. Soil Microbiology ----------------------------- AGS 422
36. Soil and plant analysis ----------------------- AGS 532
37. Soil Physics for Agricultural Engineering ----- AGS 483
38. Energy Source and Utilisation in Agriculture ---- EA 453
39. Energry sources and utilization in agriculture -- EA 400
40. Farm structures and environment --------------- EA 520
41. Post-Harvest technology ----------------------- EA 453
42. Irrigation Engineering ------------------------ EA 543

THE UNIVERSITY OF ZAMBIA

UNIVERSITY OF ZAMBIA - EXAMINATIONS OCTOBER/NOVEMBER 1995

AGA 210

FUNDAMENTALS OF ANIMAL SCIENCE

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ANY FIVE (5) OF THE FOLLOWING
                        QUESTIONS.   ALL QUESTIONS CARRY EQUAL MARKS.

1.   In beef production, the frequency of service by bulls must
        be regulated.

   (a)   What is the physiological reason behind this?

   (b)   What factors affect the number of spermatozoa per
            ejaculation? Why is the number of spermatozoa
            important?

   (c)   A bull has ejaculated semen in the cow's vagina;
            discuss the transport of spermatozoa in the female
            reproductive tract up to fertilization point.

   (d)   Cows will accept mating only when they are in estrus.
            What are the signs of estrus in cattle?

2.   Hormones control long term body activities. Production
        of hormones is regulated by feedback mechanisms.

   (a)   What is meant by feedback mechanism. Give one
            example.

   (b)   If there is over or underproduction of thyroid
            hormones, what would be the consequences in a young
            and adult animal?

   (c)   How is blood sugar controlled?

3. (a) What is the function of the Nervous System?

   (b) Describe with a labelled diagram, how an impulse is initiated, propagated and conveyed up to production of a response.

   (c) Why is the synapse said to be the weakest link in impulse transmission?

   (d) What effect does myelination have on impulse transmission?

4. Compare and contrast digestion in a cow and a pig.

5. You have qualified for soccer finals to be played in a month's time in Tripoli, a town that is 1500 metres above sea level. Assuming your hometown is 500 metres above sea level.

   (a) Describe the steps your body will go through to acclimatize at 1500 metres.

   (b) When should your team leave for the game and why?

   (c) What factors control respiration?

   (d) How is carbon dioxide transported in blood?

6. Write notes on any four (4) of the following:-

   (a) Temperature regulation in any domestic animal

   (b) Skeletal muscle contraction

   (c) Evolution of a heart beat

   d) Factors affecting quality and quantity of milk

   (e) Basic theory of nephron function

   (f) True Joint

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGA322

RUMINANT PRODUCTION

TIME: THREE HOURS

ANSWER: QUESTIONS ONE AND TWO AND ANY TWO QUESTIONS FROM SECTION I AND ALL QUESTIONS FROM SECTION II.

BEEF AND DAIRY PRODUCTION (55 MARKS)

Q1.

(a) Illustrate through diagrams the general picture obtained by slaughtering and dissecting a series of average carcasses as they grow for an early, average and late maturing steer in terms of tissue growth.

(b) What is the most significant fact in the developmental growth concept of cattle?

(c) Explain the negative growth phenomenon in relation to the three carcass tissues of cattle grazing tropical pastures.   (15 ma

Q2. Discuss briefly how calving percentages and mortality rates affect offtake rate from the ranch.   (10 ma

Q3. Mr George Banda is a smallholder dairy farmer along the Kafue-Lusaka road. Mr Banda has just acquired 500 hectare of land in Chisamba area and he intends to develop a modern ranch on this land.

(a) What type of beef cattle breeds would you advice Mr Banda to stock on this ranch?

(b) The natural vegetation on this area is predominantly hyperrhenia and heteropogon species and **Themeda triandra** (range grass) mixed with acacia shrubs and trees. In an average season with about 830mm of rainfall, normally distributed, the yield of fodder from this natural veldt is 2800kg of dry matter per hectare.

Calculate the carrying capacity of this ranch (Remember 1 livestock unit consumes 10kg of DM per day).

(c) If Mr. Banda feels that the carrying capacity of this ranch is low, how would he raise the level of stocking on this ranch?

(d) List the basic facilities that Mr. Banda is likely to develop on this ranch. (15 ma

Q4. Discuss dairy farming as an occupation in Zambia touching upon:

(a) four of its advantages.

(b) three of its limitations.

(c) kinds of products produced.

(d) nature and location of markets.

(e) sources and regularity of income the dairy farmer may expect. (15 ma

Q5. Write short notes on the following factors as they affect productivity on a dairy farm.

(a) length of time between calving and reconception

(b) length of lactation

(c) challenge feeding. (15 mar

SECTION II SHEEP, GOATS AND RABBITS PRODUCTION
(45 MARKS)

Q1. Describe briefly the potential of rabbits as sources of food and income in Zambia. (20 mar

Q2. (a) Sheep and goats are kept for a variety of reasons by farmers. Discuss THREE of these reasons. (9 mark

(b) Compare and contrast the feeding habits and behaviours of grazing sheep and goats. (8 mark

(c) What time of the year is it considered best for
sheep to lamb in Zambia? Give TWO reasons for
your answer. Include in your answer a timetable
for routine management which would allow the sheep
to lamb at this time. (8mark

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-YEAR EXAMINATIONS - JUNE 1995

AGA 383

ANIMAL SCIENCE

TIME ALLOWED: THREE (3) HOURS ONLY

INSTRUCTIONS TO CANDIDATES:

(I) ANSWER ANY FIVE (5) QUESTIONS.

(II) ALL QUESTIONS CARRY EQUAL MARKS.

Q1. a) What are the enzymes secreted by the stomach of the non-ruminant animal and indicate their functions?

b) What are the functions of the micro-organisms found in the ruminant stomach?

c) Draw a diagram showing the digestion and metabolism of nitrogenous compounds in the ruminant animal.
(20 marks)

Q2. a) What are the functions of the skin?

b) Draw a well-labelled diagram of the skin showing its various structures and indicate their functions. (20 marks)

Q3. a) Explain in detail the sequence of events that take place during Prophase I of Meiosis and indicate their genetic consequences.

b) State Gregor Mendel's Laws of Inheritance?
(20 marks)

Q4. Domestic female animal come to heat at regular intervals. The interval from the beginning of one heat period to the next is called the oestrous cycle. The oestrous cycle is controlled by hormones from adenohypophysis of the pituitary gland:

a) What are the signs of heat in cows?

b) What are the advantages and disadvantages of using artificial insemination in a herd of your choice?
(20 marks)

1

Q5. Write notes on the following:

a) Cyanogenetic glycosides

b) Why are some amino acids referred to as "Essential Amino Acids". List them down.

c) The physiological functions of water in the body of the animal and possible sources of water for the animal.   (20 marks)

Q6. Outline the structure of Deoxyribonucleic Acid (DNA) as a carrier of genetic information.   (20 marks)

Q7. Write notes on any four (4) of the following:

a) Performance Testing
b) Cross-breeding
c) Sex determination and sex-linkage
d) Functions of the respiratory system
e) What are the expected genotypic and phenotypic ratios in the F_1 and F_2 when a tall plant producing round seed is crossed with a short plant producing wrinkled seed?   (20 marks)

END OF EXAMINATION

2

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-YEAR EXAMINATIONS - JUNE 1995

AGA 411

PIG AND POULTRY PRODUCTION

TIME: THREE (3) HOURS

ANSWER: ALL QUESTIONS

SECTION A

POULTRY PRODUCTION

1. a. Give the names, sites of origin and functions of the two most important hormones involved in egg production. (6 marks)

   b. Given the data below from two breeds of layers.

DATA	A	B
Average length of time an egg is in the oviduct	24 hours	26 hours
Average time from oviposition to ovulation	1 hour	2 hours
Time first egg in a clutch is laid	7 am	7 am
Time after which hen stops ovulating	3 pm	3 pm

   Time next egg in a clutch is laid -   -

    Breed A .... (4 marks)

    Breed B ....

   Define clutch size (2 marks)

   What is the clutch size of:

    Breed A ....

    Breed B .... (4 marks)

What is the total number of eggs the two hens will lay in a month? (2 marks)

2. (a) What advice would you give a farmer as regards time of purchasing replacement pullet chicks, orientation of the building, and on solving the problem of floor eggs to ensure maximum egg production with minimum egg loss and high egg quality for a deep litter type of house. (12 marks)

   (b) Discuss factors affecting egg quality with special reference to shell quality problem. (14 marks)

3. Discuss management practices you would undertake to ensure low mortality and fast growth rates for broiler chicks during brooding period. (8 marks)

SECTION B

PIG PRODUCTION

4. A farmer intending to go into pig production approached you, and during your discussion he informs you that he intends to run a hundred (100) sow unit and thus advice on the following:

   (a) the maximum number of boars he should purchase.

   (b) when the sows and boars can be mature for breeding and why

   (c) how to achieve successful mating with conception rates of 80 - 90%

   (d) frequency of using the boars (young and old) in servicing. (20 marks)

5. Write brief notes on any **five** of the following:

   (a) Ovulation rate and factors affecting it.

   (b) Embryonic losses in sows during gestation period.

   (c) "Three week crisis" in piglets.

   (d) Plan of the pig herd.

(e) Hormonal and physiological changes occuring in diestrus if fertilization fails.

(f) Pigs having a high percentage of useful products.

(g) Abortions in pigs. (30 marks)

END OF EXAMINATION

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ANY FIVE QUESTIONS. EACH QUESTION IS
WORTH 20 MARKS.

QUESTION 1

Animals have various mechanisms within their body which allows them to lose heat.

(a)   Describe TWO methods by which a pig loses heat.   (6 mark

(b)   Hens lose heat by panting. Discuss TWO disadvantages of losing heat by this method. What building design features could help layers to keep cool?   (6 mark

(c)   Describe the processes by which an animal uses tissue insulation to keep warm   (8 mark

QUESTION 2

(a)   What is meant by the term heat increment of feeding? Discuss how the thermostatic theory describes how a pig controls it's food intake.   (6 mark

(b)   Discuss THREE managerial steps which could be taken to encourage an increase in food intake in layers during the hot season.   (6 mark

(c)   Why do neonates have problems maintaining homeostatis? Discuss THREE design features you might include when designing farrowing houses to assist neonates in their homeostatis.   (8 mark

QUESTION 3

(a) What is the difference between a circadian rhythm and
a circennial rhythm? Give an example of each as it
relates to a layer. (4 mark

(b) What is a primary timegiver? How does this differ to
a secondary timegiver? Give an example of each as they
relate to housed dairy cows. (6 mark

(c) Moulting can be controlled by photoperiod. Discuss how
this can be achieved in a layer unit. What advantages
are there to being able to control this moulting? (4 mark

(d) Describe TWO pathological disturbances which may result
as a consequence to exposure to ultra violet light. In
each case, state what managerial steps can be taken to
avoid the problem. (6 mark

QUESTION 4

(a) What is the difference between a behaviour pattern and
a behaviour system? Give an example of each. (6 mar

(b) Out of all the animals available to Man, only a few
have been domesticated. Discuss THREE criteria which
makes a species of animal suitable for domestication. (6 ma

(c) Why is it important that a mother-young bond be developed
in ranch animals? Describe the process by which this
bond occurs. State TWO factors which could disrupt this
bonding process. (8 mar

QUESTION 5

Make notes of the following as they relate to the management
of farm animals

(a) Territory versus home range (5 mar

(b) Noxious behaviour in pigs (5 mar

(c) Dominance order in dairy cows (5 mar

(d) Imprinting in broiler chicks (5 mar

QUESTION 6

(a) Animals are said to have primary and secondary defence mechanisms in the prevention of infectious diseases. Describe the activities of ONE primary and ONE secondary defence mechanism.   (5 mark

(b) Discuss THREE ways by which the management of housed animals can reduce parasitic infection.   (6 mark

(c) Describe TWO methods of sanitation which can be used to clean a broiler house.   (4 mark

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END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – OCTOBER/NOVEMBER 1995

AGA 511

AQUACULTURE

TIME ALLOWED: 3 HOURS ONLY

INSTRUCTIONS TO CANDIDATES:

1.   ANSWER ANY FIVE (5) QUESTIONS

2.   ALL QUESTIONS CARRY EQUAL MARKS.

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1.   Mr. Yikolo has constructed a canal 20 cm wide and 60 cm deep. From the dam wall to his fish pond, the distance is 0.25 km and the water takes 7 minutes to cover this distance.

    (a)   What is the water flow in litres/sec?

    (b)   Assuming that the water flow (in (a)) remains uniform, how long in hours, will it take to fill to the brim, a pond 0.6 m deep, 2000 cm wide and 0.04 km long?

    (c)   Suggest certain measures to be taken if aquaculture has to develop fully in Zambia.   (20 marks)

2.   (a)   Discuss the importance of temperature on water bodies and its effect on aquatic plants and animals.

    (b)   What are the advantages and disadvantages of a polyculture of different age groups at subsistence levels in fish culture?   (20 marks)

3.   (a)   Knowledge of the food spectrum and feeding habits of a prospective culture species is very important. Discuss with valid resons.

    (b)   In fish ponds both organic and inorganic materials are not in constant circulation. True/False. Support your answer with reasons.   (20 marks)

4. (a) Give a detailed account of the general composition of the fish diet, giving the importance of each of the said components.

    (b) What is BOD and how is it used for effective fish pond management?   (20 marks)

5. (a) What determines the growth patterns of cultured fishes?

    (b) Give a full account of a disease in fish closely related to rough handling of fish. Suggest curative measures.   (20 marks)

6. (a) Citing an appropriate example, discuss the importance and effectiveness of an agro-livestock-fish farming system.

    (b) What are the advantages and disadvantages of organic and inorganic fertilizers respectively?   (20 marks)

7. (a) What is AFCR and how appropriate is it in fish farming?

    (b) What is the difference between simple and sophisticated outlets. Describe how they work.   (20 marks)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS.   ALL QUESTIONS CARRY EQUAL MARKS

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1.   Knowledge of estrous cycle can be used to improve production methods of a dairy herd.

   a)   Outline one method of improving production that uses this knowledge.

   b)   How does the method you have chosen work?

   c)   What are the limitations of the method you have chosen?

2.   To reduce breeding cycles, it is necessary to establish failure of pregnancy early.

   a)   Describe the different methods used to determine pregnancy in cattle.

   b)   List the advantages and disadvantages of the methods listed.

   c)   Which method would you choose and why?

3.   You have been appointed farm manager of a Dairy herd.   On inspection of records, herd performance is as follows:-

   -   40% cows showing heat by day 60 postpartum

   -   30% cows conceive on first service

   -   20% cows calve to first service

   -   30 months calving interval

   -   20% perinatal losses

   a)   Is this farm attaining expected reproductive efficiency?   Explain your answer.

b) Outline and discuss the steps you would take if any to bring the performance of the herd to expected levels.

4. a) Outline the procedures used in collecting, processing and packaging of bull semen.

   b) When is the appropriate time to inseminate cattle?

   c) What are the factors that affect conception rate with artificial insemination?

5. Write short notes on any four of the following topics:-

   a) Transport of sperm in male and female reproductive tract

   b) Causes of reproductive failure in females

   c) Choosing a breeding bull

   d) Embryo Transfer

   e) Factors affecting puberty.

6. a) What are the signs of approaching parturition.

   b) Describe the hormonal basis of parturition and how it is utilized in the farmer's practice of induced parturition.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGA 542

ANIMAL HEALTH

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ANY FIVE QUESTIONS.   ALL QUESTIONS
                 CARRY EQUAL MARKS.

Q1.   Briefly describe the common life cycle and the factors
      affecting the epidemiology of Nematodes infection in
      livestock under the Zambian conditions.

Q2.   Briefly discuss, the mode of transmission and control
      strategies for any two of the following diseases in
      Zambian livestock.

      (i)   corridor disease

      (ii) Bovine trypanosomiasis

      (iii) Foot and mouth disease

Q3.   Name Five common skin diseases of livestock. Discuss
      in details the economic importance and control strategies
      of two important ectoparasitic conditions of pigs in
      Zambia.

Q4.   Name five economically important diseases causing severe
      respiratory distress in livestock. Discuss one of them
      under the following headings:

      (i)   species affected
      (ii) mode of transmission
      (iii) Carrier status
      (iv) specimen for diagnosis
      (v)   control measures
      (vi) Post mortem lesions

Q5. Name <u>six</u> diseases causing abortion in cattle. What control and preventive measures would you take against suspected case of Anthrax outbreak at a farm if you were the farm Manager?

Q6. Name <u>four</u> <u>economically important</u> infectious diseases of poultry found in Zambia. Discuss <u>two</u> of them under the following headings:

    (i)   Etiology

   (ii)   Symptoms

  (iii)   Diagnosis

   (iv)   Post mortem lesions

    (v)   Prevention.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 210

FUNDAMENTALS OF CROP SCIENCE

TIME: THREE HOURS

INSTRUCTIONS: ANSWER <u>ANY FIVE QUESTIONS</u>

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1.   Describe the structure of a plant root, showing how photosynthates are transported and distributed to all the tissues.   (20)

2.   In what respects and under what conditions would conservational tillage be more advisable to a wheat farmer than conventional tillage?   (20)

3.   Explain in detail the reasons for considering the Farming Systems Research approach as being comprehensive problem solving and iterative.   (20)

4.   Write short notes on:-

     (a)   The function of cytokinins in plants   (5)
     (b)   The function of chloroplasts in plants   (5)
     (c)   Importance of family <u>Cucuritaceae</u> in Zambia   (5)
     (d)   Economic importance of <u>ONE</u> solanaceous crop
           in Zambia.   (5)

5.   A European Farmer would like to migrate to Zambia and open a farm in Mwinilunga where you are the District Agricultural Officer. The farmer has written to you asking for details of the Agro-climate and dominant farming system of the rural community in the area. Write an essay giving the full details in reply to the farmer's request.   (20)

6.   A small scale farmer has been planting a maize variety at 26,000 plants/ha. After receiving advice from Extension Officers to plant at 44,000 plants/ha, he wrongly planted at 60,000 plants/ha.

     (a)   What could have been wrong with his previous practice?
                                                       (8)

(b) Does he expect a higher yield with the new practice? Explain. (8)

(c) Compare cob size and grain size under the two practices. (4)

7. Give a thorough explanation of the 'SYSTEMS THEORY' and why it is relevant in agriculture. Give examples in your answer. (20)

END OF EXAMINATION

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 312

PLANT PROTECTION

TIME: 3 HOURS

ANSWER: 5 QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

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1.   Define metamorphosis and explain the different types
     of metamorphosis in insects.

2.   Outline the various methods of biological control and discuss
     in detail the advantages and disadvantages of this method.

3.   Describe ways of integrating physical and chemical weed
     control methods in crops.

4.   Given: Dose rate = 2.5 L/ha,
              Area to be sprayed = 4000 m^2

     The knapsack sprayer (capacity 20 L), calibrated on a test
     area of 100 m^2 gave an output of 3.5 L. Calculate:

     a)   amount of water needed for the 4000 m^2
     b)   amount of chemical needed for 4000 m^2
     c)   size of area that can be covered with a full sprayer
     d)   how much of the chemical must be added to a full
          sprayer?

5.   a)   Write an essay on stages in disease development.

     b)   Why is plant pathology important?

6.   a)   Write short notes on non-infectious causal organisms
          of plant diseases.

     b)   Give 10 examples of plant disease symptoms and
          describe each one briefly.

     c)   What is the difference between viruses and other
          disease causing organisms.

                    END OF EXAMINATION

1

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-YEAR EXAMINATIONS - JUNE 1995

AGC 322

RANGE MANAGEMENT AND FORAGE PRODUCTION

TIME: THREE (3) HOURS

ANSWER: QUESTION ONE AND ANY OTHER FOUR.

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1. (a) Discuss the state and transition range management model and explain its relevance to a beef producer in the Mkushi farming block.   (15)

    (b) List the different mechanisms by which plants are able to tolerate or avoid drought.   (5)

2. Discuss briefly any four of the following: (5 marks each)

    (a) The severity and frequency of cut on pasture productivity
    (b) Tannins
    (c) Hard seed and pasture establishment
    (d) Nitrate poisoning
    (e) The stage of cut on the yield and quality of conserved forage.

3. (a) A dairy farmer in Chisamba is undecided on whether to conserve fodder or not. What do you think the farmer should do?   (10)

    (b) Briefly outline the options a farmer has, to ensure the continuity of feed supply on his property. (10)

4. Continuous grazing system is no better than the other grazing systems. Discuss this statement.   (20)

5. The degradation of Zambian rangelands is a serious problem threatening the long term sustainability and productivity of the beef industry in Zambia. Identify a rangeland that has been degraded and suggest the management options that should be put in place in order to either prevent or alleviate further degradation.   (20)

6. Discuss the use of fire in pasture/rangelands management.   (20)

END OF EXAMINATION

1

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 332

PLANT PATHOLOGY

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

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1.   Write short notes on the following:-

      - Histological defense structures.

      - Differences between viruses and other infectious disease
        causing organisms.

      - Disease tolerance.

      - Cellular defense structures.   (20)

2.   a)   Why are toxins, enzymes, and growth regulators
           important in plant disease development?

      b)   Which pathogen produces T-toxin? Is this toxin host
           specific or non-host specific?   (20)

3.   a)   Write an essay on how plants defend themselves by
           using physical barriers.

      b)   How would you go about identifying an unknown infectious
           disease causing organism.   (20)

4.   a)   How does human cultural practices and control measures
           affect epidemics?

      b)   Draw and label the plant disease triangle and explain
           what happens before disease development.   (20)

5.   a)   Why is crop loss assessment important in the agricultural
           industry?

      b)   Write short notes on the following:-

           - Potential losses
           - Actual losses
           - Indirect losses
           - Apparent crop injury   (20)

                    END OF EXAMINATION

                           1

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 383

CROP PRODUCTION

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ANY FIVE QUESTIONS

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1.   A retiree wants to start farming in Gwembe valley (Southern Province). Give guidelines as to what crops he can successfully grow.   (20 marks)

2.   a)   Discuss how crop improvement (or plant breeding) has contributed to improved agricultural productivity.   (10 marks)

     b)   Distinguish between land preparation for maize and wheat.   (10 marks)

3.   Discuss the production of maize and soyabeans with respect to:

     a)   Climate   (5 marks)
     b)   Soil   (5 marks)
     c)   Fertiliser   (5 marks)
     d)   Timing of harvesting   (5 marks)

4.   Discuss and compare the objectives, methods and problems involved in making hay and silage.   (20 marks)

5.   Discuss the concept of integrated pest management.   (20 marks)

6.   Discuss methods commonly used to classify herbicides.   (20 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 411

FIELD CROP PRODUCTION

TIME: THREE HOURS

ANSWER: ANY FIVE QUESTIONS

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1. You have been recruited as a Farm Manager of a tea estate that is 2 years old. Outline the three major routine management practices you would be carrying out on the plantation to ensure high productivity. In each case, explain why and how you would do it.   (20 marks)

2. Compare the occurrence, effect and control strategies of weeds in plantatioin crops and oil crops. (Give examples).
      (20 marks)

3. Discuss in detail the technique of ratooning in sugarcane production.   (20 marks)

4. Discuss how under utilized crops can diversify our agriculture and supplement our diet. Recommend any four crops that could be used for this purpose.   (20 marks)

5. Discuss the production requirements of maize and contrast them with those of soyabeans.   (20 marks)

6. "Wheat has a great potential in Zambia". Discuss this statement.   (20 marks)

END OF EXAMINATION

1

TIME: 3 HOURS

ANSWER: QUESTIONS 1 AND ANY THREE: POINTS FOR EACH
          QUESTION ARE INDICATED

Q1.   Discuss potato (<u>solanum</u> <u>tuberosum</u>) production under
      the following headings:

      (i)   Irrigation
      (ii)   Disease control
      (iii)   Insect control
      (iv)   Harvesting   (25 marks) ╱

Q2.   (a)   Briefly classify fruits according to temperature
            requirements.   (12 marks)

      (b)   Briefly comment on the following:

            (i)   Orange production in Britain
            (ii)   Production of apples in Zambia
            (iii)   The planting operation of a fruit tree
                                                      (13 marks) .

Q3.   Write a detailed account on Tomato production from land
      preparation to harvesting.   (25 marks)

Q4.   (a)   Define the following:

            (i)   Horticulture
            (ii)   Species
            (iii)   Variety
            (iv)   Cultivar
            (v)   Vegetable
            (vi)   Fruit   (6 marks)

      (b)   Classify the following as either a fruit or vegetable:

            (i)   Eggplant
            (ii)   Green maize
            (iii)   Carrot
            (iv)   Tomato
            (v)   Onion
            (vi)   Okra   (6 marks)

1

Q5. (a) Below are some well-known families of horticultural
interest. Give one example of a horticultural plant
of interest in each of these families:

    (i)   Amaryllidaceae
    (ii)   Gramineae
    (iii)   Compositae
    (iv)   Cruciferae
    (v)   Cucurbitaceae
    (vi)   Umbelliferae
    (vii)   Solanaceae   (7 marks)

(b) Describe the following categories of cultivars:

    (i)   Clonal cultivars
    (ii)   Pure-line cultivars
    (iii)   Open-pollinated cultivars
    (iv)   Hybrid cultivars   (8 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 431

AGRICULTURAL ENTOMOLOGY

TIME: 3 HOURS

ANSWER: 5 QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS

1. Outline the functions of an exoskeleton and discuss the consequences of possessing such a structure in insects.

2. What is legislative control? Discuss in detail the functions of a plant quarantine division.

3. What is microbial control? Discuss the advantages and disadvantages of this method.

4. Describe the general characters and economic importance of the order ISOPTERA.

5. The sole reliance on insecticides for the control of insect pests has lead to many problems. Discuss.

6. Define IPM and outline the principal components of this programme.

END OF EXAMINATION

1

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-YEAR EXAMINATIONS - JUNE 1995

AGC 442

PLANT BREEDING

TIME: THREE HOURS

INSTRUCTIONS:

ANSWER QUESTION 1 AND ANY OTHER FOUR.   ALL QUESTIONS CARRY
EQUAL POINTS.

Q1.   You are recruited as a cassava breeder with the task
      to develop and provide the particular agro-ecological
      region with appropriate varieties. What would be your
      objectives and describe how you would attempt to
      achieve a particular objective in cassava.

Q2.   Describe how sunflower has been important in Zambia. Give
      the objectives of the breeding programme and the
      methodologies used. Illustrate your answer.

Q3.   Write short notes on the following:

      (a)   Genetic variability
      (b)   Interspecific hybridization
      (c)   Incompatibility
      (d)   Mutation
      (e)   Field Plot technique

Q4.   When considering breeding for tolerance to diseases
      certain critical aspects must be considered. What are
      these and how are they related?

Q5.   Describe the Phenotypic Mass Selection method and the
      Ear-to-Row Selection method, pointing out the
      differences and similarities.

Q6.   What have been the main methods of breeding in vegetables
      in Zambia? What have been the accomplishments and
      short comings?

                    END OF EXAMINATION

1

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – OCTOBER/NOVEMBER 1995

AGC 511

ADVANCED ASPECTS OF CROP PRODUCTION

TIME: THREE HOURS

ANSWER: QUESTION 1 AND ANY OTHER FOUR QUESTIONS

1.   You are an Agroclimatologist involved in crop yield forecasting.
You are required to develop a model for crop yield forecasting
using crop water requirement satisfaction index (WRSI), an
index obtained from a water balance calculation with rainfall
as one of the inputs. Given the following data:

REGRESSION OUTPUT

Constant	-18.7122
Standard error of Y estimate	1.545982
R Squared	0.97621
Number of observations	12
Degrees of freedom	10
X coefficient	0.586934
Standard error of coefficient	0.028974

(a) Explain what crop yield model is and develop one from
the above data   (5 marks)

(b) Between the two variables in the model, which is the
independent variable and which is the dependent
variable? Explain how these are determined.   (5 marks)

(c) Explain what coefficient of determination is   (4 marks)

(d) From the above data, explain what R Squared (0.97621)
means with respect to WRSI and the equation. (6 marks)

2. Write short notes on the following:-

(a)   Yield components   (5 marks)

(b)   Conversion of solar radiation by plants   (10 marks)

(c)   LAI, CGR and NAR   (5 marks)

3. You have a field of okra which you divide into two. In one section you carry out periodic harvesting, while in the other you only harvest once (at the end). Discuss the possible sink-source relationships in the two fields. (20 marks)

4. Discuss the physiological basis for yield responses to increasing plant desnsities. (20 marks)

5. Discuss the process of nitrogen fixation and the factors that affect it. (20 marks)

6. Discuss the potential role of genetic engineering in crop production. (20 marks)

END OF EXAMINATION

TIME: THREE HOURS

INSTRUCTIONS: ANSWER QUESTION 1 AND ANY OTHER THREE.

Q1. Crop improvement, like any other scientific undertaking, has undergone changes to deal with new situations as well as increase effectiveness and efficiency. To this end, novel breeding methods have become more popular in to-day's plant breeding programmes. What are these methods? Describe two of them in detail, highlighting what you see as being novel about them. Indicate circumstances that warrant their use.   (25 points)

Q2. Describe, in detail, the strategies and statistical analyses of the North Carolina Design I, Biparental progenies (BIP) and Diallels. Clearly state the differences among the designs.   (25 points)

Q3. You have been just recruited as a new but experienced plant breeder in a well established plant breeding programme. Among the first things you want to do, is to establish the heritabilities of two important traits in the various populations of the programme. Examination of the records in the programme reveal that you have the following data:-

Trait	Population	$\hat{\sigma}^2_g$	$\hat{\sigma}^2_{gl}$	$\hat{\sigma}^2_{gy}$	$\hat{\sigma}^2_{gly}$	$\hat{\sigma}^2_e$
Seed Yield	1	248	0.0	206	311	1658
	2	334	0.0	86	207	1743
	3	208	178	175	146	1507
	4	316	94	200	185	1316
Seedling Vigour	1	31.7	2.7	10.1	25.9	106.1
	2	20.6	0.9	12.3	32.2	99.3
	3	12.2	3.4	5.9	11.2	40.3
	4	11.4	3.1	8.5	14.4	81.7

(1) Calculate the heritabilities for the traits for each population.

(2) Interpret your results. (25 points)

Q4. Wrte short notes on the following:

(a) Centres of diversity

(b) Quality as a breeding objective

(c) Interspecific hybridization

(d) Germplasm conservation (25 points)

Q5. What do you understand by the term selection? How do you measure gain from selection? Give details. (25 points)

END OF EXAMINATION

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 552

HORTICULTURAL SCIENCE II

TIME: THREE HOURS

ANSWER: ANY FOUR QUESTIONS
----

1.   What are growth regulators? Discuss their role in
     horticulture, giving specific practical examples.
                                                 (25 marks)

2.   Discuss the merits and demerits of propagation by seed
     and by vegetative means.   (25 marks)

3.   (a) Indicate the phase of development sensitive to the
          photoperiod, and explain its practical importance in
          the following vegetables: (10 marks)

          (i)   Okra
          (ii)   Carrot
          (iii)   Eggplant
          (iv)   Sweet potato
          (v)   Onion

     (b) Explain the effect of solar radiation (in terms of
          quality, intensity and duration) on horticultural crops.
                                                 (15 marks)

4.   Write short notes on the following: (25 marks)

     (i)   Vegetative propagation
     (ii)   Vernalization
     (iii)   Factors affecting rooting of cuttings

5.   "Temperature produces different responses on horticultural
     crops". Discuss.   (25 marks)

                  END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGC 572

POST-HARVEST TECHNOLOGY

TIME: THREE HOURS

ANSWER:

QUESTION <u>ONE</u> AND ANY <u>FOUR</u> QUESTIONS (<u>TWO</u> FROM
SECTION B AND <u>TWO</u> FROM SECTION C). ALL QUESTIONS CARRY
EQUAL MARKS.

SECTION A

1.   One of the main reasons why the Governments are involved
     in storage is concern for National Food Security.

     (a) Discuss in detail how the Zambian Government can
          ensure proper storage of maize to ensure National
          Food Security.

     (b) Discuss the following statement:
          "From maize to dust".

SECTION B

2.   (a) Describe in detail a procedure you would use to
          isolate pathogenic microorganisms from a rotten fruit.

     (b) List and explain the principles behind the use of
          traditional methods of controlling insects without
          insecticides.

3.   (a) Explain how the chemical composition of legumes provide
          basic food needs for mankind.

     (b) Describe the bean seed structure and its significance
          in storage.

1

4. (a) Discuss the following statement:
"Fruits and vegetables are perishables".

(b) A lot of mangoes go to waste in Zambia.
Explain in detail:

(i) the main causes of losses in mangoes and
(ii) measures to prevent these losses.

(c) Briefly state why it is difficult to determine the
magnitude of losses in fruits and vegetables.

SECTION C

5. (a) Giving specific examples, explain how the structure of
a cereal grain affect their milling characteristics.

(b) Describe the process involved in producing high quality
soyabean cake for use in stockfeed production. Also
list and explain the chemical analysis used to verify
the quality of soyabean based stockfeeds.

6. (a) Discuss the various options used for storage of fresh
fruits and vegetables.

(b) What are the advantages of using solar dryer as opposed
to traditional methods of drying vegetables?

7. (a) What is meant by the term "Improved Storage Structures"?

(b) Giving specific examples, outline the principles
underlying the use of improved storage structures.

8. List and in each case explain the steps involved in
grain/seed cleaning process and explain the quality
characteristics of the grain.

END OF EXAMINATION

2

TIME: THREE HOURS

ANSWER:

QUESTION ONE AND ANY FOUR QUESTIONS.   ALL QUESTIONS CARRY
EQUAL MARKS.
==

1.   (a)   Discuss the main causes of losses in fruits and
           vegetables. How can these losses be prevented?

     (b)   Give reasons why it is difficult to estimate losses
           in fruits and vegetables.

     (c)   Vegetable dehydration a method which is used
           traditionally for preservation of vegetables such as
           Cowpea Leaves. What are the disadvantages of the
           traditional method of vegetable dehydration.

2.   Explain in detail the components of post-harvest
     technology.

3.   (a)   Give reasons why the Government is involved in the
           storage of produce.

     (b)   Discuss bag storage of maize and explain how
           fumigation is done.

4.   (a)   What is meant by "improved storage structures"?

     (b)   Giving specific examples outline the principles
           underlying the use of improved storage structures.

5.   (a)   Looking at the nutritional composition of legumes.
           Give reason(s) why legumes are important as food.

     (b)   Legumes contain antinutritional factors. Name the
           antinutritional factors found in soya beans and
           explain how they can be eliminated.

6. Explain the principal operations in freezing high quality vegetables e.g. green peas.

7. Write short notes on any FOUR of the following

   (a) Blanching
   (b) Degumming
   (c) Degermination
   (d) Aseptic packing
   (e) Exhausting

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE 222

FUNDAMENTALS OF MACROECONOMICS

TIME: THREE HOURS

INSTRUCTIONS: ANSWER FIVE QUESTIONS.   QUESTION 1
IS COMPULSORY.

---

1.   Given the following economic system

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

$C = 100 + 0.8Yd$ Consumption function

$T = 10 + 0.1 Y$ Tax function

$G = 40$ Government expenditure

$I = 30 - 50i$ Investment function

$X = 10$ Exports

$M = 5 + 0.2 Y$ Imports

$YF = 320$ full employment output

(a)   Derive the equilibrium equation for Y.

(b)   If i = 0.2, what is the state of the Government budget?

(c)   If the marginal propensity to save increases to 0.4,
    what is the new level of income?
    given that i = 0.2

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

2.   The Zambian economy has been going through a hard period.
    When the MMD Government came into power, they started
    tackling economic fluctuations which have characterized
    our economy, the major one being inflation.

(a)   What does an inflationary situation entail and how would
    you get out of such a situation?

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

3. Write briefly on the following concepts:-

    (a) Deflationary gap
    (b) Cost push inflation
    (c) Multiplier
    (d) Crowding out effect   (18 marks)

4. Which tool of fiscal policy has a more specific impact
    on changes in GNP; Government expenditure or changes
    in taxation?
    Justify your answer.   (18 marks)

5. (a) What are the kinds of money used by the public?
         Briefly discuss the functions of money.
    (b) Explain how securities act as a tool of monetary
         policy in influencing the supply of money.   (18 marks)

6. (a) What were the motives Keynes put forward in his
         theory of demand for money?
    (b) Discuss the arguments advanced by Keynes and
         monetarists in justifying the more effective policy
         (fiscal or monetary policy) in stabilizing the
         economy.   (18 marks)

7. (a) What should a firm consider when making an investment?
    (b) Explain the relationship between interest rate and
         investment.   (18 marks)

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS. QUESTION ONE AND TWO ARE COMPULSORY
==

1.   Suppose that the following was data for the Zambian
      economy in 1970. All figures are in billions of kwacha.

Exports of goods and services	406
Imports of goods and services	480
Rental Income	70
Net property income from abroad	10
Business profit	318
Depreciation	450
Personal consumption expenditure	2,618
Compensation of employees for labor	2,594
Sales and excise taxes	340
Gross Investment	712
Production cost of goods	1,500
Government expenditure	836
Net interest	320

(a) What is the value of

    (i)   GNP
    (ii)   GDP
    (iii)   NNP

(b) What is meant by depreciation   (15 marks)

1

2. 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 = .20 what is the state of the government
       budget?

   (c) If the marginal propensity to consume drops to 0.6,
       what is the new equilibrium level of income.

   (d) Is the government pursuing an expansionist, passive
       or deflationary policy? Explain.   (25 marks)

3. What do you understand by the following concepts:

   (a) Full employment surplus

   (b) Value added

   (c) Minimum reserve ratio

   (d) Stagflation   (20 marks)

4. What are the tools of monetary policy? Explain how one
   of the tools influences the amount of money in supply.
                                                (20 marks)

5. (a) Distinguish between tight money and easy money
       policy.   (10 marks)

   (b) Why would easy money policy be considered a less
       effective policy than tight money policy? (10 marks)

6. What is inflation? Distinguish between 'demand pull' and
   'structural inflation.'   (20 marks)

7. (a) Briefly discuss the functions of money. (5 marks)

   (b) Briefly discuss the role of the Central Bank in
       an economy.   (15 marks)

                    END OF EXAMINATION

                            2

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE442

INTRODUCTION TO ECONOMETRICS

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

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1. Zambian agricultural sector for the period 1980 to 1994
    was estimated as follows:

    $$Y = B_0 \; X_1^{B1} \; X_2^{B2}$$

    Where; Y = output of agricultural products

    X1 = labor input

    X2 = capital input

    If the equation is expressed in logarithmic form and
    estimated using regression analysis. The following
    were the results at 5% level of significance.

VARIABLE	COEFFICIENT	STANDARD ERROR	T-STATISTIC
CONSTANT	-3.3384		
LABOR	1.4988	0.5398	2.7765
CAPITAL	0.4899	0.1020	4.8005

R-SQUARED	0.8892
ADJUSTED R-SQUARED	0.793
S.E. OF REGRESSION	0.012
DURBIN WATSON	2.012
F-STATISTIC	28

(a) Set up and test the relevant hypothesis for the
     significance of the individual coefficients and
     the overall model. Illustrate your answers where
     possible and use the statistical tables provided.

(b) Interpret the input elasticities of labor and capital

(c) Interpret the R-SQUARED, ADJUSTED R-SQUARED, S.E. OF REGRESSION and DURBIN-WATSON.

(d) What kind of returns to scale were experienced over this period?

(e) If the variable representing the land input (X3) was included in the model, would the explanatory power of the model improve? why?   (20 marks)

2. Briefly discuss for each one of the following:

   Heteroscedasticity, autocorrelation and multicollinearity

   (a) the nature of the violation

   (b) its consequences

   (c) its detection or tests

   (d) remedial measures   (20 marks)

3. Consider the following model

   $$Sales = 1526 - 242.5D_1 - 334.67D_2 - 101.67D_3$$

   standard errors   (174.10)   (174.10)   (174.10)

   Where

   D1=1 for the second quarter, 0 otherwise
   D2=1 for the third quarter, 0 otherwise
   D3=1 for the fourth quarter, 0 otherwise

   (a) How can you interpret the estimated coefficients?

   (b) In which quarter(s) is a seasonal factor operating?

   (c) Discuss briefly the implications of seasonal factors in econometric analysis. What is the process of removing this seasonal effect called?

   (d) Is this model an Analysis of Variance (AOV) or Analysis of covariance (ACOV) model?

(e) Can the model be estimated if the dummy variables take values of 1 or 0 in quarters 1 to 4. What econometric problem will be encountered with such an estimation? (20 marks)

4. A study is made to determine the characteristics that enable farmers to participate in government agricultural programs. The dependent variable is a dummy, taking a value of 1 if a person is in the program, 0 if they are not. The following were the results obtained using OLS;

Explanatory variable	coefficient	t-ratio
CONSTANT	0.4368	15.4
Marital stutus		
Married	****	****
single	0.1523	13.8
Divorced	0.2915	22.0
Age of farmer		
22-54	****	****
55-64	-0.0594	-5.7
65 and over	-0.2753	-9.0
Extension visits		
no visits	****	****
Once a week	0.1255	5.8
twice	0.1704	7.9
Schooling level		
primary	****	****
secondary	-0.0885	-2.8
college	-0.0858	-2.4

**** = the base category

(a) Define a Linear probability model (LPM)

(b) Interpret the coefficients of the following categories
(1.) Single farmer (2.) aged 55-64 (3). extension visits
once a week and (4) with secondary education.

(c) What is the probability of a farmer who is divorced, aged
65 and above, with two visits a week and with secondary
education participating in a government program?

(d) What is the probability of a married farmer, aged between
22 and 54 years, with no extension visits and no education
participating in a government program?

From (b) and (c) what would be your recommendation on
what combination of categories is preferable? (20 marks)

5. Consider the following demand and supply model for money

Money demand $Md = \beta_0 + \beta_1 Y + \beta_2 R + \beta_3 P$

Money supply $Ms = \alpha_0 + \alpha_1 Y$

Where; M=money, Y=income, R=rate of interest, P=price
R and P are exogenous variables

(a) Are the demand and supply functions identified?

(b) What is the best method of estimating the identified
equation(s)?

(c) If we add the variables Y_{t-1} and M_{t-1} to the supply
function, what will happen to its identification? In
this case, what will be the best method of estimating
the parameters?

(d) Briefly discuss the nature of simultaneous equations
and the technique used to estimate their parameters.

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS

MARKS: ALL QUESTIONS CARRY EQUAL MARKS
----

1. (a) Define and discuss the management functions.

    (b) Examine and describe the steps in the planning
         process.

2. (a) List and discuss the factors involved in deciding
         which form of business organization is best suited
         to an agribusiness.

    (b) How would you describe the importance to an
         agribusiness of choosing the best organizational
         form for conducting its business?

3. (a) Discuss the meaning of depreciation and describe
         how it is treated on the financial statement?

    (b) Define the difference between an expenditure and
         an expense from an accounting point of view.

4. (a) What criteria should the agribusiness manager use to
         select ratios needed by the business?

    (b) Discuss the major value of financial analysis to
         agribusiness managers.

5. (a) Discuss the issues surrounding the different costs
         of loans, and describe how those costs are figured.

    (b) Discuss the different kinds of loans and focus on
         the nature of collateral factors in each case.

6. (a) What is the basic difference between a forecast and
         a budget? How are they linked together.

    (b) List the advantages of using the management by
         exception management approach to control programs.

7. (a) Explain the difference between variable costs and controllable costs.

   (b) Draw an ego potriat of a typical manager and the typical employee. Explain why you have drawn it in this manner.

8. (a) Give an example of a crossed transaction. Diagram the response.

   (b) What gives a manager the right to issue orders to employees? Should the boss's orders always be followed? Why or why not?

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE452

INTERMEDIATE AGRIBUSINESS MANAGEMENT

TIME: THREE HOURS

ANSWER FIVE QUESTIONS
MARKS: AS GIVEN BELOW

1. (a) Describe the differences between materials management, physical distribution, and business logistics.   (10 marks)

   (b) What are conflicting costs? Why are they important to physical distribution management?   (10 marks)

2. (a) What are the differences (or similarities) between cost trade-offs, the total cost concept, and the total system concept? (10 marks)

   (b) Describe the threshold, diminishing returns, and decline stages of the sales service relationship. (10 marks)

3. (a) Why is the order cycle so important to logistics management? (10 marks)

   (b) Explain what you understand by the following:

       (i)   pretransaction elements

       (ii) Transaction elements

       (iii) post transaction elements. (10 marks)

4. (a) Identify three products that have extreme characteristics as to (a) weight-bulk (b) value weight (c) substitutability (d) Risk. Indicate how they might be favourably altered to lower logistical costs. (10 marks)

(b) Why are uniform and zone pricing schemes fair for customers on the whole but discriminatory and unfair for a great many of them individually? (10 marks)

5. (a) When does privately owned transportation become a better choice than common carrier transportation (public)? Discuss this in terms of product characteristics, customer service, management, and cost. (10 marks)

(b) Explain why transportation rates typically vary with (a) the volume of a shipment, (b) the distance a shipment is transported and (c) the value of the transport service. (10 marks)

6. (a) Explain how warehousing, which is an added expense to the supply or distribution channel, can lower logistical costs. (10 marks)

(b) Define the following terms that are associated with product storage:

    (a) Bonding
    (b) Free trade zone
    (c) Warehouse receipt
    (d) In-transit storage
    (e) Stock spotting   (10 marks)

7. (a) Explain why:

    (a) Inventory costs increase as a higher level of customer service is provided.

    (b) Inventory costs increase as larger reorders an placed.

    (c) Ordering fewer times per year can lower annual out-of-stock costs. (10 marks)

(b) What is the distinction between acquisition and purchasing? Why is it important for logistics to make this contrast? (10 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE462

AGRICULTURAL MARKETING AND POLICY

TIME: THREE HOURS

ANSWER: FIVE QUESTIONS, QUESTIONS 1, 2 AND 3 ARE COMPULSORY

MARKS: AS GIVEN BELOW

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1. (a) A marketing chain could be described as a series
         of changes of ownership and economic processes by
         which products are transferred from the producer
         to the final consumer. Explain in detail the five
         alternative marketing chains. Also describe these
         chains in institutional and functional terms. (10 marks)

    (b) Explain what you understand by the following concepts:

         (i)   Market conduct

         (ii)   Performance

         (iii) Operational efficiency
         (iv)   Marketing efficiency   (10 marks)

2. (a) Discuss the most common problems associated with
         cooperatives enterprise in Zambia. How far do you
         think these can be overcome?   (15 marks)

    (b) Explain what you understand by the concept of
         derived demand. What is the practical use of this
         concept in economic analysis? Give an example of
         a product whose demand is derived.   (10 marks)

3. (a) Discuss the problems of developing and using grades
         in Zambia with specific reference to maize. (15 marks)

    (b) Explain the potential gains of uniform product
         grading for maize.   (10 marks)

4. Explain in detail the assumptions underlying the concept of pure competition market model and the price formation process leading to the market equilibrium price in this model. (15 marks)

5. What have been the positive and negative effects of the liberalization of maize marketing in Zambia? In your view do you think that the government still has a role to play in regulating producer prices? Why or why not? (15 marks)

6. Continued changes in the markets for and marketing of agricultural products have resulted in increased attention being given to the effects of these changes on pricing efficiency.

   (a) What is pricing efficiency?

   (b) What conditions are necessary to attain pricing efficiency?

   (c) Describe changes in marketing which have tended to improve pricing efficiency. (15 marks)

7. Explain the determinants of demand and supply of agricultural commodities and elaborate on the different reasons causing a shift of the demand and supply curves. (15 marks)

8. State and briefly describe the three approaches used in analyzing marketing problems.

9. Discuss the three categories of agricultural policy and explain the particular objectives and methods used by each.

10. (a) What components of marketing costs constitute marketing margin for maize in Zambia?

    (b) If the marketing margin is an absolute percentage mark up type, will the price elasticity of demand at retail always be greater or equal to the farm level. Describe the nature of the elasticity relationship with a constant percentage margin.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE552

AGRICULTURAL EXTENSION EDUCATION

TIME: THREE HOURS

ANSWER: SIX QUESTIONS.   QUESTION NUMBER ONE IS COMPULSORY.

TOTAL MARKS: 100

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1. As an agricultural extension expert at a District level
   in the Ministry of Agriculture, Food and Fisheries. You
   are to talk to field Extension Staff on the importance
   of extension programme planning.

   (a) With an aid of a diagram, briefly describe the steps of an
       extension programme plan.

   (b) List the advantages of having a programme plan.

   (c) Who plans extension programmes in Zambia and in
       your opinion who should determine the extension
       programme?

   (d) Outlined below are some of the steps in an extension
       programme. Explain reasons for each step.

       (i)   Programme planning

       (ii) Evaluation

       (iii) Assessment of the existing situation
                                                    (25 marks)

2.   "Research creates knowledge, extension
   transfers it to farmers and farmers utilize it."
   Critically discuss this statement in terms of a diffusion
   strategy.

3. What is meant by 'research-extension-farmer linkage' and in what ways can it be achieved? What is it's importance?

(15 marks)

4. What is meant by 'targetting?' Describe the process and explain which extension problem it helps to solve.

(15 marks)

5. Communication is the basic precondition of any extension method, Explain the principles and main influencing factors of the communication process, and emphasize the problems of inter-cultural communication.

(20 marks)

6. Define the concepts information and knowledge. Can you as an extension officer describe some "bottom-up" flows of information and why these are important for agricultural extension?

(10 marks)

7. Examine what visual and teaching aids are suitable for farmers in areas of low literacy, giving reasons for your choice.

8. Account for a range of visual and teaching aids which can be produced at low cost for use within an agricultural institution.

(15 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY SUPPLEMENTARY/DEFERRED EXAMINATIONS - JANUARY 1996

AGE 552

AGRICULTURAL EXTENSION EDUCATION

TIME: 3 HOURS   TOTAL MARKS: 100

ANSWER: SIX QUESTIONS. QUESTION NUMBER ONE IS COMPULSORY
----

1.   "Agricultural extension has not been very successful in
     bringing benefits to small-scale farmers". Critically discuss
     the statement with particular reference to the approach used
     by the Training and Visit System of extension.   (25 marks)

2.   What are the past characteristics of Extension that
     agricultural Sector Investment Programme (ASIP) makes a
     critique of? Briefly explain.   (15 marks)

3.   How do the decision-making and adoption process agree with
     and differ from each other?   (15 marks)

4.   What do you understand by the term "homophily" and
     "heterophily" and how can these concepts be applied to
     extension.   (15 marks)

5.   Discuss the fate of the Ministry of Agriculture, Food and
     Fisheries organisation in the light of your knowledge about
     participation and decentralization.   (15 marks)

6.   Extension without a sensible "offer" cannot work. Explain
     what this means to you, giving arguments why you agree or
     disagree.   (15 marks)

7.   Identify any three teaching visual aids and discuss the
     advantages and disadvantages of using each in any known
     local situation.   (15 marks)

8.   What are the ideal types of adopter categories according to
     research work and what is the use of these categories for
     extension?   (15 marks)

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS.

---

1. (a) Risk, rate of return, and repayment capacity are important in acquiring credit. Briefly discuss the effect of each term on the farmer's ability to borrow money.

    (b) Briefly discuss the major sources of capital for most farm operations.   (20 marks)

2. (a) How would you establish the economic profitability and financial feasibility of land purchase?

    (b) Many Zambians complain that it is difficult to acquire farm land. Briefly discuss the various ways of gaining access to land. Be sure to discuss the advantages and disadvantages.   (20 marks)

3. (a) What types of standards or values can be used to compare and evaluate efficiency measures for a farm? Discuss some advantages and disadvantages.

    (b) What is the purpose of enterprise analysis? (20 marks)

4. One of the key functions of management is control.

    (a) Briefly discuss the key elements of the control process on the farm.

    (b) Briefly discuss the relationship between information and data

    (c) Briefly describe the components of a management information system.   (20 marks)

THE UNIVERSITY OF ZAMBIA

UNIVERSITY SUPPLEMENTARY/DEFERRED EXAMINATIONS - JANUARY 1996

AGE 562

INTERMEDIATE FARM MANAGEMENT

TIME: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS

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1.   a)   What are the advantages of owning land compared to
          renting land?   (5 marks)

     b)   Many people argue that the value of land should be
          based on the income earning profile of land. How
          much could you pay for the land if the estimated net
          return per hectare is K70,000 per year, and you want
          a 30 percent return on investment?   (5 marks)

     c)   List three advantages and disadvantages of each lease
          type.   (10 marks)

     d)   Why is a cashflow analysis important.

2.   a)   Assume you are about to begin farming and need capital.
          What information and material would you need to
          provide a lender to improve your chances of getting a
          loan? Explain the relevance of information and
          material.   (10 marks)

     b)   What is the difference between short term, intermediate
          term, and long term loans? List the type of assets
          which might be collateral for each.   (15 marks)

3.   a)   Briefly discuss the functions of human resource
          management.   (5 marks)

     b)   Briefly discuss the sources of farm employee
          satisfaction.   (10 marks)

     c)   What factors would you consider in establishing the
          conditions of service for farm employees. (10 marks)

4. a) Choice of machinery is a difficult decision. Very
        often the benefits of owning machinery are not easy
        to identify and value. However, the costs of machinery
        are easy to determine. Briefly outline how you would
        identify the right machinery among competing models.
                                                (10 marks)

    b) Write brief notes on the advantages and disadvantages
        of the various depreciation methods.   (15 marks)

                    END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGE572

ADVANCED AGRICULTURAL POLICY

TIME: THREE HOURS

INSTRUCTIONS: ALL STUDENTS SHOULD ANSWER QUESTION 1 AND 7 AND ANY
THREE QUESTIONS FROM 2-6

1.   (a)   What is Zambia's agricultural policy?

     (b)   What are Zambia's agricultural policy objectives?

     (c)   What are Zambia's agricultural policy instruments/
           strategies?

     (d)   Why is it important to monitor, evaluate and review
           policy objectives and instruments on a periodic and
           on-going basis?

2.   "Structural Adjustment Programmes and Agricultural
     Development via the Small Scale Sub-sector." Is there
     a conflict? Discuss using the Zambian Case.

3.   Cheap food policies may produce effects detrimental to
     sustainable agricultural development. Use the Zambian
     example to illustrate the circumstances under which
     and the mechanism through which this may occur.

4.   Write brief notes on each of the following:-

     (a)   Comparative advantage (both domestic and international);

     (b)   Allocative efficiency in agricultural production;

     (c)   Technical efficiency in agricultural production; and

     (d)   Barter and Income Terms of Trade.

5.   To what extent is the quality of the Zambian agricultural
     extension service a reflection of the quality of agricul-
     tural research in Zambia?

6. Give three detailed examples to illustrate how macro-economic policies may adversely affect the achievement of well intended agricultural sector specific objectives.

7. Environmental concerns are increasingly becoming a vital component of the sustainable agricultural development process. Despite these concerns, instances where agricultural sector specific policies, objectives and strategies run counter to environmental policies and objectives, are not uncommon.

   Using examples, illustrate how agricultural sector specific policies, objectives and strategies in Zambia may have been or may be in conflict with environmental policies and objectives.

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: QUESTION NUMBER 1 AND ANY OTHER THREE. ALL QUESTIONS CARRY POINTS INDICATED.

Q1. In order to deal with the two sources of variation in the investigation a Latin square design was used. Data obtained from a wheat yield trial are given below in kg/ha.

		Column			
		1	2	3	4
	1	C = 10.5	D = 7.7	B = 12.0	A = 13.2
	2	B = 11.1	A = 12.0	C = 10.3	D = 7.5
Row	3	D = 5.8	C = 12.2	A = 11.2	B = 13.7
	4	A = 11.6	B = 12.3	D = 5.9	C = 12.2

Complete the analysis of variance and interpret the results. (40 points)

Q2. Define the following

(a) An experiment

(b) Mode

(c) Mean

(d) Replication

(e) Correction factor

(f) Union

(g) Intersect

(h) Hypothesis

(i) Regression

(j) Standard error

(20 points)

Q3. (a) From a deck of playing cards with 26 red and 26 black cards consisting of 13 spades (black), 13 diamond (Red), 13 hearts (red) 13 clubs (black).

What is the probability of drawing a spade? And what is the probability of drawing a diamond?

(b) An experiment consists of drawing one marble from a box that contains a mixture of red, yellow and green marbles. List the sample space and comment on whether one can be sure that this is an equally likely sample space.

(c) Define probability and explain why we need to know about it.

(20 points)

Q4. Given the following as plant heights of three cultivar in cm.

Cultivar A			Cultivar B			Cultivar C		
R_1	R_2	R_3	R_1	R_2	R_3	R_1	R_2	R_3
27.3	25.5	26.7	17.3	11.0	17.6	8.8	9.0	8.2
27.2	27.5	27.6	11.7	15.6	11.1	9.0	9.2	9.4
26.0	27.0	28.0	10.0	13.5	12.2	8.7	5.0	8.0

Analyze the data as RCDB

(20 points)

Q5. In a study to determine the effect of stirring rate on the amount of impurity in drinking water the following data were obtained.

Stiring rate (rpm)	20	22	24	26	28	30	32	34
Impurity (%)	8.4	9.5	11.8	10.4	13.3	14.8	13.2	14.7

Is there any effect? Describe it if any? (20 points)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - OCTOBER/NOVEMBER 1995

AGS 210

FUNDAMENTALS OF SOIL SCIENCE

TIME: THREE HOURS

ANSWER: ALL QUESTIONS   TEN POINTS EACH
- -

1.   Define Cation Exchange Capacity (CEC) and briefly discuss
      its importance in soil fertility.

2.   List five elements which are essential for plant growth
      and indicate the effect of soil pH on their availability.

3.   Explain each of the following terms:

      a.   Metamorphism
      b.   A mineral
      c.   Crystal lattice
      d.   Silicate clays
      e.   Cleavage

4.   Explain or draw the rock cycle of igneous, sedimentary
      and metamorphic rocks.

5.   (a)   What are the two steps followed in particle size
            analysis by mechanical method?

      (b)   Why is it necessary to measure temperature in
            particle size analysis?

6.   Briefly define each of the following terms:

      a.   Soil consistency
      b.   Soil plasticity
      c.   Convective flow
      d.   Diffusive flow
      e.   Soil air capacity

7.   Soil wetness can be expressed on wet mass base, dry mass
      base and volume base.

      a.   Define soil wetness on wet and dry mass basis

      b.   Given a sample of 120g wet soil containing 80g of soil
            particles and 15g of water. Calculate the moisture
            content expressed on wet mass base and dry mass base.

1

8. a. Define soil air porosity.

    b. Of what importance is it to plant growth.

    c. What is the difference in soil air near the soil
        surface and in the root zone?

9. a. What is capillarity?

    b. What would happen to capillary flow from bottom to
        the top when a coarse textured soil overlays a fine
        textured soil?

10. Give the optimum percentages of soil solid, liquid and gas.
    What happens upon compaction?

                    END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY MID-YEAR EXAMINATIONS - JUNE 1995

AGS 421

SOIL FERTILITY

TIME: THREE HOURS

ANSWER: ALL QUESTIONS
----

1. a) Why are fertilizers applied to soils?   (2)

    b) Why is soil pH important in nutrient availability
        considerations? Give examples.   (2)

    c) What is potential acidity and active acidity? (2)

2. a) List all the essential elements.   (4)

    b) Give the criteria for essential nutrients. (6)

3. a) Why is elemental S acidifying? Give equation. (2)

    b) Give the historical basis for the present S
        recommendations in Zambia.   (2)

4. a) Define macronutrient.   (2)

    b) Why are nutrient ratios important in soil fertility
        evaluations?   (2)

5. a) What is nitrification? Describe the steps involved.
                                                    (6)

    b) What are the factors affecting nitrification? (2)

    c) What are the effects of N fertilizers on soil
        pH? Explain.   (2)

6. a) Define sodic soils. (3)

    b) What is the effect of sodicity on soil properties?
                                                    (3)

    c) What is SAR and ESP? Explain.   (2)

7. Give five (5) reasons why organic matter is very important
    in soil fertility maintenance.   (10)

1

8. Define and briefly explain the following:

    a) Quantity factor   (2)
    b) Cation exchange process   (2)
    c) Denitrification   (2)
    d) Adsorption isotherm   (2)

_____
                        END OF EXAMINATION

TIME: 3 HOURS

ANSWER ALL QUESTIONS

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1.   Diagramatically illustrate the flow of biochemical energy
     in nature and explain the role played by microorganisms
     in this process.   (10 marks)

2.   Describe the common characteristics of soil nutrient cycles
     and highlight the significance of each characteristic.   (10 marks)

3.   What are the components of the three main soil organic
     carbon pools. Which of these pools normally exists in
     low concentration. Explain why.   (20 marks)

4.   Provide three reasons that explain why measurement of
     CO_2 evolution is not always a reliable indicator of organic
     matter decomposition.   (15 marks)

5.   What are the different types of nitrogen fixing
     microorganisms in soil?   (15 marks)

6.   Describe the microbial activities which enhance availability
     of phosphate in the rhizosphere. How can this influence be
     demonstrated experimentally?   (15 marks)

7.   Some soil environmental conditions can in principle
     promote accumulation of ammonium. Identify these
     conditions.   (15 marks)

END OF EXAMINATION

UNIVERSITY SUPPLEMENTARY/DEFERRED EXAMINATIONS - JANUARY 1996

AGS 422

SOIL MICROBIOLOGY

TIME: THREE HOURS

ANSWER: ALL QUESTIONS

1. Which organic substrates constitute the soluble fraction of soil organic carbon and how do these compounds enter the soil?   (10 marks)

2. Describe the different ways by which mineralized nutrients can be made unavailable for uptake by plants. (15 marks)

3. What plant factors affect the decomposition rate of plant residues. Which mathematical expression defines the relationship between rate of decomposition and these plant factors.   (10 marks)

4. What is the significance of the following formula and what important information is derived from it?   (15 marks)

$$C = C_i \left[1 + Y/(100 - Y)\right]$$

5. By the aid of a diagram, show the oxidative and reductive reactions in the transformation of inorganic nitrogen in soil.

    What is the difference between dissimilatory reduction of inorganic nitrogen and nitrification.   (15 marks)

6. What are the major differences between nitrification and sulfur oxidation with regard to the microorganisms involved?   (10 marks)

7. Describe how you can demonstrate that the root rhizosphere accommodates microorganisms that are capable of solubilizing inorganic phosphorus sources. (15 marks)

8. What can you do to prove that a microbial isolate belongs to the genus 'Rhizobium'?   (10 marks)

END OF EXAMINATION

TIME: 3 HOURS

ANSWER: ALL QUESTIONS (CALCULATORS ARE ALLOWED)

---

1.   Define the following terms   (20 marks)
  - (a) Diffusivity
  - (b) Hysteresis
  - (c) Tensiometer response time
  - (d) Surface tension
  - (c) Soil water characteristic curve
  - (f) Soil structural type
  - (g) Hydraulic conductivity
  - (h) Soil water capacity
  - (i) Aeration porosity
  - (h) Adhesive forces

2.   What is the significance of soil structural and texture in soil and water management in agriculture.   (10 marks)

3.   Given that the depth of air and water is 1.80cm and 2.60cm respectively in a cubic soil sample with a volume of $1000cm^3$. Assume particle density of $2.65g/cm^3$.
Determine: (10 marks)

  - (a) Relative saturation (%)
  - (b) Porosity (%)
  - (c) Bulk density (kg/m^3)
  - (d) Weight of dry soil (g)
  - (e) Weight of wet soil (g)

4. (a) Give <u>two</u> advantages and <u>two</u> disadvantages of the following methods of measuring soil water content:

    (i) Gamma attenuation

    (ii) Gravimetric

    (b) What are the <u>water</u> and <u>soil</u> parameters that influence the neutron probe response during soil water content measurement.

    (c) Describe the field method of calibrating the neutron probe.

    (15 marks)

5. A farmer in Chama South, Eastern Zambia, has a paddy rice field of 1.5 hactare. This field has an upper soil layer of 0.4m underlyed by a soil layer of 0.8 m. The saturated hydraulic conductivity of the lower layer is 4 times that of the upper layer. Given that the discharge at the bottom of the lower layer is 2.5 cm^3. min^{-1} in a cross sectional area of 50cm^2 when a water height of 0.1m is maintained on the soil surface. Assuming that the rice crop is at tillering stage: (20 marks)

    (a) Make a schematic drawing of the system and a potential diagram.

    (b) Calculate the flux density (mm/day) passing through the lower layer.

    (c) Calculate the hydraulic conductivity (mm/day) for the two layers.

    (d) Calculate the daily water supply required to maintain a constant water depth at the soil surface for this rice field in terms of height (mm) and volume (m^3).

6. Golden Valley Research Trust Farm is located approximately 150km north of Lusaka. As part of soil fertility research conducted on the farm, a water use trial on three maize varieties (mmv 600, mm 504 and mm 502) was carried out during the 1993/94 season. In one of the mmv 600 replicates, the following data was obtained at grain filling stage using the Neutron Probe Meter and Tensiometers.   (25 marks)

Depth	11/6/94		15/6/95	
	h	θ_v	h	θ_v
(cm)	(cm)	(%)	(cm)	(%)
10	-765.8	6.2	-754.4	5.4
20	-525.9	4.6	-556.6	3.2
30	-285.9	13.5	-358.8	11.1
40	-226.8	14.5	-273.9	12.3
50	-167.6	16.1	-189.0	14.7
60	-156.4	14.4	-169.0	13.7
70	-145.1	15.2	-148.9	13.8
80	-133.8	20.7	-138.3	21.2
90	-122.5	23.4	-127.6	23.2
100	-128.3	19.8	-130.8	20.4
110	-134.0	15.1	-134.0	14.4

$$K_{(\theta)} = 4.49 * 10^{-12} * e^{107-6 \theta_v} \quad (mm/day)$$

If the rainfall during this period was 3.1 mm, negligible run off was observed and the root zone was at 92 cm.

(a) Determine the evapotranspiration of the crop (mm/day) during this period.

(b) How much amount of water was used up in a one hactare field of maize.

(c) If the potential evapotranspiration of the crop was 50mm and 60mm in the first decade and second decade of June respectively, estimate the crop coefficient during the soil water measurement period.

END OF EXAMINATION

TIME: THREE HOURS

ANSWER: ALL QUESTIONS   TEN POINTS EACH
----

1.   a.   What is the difference between active and reserve
          acidity?

     b.   How is each portion measured and what are the potential
          problems with these procedures?

     c.   How does each portion affect or influence the lime
          requirements of soils?

     d.   What is acidity?

2.   Given a stock solution which is 2.5$\underline{N}$ HCl, how would
     you prepare a 0.01$\underline{N}$ solution?

3.   How much lime ($CaCO_3$) is required to neutralise 60% of the
     aluminium in a soil which is 35% aluminium saturated?

4.   In order to determine the calcium content of a lime sample,
     0.5g material was weighed, digested and diluted to 100 ml.
     Out of this, 10 ml solution was removed and diluted to
     200 ml mark in a volumetric flask. Upon reading this sample
     on the AAS, a reading of 300 mg/L was obtained. Calculate
     and express the calcium contained in the lime sample on
     a percent basis.

5.   Explain the differences between the SLAN (sufficiency level
     of available nutrients) and the BCSR (basic cation
     saturation ratio) approaches to making fertilizer
     recommendations. What are the relative merits of each
     method?

6.   Soil and plant analyses provide us with data. On what basis
     are we able to interprete the data and make recommendations?

7.   Discuss and differentiate between the plant deficiency
     symptoms of N, K and Mg.

1

8. Select the best answer:

(i)   Most of the analyses of an agricultural soil
        testing lab are measurements of the physical
        properties of the soil.

        (a) True
        (b) False

(ii)   The portion of a nutrient present in the soil
        solution is most appropriately referred to as

        (a) capacity factor
        (b) intensity factor
        (c) reserve factor
        (d) latent factor

(iii)   Soil test correlation

        (a) seeks to find the amount of fertilizer
             required at various soil test levels

        (b) must always be done in the field

        (c) examines how the amount of nutrient extracted
             is related to crop growth

        (d) a and b

(iv)   Rating a soil test as low, medium or high is best
        described as

        (a) calibration
        (b) interpretation
        (c) correlation
        (d) extraction

(v)   We are concerned about acid soils because they
        may contain harmful concentrations of

        (a) Al
        (b) Mg
        (c) H
        (d) a and c
        (e) all the above

2

9. Given the following soil test results, indicate your
    interpretations and where you would make fertilizer
    recommendations for maize.

Element	Test Level	Interpretation	Recommendation (Y or N)
N	0.2%		
P	30 ppm		
K	90 ppm		
Ca	100 ppm		
Mg	40 ppm		
S	10 ppm		
Mn	20 ppm		
Zn	4 ppm		
Fe	10 ppm		
Cu	5 ppm		
B	0.2 ppm		

10. In the Kjeldahl procedure for total N, NaOH is added to the
    digest during distillation. What is its purpose?

                        END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS – OCTOBER/NOVEMBER 1995

EA 400

ENERGY SOURCES AND UTILISATION IN AGRICULTURE

TIME: THREE HOURS
MARKS: 100   ANSWER: FIVE QUESTIONS ONLY

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1. What role does air play in a fuel system? Why is it necessary to supply clean air? Name two common types of air cleaner. With the help of a neat schematic diagram, explain the working of a oil bath type air cleaner.

   [20 marks]

2. A Massey Ferguson 1035 tractor has a three cylinder four-stroke cycle internal combustion engine with the following dimensions: cylinder diameter 240 mm, stroke-bore ratio 1.5, clearance volume 4200 cc, engine speed 230 rpm.

   Calculate:

   a) compression ratio,   (3.5)
   b) swept volume,   (3.5)
   c) piston displacement,   (2.0)
   d) displacement volume,   (3.5)
   e) piston speed.   (3.5)

   Is the engine a diesel or otto cycle engine? Which can produce more power – a two cycle or four cycle engine of the same size?   (2+2)

   [20 marks]

3a) How does a solar collector differ from a conventional heat exchanger?

   [5 marks]

 b) Calculate the angle of incidence of beam radiation at 14:00 solar time on January 20 at latitude 35°N on a surface at slope of 40°, but facing 25° west of south given the formula:

$$\cos \theta = \sin \delta \, \sin \varnothing \, \cos s - \sin \delta \, \cos \varnothing \, \sin s \, \cos \gamma$$
$$+ \cos \delta \, \cos \varnothing \, \cos s \, \cos w$$
$$+ \cos \delta \, \sin \varnothing \, \sin s \, \cos \gamma \, \cos w$$
$$+ \cos \delta \, \sin s \, \sin \gamma \, \sin w$$

where

θ = angle of incidence of beam radiation
δ = declination
ϕ = latitude
s = slope
T = surface azimuth angle
w = hour angle.

[15 marks]

4a) What are the factors that limit the pulling performance of a tractor?

[5 marks]

b) A four-wheel-drive tractor with a total weight of 125.6 kN is pulling a level drawbar load of 55.4 kN on a concrete track. The actual travel speed is 11.04 km/h, and the no-load travel speed is 11.40 km/h. The axle power is 185.5 kW. Calculate:

[15 marks]

i) travel reduction,
ii) dynamic traction ratio, and
iii) tractive efficiency.

5a) What is percent theoretical air and percent excess air?

[5 marks]

b) An unknown hydrocarbon fuel is burned with air and a volumetric analysis of the combustion products yields the following percent composition on a dry basis.

CO_2 10.5%
O_2 5.3
N_2 84.2

Determine the composition of the fuel on a mass basis and the per cent of theoretical air used in the combustion process.

[15 marks]

6a) Write short notes on;   [12 marks]

i) Muscle metabolism
ii) Technical criteria for harness design
iii) Load center.

b) Answer the following   [8 marks]

    i)   What is digestion? What are the factors that affect the bacterial activities in a digester?

    ii)   List the farm operations for which wind power can be used. What are the advantages of wind power?

END OF EXAMINATION

TIME: 3 HOURS

ANSWER: FIVE (5) QUESTIONS

---

1.   (a)   Briefly explain what Equilibrium Moisture Content is, (4 mark

     (b)   Ambient air at 25°C and 70% RH is heated to 45°C and
           and 24% RH. Then upon passing through wet grain, it
           gains enough moisture to again reach 70% RH while the
           temperature drops to 30.1°C. How many kgs of moisture
           does each kg of air remove from the grain?   (4 marks)

     (c)   If one and a half tonnes of maize at 20% moisture
           is dried to 12.5% moisture content, what is the
           weight of the dried grain?   (4 marks)

     (d)   Briefly describe the two principle groups into which
           drying systems fall.   (4 marks)

     (e)   Briefly explain three measures that can be taken to
           reduce grain losses in storage.   (4 marks)

2.   (a)   In convective drying equipment, what are the two
           functions of the drying medium?   (2 marks)

     (b)   Briefly describe the stages of drying that a wet solid
           undergoes when it is being dried in a current of
           heated air.   (6 marks)

(c) A wet solid consisting of an inert granular material, wetted with pure water, is being dried in a current of heated air so that the air temperature and humidity remain constant at 344°k and 0.02kg/kg dry air respectively. The material has effective drying area of $0.06m^2$/kg dry solids, and the following characteristics:-

Initial moisture content............ 1.0kg/kg dry solids

Critical moisture content .... 0.5kg/kg dry solids

Equilibrium moisture content...... 0.03 kg/kg dry solids

The rate of drying during the constant rate period is 5 kg/m^2h. Assuming that no shrinkage takes place and that water movement within the solid is controlled by capillary flow, calculate:-

(i) The coefficient of mass transfer at the surface during the constant rate period.

(ii) The coefficient of heat transfer at the surface during the constant rate period.

(iii) The duration of the constant rate period. (12 marks)

3. (a) Briefly explain the operation of a spiral separator (5 marks)

(b) Briefly describe the wet cleaning method of soaking. (5 marks)

(c) Give one application of centrifugal separation in the food industry other than for cream separation and briefly explain how the principle is used in the application. (5 marks)

(d) Water, contaminated with cooking oil, is contained in a tin up to its capacity. The tin with a base of 150^2cm has to be left standing for 48 hours for the cooking oil to rise to the top. The average diameter of a cooking oil particle is 5 microns and has density 900 kg/m^3. The water weighs 1000 kg/m^3 and has viscosity 1.4×10^{-3} Ns/m^2. Determine the volume of the tin in litres. (5 marks)

4. (a) What are the reasons for size reduction of food materials?   (5 marks)

    (b) Briefly describe with the aid of a sketch how crushing rolls work.   (5 marks)

    (c) In the production of maize meal, maize grains of size 4.8mm in diameter are passed through a pair of crushing rolls. The requirement is for a finished product of average size 0.5mm is diameter. Calculate the theoretical diameter of the rolls. Also determine the energy required for a size reduction of 1,000 bags of maize (1 bag weighs 90 kg). Take coefficient of friction between the maize grain and the roll, m=0.3, and kick's constant, k=3.71 hp-hr/ton.   (10 marks)

5. (a) Describe with the aid of sketches, the operation of three types of heat exchangers.   (5 marks)

    (b) In a pasteurisation operation, fresh milk is heated by a counter-current heat exchange in a pipe heat exchanger. The hot fluid enters the heat exchanger at 146°C and leaves at 107°C. The flowrate of the milk is 3.0kg/s and it is to be heated from 21°C to 73°C. Calculate the required length of the heat transfer pipe if its internal diameter is 1.85 cm. The specific heat of milk is 3890 J/kg °C and the overall heat transfer coefficient value may be taken as 850 W/m²°C.   (15 marks)

6. (a) Write short notes on the following solids mixing equipment, you may use sketches.

        (i)   Horizontal trough mixers
        (ii) Vertical screw mixers   (10 marks)

(b) A liquid having viscosity 2.5×10^{-2} kg/ms and density 1.2×10 kg/m is agitated in a baffled tank (vortexing minimised). The imeller used has a diameter of 40cm and rotates at 360 rpm. The relationship between the power number Np, and Reynolds number NRe for the impeller used is given by

NRe	10	10^2	10^3	10^4	10^5	10^6
Np	4.0	1.0	0.4	0.27	0.22	0.22

Calculate the theoretical power requirement for this operation. (10 marks)

7. (a) Write short notes on the following expression equipment, you may use sketches.

   (i) Roller press
   (ii) Screw press (8 marks)

(b) Oil seeds containing 20% by weight of oil are being extracted in a multistage counte-current system. Fresh solvent is used initially and the final solution contains 50% of oil. The spent cake must not contain more than 5% of oil. A constant underflow of 0.5 kg of solution per kg of solid leaves each stage. Calculate the number of ideal stages required. (12 marks)
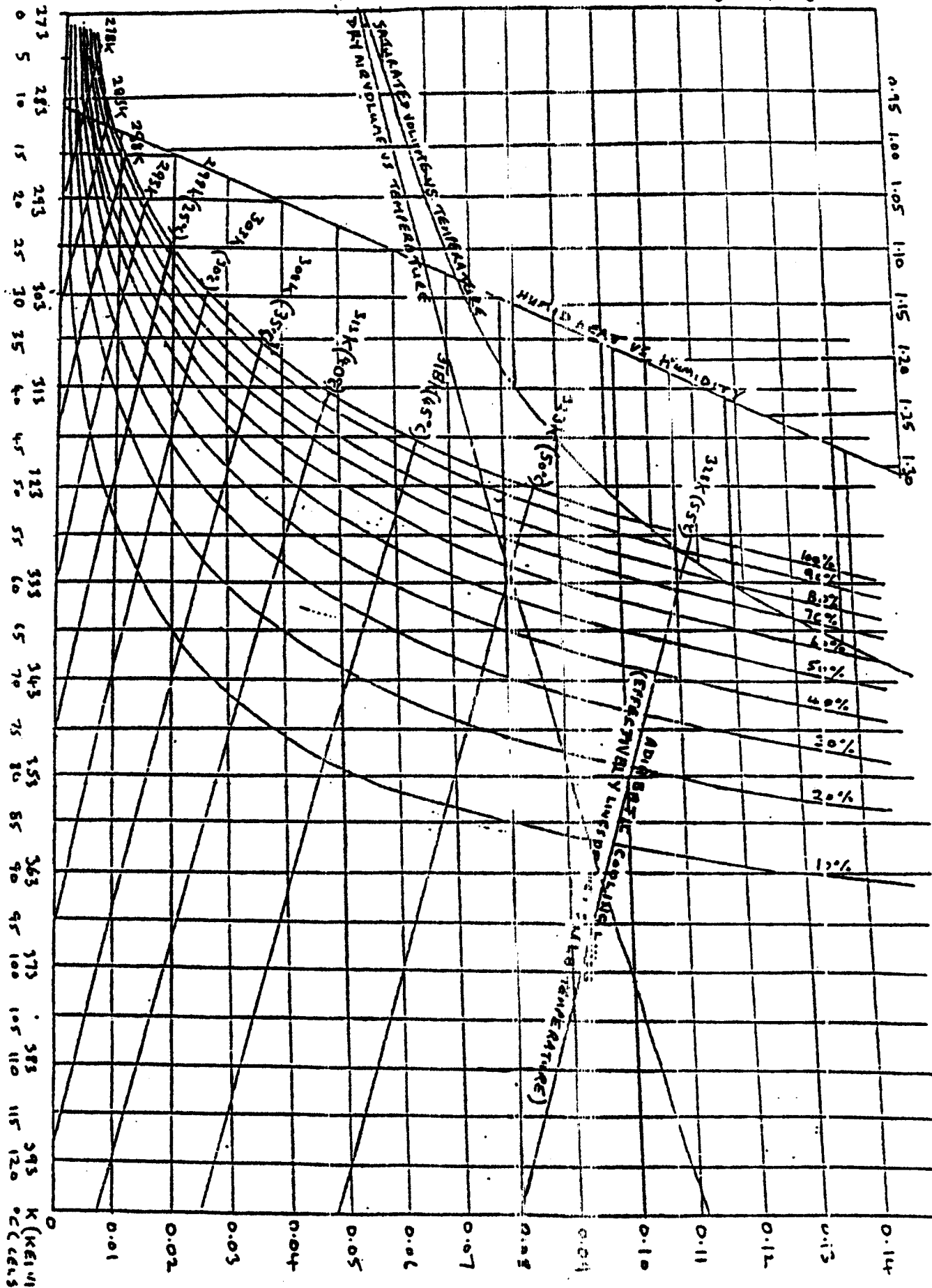

END OF EXAMINATION

STEAM TABLE   SATURATED STEAM

(Temperature Table)

Temperature (°C)	Pressure (kPa)	Enthalpy (sat. vap.) (kJ kg⁻¹)	Latent heat (kJ kg⁻¹)	Specific volume (m³ kg⁻¹)
0	0.611	2501	2501	206
1	0.66	2503	2499	193
2	0.71	2505	2497	180
4	0.81	2509	2492	157
6	0.93	2512	2487	138
8	1.07	2516	2483	121
10	1.23	2520	2478	106
12	1.40	2523	2473	93.8
14	1.60	2527	2468	82.8
16	1.82	2531	2464	73.3
18	2.06	2534	2459	65.0
20	2.34	2538	2454	57.8
22	2.65	2542	2449	51.4
24	2.99	2545	2445	45.9
26	3.36	2549	2440	40.0
28	3.78	2553	2435	36.7
30	4.25	2556	2431	32.9
40	7.38	2574	2407	19.5
50	12.3	2592	2383	12.0
60	19.9	2610	2359	7.67
70	31.2	2627	2334	5.04
80	47.4	2644	2309	3.41
90	70.1	2660	2283	2.36
100	101.35	2676	2257	1.673
105	120.8	2684	2244	1.42
110	143.3	2692	2230	1.21
115	169.1	2699	2217	1.04
120	198.5	2706	2203	0.892
125	232.1	2714	2189	0.771

SPECIFIC VOLUME m³/Kg

DRY BULB TEMPERATURE

ABSOLUTE HUMIDITY (kg w.v. per kg dry air)

TIME ALLOWED : 3HOURS

ANSWER : ANY FIVE(5) QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS

_____

1. (a) What is the difference between a hydraulic and non-hydraulic
       cement. (2)
   (b) What are the functions of admixtures with respect to
       concrete. (8)
   (c) Mention the different types of portland cement and describe
       the difference between rapid hardening portland cement and
       low heat portland cements. When is each required to be used
       in concrete work. (10)

2. (a) Draw the shear force and bending moment diagrams for the
       beam shown in the figure below. (15)
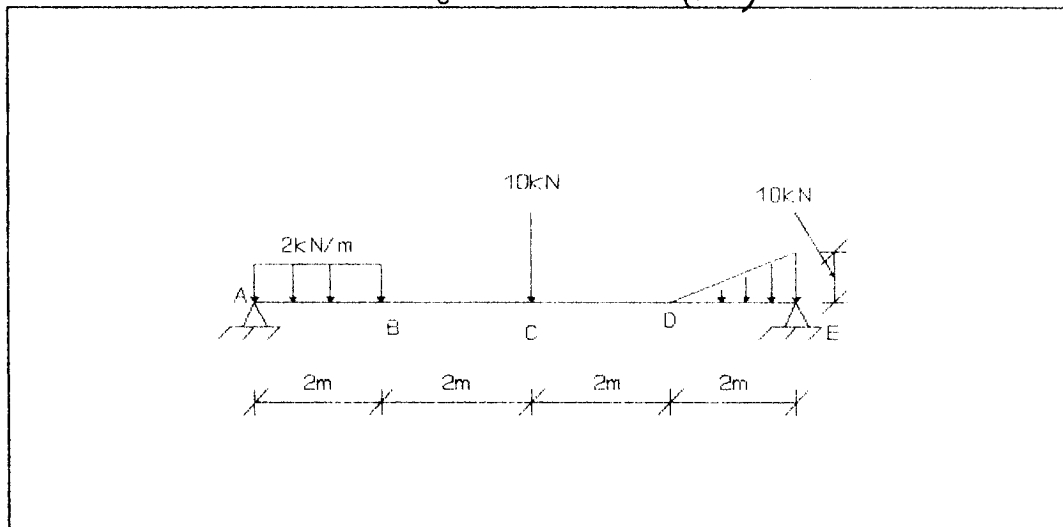
   (b) What is the difference between the planar and the linear
       structural building systems (5)

3. (a) Find the deflection of the beam shown below at point C.
Assume that $EI = 200\,000\,kNm^2$. (12)
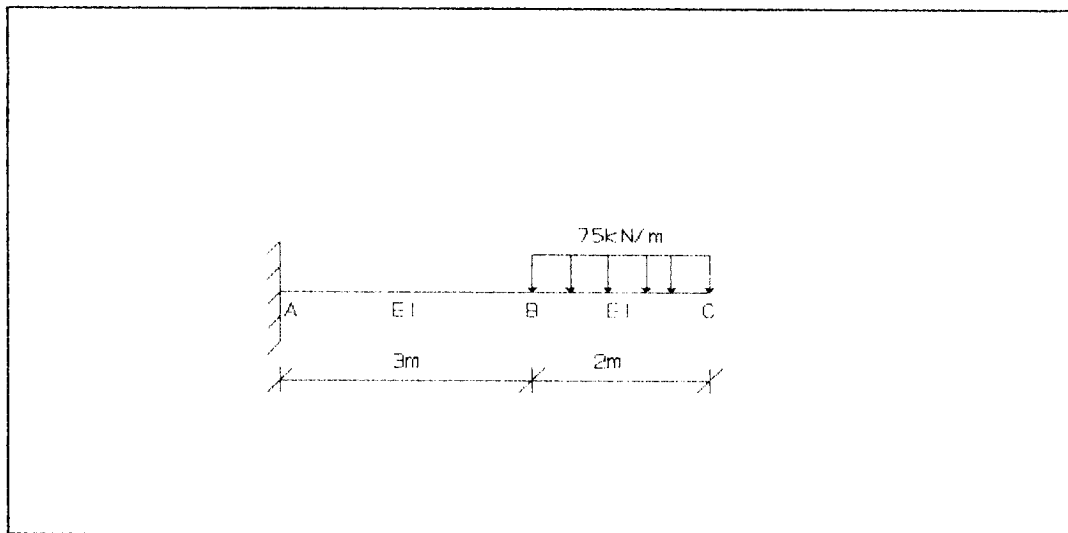
(b) Describe the different types of buiding loads. (8)

4. (a) What climatic factors affect farm building design and
orientation. Discuss their effects. (12)
(b) The comfort zone for a building in Lusaka (16°S) is between
15°C and 30°C. The building is oriented in the NW-SE
direction. What are the shadow angles necessary to design
the shading devices which will protect the building from the
'overheated period' as shown on the provided solar chart. (8)

5. (a) Define the following terms giving appropriate units where
necessary.
(i)   Relative humidity
(ii)   Wet-bulb temperature
(iii) Dew-point temperature
(iv)   Enthalpy   (8)
(b) Calculate the total heat transferred across four walls of a
room with the following specifications :
- 5x5m floor and 2.5m high with flat roof
- One wall is shared with a room which has heating and
internal temperature of 33°C.
- the other three walls are exposed to the external air with
temperature of 12°C.
- the internal temperature in the room is to be maintained
at 22°C.   (12)

The room has a door on one of the walls open to the outside and
another on the wall joining the other room of area $1.6m^2$ and
$U = 2.4W/m^2.K$. The room has a window of area $7.5m^2$ and
$U = 4.48W/m^2.K$. The wall has a $U = 1.35W/m^2.K$. Neglect heat
transferred on the roof and the floor.

6. (a) Briefly explain what is meant by 'zoning' in farmstead planning. *(4)*
   (b) List the factors which affect farmstead planning. *(6)*
   (c) A farmer needs a plan of a well zoned farmstead with the following areas and operations :-

   (i)   Dwelling house
   (ii)   Tractor sheds
   (iii) Dairy unit and poultry unit
   (iv)   Grain silos and feed processing center
   (v)   Offices, carpark and access to all centers and units
   (vi)   Refuse and muck collection center   *(10)*

   Draw a neat sketch indicating the appropriate position of each area and operation and the position of the main road and access to the farm. Show the prevailing wind direction and possible location of wind breaks.

7. (a) Describe the rotary method of drilling boreholes. What are the advantages and disadvantages of this method. *(5)*
   (b) Mention and describe the factors that influence selection of a water source. *(10)*
   (c) What are the functions of a storage reservoir in a pumped water distribution system. Make a labelled sketch of such a system showing all the components from the water source to consumer connections. *(5)*

LATITUDE 16° SOUTH

LATITUDE 16° NORTH

21

THE UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS - NOVEMBER, 1995

EA 543: IRRIGATION ENGINEERING

TIME: THREE HOURS

INSTRUCTIONS: ATTEMPT FIVE (5) QUESTIONS ONLY
                ALL QUESTIONS CARRY EQUAL MARKS.
==

QUESTION 1

(a)   A basin 20 m wide is constructed on sloping ground and the
      land is not levelled. The irrigation depth required to fill
      the soil reservoir is 90 mm. To apply 90 mm of water at the
      upper end, 160 mm must be applied at the lower end.

      i)   What irrigation depth must actually be applied?
      ii)   How much water will be lost?
      iii) What is the irrigation efficiency?
                                              [3 marks]

(b)   A 24-ha field of potatoes is to be irrigated by the furrow
      method.   The runs are 300 m long, the average slope is 0.75%
      and the rows are spaced 80 cm apart.   The water application
      efficiency is 60%. The effective root zone is 90 cm deep.
      The available moisture holding capacity is 17 cm/m depth.
      The field is to be irrigated when 45% of the available
      moisture capacity is depleted.

      i)   What flow rate is required if the field is to be
            irrigated in 13 days?
      ii)   If the maximum non-erosive furrow stream is used, how
            many hours should you leave the water running to a
            'set' in order to apply the specified depth of water?
      iii) How many furrow rows can be irrigated in a set?
                                              [12 marks]

(c)   In the furrow irrigated field above, the irrigator plans to
      use 3 cm diameter plastic siphon tubes.   What head (i.e.
      water surface elevation in the ditch to water surface
      elevation on the field) would be needed? Assume C = 0.65.
      One siphon is used per row.
                                              [5 marks]

QUESTION 2

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

i) Mass basis moisture contents (%)	A horizon	B horizon
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

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

[3 marks]

(b) Plot the resultant moisture content of the profile if 18.29 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.

[9 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 Evapotranspiration (ET) rate is 6.21 mm/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?

(e) If a rainfall of 15 mm 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 of the A horizon is at 25% of capacity.

[3 marks]

QESTION 3

(a) Write a note (about 100 words) on the nature and effect of cavitation).

[5 marks]

(b) Water is being pumped from a reservoir into a 25 cm diameter pipe and conveyed to a sprinkler irrigation system. A pressure gauge located immediately downstream of the pump reads 600 kPa. The water surface of the reservoir is 2.5 m below the centre line of the pump. The system design capacity is 4000 L/min. The total friction loss in the suction line and fittings is 1.68 m. Determine the brake power requirement of the pump if it is 69% efficient.

[8 marks]

(c) The pump above is operating at an elevation of 1540 m where the water temperature is 30°C. From the pump characteristic curves a discharge of 4000 L/min corresponds to a required net positive suction head (NPSHr) of 2.94 m. Check for cavitation by computing the available net positive suction head (NPSHa). The drawdown is negligible in a very large reservoir.

[7 marks]

QUESTION 4

(a) Illustrate with the aid of a schematic sketch the four main components of a sprinkler irrigation system.

[2 marks]

(b) A 12 cm diameter aluminium sprinkler lateral has 35 equally spaced 40 L/min sprinklers. The spacing between sprinklers is 12.2 m. The first sprinkler is 6.1 m downstream of the main line. The pressure at the upstream end of the lateral (at main line) is 620 kPa. Determine the pressure at the downstream end of the lateral if the lateral is laid on a field with a constant upward 1.5 per cent slope. Use F = 0.350.

[9 marks]

(c) In order to evaluate the irrigation system performance, an irrigator used catch cans located in a square grid throughout the field. The data in the table are the depths of catch (in mm) at 25 observation points. Check if the sprinkler system performance is satisfactory by evaluating the uniformity coefficient.

31	30	35	34	37
38	39	33	27	35
35	26	28	39	32
32	37	30	31	43
27	33	40	29	36

[9 marks]

QUESTION 5

(a) Prove the following statements:

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

[3 marks]

   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".

[3 marks]

(b) Consider a farm irrigation ditch having the following dimensions: bottom width, 0.94 m; side slopes of 1.5 horizontal to 1 vertical; depth of water, 0.40 m. If the bottom of the ditch has a uniform slope of 1 metre per kilometre, and if the bottom and sides are kept smooth and free from weeds, what will be the discharge capacity of the channel? Use n = 0.020.

[9 marks]

(c) If a Cipolletti weir with a crest width of 94 cm is used to measure the flow in the irrigation ditch above, compute the expected head on the weir.

[5 marks]

QUESTION 6

(a) An auger hole 15 cm in diameter is bored in the soil to a depth of 190 cm below the water table. After the hole has been pumped out several times and allowed to refill, it is pumped out again and the rate of rise of the water at an elevation of 101.60 cm below the water table is observed to be 1.91 cm in one minute. What is the hydraulic conductivity of the soil (in metres per day)?

[6 marks]

(b) For the drainage of an irrigated area, drain pipes with a radius of 0.1 m will be used. They will be placed at a depth of 1.8 m below the soil surface. A relatively impermeable soil layer was found at a depth of 6.8 m below the soil surface. From auger hole tests, the hydraulic conductivity above this layer was estimated at 0.8 m/day. Irrigation is applied approximately every 20 days. The average irrigation losses, which recharge the already high water table, amount to 40 mm.

What drain spacing must be applied when an average water table depth of 1.20 m below the soil surface is to be maintained? (Use the table provided to find the equivalent depth).

[14 marks]

QUESTION 7

(a) Briefly define the following terms:

    i)   Recession phase
    ii)   Advance phase
    iii) Surface drainage
    iv)   Sub-surface drainage
    v)   Relief drain.

[5 marks]

(b) An irrigation water contains 450 mg/l salt and the drainage water from the area contains 1500 mg/l. Compute the maximum possible water application efficiency so as to maintain the salt balance in the soil and not increase the amount of salt in the drainage water.

[5 marks]

(c) 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%.

[10 marks]

USEFUL INFORMATION

$WP = QH/6116$

$BaPr = 10.33 - 1.17 \times 10^{-3}h + 5.55 \times 10^{-8}h^2$

$K = Ks/348$

$H_L = KC_1LQ^m/D^{2m+n}$

$C_1 = 277778, 572888, 610042$

$m = 2.0, 1.85, 1.90$

$n = 1.0, 1.16, 1.10$

$h_L = FH_L + M_L$

$NPSHa = BaPr - VPw - H_L - ML - VH - SL - DD$

$Cu = (1-(\Sigma X/mn))100$

$LR = Ddw/Diw = ECiw/ECdw$

Aluminium Tubing without couplers, $Ks = 0.33$

Aluminium Tubing with couplers each 6.1 m, $Ks = 0.43$

Aluminium Tubing with couplers each 12.2 m, $Ks = 0.39$

Temperature (°C)	Vapour Pressure (kN/m^2)
20	2.34
25	3.17
30	4.24
40	7.38

$Q = 1859bh^{3/2}$

$Q = CA(2gh)^{\frac{1}{2}}$

$V = (R^{2/3} S^{\frac{1}{2}})/n$

$K = 523000a^2 \log_{10}(Y_o/Y_1)/At$

$s^2 = (4(KaH^2)/v)+(8Kb\,dH)/v$

$S \rightarrow$	5 m	7.5	10	15	20	25	30	35	40	45	50
d											
0.5 m	0.47	0.48	0.49	0.49	0.49	0.50	0.50	—			
0.75	0.60	0.65	0.69	0.71	0.73	0.74	0.75	0.75	0.75	0.76	0.76
1.00	0.67	0.75	0.80	0.86	0.89	0.91	0.93	0.94	0.96	0.96	0.96
1.25	0.70	0.82	0.89	1.00	1.05	1.09	1.12	1.13	1.14	1.14	1.15
1.50		0.88	0.97	1.11	1.19	1.25	1.28	1.31	1.34	1.35	1.36
1.75		0.91	1.02	1.20	1.30	1.39	1.45	1.49	1.52	1.55	1.57
2.00			1.08	1.28	1.41	1.5	1.57	1.62	1.66	1.70	1.72
2.25			1.13	1.34	1.50	1.69	1.69	1.76	1.81	1.84	1.86
2.50				1.38	1.57	1.69	1.79	1.87	1.94	1.99	2.02
2.75				1.42	1.63	1.76	1.88	1.98	2.05	2.12	2.18
3.00				1.45	1.67	1.83	1.97	2.08	2.16	2.23	2.29
3.25				1.48	1.71	1.88	2.04	2.16	2.26	2.35	2.42
3.50				1.50	1.75	1.93	2.11	2.24	2.35	2.45	2.54
3.75				1.52	1.78	1.97	2.17	2.31	2.44	2.54	2.64
4.00					1.81	2.02	2.22	2.37	2.51	2.62	2.71
4.50					1.85	2.08	2.31	2.50	2.63	2.76	2.87
5.00					1.88	2.15	2.38	2.58	2.75	2.89	3.02
5.50						2.20	2.43	2.65	2.84	3.00	3.15
6.00							2.48	2.70	2.93	3.09	3.26
7.00							2.54	2.81	3.13	3.24	3.43
8.00							2.57	2.85	3.17	3.35	3.55
9.00								2.89	3.16	3.43	3.66
10.00									3.23	3.48	3.74
∞	0.71	0.93	1.14	1.53	1.85	2.24	2.58	2.91	3.24	3.56	3.88

Table 1. (cont.)

$S \rightarrow$	50	75	80	85	90	100	150	200	250
d									
0.5	0.50	—							
1	0.96	0.97	0.97	0.97	0.98	0.98	0.99	0.99	0.99
2	1.72	1.80	1.82	1.82	1.83	1.85	1.00	1.92	1.94
3	2.29	2.49	2.52	2.54	2.56	2.60	2.72	2.70	2.83
4	2.71	3.04	3.08	3.12	3.16	3.24	3.46	3.58	3.66
5	3.02	3.49	3.55	3.61	3.67	3.78	4.12	4.31	4.43
6	3.23	3.85	3.93	4.00	4.08	4.23	4.70	4.97	5.15
7	3.43	4.14	4.23	4.33	4.42	4.62	5.22	5.57	5.81
8	3.56	4.38	4.49	4.61	4.72	4.95	5.68	6.13	6.43
9	3.66	4.57	4.70	4.82	4.95	5.23	6.09	6.63	7.00
10	3.74	4.74	4.89	5.04	5.18	5.47	6.45	7.09	7.53
12.5		5.02	5.20	5.38	5.56	5.92	7.20	8.06	8.68
15		5.20	5.40	5.62	5.80	6.25	7.77	8.84	9.64
17.5		5.30	5.53	5.75	5.99	6.44	8.20	9.47	10.4
20			5.62	5.87	6.12	6.60	8.54	9.97	11.1
25			5.74	5.96	6.20	6.79	8.99	10.7	12.1
30							9.27	11.3	12.9
35							9.44	11.6	13.4
40								11.8	13.8
45								12.0	13.8
50								12.1	14.3
60									14.6
∞	3.88	5.38	5.76	6.00	6.26	6.82	9.55	12.2	14.7