

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 FIRST SEMESTER EXAMINATIONS

COURSE CODE		COURSE TITLE
AGA	211	Anatomy of farm Animals
AGA	351	Animals science for engineers
AGA	441	Introduction to Agriculture
AGA	511	Techniques in Animals Science
AGA	521	Applied Animal reproduction
AGA	531	Topics in Animal nutrition
AGC	411	Field crop production
AGC	431	Agricultural Entomology
AGC	531	Principles of weed management
AGE	211	Fundamentals of microeconomics
AGE	311	Rural sociology
AGE	411	Introduction to Agribusiness
AGE	421	Production Economics
AGE	431	Linear programming Applications for Agribusiness
AGE	511	Agricultural Organisation and Administration
AGE	531	International Agricultural markets, trade and Development
AGE	541	Agricultural project planning and appraisal
AGE	211	General microbiology (Theory paper)
AGE	211	General microbiology (Practical paper)
AGF	221	Computer Science
AGF	311	Chemical techniques in Food analysis (Theory Paper)
AEF	311	Chemical techniques in Food analysis (Practical paper)
AGF	321	Food chemistry (Theory Paper)
AGF	321	Food Chemistry (Practical paper)
AGF	341	Technical Thermodynamics
AGF	411	Food Engineering
AGF	421	Food Technology 1 (theory paper)

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THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF CROP SCIENCE

SECOND SEMESTER EXAMINATIONS, SEPTEMBER 2007

AGC 411: FIELD CROP PRODUCTION

DATE: 11TH SEPTEMBER 2007

TIME ALLOWED: Two and Half Hours

INSTRUCTIONS: Answer all Questions and Marks are as Indicated.

Q1. (25 marks)

A farmer suspects boll rot on his Cotton. As an Agricultural Officer in Lundazi District, how can you confirm his suspicion, give a full description on how the disease progresses and advise the farmer on what he should do?

Q2. (15 marks)

A farmer in Mkushi in her first season of farming is about to harvest her crops. As an Agronomist, give advice on the indications to show that crops are ready for harvesting for the following:-

- a. Cotton
- b. Groundnuts
- c. Sunflower
- d. Beans.

Q3. (45 marks)

Answer the following Questions:

- a. What is the major weed associated with Finger millet?
- b. What is the major weed associated with Sorghum?
- c. From which species is Wheat domesticated?
- d. From which species is Soyabeans derived?
- e. In vegetatively propagated crops, the choice of planting material is key to improved production. What makes a good planting material and what specifications are recommended?

- f. Planting earlier than the recommended date in Soyabeans results in the development of a particular disease. Name the disease and state the recommended date of planting.
- g. Aphids are vectors of a disease in groundnuts. Name the disease and what are the general symptoms of this disease. What can be done to prevent/control the disease?
- h. What happens to Sunflower when grown in the cool wet weather?
- i. Shelling of Groundnuts is not recommended for nuts destined for long term storage. Give reason(s) for this.
- j. What is the chief limiting factor in Cassava production?
- k. Under and over application of nitrogen fertilizer is detrimental to a Cotton crop. Why is this so?
- l. What is trimming and why is it an important operation in Cassava production?
- m. What is required for Cotton to be graded as Grade A?
- n. When is the best time to harvest Cassava? Give reasons for your answer.
- o. When a farmer is in the production of planting material, select the best method(s) of planting cassava and give short a description for the selection(s).
- p. What makes Cassava a preferred crop among subsistence farmers?
- q. Why is earthing of a Sweet Potato crop necessary?
- r. Heavy soils are generally not suitable for production of crops. What is the reason for this?
- s. In Cotton, what is thinning and when is it done?
- t. What is the vector of Maize streak?
- u. How much increase in yield can a farmer expect to obtain by using inoculum in Soyabean production?
- v. How much loss in yield is expected for every week of delayed weeding in Cotton?

End of Exam

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**

**2007 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS**

AGF 411: UNIT OPERATIONS IN FOOD ENGINEERING 1

TIME: THREE HOURS

INSTRUCTIONS:

1. Please read the instructions and each question carefully.
2. Answer **ALL** questions.
3. **ALL** questions carry equal marks.
4. Useful formulas are provided on the last page.

1. In the process of producing concentrated juice, a fresh extracted and strained juice containing 10 wt % solids is evaporated in the first evaporator, giving 18 wt % solids in the juice. This is fed to a second evaporator, which gives 50 wt % concentrated juice as a final product.
 - a) Draw and clearly label the process flow diagram **(6 points)**
 - b) Calculate the water removal from each evaporator **(6points)**
 - c) Calculate the amount of product produced (concentrated juice) **(6 points)**
 - d) What does the law of conservation of mass state? Is it holding in the above process? Show by performing a check either on a component or on the overall process. **(7 points)**

2. A large storage tank contains sunflower oil with a density of 917kg/m^3 . The tank is 3.66 m tall and is vented (open) to the atmospheric pressures of 1 atm at the top. The tank is filled with oil to a depth of 3.05 m and also contains 0.61 m of water at the bottom on which an oil layer floats. $1\text{ atm} = 1.01325 \times 10^5\text{ Pa}$
 - a) Calculate in Pa,

- I. The pressure at a point 3.05 m from the top of the tank. **(2 points)**
 - II. The pressure at the bottom of the tank. **(3.5 points)**
 - III. The gauge pressure at the bottom of the tank. **(3.5 points)**
- b) Why must Food engineers be familiar with principles governing fluid flow? **(5 points)**
- c) Define pseudoplastic fluids and give one example of a food product **(4 points)**
- d) Reynolds number is very important in determining the flow type in fluid flow. This number has dimensions. YES or NO, elaborate. **(7 points)**
3. A liquid fermentation medium at 30°C is pumped at a rate of 2000 Kg/h through a heater, where it is heated to 70°C under pressure. The waste heat water used to heat this medium enters at 95°C and leaves at 85°C. The average heat capacity capacity of the fermentation medium is 4.06 KJ/Kg.K, and that of water is 4.21 KJ/Kg.K. The fermentation stream and the water stream are separated by a metal surface through which heat is transferred and do not physically mix with each other.
- a) Calculate:
- I. The water flow rate **(4 points)**
 - II. The amount of heat added to the fermentation medium **(4 points)**
- b) In the initial design phase of reactors in a food processing plant, there are important design considerations of particular concern. Briefly discuss these considerations. **(8 points)**
- c) Plug flow and CSTR reactors are commonly used in the brewing industry. Describe each of them and state their advantages and disadvantages. **(5 points)**
- d) Classify the reactors based on the reactants phase. **(4 points)**
4. a) A filtration test was carried out, with a particular product slurry, on a laboratory filter press under a constant pressure of 340 kPa and volumes of the filtrate were collected as follows:

Filtrate volume (kg)	20	40	60	80
Time (min)	8	26	54.5	93

Plot a filtration curve and estimate the slope and the intercept **(7 points)**

- b) Centrifugal separations are commonly used in the food industry, describe the principal and give examples of food products that can be separated by this method. **(5 points)**
- c) What is Glass Transition Temperature? Why is it important in the storage of powdered food products? Is this tool useful to multi component powders? **(6 points)**
- d) Describe problems that occur during handling, storage and transportation of powdered food products and why? How can each of these problems be avoided or solved? **(7 points)**

FORMULA LIST

$$F = mg = V\rho g$$

$$P = F/A = P_s + Z\rho g$$

$$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$$

$$A_1 v_1 = A_2 v_2$$

$$E_{p1} + E_{k1} + E_{r1} = E_{p2} + E_{k2} + E_{r2} + E_f - E_c.$$

$$Z_1 g + v_1^2/2 + P_1/\rho_1 = Z_2 g + v_2^2/2 + P_2/\rho_2 + E_f - E_c.$$

$$Z_1 g + v_1^2/2 + P_1/\rho_1 = Z_2 g + v_2^2/2 + P_2/\rho_2$$

$$E_f = \Delta P_f/\rho = (2fv^2)(L/D)$$

$$v_1^2/2 + P_1/\rho_1 = v_1^2 A_1^2/(2 A_2^2) + P_2/\rho_2$$

$$\Delta P_f = (4fpv^2/2) \times (L/D)$$

$$F/A = \mu v/Z = \mu (dv/dz) = \tau$$

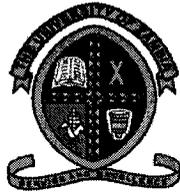
$$\tau = k(dv/dz)^n$$

$$\rho v^2 D/\mu v = Dv\rho/\mu$$

$$P = Z \rho g$$

$$P_1 - P_2 = (4fpv^2/2)(L_1 - L_2)/D$$

$$t/(V/A) = [\mu r w/2\Delta P] \times (V/A) + \mu r L/\Delta P$$



THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF CROP SCIENCE

FIRST SEMESTER

FINAL EXAMINATION

30TH AUGUST, 2007

COURSE CODE: AGC 431

COURSE NAME: AGRICULTURAL ENTOMOLOGY

TIME ALLOWED: 3 HOURS

VENUE: G7

INSTRUCTIONS: i. **Answer ALL questions**
ii. **All questions carry equal marks (20 marks each)**

- Q1** Explain the different types of metamorphosis in insects.
- Q2.** With aid of a diagram explain the nervous system of an insect.
- Q3.** Explain with examples the following:
- i. Six different types of larvae of insects.
 - ii. Three types of pupae of insects.
 - iii. Heterodynamic and homodynamic life cycles.
- Q4.** Compare and contrast the distinguishing characteristics and economic importance of the suborders Homoptera and Heteroptera.
- Q5.** Insect collection either as a hobby or career plays an important role in insect taxonomy.
- i. List twelve equipments required for insect collection.
 - ii. List four things that should be included on the insect label or data slip.
 - iii. What is the composition or formula of the Barber's fluid?

*******END OF EXAMINATION*******

UNIVERSITY OF ZAMBIA

UNIVERSITY EXAMINATIONS

AGC 521 ADVANCED PLANT BREEDING

AUGUST 2007

INSTRUCTIONS

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

TIME: 3 hours

Q. 1 You are given the following data from a maize breeding programme. What is the purpose the experiment was conducted to generate such data? Ie below:

Treatments	Replication 1	Replication 2
Hybrids		
L1 X P1	41.6	41.8
P2	46.5	44.7
F1	43.5	42.4
L2 X P1	39.0	38.9
P2	50.4	49.5
F1	47.2	40.1
L3 X P1	29.6	32.1
P2	42.1	40.8
F1	39.9	34.3
L4 X P1	42.9	35.8
P2	49.9	43.0
F1	51.8	40.6
Accessions		
L1	39.8	35.3
L2	34.0	34.4
L3	35.1	45.6
L4	29.6	33.1
Testers		
KL 100	33.0	35.8
Zea 100	54.0	55.0

Answer the following questions about the data:

- a. What was the purpose for which the experiment to generate such data was conducted?
- b. Test for the presence or absence of epistasis
- c. If epistasis is absent, estimate the additive and dominance genetic variance components. **(40 points)**

Q. 2 From the ANOVA given below:

Source	Df	SS	MS	EMS
Replication	2	437.34	X=	
Treatment	24	195.73	X=	
Error	48	71.56	X=	
Total	74	704.43		

- Fill the blanks spaces for MS and EMS
- Calculate the estimates of the components of variance
- Calculate the estimate of heritability (broad sense)
- Interpret the results

(20 points)

Q. 3 In this course you covered topics on centers of origin of crop plants and germplasm conservation. Explain in details how these two topics are important in plant breeding singularly and when considered together. **(20 points)**

Q.4 Write short notes on the following:

- Properties of the Hardy Weinberg Equilibrium? **(5 points)**
- Genetic composition of cross-pollinated populations **(5 points)**
- Use of Marker Assisted Selection in plant breeding **(5 points)**
- Improvement of response to selection **(5 points)**

Q. 5 Describe the types of responses one expects from selection in crop populations. State the underlining genetic reasons for what you would be observing in the type of selection. **(20 points)**

END OF EXAMINATION

**THE UNIVERSITY OF ZAMBIA
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2007 ACADEMIC YEAR FIRST SEMESTER EXAMINATIONS**

AGE 211: FUNDAMENTALS OF MICRO-ECONOMICS

TIME: THREE (3) HOURS

**SECTION A
ANSWER ALL QUESTIONS
(Multiple choice – Each question carries 1 mark)
Tick or circle the correct answer**

1. Resource allocation means answering the question:
 - (a) Who will get how much?
 - (b) What will be produced?
 - (c) Who will produce what?
 - (d) How will things be produced?
 - (e) All of the above.

2. A change in quantity demanded with no shift in the demand curve could result from a change in
 - (a) Tastes and preferences
 - (b) Income
 - (c) The position of the supply curve
 - (d) All of the above
 - (e) None of the above, since the statement above is impossible.

3. If two goods fulfill the same needs, they may be called
 - (a) Normal goods
 - (b) Complements
 - (c) Inferior goods
 - (d) Substitutes

4. If an increase in the price of good X causes the quantity demanded of good Y to decrease, the two goods are:
 - (a) Normal
 - (b) Inferior
 - (c) Substitutes
 - (d) Complements
 - (e) Not related

5. If a small percentage change in price is associated with a relatively large percentage change in the quantity demanded, demand is said to be
- (a) Perfectly elastic
 - (b) Elastic but not perfectly elastic
 - (c) Unit elastic
 - (d) Inelastic but not perfectly elastic
 - (e) Perfectly inelastic
6. If the sale of additional units results in more total revenue to the sellers, and if there is no reason to think the demand curve has shifted, demand must be
- (a) Upward sloping
 - (b) Perfectly elastic
 - (c) Elastic
 - (d) Inelastic
 - (e) Perfectly inelastic
7. If quantity demanded is 5 when the price is K10 and the quantity demanded is 6 when the price is K19, then this portion of the demand curve is
- (a) Elastic
 - (b) Inelastic
 - (c) Unit elastic
 - (d) Perfectly elastic
8. The principle of diminishing marginal utility implies that
- (a) The total satisfaction from all units of a good must decline as more of the good is consumed.
 - (b) The rich are not as happy as the poor.
 - (c) The extra satisfaction from consuming an additional unit of a good must eventually decline as the rate of consumption increases
 - (d) Choices a and c
 - (e) All of the above
9. The income effect works in the same way as the substitution effect whenever
- (a) Prices rise
 - (b) Prices fall
 - (c) The good whose price has changed, regardless of which direction is a normal good
 - (d) The good whose price has changed, regardless of which direction is an inferior good

10. The marginal Rate of substitution is
- (a) The same as marginal utility
 - (b) Equal to the slope of the budget line
 - (c) Equal to the rate at which one individual would voluntarily trade one good for another.
 - (d) Equal to the rate at which you can buy less of one good and more of another good
11. The curve showing the different combinations of two goods that can be purchased with a given amount of money is called a (n)
- (a) Demand curve
 - (b) Supply curve
 - (c) Indifference curve
 - (d) Budget line
 - (e) Marginal utility curve
12. The long-run average cost curve declines because of
- (a) The mathematics alone
 - (b) The law of diminishing marginal utility
 - (c) The law of diminishing returns
 - (d) Diseconomies of scale
 - (e) Economies of scale
13. Short-run average total cost equals average fixed cost plus
- (a) Marginal cost
 - (b) Marginal product
 - (c) Average variable cost
 - (d) Average total cost
 - (e) Price
14. If average fixed cost is decreasing, where is marginal cost with respect to average fixed cost?
- (a) Above it
 - (b) Below it
 - (c) Equal to it
 - (d) Any of the above, these two cost relationships are not related
 - (e) All of the above at the same time

15. Increasing long-run average cost is a result of
- (a) The law of diminishing returns
 - (b) Diseconomies of scale
 - (c) Constant return to scale
 - (d) Economies of scale
 - (e) Decreasing costs
16. A perfectly competitive firm in long-run equilibrium will have all of the following equal except:
- (a) Marginal cost
 - (b) Long-run average cost
 - (c) Short-run average cost
 - (d) Price
 - (e) Short-run average variable cost
17. A profit-maximizing monopolist will produce where
- (a) Marginal cost equals price
 - (b) Marginal cost equals marginal revenue
 - (c) Average variable cost equals price
 - (d) Average variable cost equals marginal revenue
 - (e) Average cost equals marginal revenue
18. A cartel tries to raise industry profits by:
- (a) Increasing price and quantity sold
 - (b) Cutting price to increase the quantity sold
 - (c) Restricting output in order to raise price.
19. Equilibrium of the monopolistic firm
- (a) Occurs where $P = MC$
 - (b) Occurs where $MR = MC$
 - (c) Occurs where $P = MR$
 - (d) Necessarily is profitable
 - (e) Both (c) and (d) are satisfactory
 - (f) Both (a) and (d) are satisfactory
 - (g) None of above answers
20. The theory of price discrimination predicts that in comparison to single price monopoly
- (a) Output will increase, and average revenue will decrease
 - (b) Output will increase and average revenue will increase
 - (c) Output will decrease and average revenue will decrease
 - (d) Output will decrease and average revenue will increase
 - (e) None of the above answers is satisfactory

END OF SECTION A

SECTION B
ANSWER ALL THE QUESTIONS IN THIS SECTION

1. (a) The supply and demand schedules for maize is as follows:

Demand	Quantity demanded Per Year	Supply	
		Price Per Kg	Quantity supplied Per Year
K0.90	100,000	K0.60	100,000
0.80	110,000	0.70	120,000
0.70	120,000	0.80	140,000
0.60	135,000	0.90	150,000

Use graphs to answer the following questions.

- (i) What is the market equilibrium price and quantity?
- (ii) The government agrees to purchase as many kilograms of maize as growers will sell to it at a price of K0.80. How much will consumers purchase and how much will be produced. (10 marks)
- (b) (i) Explain why a consumer will choose a market basket so that the MRS equals the price ratio.
- (ii) Suppose a consumer has a weekly income of K80, the food price is K1 per unit and the price of clothing is K2 per unit. Using the above information draw a budget line. What is the significance of the budget line in the study of consumer behaviour? Given the following market baskets for food and clothing below:

<u>Market Basket</u>	<u>Food</u>	<u>Clothing</u>
A	20	30
B	10	50
C	40	20
D	30	40
E	10	20
F	10	40

- (a) Draw an indifference curve.
- (b) Using the weekly income of K80 and prices of food and clothing given above is the consumer in equilibrium? (15 marks)
2. (a) Suppose you are a manager of a watch making firm operating in a competitive market. Your cost of production is given by $C = 100 + Q^2$, where Q is the level of output and C is total cost.
- (i) What are the fixed costs?
- (ii) What is the marginal cost of production?
- (iii) If the price of watches is K60, how many watches should you produce to maximize profits?
- (iv) What will your profit level be? (12 marks)
- (b) A firm can use three different production technologies, with capital and labour requirements at each level of output as follows:

Daily output	Technology 1		Technology 2		Technology 3	
	Capital	Labour	Capital	Labour	Capital	Labour
100	3	7	4	5	5	4
150	3	10	4	7	5	5
200	4	11	5	8	6	6
250	5	13	6	10	7	8

- (a) Suppose the firm is operating in a high wage country, where capital cost is K100 per unit per day and labour cost is K80 per worker per day. For each level of output, which technology is the cheapest?
- (b) Now suppose the firm is operating in a low-wage country, where capital cost is K100 per unit per day but labour costs is only K40 per unit per day. For each level of output, which technology is the cheapest?
- (c) Now suppose the firm moves from a high wage to a low-wage country but that its level of output remains constant at 200 units per day. How will its total employment change? (15 marks)
3. (a) Explain what you understand by price discrimination. Under what type of market structure does price discrimination exist? What conditions should prevail for price discrimination to succeed? Explain how a monopolist can practice third degree price discrimination. (10 marks)

- (b) Explain why a perfectly competitive firm might continue to produce and sell its product in the short-run, even though the average revenue it received was less than its short-run average total cost. (10 marks)

4. Explain what you understand by the following

- (a) Monopolistic competition
- (b) Marginal Rate of Technical Substitution
- (c) Isoquant
- (d) Income and substitution effect
- (e) Complements (15 marks)

**UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS
AGE 411: INTRODUCTION TO AGRIBUSINESS MANAGEMENT
TIME: THREE (3) HOURS**

INSTRUCTIONS: ANSWER FIVE QUESTIONS ONLY (i.e. ANSWER ALL QUESTIONS IN SECTION A; THEN SELECT THREE QUESTIONS FROM SECTION B)

SECTION A

1. a) What is the difference between cash and profit? (2Marks)
- b) List four (4) things that would lead to cash being different from profit (2Marks)
- c) The following information has been provided regarding Zulu's poultry farm
 - Production costs and estimated production are as follows:

	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
Production(Number of Trays)	250	260	275	285	280	270	1620
Monthly Production costs (K)Millions	2.50	2.70	2.90	3.10	3.10	2.90	17.20

- In addition to the above production costs, his overhead costs are estimated to be K 1.25 M per month;
- Eggs will be sold for cash at K16, 000 per tray, each tray contains 30 eggs;
- Zulu will secure a loan of K 2.4 M at the beginning of January for this project;
- He hopes to contribute a sum of K0.6 million as initial capital;
- He will pay back the loan (principal) in six equal monthly installments and will also pay a monthly flat rate of interest at 40% per annum over the same period of time.

REQUIRED

- i) Prepare a cash flow budget/statement for Zulu poultry farm (10 Marks)
- ii) How much overdraft, if any, should he get to avoid liquidity problems (1 Mark)
- iii) What profit or loss does Zulu make after six months? (5 Marks)

2. The following is a summary of the condensed financial accounts for Lombe's horticultural business for the last three years.

Profit and Loss Account for the year ended 31 March	2005 \$(‘000)	2006 \$(‘000)	2007 \$(‘000)
Sales(all on credit)	415	645	885
Less Cost of goods sold:			
Opening stock	35	40	65
Purchases	<u>340</u>	<u>565</u>	<u>805</u>
	375	605	870
Less closing stock	<u>40</u>	<u>65</u>	<u>115</u>
Gross profit	80	105	130
Less expenses	40	50	60
Loan interest	—	<u>50</u>	<u>10</u>
Net profit	<u>40</u>	<u>55</u>	<u>60</u>
Balance sheet as at 31 March	2005 \$(‘000)	2006 \$(‘000)	2007 \$(‘000)
Fixed Assets	89	93	101
Current Assets			
Stocks	40	65	115
Trade debtors	52	108	250
Cash at bank	<u>12</u>	<u>6</u>	<u>179</u>
Total Assets	<u>193</u>	<u>272</u>	<u>365</u>
Financed by:			
Capital	100	120	146
Add net profit for the year	40	55	60
Less drawings(all on 31March)	<u>24</u>	<u>35</u>	<u>38</u>
	116	140	168
Loan	-	-	110
Current Liabilities			
Creditors	77	132	178
Bank overdraft	—	<u>132</u>	<u>10</u>
	<u>174</u>	<u>272</u>	<u>466</u>

REQUIRED

- a) Compute the following ratios for 2005, 2006, and 2007 :
 - i) Quick ratio(6 Marks)
 - ii) Gross profit on cost of goods sold(6 Marks)
 - iii) Return on capital employed(6 Marks)

- b) With reference to the ratios above, comment on the profitability and liquidity of Lombe's horticultural business(2 Marks)

SECTION B

3. Discuss the factors that influence the choice of the best form of business organization suitable for an agribusiness. Use Sole proprietorship and Corporations as examples, and in the process contrast the two forms of business organization **(20 Marks)**
4. The following information has been given for Alpha Farm; a producer of Irish potatoes:
- Area under potatoes 0.5ha
 - Annual marketed production 500 x 10 Kg pockets
 - Total sales revenue K 5,000,000
 - Total Variable cost K 2,250,000
 - Total Fixed cost K 1,750,000

REQUIRED

- i) Calculate the number of pockets required to break even **(4Marks)**
 - ii) What is his margin of safety? **(4Marks)**
 - iii) Suppose the owner wanted to make a profit of K 1,250,000. How many pockets of potatoes should he sell **(4Marks)**
 - iv) Highlight four(4) assumptions of break even analysis **(4Marks)**
 - v) Highlight four(4) Limitations of break even analysis **(4Marks)**
- 5 i) Both preference shares and loan capital are forms of finance that require the agribusiness to provide a particular rate of return to investors. What are the factors that may be taken into account by a business when deciding between these two sources of finance? **(12 Marks)**
- ii) The first thing that Agribusiness managers must understand about bank borrowing is that the bank desires to make a profit from the transaction while at the same time reducing the risk of the transaction. Therefore, as required by the lending rules, the banker will apply the three C's of lending before finally approving the loan:
- a) Specify the three C's of lending and describe the significance of each **(6 Marks)**
 - b) What is the role of owner's capital(equity) in bank borrowing **(2 Marks)**
- 6 i) Briefly discuss five major challenges posed by the special nature of Agricultural products **(5Marks)**
- ii) What do you understand by effective coordination as a function of a manager? **(4Marks)**
- iii) What is the assumption made by Scientific Management School of thought about Motivation and why is this School of thought criticized by many scholars? **(4Marks)**
- iv) Briefly discuss the importance of choosing wisely where one locates his/her Agribusiness **(7 Marks)**

END OF EXAM

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS
AGE 421: PRODUCTION ECONOMICS

TIME: THREE (3) HOURS

ANSWER: ALL QUESTIONS

MARKS: 100 TOTAL (each question carries 20 marks)

1.
 - a. Define *Substitution effect* and *Income effect* with regards to input relationships in a production process. **(4 Marks)**
 - b. Technical substitutability between factors of production may lead to economic complementarity among the same factors of production. Discuss the meaning of this statement. **(8 Marks)**
 - c. Assume two factors of production are competing in a production process. Explain how a decrease in the price of one input *may* result in an increase in the market price of the other input. **(8 Marks)**

2. Given the following equation defining a product-product relationship between maize (Y_1) and wheat (Y_2):
$$Y_1 = 145 - 0.0088 Y_2^2$$
and prices of maize and wheat being K10, 000 and K15, 000 respectively:
 - a. Calculate the maximum amounts of maize and wheat possible. **(4 Marks)**
 - b. Find the optimum combinations of the maize and wheat that can be produced. **(8 Marks)**
 - c. What are the optimum combinations of maize and wheat if the price of maize reduces to K8, 000 and that of wheat to K13, 000? **(8 Marks)**

3. Given the following production functions for maize (M) and Wheat (W).

$$M = 65.54 + 1.084 N_m - 0.003 N_m^2$$

$$W = 68.07 + 0.830 N_w - 0.002 N_w^2$$

Where:

N_m = Nitrogen used in maize production in kg

N_w = Nitrogen used in wheat production in kg

You have 200 kg of Nitrogen available for 2 hectares, one for maize and one for wheat.

The following prices are prevailing in the market.

P_m = maize price = K2 per kg

P_w = wheat price = K3 per kg

- a) How much of N_m and N_w can you use? **(6 Marks)**
- b) How much M and W will be produced from the levels of nitrogen in (a). **(6 Marks)**
- c) Determine the value marginal products (VMP) of the two enterprises. **(5 Marks)**
- d) Without using any word in the concept (VMP), define *value marginal product*. **(3 Marks)**

4.

- a) Explain and illustrate that maximum profits from an enterprise do not always occur where physical output is maximum. Show also that if there is a zero price tag to the variable input then maximum profits can be equal to maximum physical output. **(15 Marks)**
- b) What are the major differences between an *income* statement and a *cash flow* analysis? **(5 Marks)**

5.

- a). Some authors have defined *uncertainty* as existing when a manager is unable to associate probabilities with the outcomes of the production process. Criticize this definition **(4 Marks)**.
- b). What do you understand by the term *perfect forecast* in risk and uncertain situations? **(6 Marks)**
- c). Explain in details why the long-run average cost curve is called a *planning curve*. **(6 Marks)**
- d) Why is the long-run curve referred to as an *envelop curve*? **(4 Marks)**

END OF EXAMINATION

**THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS AUGUST 2007**

**AGE 511
AGRICULTURAL ORGANIZATION AND ADMINISTRATION**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER FOUR FOR A
TOTAL OF FIVE QUESTIONS. EACH QUESTION IS WORTH 20%.**

TIME: 3 HOURS

1. (a) Define management. Elaborate by identifying and briefly explaining the five management functions.

(b) Explain and elaborate the three management skill areas that managers must possess and apply in organizations. Cite an example illustrating the application of each type of skill area. You should also briefly comment on the proportions of these management skills needed at different levels of management.

(c) Identify the various roles managers play in executing their duties and briefly outline the nature of each of these roles.
2. (a) What is delegation? Elaborate by outlining the advantages and risks of delegation.

(b) What is unity of command? Outline the reasons why unity of command is important in an organization.
3. (a) Discuss the similarities and differences between Abraham Maslow's theory of human needs and Clayton Alderfer's theory of Existence, Relatedness and Growth needs (ERG theory).

(b) Citing relevant examples, explain how you would apply Maslow's theory in motivating employees in an organization?
4. (a) Managers are expected to have a reasonable degree of leadership ability. What is leadership? Comment and elaborate on the bases of leadership power.

(b) Based on the interactive functions of a leader, identify and briefly explain the four leadership styles.

5. Agricultural Outgrowers Support Project is a project management organization which has been operating for one year in three provinces. In recent months, the project/organization has been experiencing several operational problems. One of these is related to an inefficient Management Information System (MIS) that was established. The other problems concern disciplinary cases and conflicts among its staff at the head office and in the provincial offices. As Project Manager, you are expected to provide overall leadership and solve these problems.
- (a) Explain what a Management information System (MIS) is. Citing relevant examples, explain how a MIS can be used to efficiently carry out 3 management functions in the project.
 - (b) Outline the principles you would implement in maintaining discipline among the project staff in the organization.
6. Write brief notes explaining salient aspects of the following:
- (a) Characteristics of a bureaucracy
 - (b) Strategic Planning
 - (c) Functional Departmentation
 - (d) Staff Orientation

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION
EDUCATION

AGE 531 EXAMINATION

Thursday, 6th September, 2007

INSTRUCTIONS:

1. Read the questions carefully and answer any five (5) of the questions in this exam. All questions carry equal marks.
 2. You have 3 hours to complete the exam
 3. Please write **legibly**
-

- Q1 a) Briefly explain the difference between the mercantilist doctrine and the theory of absolute advantage as postulated by Adam Smith and David Ricardo. **(5 Points)**
- b) Briefly define and distinguish the meaning of the following pairs of concepts
- i) Comparative advantage and absolute advantage **(5 points)**
 - ii) Commodity terms of trade and opportunity cost **(5 points)**
 - iii) Advalorem Tariff and Specific Tarrif **(5 points)**
- Q2. Using an example of a large country case, explain the welfare and trade effects of an export subsidy on the country imposing the export subsidy (home country) and in the international market. **(20 points)**
- Q3. State and briefly explain five (5) reasons why protectionism has continued among nations involved in international trade. **(20 points)**
- Q4. The term dumping is widely used in international trade.
- a) What is dumping? **(4 points)**
 - b) Outline two (2) conditions that need to be met for dumping to have occurred. **(6 points)**
 - c) With the aid of a diagram, explain the economic principle behind dumping. **(10 points)**

- Q5. a) State at least five objectives of the current Commerce, Trade and Industry Policy in Zambia. **(5 Points)**
- b) State at least five priority sectors which the government has identified for promotion in the current Commerce, Trade and Industry Policy. **(5 Points)**
- c) Name and briefly describe four (4) policy instruments that are being used in the current Commerce, Trade and Industry policy. **(10 points)**

Q2. A small country can import a good at a world price of 10 per unit. The domestic supply curve of the good is;

$$S = 50 + 5P$$

The demand curve is;

$$D = 400 - 10P$$

In addition, each unit of production yields a marginal social benefit of 10.

- a) Calculate the total effect on welfare of a tariff of 5% per unit levied on imports? **(5 points)**
- b) Calculate the total effect of a production subsidy of 5 per unit. **(5 points)**
- c) Why does the production subsidy produce a greater gain in welfare than the tariff? **(5 points)**
- d) What would the optimal production subsidy be? (5 points)

End of Examination

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS
AGE 541: AGRICULTURAL PROJECT PLANNING AND APPRAISAL
TIME: THREE HOURS

INSTRUCTIONS:

- i) Answer all questions
- ii) Leave the discount tables in the examination hall

1. a) Why is choosing a discount rate important in project analysis? Describe and explain briefly the discount rates that can be used in both financial and economic analysis. (14 marks)
 b) "Projects are the cutting edge of development" (Gittinger). Explain what is meant by projects being the cutting edge of development. (6 marks)
2. The following investment outlay, operation and maintenance costs (cash outflows) as well as gross benefits (cash inflows) are given for a mixed farming project proposal.

Amounts in K'million				
Year	Investment Outlay	Operation and maintenance	Production Cost	Gross Benefit
1	300	0	0	0
2	250	0	0	0
3	200	0	0	0
4	150	0	0	0
5	100	0	0	0
6	0	20	30	550
7	0	20	40	660
8	0	20	50	770
9	0	20	60	880
10	0	20	70	890

- a) Compute the Net Benefit-Investment (N/K) ratio if the opportunity cost of capital is 20%. On the basis of the N/K you obtain, would you recommend the project as good investment? Explain why? (6 marks)
- b) Compute the Internal Rate of Return (IRR). On the basis of the IRR you obtain and given 20% as the opportunity cost of capital, would you recommend the project as good investment? Explain why? (10 marks)
- c) Suppose in another project you are informed that at an opportunity cost of capital of 20%, a 25% reduction in the project's net benefits results in a positive net present value of K+15,000, whereas a 30% reduction in the project's net benefits results in a negative net present value of K-20,000. What is the magnitude (switching value) of the net benefits decrease before the project's net present value falls below an unacceptable level? Explain your answer. (4 marks)

3. The foreign exchange component and the domestic currency component of a layers cages production project are as given in the following table:

Year	Foreign Exchange Component (US\$'000)			Domestic Currency Component (K'million)	
	Value of Production	Investment Cost	Production Cost	Investment Cost	Production Cost
1	0	100	0	350	0
2	0	150	0	300	0
3	0	150	0	200	0
4	200	0	100	150	120
5	450	0	200	0	150
6	600	0	300	0	150
7	600	0	300	0	150
8	600	0	300	0	150
9	600	0	300	0	150
10	600	0	300	0	150

- a) If the opportunity cost of capital is 20%, compute the domestic resource cost (DRC). If the official exchange rate (OER) is K4, 000 to US\$1 and on the basis of the DRC you obtain, is the project favourable? Explain why? (10 marks)
- b) If there is a foreign exchange premium of 20%, what is the shadow exchange rate (SER)? In the light of the SER you obtain and on the basis of the DRC you obtained in a) above, would you say the project is favourable? Explain why? (5 marks)
- c) What are the limitations of the DRC as a tool of project analysis? (5 marks)
4. a) The c.i.f. price for a wheat milling plant is US\$105,000; the import levy is 10% of the c.i.f. price; the domestic handling and marketing charges amount to K15 million and transportation to the project site K5 million. The official exchange rate (OER) is K4, 000 to US\$1 and the foreign exchange premium is 20%. Compute the economic parity values at project boundary using the conversion factor and the shadow exchange rate approaches. (10 marks)
- b) "Trade Policy Signals from Project Analysis" (Gittinger). Discuss. (5 marks)
- c) How do you go about valuing intangible costs and benefits in economic analysis? (5 marks)
5. Write short notes on the following giving formulas and/or examples where appropriate:
- Declining real burden of debt service (5marks)
 - Determining the premium on foreign exchange (5 marks)
 - Benefit-Cost Ratio (5 marks)
 - Sensitivity analysis (5 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS

AGF 311 CHEMICAL TECHNIQUES IN FOOD ANALYSIS

TIME ALLOWED: THREE HOURS

INSTRUCTIONS

- 1 There are five questions in this examination paper.
 - 2 Answer any **four** questions.
 - 3 Questions carry equal marks.
-

1. (a) You work in a flourmill and part of your monthly quality systems stipulates that you need to calculate the mill yield (number of kilogrammes of flour produced/ number of bags of wheat milled). Consequently you need to determine the average moisture content of the flour produced in a 24 hr period at the flourmill. The mill has two shifts (day and night) and each shift produces 8 lots of flour. Each lot produces 500 pallets and each pallet contains 100 bags of flour. Prior to being placed on the pallet each bag of flour is coded with the shift, lot number, pallet number, and bag number. Describe the sample plan you would use to determine the average moisture content (make sure to include the logistics of sample handling). (5 marks)
- (b) How would you overcome the following problems that could arise during the conventional dry ashing of various foods?
 - (i) You are getting volatilization of phosphorus (2 marks)
 - (ii) You are using a porcelain crucible and you suspect that a compound in your sample is reacting with the crucible (2 marks)
- (c) Zinc analysis (%) in a food sample gave the following results: 33.27, 33.37 and 33.34. Calculate the coefficient of variation. (3marks)

- (d) The Manager of a Food Processing Company was trying to decide whether or not to keep a young recently hired food technologist. The Manager decided to see if the new food technologist's work was of the same quality as that of the other staff. She asked both a senior food technologist and the new food technologist to analyze the same food sample using the same procedure, reagents and instruments. They obtained the following results:

Senior Food Technologist	New Food Technologist
(% Ca)	(%Ca)
18.89	20.10
19.20	20.50
19.00	18.65
19.70	19.25
19.40	19.40
	19.99

Determine if there is a significant difference in the precision of the data at 95% confidence level. (5marks)

- 2 (a) You manage three laboratories that use three different methods of analyzing the moisture content of Cheddar cheese. In order to check the accuracy and precision of each laboratory, you send the same sample of cheese to each lab and tell them to analyze it five times. You previously analyzed the sample and you know it has 36.15% moisture. The results from each lab are shown below:

Lab1 - vacuum oven	Lab2 - microwave oven	Lab3 forced draft oven
37.5%	34.3%	36.1%
37.5%	34.1%	36.2%
37.3%	34.3%	36.2%
37.7%	34.2%	36.1%
37.4%	34.5%	46.4%

- (i) What type of error has occurred at each laboratory? (3marks)
- (ii) How would you correct the problem with each method? (3marks)
- (b) Lead on leaves by a roadside was measured spectrophotometrically by reaction with dithizone. The standard deviation for a triplicate analysis was 2.3ppm. What is the 90% confidence limit? (3marks)

- (c) A molecular species with a molecular weight of 80,000 was passed through a column with a stationary phase which had an exclusion limit of 40,000. The retention volume was 25ml. A low molecular weight compound which was small enough to enter the pores of the stationary phase completely had a retention volume of 152ml, and a sample component had a retention volume of 102ml. Calculate the void volume, V_m , the total pore volume, V_s , and the distribution coefficient of the sample component. (4marks)
- (d) What is the minimum value of D that will allow the extraction of 99.9% of a food sample from 75.0cm³ of water with four successive extractions by 75.0cm³ quantities of ether? (3 marks)
3. (a) Calculate the resolution between two chromatographic peaks if the retention time corresponding to the first peak is 10.52 minutes, the retention time corresponding to the second peak is 11.36 minutes, and the widths of the two peaks are 0.38 and 0.48 minutes, respectively. Is this resolution adequate for analysis? (5marks)
- (b) (i) Describe how non linear partition isotherms lead to no Gaussian band shapes. (2marks)
- (ii) Draw the band shape produced by an overloaded column and a column with tailing. (2marks)
- (c) Describe why an improvement in selectivity improves resolution more than an improvement in HETP. (3marks)
- (d) A solid food sample is known to contain only NaCl (MM 58.44) and KCl (MM 74.56). A 2.000g sample of this solid is dissolved in water and all the chloride ion is precipitated as AgCl by the addition of 50.0cm³ of 0.60M AgNO₃ solution. What is the percentage of KCl in the mixture? (4marks)
4. (a) You need to purify an enzyme from a crude cell extract. Subsequently you will analyze the activity of the purified enzyme. As a result, it is important that you do not denature or lose the biological activity of the enzyme. What kind of chromatography would you perform (include a description of the stationary and mobile phase you would use)? (5marks)
- (b) Explain the difference between an external and an internal standard as used in chromatographic methods of analysis. (2marks)

- (c) You need to measure the salt content of a lunchmeat product. The Mohr method was used to determine the concentration of sodium chloride in a 1.004g sample. The sample was dissolved in water and titrated to the end point with 32.36ml of 0.1012M silver nitrate. Calculate the percent of sodium chloride in the sample.
- (d) The following retention times were recorded for the separation of a series of pesticides on a reverse phase chromatographic column. Assuming a flow rate of $1.15\text{cm}^3/\text{min}$, calculate the retention volume for each pesticide. (3marks)

Pesticide	Retention time, minutes
Baygon	5.25
Carbamate	6.03
Barban	12.41

5. (a) (i) The retention time of an organic compound on a 100cm long liquid Chromatography column was 10.0 minutes. The width of the chromatographic peak was 24 seconds. Calculate the height equivalent of a theoretical plate for this column. (3marks)
- (ii) Calculate H and N for a 25.0cm column if a fatty acid has a retention time of 17.6minutes and a half peak width of 0.59minutes. (2marks)
- (b) You are performing HPLC analysis and you think two compounds may be co-eluting. Describe how you would determine if this were happening? (3marks)
- (c) You have a protein system with the following characteristics:

protein	Solubility in $(\text{NH}_4)_2\text{SO}_4$	Solubility in ethanol	pI	Denaturation temperature
1	10-20%	5-10%	4.6	80°C
2	70-80%	10-20%	6.4	40°C
3	60-75%	10-20%	4.6	40°C
4	50-70%	5-10%	6.4	70°C

Describe how you would separate protein 4 from the others. (3 marks)

- (d) What amount of NaCl (MM 58.44) is present in a food sample that yields on precipitation of the chloride ion with silver nitrate, 0.8342g of silver chloride (MM 143.32)? (4marks)

END OF EXAMINATION

ANNEX

VALUES OF t FOR v DEGREES OF FREEDOMS FOR VARIOUS CONFIDENCE LEVELS.

v	CONFIDENCE LEVEL			
	90%	95%	99%	99.5%
1	6.314	12.706	63.657	127.32
2	2.920	4.303	9.925	14.089
3	2.353	3.182	5.841	7.453
4	2.132	2.776	4.604	5.598
5	2.015	2.571	4.032	4.773
6	1.943	2.447	3.707	4.317
7	1.895	2.365	3.500	4.029
8	1.860	2.306	3.355	3.832
9	1.833	2.262	3.250	3.690
10	1.812	2.228	3.169	3.581
15	1.753	2.131	2.947	3.252
20	1.725	2.086	2.845	3.153
25	1.708	2.060	2.787	3.078
∞	1.645	1.960	2.576	2.807

$v = N-1 = \text{Degrees of freedom.}$

REJECTION QUOTIENT, Q , AT DIFFERENT CONFIDENCE LIMITS

Number of observation	Confidence Level		
	Q90	Q95	Q99
3	0.94	0.970	0.994
4	0.76	0.829	0.926
5	0.64	0.710	0.821
6	0.56	0.625	0.740
7	0.51	0.568	0.680
8	0.47	0.526	0.634
9	0.44	0.493	0.598
10	0.41	0.466	0.568
15	0.338	0.384	0.475
20	0.300	0.342	0.425
25	0.277	0.317	0.393
30	0.260	0.298	0.372

Values of F at 95% confidence level

$v_1 =$	2	3	4	5	6	7	8	9	10	15	20	
$v_2 =$	2	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4
3	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.70	8.66	8.62
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.86	5.80	5.76
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.62	4.56	4.52
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	3.94	3.87	3.83
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.51	3.44	3.40
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.22	3.15	3.11
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.01	2.94	2.90
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.85	2.77	2.73
15	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.40	2.33	2.29
20	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.20	2.12	2.08
30	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.01	1.93	1.89

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
FOOD SCIENCE AND TECHNOLOGY DEPARTMENT
FIRST SEMESTER 2007 FINAL EXAMINATION
COURSE: FOOD CHEMISTRY AGF 321 PRACTICAL

TIME: THREE HOURS

INSTRUCTIONS: QUESTION ONE IS COMPULSARY. FROM SECTION II ANSWER ANY FOUR QUESTIONS OF YOUR CHOICE. ALL QUESTIONS CARRY 20 POINTS

SECTION I (20 Points)

1. (a) The Kjeldahl method of crude determination of protein is one method of determining crude protein. Is this the only method used for protein determination if not mention at least three other methods you know **(5 Points)**.
(b) Name the three reagents added during sample digestion. Why are they added? **(3 Points)**
(c) If upon digestion for a long time no colour changed to the things you are digesting what possible things could have gone wrong. **(4 Points)**
(d) Why can distillation not proceed without the dilution step **(3 Points)**
(e) What reagent is added at the distillation stage and what is its function **(2 Points)**
(f) Explain what would happen if standardisation is omitted at the titration stage **(3 Points)**
-

SECTION II

2. If you were in charge of product development in a food company and you given a new food product explain how you would determine its moisture, fat, ash and calcium. How can this information be helpful in as far as this product is concerned **(20 Points)**.
3. You are given two different samples of food products whose moisture content is 15%. One product is very stable at this moisture content while another is highly unstable explain how you will convince the person who gave you the sample that this is an expected phenomenon. What explanation tool which is scientific, would you use to make your answer convincing. **(20 Points)**
4. You have been given a sample with obvious signs of oxidative rancidity explain how you would explain this scientifically to the person who has given you. How would you classify this food product? What would be your advice on how to stop such type of loss of quality in foodstuffs?
(20 Points)

5. Define the following

- (a) Non protein Nitrogen What is its significance in protein determination
- (b) Peroxide Value
- (c) Iso-electric point of proteins what is crucial about this point name two proteins and their Isoelectric points.
- (d) Free Fatty Acid

(20 Points)

6. The following vegetables peas, carrots, and beans and the following fruits apples and pineapples and dry maize were grown and harvested in Mwinilunga . After harvest they were transported to a Lusaka factory in an open van. Upon arrival at the factory the fruits were peeled and seeds and core removed. The carrots were peeled. The pees and fresh beans trimmed and blanched. The maize was ground into breakfast mealie meal.

Explain how the quality of these products will be affected during post harvest handling, during transportation and during the processing treatment mentioned in the background information. Mention the type of nutrient loss for each group of foods mentioned for each processing treatment mentioned. What advice would you give to all the people involved in this food chain to ensure that the quality products are produced?

(20 Points).

END OF EXAMINATION!!

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION
AGF 341 – Technical Thermodynamics

Instructions: Answer **Five (5)** questions; answer **question 1** and **any other 4**.

Marks allocated for each question are indicated at the end the questions

Useful formula and constants are listed on the last page

Time allowed: Three (3) Hours

- Q.1 A 3kg-box made of polypropylene ($c_p=1.9\text{kJ/kg}_K$) contains 37 kg of Tiger fish with a water content of 83% (by mass) at 15°C . The fish is to be frozen to an average temperature of -18°C in 4h in its box. The specific heat of the fish is 3.62 kJ/kg_K above the freezing temperature of -2.2°C , and 1.89kJ/kg_K below the freezing temperature and the latent heat of fusion for water is 337 kJ/kg . Determine:
- a. the total amount of heat that must be removed from the fish. [7]
 - b. the average rate of heat removal from the fish. [3]
 - c. A 20-kg aluminium block ($C = 0,98\text{kJ}/(\text{kg K})$) initially at 200°C is brought into contact with a 20kg block of iron ($C = 0,45\text{kJ}/\text{kg}_K$) at 100°C in an insulated enclosure. Determine:
 - I. the final temperature, [6]
 - II. the entropy change for this process. [4]
- Q.2 An ordinary egg can be approximated as a 5,5cm-diameter sphere. The egg is initially at temperature of 8°C and is dropped into boiling water at 97°C . Taking the properties of the egg to be $\rho = 1020\text{kg}/\text{m}^3$ and $c_p = 3,32\text{kJ}/(\text{kg K})$, determine:
- a. how much heat is transferred to the egg by the time the temperature of the egg rises to 70°C . [10]
 - b. the amount of entropy generation associated with this heat transfer process. [10]
- Q.3
- a. A heat pump is used to maintain a house at a constant temperature of 23°C . The house is losing heat to the outside air through the walls and windows at a rate of $60,000\text{ KJ/h}$ while the energy generated within the house from the people, lights and appliances amounts to 4000 kJ/h . For a COP of 2.5, determine the required power input to the heat pump. [6]

- b. An inventor claims to have developed a refrigerator that maintains the refrigerated space at 2°C while operating in a room where the temperature is 24°C and that has a COP of 13.5. Is this claim reasonable? **[6]**
- c. Refrigerant-134a is throttled from the saturated liquid state at 800kPa to a pressure of 140kPa. Determine:
- I. the temperature drop during this process **[3]**
 - II. the change in entropy during this process **[5]**

Q.4

- a. Describe with illustrations, the differences between the ideal and the actual cycle for a spark-ignition engine and state its application in the food industry. **[10]**
- b. Steam at 3Mpa and 400°C enters an adiabatic nozzle steadily with a velocity of 40m/s and leaves at 2,5Mpa and 300m/s. Determine:
- I. the exit temperature. **[5]**
 - II. the ratio of the inlet to exit area A_1/A_2 **[5]**

Q.5

- a. Explain and illustrate the Actual-Vapour Compression Refrigeration cycle. **[8]**
- b. Discuss and illustrate the Multipurpose Refrigeration System and its application in the food industry. **[7]**
- c. Your roommate opens the door of their refrigerator on a hot October day in order to cool the room. As thermodynamics student, is this goal attainable and what is effect of this action on the refrigerator components. **[5]**

Q.6

- a. Explain and illustrate a T-v diagram in detail. **[9]**
- b. Describe the principle of vacuum cooling and freezing using a P-v diagram and give examples of its application. **[11]**

Data

$$Q = \Delta U + W$$

$$\text{COP}_{\text{HP}} = Q_H / (Q_H - Q_L)$$

$$\text{COP}_{\text{HP}} = Q_H / W$$

$$\text{COP}_R = Q_L / W$$

$$\eta_{\text{th}} = W / Q_H$$

$$\Delta H = mc_p \Delta T$$

$$V = 4/3 \pi r^3$$

$$m = \rho v A$$

$$\theta = h + v^2/2 + gz$$

$$Q_{\text{in}} + W_{\text{in}} + \sum m_i \theta_i = Q_{\text{out}} + W_{\text{out}} + \sum m_e \theta_e$$

$$s = s_f + x s_{fg}$$

$$\Delta S_{\text{sys}} = Q / T_{\text{sys}}$$

$$W = m(h_1 - h_2)$$

$$P_1 V_1 / T_1 = P_2 V_2 / T_2$$

$$\Delta s = mc_v \ln(T_2 / T_1)$$

$$\Delta s = mc_p \ln(T_2 / T_1)$$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

First Semester Examination August 2007

AGF 421 THEORY

FOOD TECHNOLOGY I

INSTRUCTIONS

- Answer question 1 and any other 4 questions
- Each question carries 12 marks
- Time : 3 hours

1. Discuss in five lines

- a) fricke
- b) sterilization
- c) freezer burn
- d) specific heat
- e) cook value
- f) semi-preserve
- g) steam quality
- h) radura
- i) log mean radius
- j) convective heat transfer

2. a) What are the major aims of heat treatment in food processing? (8)
- b) Discuss the sources of radiation. (4)

3. (a) Bananas, tomatoes and vegetables are stored in cool storage. The atmosphere in cool storage has to be conditioned with respect to many parameters. Discuss which parameters have to be controlled and how these are controlled. **(8)**
- (b) How does fast freezing give a better product as opposed to slow freezing? **(4)**
4. (a) Discuss in detail the factors that influence freezing. **(6)**
- (b) How does a multiple effect evaporator operate? Discuss the advantages of forward feeding over backward feeding. **(6)**
5. (a) What are the sources of radiation in the food industry? **(5)**
- (b) Spray drying can occur in a counter current or a co-current mode. Compare and discuss the two configurations, giving pros and cons of each. **(5)**
- (c)** What is radurization? **(2)**
6. (a) Describe in detail the major causes of quality loss in frozen food. **(6)**
- (b) Give the factors that determine the penetration of heat from a heating medium such as water to the food. **(4)**
- (c)** Why is it important to characterize the condition of air used in the food industry? **(2)**
7. (a) Discuss and illustrate the following: Heat recuperation is a major issue in food technology. **(10)**
- (b) How do the differences in D and Z values of nutrient and quality factors and those of microorganisms permit the optimization of heat treatment processes? **(2)**

- END -

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**

**2007 ACADEMIC YEAR FIRST SEMESTER
FINAL EXAMINATIONS**

AGF 431: FUNDAMENTALS OF BIOCHEMICAL ENGINEERING

TIME: THREE HOURS

INSTRUCTIONS:

1. Please read the instructions and each question carefully.
2. Answer **ALL** questions.
3. **ALL** questions carry equal marks.
4. Useful formulas are provided on the last page.

1. In the process of producing starter culture to be used for cheese production, a continuous fermenter with the operating volume of 25 L is used. The feed stream is sterile and contains limiting substrate at 2000 mg/L and enters the vessel at 8 L/h. The Monod kinetic parameters K_S and μ_{max} are 10.5 mg/L and 0.45 h^{-1} , respectively, and the yield coefficient may be taken to be 0.48.
 - a) Calculate:
 - I. The steady – state substrate concentration **(5 points)**
 - II. The Steady – state biomass concentration. **(5 points)**
 - III. The required residence time **(5 points)**
 - b) What will be the effect of increasing the residence time on the dilution rate and the steady - state substrate concentration? **(5 points)**
 - c) In a continuous culture unlike in a batch, what determines the specific growth rate under steady – state conditions? **(5 points)**

2. a) Physical immobilization technique is one of the methods used to immobilize enzymes so as to separate them for re – use in biochemical fermenters and reactors.
- I. Describe three methods under this technique (5 points)
 - II. Describe the advantages and disadvantages for each method (5 points)
- b) Vinegar is one of the products produced using Biochemical engineering techniques. Describe two routes by which it is produced (5 points)
- c) Figure 1 below shows the change of the concentrations of cells and substrate as a function of the residence time

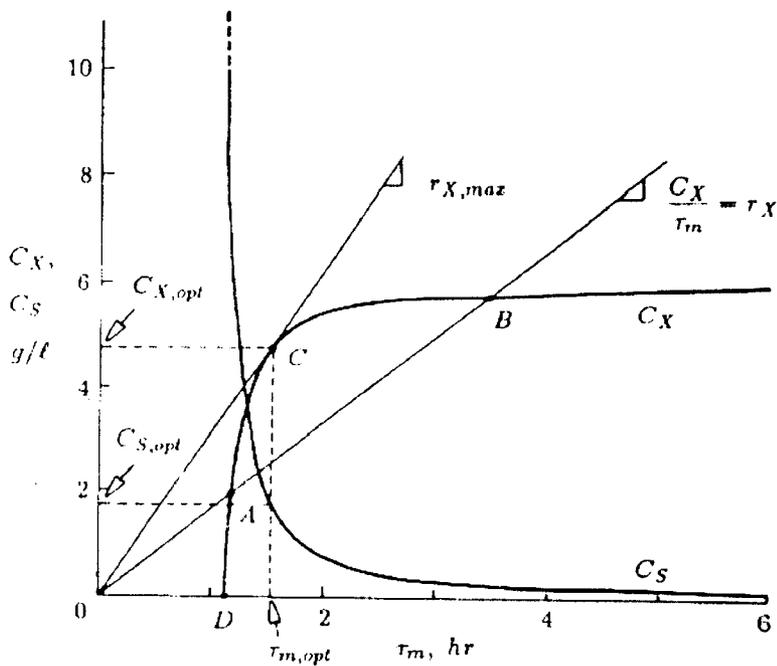


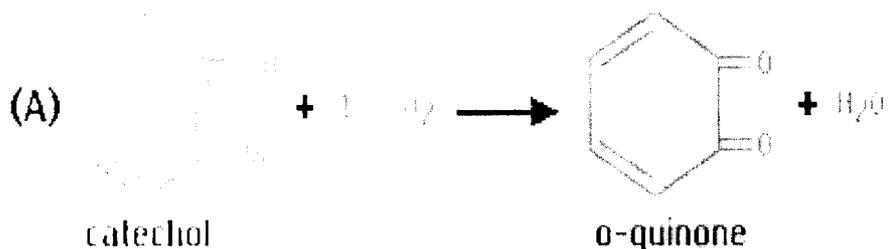
Figure 1

- I. What do you understand by the term fermenter productivity? (2 points)
- II. From the figure, how can the fermenter productivity be computed? (1.5 points)
- III. What is common and not common about points A and B in the figure? (2 points)
- IV. At which point on the figure is the maximum productivity obtained (1 point)
- V. Why is point A considered an unstable region of operation? (3.5 points)

3. When a slice of apple is exposed to air, it quickly turns brown. This is because the enzyme **o-diphenol oxidase** catalyzes the oxidation of phenols in the apple to dark-colored products.

To determine:

- the maximum rate at which the enzyme can perform (V_{\max}) and
- the Michaelis-Menten constant (K_m) for this enzyme
 1. when it acts **alone**, **catechol** is the substrate. The enzyme converts it into **o-quinone (A)**, which is then further oxidized to dark products.
 2. when it acts in the presence of a **competitive inhibitor**, para-hydroxybenzoic acid (**PHBA (B)**), which binds the same site as catechol but is not acted upon.
 3. when it acts in the presence of a **noncompetitive inhibitor**, phenylthiourea binds to a copper atom in the enzyme which is essential for its activity.



- Pieces of apple are ground up and the resulting soup centrifuged, the supernatant is the enzyme preparation.
- The intensity of the color is used as a measure of product formation.
- This is measured in a spectrophotometer at 540 nm.

First Experiment: No Inhibitor

- Four tubes are set up with different concentrations of catechol (the substrate).
 - A = 4.8 mM; B = 1.2 mM; C = 0.6 mM; D = 0.3 mM
- A fixed amount of enzyme preparation is added to Tube A and the change in absorbance measured ((Optical Density) at 540 nm) at 1 minute intervals for several minutes.
- The average **change** in OD₅₄₀ per minute (ΔOD_{540}) is recorded
- Because the OD is directly proportional to the concentration of the products, we use it as a measure of the rate or velocity of the reaction (V_i).
- This is repeated with the other three tubes.

	Tube A	Tube B	Tube C	Tube D
[S]	4.8 mM	1.2 mM	0.6 mM	0.3 mM
ΔOD_{540} (V_i)	0.081	0.048	0.035	0.020

The table above summarizes the results.

Second Experiment: Effect of para-hydroxybenzoic acid (PHBA)

As before, but this time with a fixed amount of a solution of PHBA added to each of the four tubes.

The table below summarizes the results.

	Tube A	Tube B	Tube C	Tube D
[S]	4.8 mM	1.2 mM	0.6 mM	0.3 mM
ΔOD_{540} (V_i)	0.060	0.032	0.019	0.011

Third Experiment: Effect of phenylthiourea

As before, but this time add a fixed amount of a solution of phenylthiourea in each of the four tubes.

The table below summarizes the results.

	Tube A	Tube B	Tube C	Tube D
[S]	4.8 mM	1.2 mM	0.6 mM	0.3 mM
ΔOD_{540} (V_i)	0.040	0.024	0.016	0.010

- a) Plot the Lineweaver-burk plot for the above experiments and determine the kinetic parameters, K_m and V_{max} . **(10 points)**
 - b) Discuss what is happening to the parameters in each case. **(5 points)**
 - c) Plot the Eadie hofstee plot for the first experiment (experiment without inhibitor) and determine the kinetic parameters. **(5 points)**
 - d) What is the effect of pH on enzymes? **(5 points)**
- 4.
- a) Derive the Michaelis-Menten rate equation, giving all the assumptions made. **(10 points)**
 - b) Outline the differences between the Michaelis-Menten approach and the Briggs-Haldane approach to the rate of enzyme reactions. **(5 points)**
 - c) How do enzyme reactions differ from chemical reactions? **(5 points)**
 - d) List some commercial applications of enzymes. **(5 points)**

FORMULA LIST

$$\int_{C_{X0}}^{C_X} \frac{dC_X}{r_X} = \int_{C_{X0}}^{C_X} \frac{dC_X}{\mu C_X} = \int_0^t dt = t - t_0$$

$$\mu = \mu_{\max} \left(\frac{C_S}{K_S + C_S} \right) \left(\frac{K_P}{K_P + C_P} \right)$$

$$\frac{C_X}{\tau_m} = r_X = \frac{\mu_{\max} C_S C_X}{K_S + C_S}$$

$$\mu = \frac{\mu_{\max} C_S}{K_S + C_S}$$

$$\mu = \frac{\mu_{\max} C_S}{K_S + C_S} - k_e$$

$$CX = Y_{X/S}(C_{Si} - CS)$$

$$D_2 = \frac{F}{V_2} = \frac{r_{X_2}}{C_{X_2} - C_{X_1}}$$

$$D = \mu = \frac{1}{\tau_m} = \frac{\mu_{\max} C_S}{K_S + C_S}$$

$$\tau_m = \frac{V}{F} = \frac{C_X - C_{X_1}}{r_X}$$

$$C_S = \frac{K_S}{\tau_m \mu_{\max} - 1}$$

$$\frac{1}{\mu} = \frac{K_S}{\mu_{\max} C_S} + \frac{1}{\mu_{\max}}$$

$$\tau_m = \frac{1}{\mu} = \frac{1}{D}$$

$$Y_{X/S} = \frac{\Delta C_X}{-\Delta C_S} = \frac{C_X - C_{X0}}{-(C_S - C_{S0})}$$

$$\mu = \mu_{\max} \left(\frac{C_S}{K_S + C_S} \right) \left(1 - \frac{C_P}{C_{Pm}} \right)^n$$

$$\mu = \frac{\mu_{\max}}{(1 + K_S C_S^\lambda)}$$

$$(t - t_0) \mu_{\max} = \left(\frac{K_S Y_{X/S}}{C_{X0} + C_{S0} Y_{X/S}} + 1 \right) \ln \frac{C_X}{C_{X0}} + \frac{K_S Y_{X/S}}{C_{X0} + C_{S0} Y_{X/S}}$$

$$Y_{X/S} = \frac{\Delta C_X}{-\Delta C_S} = \frac{C_X - C_{X0}}{-(C_S - C_{S0})}$$

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
FOOD SCIENCE AND TECHNOLOGY DEPARTMENT
FIRST SEMESTER 2007 FINAL EXAMINATION
COURSE: WATER AND FOOD WASTE TREATMENT
AGF441

TIME: THREE HOURS

INSTRUCTIONS: ANSWER ANY FIVE QUESTIONS OF YOUR CHOICE
ALL QUESTIONS CARRY 20 POINTS.

1. Why is stabilisation important in wastewater treatment? Explain in detail the system and **stages** used in stabilising wastewater. In your explanation explain the advantages and disadvantages of using this system. Explain how you would ascertain that this water coming from this system is indeed stable
2. Mention and describe **4 recovery products** of activated sludges. What are the economical environmental and economic implications of each product.
3. (a) What species of flies cause most problems to trickling filters, What encourages them most What causes most breakages to filters in developing countries (**5 Points**)
(b) What is sludge age Why is it important is sludge processes (**5 Points**)
(c) What causes the following conditions in waste management **ponding** and **sloughing off** How can they be prevented.(**5 Points**)
(d) Describe how well formed flocs and malformed ones can be distinguished.(**5 Points**)
4. Define composting and describe with a diagram and equation the conversion process in composting. Describe five factors affecting the composting process. Explain why composting important. (**20 Points**)
5. (a) Explain in detail how you would ensure that quality control and standards of waste water are maintained to meet the Government Regulations under the Environmental Council of Zambia and Zambia Bureau of Standards if you were in charge of the waste water laboratory at a sewage treatment plant (**10 Points**)
(b) Explain what is involved in methane gas production how is it connected to environmental management. How or where else can this process be useful. (**10 Points**)
6. (a) What role do microorganisms play in wastewater treatment? Describe the microbial community and their status in activated sludges.(**5Points**)

- (b) Name the 5 types of bacteria found in activated sludges and describe the role played by each one of them. **(10 Points)**
- (c) Explain how uniformity of microorganisms is maintained in physical treatment and activated sludge systems **(5Points)**
7. Describe in detail using a flow diagram, the water treatment process at Iolanda from the intake to the transmission and storage of the treated water. Highlight the significance of the physical and chemical treatment of the process. Also describe how the water quality is maintained. **(20 Points)**

END OF EXAMINATION!!

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION
AGF 511 - Principles of Food Technology II

Instructions:

Answer five (5) questions; At least **two (2) questions** from each section and a **fifth (5th)** from either section

Marks allocated for each question are indicated at the end the questions

Useful formula and constants are listed on the last page (page 5)

Time allowed: Three (3) Hours

SECTION 1: Answer questions from this section in a separate booklet(s)

1. A continuous fractionating column is to be designed to separate 30 000kg/h of a mixture of 40 percent benzene and 60 percent toluene into an overhead product containing 97 percent benzene and a bottom product containing 98 percent toluene. These percentages are by weight. A reflux ratio of 3.5 moles to 1 mole of product is to be used. The molal heats of benzene and toluene are 7360 and 7960 cal/g mol, respectively. The relative volatility of this system is 2.5. The feed has a boiling point of 95°C.

Determine the following:

- a. The moles of overhead and bottom product per hour **(4 Marks)**
- b. The number of ideal plates and the position of the feed plate if the feed is a liquid and is at 20°C with a specific heat capacity of 0.44cal/g °C. **(5 marks)**
- c. The minimum reflux ratio **(3 marks)**
- d. Briefly discuss two (2) limiting factors experienced in the operation of a distillation tower **(8 Marks)**

2. A rapeseed meal is used for oil extraction and 10 000kg/hr is fed into a counter current extraction unit for the purpose of extracting the oil. The rapeseed meal has 20% oil and 90% of the oil is to be extracted. The final solution is intended to be 50%.
1Kg of solution is associated with 2Kg of inert material.

Calculate:

- a. Stages required (5 marks)
 - b. Amount of solvent used (5 marks)
 - c. Amount of raffinate and extract (5 marks)
 - d. Composition of raffinate (5 marks)
3. Discuss the **two (2)** types of apparatus used for gas absorption (20 marks)
4. Adsorption is a process where certain components of a fluid phase are transferred to a surface of a solid adsorbent. Discuss **two (2) applications** of this unit operation that are used in the Food Industry or a related industry to Food Science. (20 marks)
- 5.
- a. Give at least two (2) benefits of material-energy balances to process development in the food processing industry. (6 marks)
 - b. .
 - i. Describe a material-energy balance system of a unit operation of your choice (evaporation, dehydration, pasteurization etc) describing a product and what happens to it from its entry to its exit. Including the energy requirements for that particular process. (10 marks)
 - ii. Draw a flow diagram or schematic diagram of the unit operation that you have chosen with all the material and energy balances entering and exiting the system. (4 marks).

SECTION 2: Answer at least 2 questions in a separate booklet. Question one is Compulsory.

1. Zammilk would like to introduce two new products namely; ice-cream and milk powder. You are approached as a consultant to spearhead this operation. With your vast knowledge of Unit Operations of Food Engineering;
 - a. What kind of equipment would you use to manufacture the two products from already pasteurized milk to the final product and why? **(10 marks)**
 - b. Explain the steps in both operations in detail from pasteurized milk to final products. **(10 marks)**

2. A single-effect evaporator is concentrating a feed solution of organic colloids from 5 to 50 wt %. The solution has a negligible boiling-point elevation. The heat capacity of the feed is $c_p = 4.06 \text{ kJ/kg.K}$ and the feed enters at 15.6°C . Saturated steam at 101.32 kPa is available for heating, and the pressure in the vapour space of the evaporator is 15.3 kPa. A total of 4236 kg/h of water is to be evaporated. The overall heat-transfer coefficient is $1988 \text{ W/m}^2.\text{K}$. Calculate:
 - a. the required surface area **(7 marks)**
 - b. the steam consumption **6marks)**
 - c. Determine the boiling temperature of the solution and the boiling-point rise for a 30% NaOH solution boiling in an evaporator at a pressure of 172.4 kPa. **(7marks)**

3.
 - a. Discuss the role of nucleation in crystallisation and its implication on product quality. **(7 marks)**

 - b. A batch of 1000kg of KCl is dissolved in sufficient water to make a saturated solution at 363 K, where the solubility is 35 wt% KCl in water. The solution is cooled to 293 K, at which temperature its solubility is 25.4 wt%.
 - i. How much water is required for the solution? **(3 marks)**
 - ii. What is the yield of KCl crystals obtained? **(4 marks)**

- iii. What is the yield of crystals obtained if 5% of the original water evaporates on cooling? **(6 marks)**

END OF EXAM

Data for the Examination

$$F = D + B$$

$$x_D / R_D + 1$$

$$R_m / R_m + 1 = (x_D - y') / (x_D - x')$$

$$R_m = (x_D - y') / (y' - x')$$

$$q = 1 - f$$

$$- q / 1 - q$$

$$q = 1 + \frac{C_{pL} (T_b - T_F)}{\lambda}$$

$$q = - \frac{C_{pV} (T_F - T_d)}{\lambda}$$

$$x_{si} = p / (p + 1)$$

$$L_o + V_2 = L_1 + V_1 = M$$

$$C_p = 1.424 m_c + 1.549 m_p + 1.675 m_f + 0.837 m_a + 4.187 m_m$$

$$C_p = 1.675 + 0.025 w$$

$$\Delta H = mc (T_2 - T_1)$$

$$\Delta H_s = m_s H_s \quad \text{or} \quad \Delta H_s = m_c H_c$$

$$MW_{\text{toluene}} = 92$$

$$MW_{\text{benzene}} = 78$$

$$\Lambda = H_s - h_s$$

$$F = L + V$$

$$F x_F = L x_L$$

$$q = U A \Delta T$$

$$q = S(H_s - h_s) = S\Lambda$$

$$q = (H_2 + H_v) - H_1$$

Molar weights

$$MgSO_4 = 120$$

$$H = 2$$

$$O = 16$$

$$K = 39.1$$

$$Cl = 35.45$$

THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATION
AGF 521 - Principles of Food Technology II

Instructions:

This paper has a total of **Eight (8)** questions and you are required to answer a total of **five (5)** questions

Answer **Question one (1)** (Compulsory) and any other four (4) questions of your choice.

All marks allocated to each question are indicated at the end of each question

Time allowed: **Three (3) Hours**

1. You are approached by a firm that has embarked on formulating a new brand of margarine which is a water-in-oil emulsion, made from vegetable oil, skimmed milk (water phase), citric acid, salt and other flavourants.

A 'dubious consultant' advised the firm to use guar gum as an emulsifier and went on to supply them with huge quantities of the gum.

In relation to the whole course of AGF 521, answer the following

- a. Describe briefly what a water-in-oil emulsion is. **(1 mark)**
- b.
- i. Describe at least **one (1) problem** that the firm could be experiencing due to the use of guar gum. **(4 marks)**
- ii. Discuss how guar gum imparts stability to an emulsion. **(2 marks)**
- iii. What is the error in using the guar gum in this formulation **(5 marks)**
- c.
- i. Give advice on what type of emulsifier you could recommend for this new brand of margarine (give **one (1) reason** for your choice)
- ii. Give names of **two (2)** alternative emulsifiers suitable for this formulation. **(4 marks)**
- d. Outline briefly at least **two (2) aspects** that you would take in consideration during product formulation (before launching of the product). The reason for these aspects

would be to ensure that the product retains its quality and integrity when it is eventually put on the shelf for sale.

(4 marks)

2.

a. Using figure 1 (below) determine the following for solutions of $C_{12}E_6$ (a hypothetical chemical solution) at 15°C (line 1)

- i. Critical micelle concentration and
- ii. The area available per mole of the adsorbed surfactant
- iii. and the area available per molecule of $C_{12}E_6$

(12 marks)

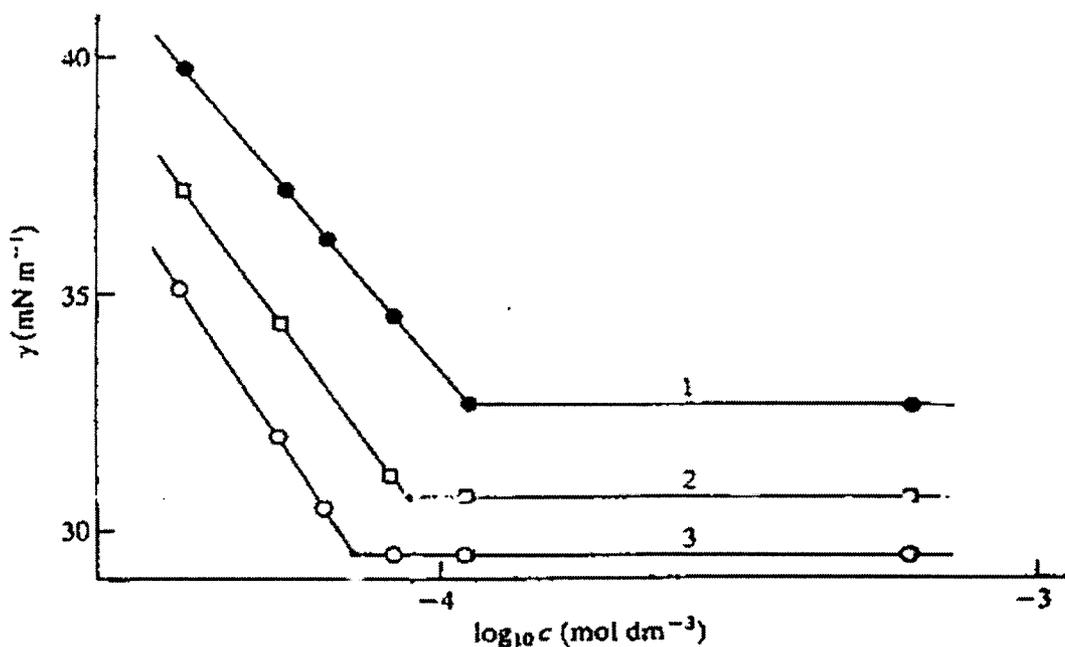


Figure 1: CMC of $C_{12}E_6$ at different temperatures

b. Discuss the principle of Gibbs Marangoni and its relevance in maintaining stability in emulsions.

(8 marks)

3.

a.

i. State and explain **two (2)** roles of emulsifiers in the process of emulsification.
(5 marks)

ii. Briefly describe what the term emulsification means and its intended purpose.
(5 marks)

b. Describe the composition of cow's milk (both raw and processed) with regards components that are crucial to emulsion (milk) stability. Explain the role that homogenization has in maintaining stability.
(10 marks)

4.

a. Given that an emulsion of 10% v/v oil-in-water emulsions at 25°C has a half life of three (3) months and that the average diameter is 500nm. Calculate the following

i. Rapid half life, $t_{1/2, \text{rapid}}$

ii. Number of particles, N_0

iii. Stability ratio, W

(10 marks)

b. Discuss and contrast steric and electrostatic stabilization. Give **one (1)** example of each in your explanations.
(10 marks)

5. A food company produces a product from milk by inoculating two strains of bacteria, *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, into fresh pasteurized milk. By an enzymic action and change in the overall pH of the milk, the liquid milk is changed into a gel-like product which is thicker in consistency. Upon stirring this thick material, it loses its consistency and turns into a less viscous substance which is later packaged and sold as a beverage.

a. Give a **graphical** explanation relating to what happens to the product in terms of viscosity and shear rates over time. In your diagram, include a line to show the behaviour of the original product (the milk) as well as the new stirred product.

(5 marks)

b. Differentiate Newtonian and non-Newtonian fluids giving an example of each.

(7 marks)

c. What category of non-Newtonian fluids does the stirred product belong to and why?

(8 marks)

6.

a) Give one (1) scenario when the stern potential (Ψ_s) = zeta (ζ) potential and another one when $\Psi_s \neq \zeta$ potential (4 marks)

b) Give the numerical dimensions or range in which the zeta potential is measured from the surface of droplet or particle. (1 mark)

c) A spherical particle of radius $r = 0.15 \mu\text{m}$ dispersed in an aqueous solution of 0.1 mol.dm^{-3} NaCl which is at a temperature of 25°C . The viscosity of the solution is $1 \times 10^{-3} \text{ Pa.s}$. The dielectric constant of the solution is 80.4. The particle moves over a distance of $96 \mu\text{m}$ within 12 seconds. Determine the following: (NB: $E = 10 \text{ V/cm}$)

i. The mobility, μ , of the particle

ii. $\kappa.r$

iii. Zeta potential of the particle

(15 marks)

7. A small scale industry has embarked on producing a salad dressing. Initially, they experienced creaming after 24 hours (they were not aware that there was a need to use a stabilizer as an ingredient). They approached a food consultancy firm that advised them to include in their formulation a polysaccharide called dextran to act as a stabiliser in the salad dressing. At first, they used 0.075% of the dextran and experienced more rapid creaming in comparison to when there was no stabiliser. On a second consultation they were advised to increase the concentration to 0.30% at which the creaming was halted and a remarkable stability was noted.

a. Explain the reason for the creaming in the absence of the stabiliser, LBG.

(2 marks)

b. Explain the creaming experienced at 0.075% LBG concentration.

(3 marks)

- c. Give the reason and phenomenon as to why creaming was halted after the second consultation. **(3marks)**
- d. In the absence of LBG, give **three (3) other different methods** of controlling creaming in the salad dressing **(12 marks)**
8. Discuss the concept of electrokinetics and its relevance to Food Technology. **(20 marks)**

End of Exam

Formulae and constants for examination

$$\Gamma = -1/(R^*T) * (d\gamma / d\ln C) = -C / R^*T * d\gamma / dC$$

$$\Gamma = -(1/(z^+ + z^-)) * 1/(R^*T) * (d\gamma / d\ln C) = -(1/(z^+ + z^-)) * C / (R^*T) * (d\gamma / dC)$$

$$\Sigma = 1 / \Gamma$$

$$Pa_1 = (1/\Gamma) / N_A = \Sigma / N_A$$

$$\Delta P_L = 2 \gamma / r$$

$$\mu = \frac{\zeta * \varepsilon}{1.5\eta}$$

$$\mu = \frac{\zeta * \varepsilon}{\eta}$$

$$\mu = \frac{v}{E}$$

$$\kappa = \sqrt{(2 * Z^2 * F^2 * C_o / \varepsilon RT)}$$

$$\kappa = \sqrt{(2 * Z^2 * e^2 * n_o / \varepsilon kT)}$$

$$\kappa = 1.04 * 10^8 \sqrt{(C_o * Z^2)}$$

$$R^*T \ln [P_{vr}/P_{vo}] = 2 * \gamma * M / \delta * r = 2 * \gamma * V_L / r$$

$$t_{1/2, \text{slow}} = W * t_{1/2, \text{fast}}$$

$$t_{1/2, \text{rapid}} = 3 * \eta / (4 * k * T * N_o) = 2 * 10^{17} / N_o$$

$$N_o = fv / [(\pi/6) * \phi^3]$$

$$F = 96485 \text{ C / Mole}$$

$$e = 1.602 * 10^{-19} \text{ C}$$

$$R = 8.314 \text{ J / (mole.K)}$$

$$\varepsilon_o = 8.85 * 10^{-12} \text{ F/m}$$

$$k = 1.38 * 10^{-23} \text{ J/K}$$

$$N_A = 6.023 * 10^{23}$$

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

First Semester Examination August 2007

AGF 531 EXAMINATION

TECHNOLOGY OF VEGETABLE PRODUCTS I

INSTRUCTIONS: Answer question 1 and any other 4 questions
Each question carries 20 marks
Time : 3 hours

1. Discuss the following terms in five lines or less

- I. extraction rate
- II. waxy starch
- III. break rolls
- IV. parboiled
- V. role of salt in bread baking
- VI. gluten
- VII. phytic acid
- VIII. cossettes
- IX. molasses
- X. saccharin

(20 marks)

2. (a) What are the properties of acid modified starch (10 marks)
(b) What are the products of a corn wet mill? (5 marks)
(c) How is the milling of rice different from that of other cereals? (5 marks)

3. (a) Give the flow diagram for the processing of sugar beet. (10marks)
- (b) Why is the pulp pressed in this flow diagram? (5 marks)
- (c) List the uses of this press pulp. (5 marks)
4. (a) Why are alternative sweeteners finding a big market industrially and domestically? (6 marks)
- (b) What is leavening? (2 marks)
- (c) What leavening agents are used in bread manufacture? Give their modes of action. (12 marks)
5. (a) How is grain cleaned and processed before the actual milling? (10 marks)
- (b) What are the end products of a corn dry milling process? (6 marks)
- (c) Sorghum is a cereal with many uses, list 4 of these uses. (4 marks)
6. (a) What is a caryopsis? (4 marks)
- (b) Give the structure of a wheat kernel. (8 marks)
- (c) What are the functions of the
- I. Aleurone layer
 - II. Starchy endosperm
 - III. Germ
 - IV. Seed coat
- (8 marks)

THE UNIVERSITY OF ZAMBIA

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THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

University Examinations – August 2007

AGG 311 Experimental Designs and Statistics

ANSWER: FIVE Questions Only. **Question 4 is compulsory.**

DATE: September 7th 2007

TIME: Three Hours

Marks

- 1.0** Write short notes on the following: 20
- a) The purpose of Blocking in Agricultural Experimentation
 - b) What is the Coefficient of Determination, R^2 ? What is the implication of statistical analysis if the R^2 is : i) 27%
ii) 100%
 - c) What is a Latin Square design? Complete the assignment of treatments for the following 3x3 Latin square Design
- | | | |
|---|---|---|
| | A | |
| C | | |
| | | B |
- d) What is the difference between the Z and the Student's t Distributions in statistical inference?
 - e) What does randomization achieve in scientific experimentation?
- 20

- 2.0** An environmentalist took water samples at four different locations in Kafue River to determine whether quantity of dissolved oxygen varied from one location to another. Locations 1 and 2 were selected upstream of the NCZ Plant with location 1 near the shore and location 2 in mid stream. Location 3 was adjacent to the NCZ industrial water discharge and location 4 was slightly down river in midstream.

Five water samples were randomly selected at each location. The data of dissolved oxygen are in the Table below:

Location	Mean Dissolved Oxygen content				
1	5.9	6.1	6.3	6.1	6.0
2	6.3	6.6	6.4	6.4	6.5
3	4.8	4.3	5.0	4.7	5.1
4	6.0	6.2	6.1	5.8	5.9

4.0

SS1234
SS1234567890

- a) Do the data provide sufficient evidence to indicate a difference in mean dissolved oxygen content for the four locations?
- b) Compare:
- i) the mean dissolved oxygen content in mid stream above the plant with the mean content adjacent to the plant (location 2 versus Location 3)
 - ii) Location 1 versus Location 4
 - iii) What is your conclusion with regards the pollution of the Kafue river from industrial discharges into the river

NOTE : Dissolved Oxygen is a measure of water pollution. The greater the pollution, the lower the oxygen readings

20

- 3.0** A sample of nine (9) 45-Horse Power Massey Ferguson Tractors were measured for mileage (measured in 1000's of tractor hours) at which time the original front brake pads were worn to 10% of their original thickness. The results are as given in the following Table.

Tractor	Front Left Wheel	Front Right Wheel
1	32.8	41.2
2	26.6	35.2
3	35.6	46.1
4	36.4	46.0
5	29.2	39.9
6	40.9	51.7
7	40.9	51.6
8	34.8	46.1
9	36.6	47.3

- a) Is there evidence that the brake pad wearing differs for right and left front tires?
- b) If the company policy is that all the brake pads should be replaced at the same time, what should management do to minimize the cost of brake pad replacements?

ANSWER QUESTION 4

20

- 4.0** A Seed Company would like to test its **five** new Maize Hybrid varieties for their drought tolerance. To do this he decides to grow the maize under four different water supply regimes. The water supply regimes are:
1. 100% recommended water supply
 2. 80% of the recommended water supply
 3. 60% of the recommended water supply
 4. 40% of the recommended water supply

In order to assess just how drought tolerant their five varieties are the company has decided to include a known drought tolerant variety of maize developed by ZARI known as *Zambian Wonder*.

- a) State the objective of this study
- b) Design an experiment that will give answers to the stated objective.
- c) Suppose at the time of harvest it was found that there was a very big variation in the plot-to-plot plant population, how should the researcher handle this variation in the analysis of the data?
- d) If the Seed Company decides to use four Replications and each maize hybrid is planted in a four row plot of 5 meters long and with inter row plot of 75 cm, how much land would the whole experiment occupy in square meters (M^2)?

20

- 5.0 The 50-year veterinary statistics for Zambia show that cattle deaths due to four major diseases, call them A, B, C, and D account for 15, 21, 18, and 14% respectively. A study of the death causes of 308 cattle in Southern Province of Zambia gave the following counts of cattle dying of diseases A, B, C, and D. are shown in table below

Disease	Number of Deaths
A	43
B	76
C	85
D	21
Other Diseases	83
	Total =308

- a) State the Null and alternative Hypotheses
- b) Do these data provide sufficient evidence to indicate that the proportions of cattle dying of diseases A, B, C, and D in Southern Province differ from the proportions of the 50 year span for the cattle populations in Zambia?

20

- 6.1 A Food Technologist is investigating the effect of four cheese manufacturing Methods W, X, Y, and Z. Four operators are selected for the study. Further more, the food technologist knows that each manufacturing method produces some fatigue (since there are some manual processes that the operator has to do) that the time required for the manufacture may take the whole day. To account for fatigue he decides to carryout the process over a four day period. Data are giving below.

Days	Operator			
	1	2	3	4
1	Y = 10	Z = 14	W = 7	X = 8
2	X = 7	Y = 18	Z = 11	W = 8
3	W = 5	X = 10	Y = 11	Z = 9
4	Z = 10	W = 10	X = 12	Y = 14

a) Analyze the data and draw appropriate conclusions (15 marks)

6.2 What do you understand by the term Stepwise Multiple Regression and when do you apply this statistical tool in scientific experimentation? (5 marks)

20

7.0 The surface finish of four timber parts made on four planing machines in a Farm Structures Course is being studied. An experiment is conducted in which each machine is run by three different operators and two pieces of timber from each operator are collected and tested with regards to the finish quality. Because of the location of the machines, different operators are used on each machine and the operators are chosen at random.

The data on scores of Finish in terms of an index of smoothness and glossiness of the surface of the plank are given in the Table below.

Operator	Machine 1			Machine 2			Machine 3			Machine 4		
	1	2	3	1	2	3	1	2	3	1	2	3
	79	94	46	92	85	76	88	53	46	36	40	62
	62	74	57	99	79	68	75	56	57	53	56	47

- State the Null and Alternative hypotheses
- Analyze the data and draw definite conclusions

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

THE UNIVERSITY OF ZAMBIA
FIRST SEMESTER EXAMINATION -September, 2007
AGS 211
FUNDAMENTALS OF SOIL SCIENCE - I

INSTRUCTIONS

Time: 3 Hours.

Answer all questions.

1. Define the following terms: (20 marks)
 - a) Solum
 - b) Plutonic rock
 - c) Atmosphere
 - d) Volumetric moisture content of a soil
 - e) Hygrometer
 - f) Elluviation
 - g) Particle density
 - h) Regolith
 - i) Pedochemical weathering
 - j) Texture of a rock

2. Indicate whether the following statements are true or false or whether you don't know the answer. (10 marks) (*correct answer 2 marks, wrong answer -1.0 mark, and 0 if you don't know*)
 - a) A medium subangular blocky structure is larger in dimensions than a medium granular structure.
 - b) A soil with a colour code of 7.5YR 6/4 is lighter than a soil with a colour code of 7.5YR3/3.
 - c) A soil with a bulk density of 1.75g.cm^{-3} and a gravimetric moisture content of 0.10 $\text{gH}_2\text{O.g}^{-1}$ soil has a total density lower than 2.0g.cm^{-3} .
 - d) A soil particle with a diameter $10\mu\text{m}$ will take more than 32 minutes to settle to a depth of 2 m in an aqueous solution with a viscosity (η) of $10^{-3}\text{ kg s}^{-1}\text{m}^{-1}$ according to Stoke's sedimentation equation.
 - e) All minerals that are able to scratch quartz have a hardness of more than 8 on Mohs' scale of hardness.

3. Answer the following questions briefly and concisely (17.5 marks)
 - a. Soil-forming processes are generally summarized into four main groups, namely (i) additions (ii) losses (iii) translocations and (iv) transformations.
 - i. What do the terms additions, losses, translocations and transformations mean in soil formation? (5 marks)
 - ii. Name and define specific soil-forming processes that correspond to (i) additions (ii) losses, (iii) translocations and (iv) transformations. (5 marks)

b. Sedimentary rocks are generally subdivided into clastic and nonclastic rocks. Answer the following:

- i. Define the terms clastic and non clastic rock (4 marks)
- ii. Describe how clastic and non clastic sedimentary rocks form (3.5 marks)

4 Answer each of the following questions concisely (22.5 marks)

- a. What is soil consistence? Describe how it is determined in the field? (7.5 marks)
- c. Define soil structure, and describe the three components of aggregated soil structure. List and describe the seven major types of aggregated structure found in soils (7.5 marks).
- d. Describe how the texture of a soil is determined in the laboratory using the hydrometer method (7.5 marks)

5 Selected physical properties of the surface horizon of a soil from Mkushi are presented in the Table below. (30 marks)

Table 1. Selected Physical properties of the top soil from Chalata area, Mkushi

ρ_b (g.cm^{-3})	ρ_s (g.cm^{-3})	θ_g gH ₂ O/gsoil	Sand (%)	Silt (%)	Clay (%)
1.40	2.65	0.22	54	16	30

Based on the data provided in the Table above answer the following questions:

- a. Sketch the USDA Textural Triangle in your answer booklet and indicate the position of the texture of this soil on that textural triangle (2.5 marks)
- b. What is the volumetric moisture content of this soil? (2.5 marks)
- c. What is the total density (ρ_t) of this soil? (4.0 marks)
- d. What is the total porosity of this soil? (2.5 marks)
- e. What is the saturation percentage of this soil? (3 marks)
- f. What is the void ratio (e) of this soil? (3.0 marks)
- g. What mass of soil would you expect to get after oven drying 40 grams of this soil? Show the calculation to support your answer. (4.0 marks)
- h. Given that the average volumetric content of oxygen in the air present in this horizon is 18 %, calculate the total volume of oxygen (in m³) present in the top 20 cm of a hectare of this soil. (4.5 marks)
- i. What will be the total density of the top 10 cm of this soil after receiving 5 mm of rainfall if all the rain water remains in the top 10 cm? (4.0 marks)

SMILE, SOIL SCIENCE IS FUN

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS-AUGUST, 2007

AGS 311: AGROCLIMATOLOGY

Time: Three (3) Hours
Instruction: Answer all Questions

Total Marks: 95

-
1. Briefly define each of the following terms *(20 marks)*
 - a) Kelvin temperature scale
 - b) Psychrometric constant
 - c) Green house effect
 - d) Basal Heat Production
 - e) Wien's Law

 2. Some organisms have developed regulation and compensation mechanisms for dealing with temperature change. Describe briefly the main features of mechanisms. *(20 marks)*

 3. With the aid of a diagram show the latitudinal distribution of mean incoming solar radiation and outgoing terrestrial radiation over the earth's surface *(10 marks)*

 4. There has been significant level of consensus amongst scientists that there has been a global precipitation change on Earth. What are these agreed changes according to IPCC (2001)? *(20 marks)*

5. Given the following meteorological data measured this year at Mount Makulu, Chilanga (28°15' E, 15°33' S and altitude 1213 m): (25 marks)

T _{max}	25.9°C
T _{min}	11.7°C
RH _{mean}	44 %
RH _{min}	26 %
Sunshine duration	9.40 hours
Wind speed at 10m height	227 km day ⁻¹
Estimated extraterrestrial radiation	358.788 W m ⁻²
Solar declination angle	0.233 radians

$$1.0 \text{ MJ m}^{-2} \text{ day}^{-1} = 11.6 \text{ W m}^{-2}$$

Determine:

- Wind speed in **metres per second**
- The day and month of this measurement
- Mean saturation vapour in *radians*
- Actual saturation vapour pressure in *radians*
- Solar radiation in $\text{MJ m}^{-2} \text{ d}^{-1}$
- Sunset hour angle *in degrees*

End of Exam

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS – SEPTEMBER 2007

AGS 411
SOIL FERTILITY

TIME: 3 Hours

Marks: 100

INSTRUCTIONS: ANSWER ALL QUESTIONS AND WRITE LEGIBLY

1. Explain how the following terms relate to each other:
 - a. Intensity factor,
 - b. Quantity factor and
 - c. Capacity factor. [6 Marks]

2. With the realization that there is a relationship between population growth and how well land is managed, discuss:
 - a. The different ways in which the rising world population negatively affects the management of land in the different parts of the world. [8 Marks],
 - b. The different ways in which agricultural activities negatively impact on the environment. [10 Marks]

3. Define the following terms:
 - a. Soil fertility [2 Marks]
 - b. Available nutrients [2 Marks]
 - c. Plant growth [2 Marks]
 - d. Law of diminishing returns [2 Marks]
 - e. Commercial yield of a crop [2 Marks]

4. Fertilizers of different nutrients are produced to improve on the soil fertility of different lands under cultivation.
 - a. What are the main sources of nitrogenous and phosphatic fertilizer?[4 Marks]
 - b. Explain in general terms how N and P fertilizers are processed from main sources. [4 Marks]
 - c. Explain how nature plays a part in contributing to the availability of N and P in the soil without the involvement of human beings. [4 Marks]

5. Give concise answers to the following questions on the subject of fertilizers.
 - a. To what type of crops are the following nutrients important and why?
 - i) Sulphur ii) Molybdenum? [4 Marks]
 - b. What form of phosphorus fertilizer is produced by treating rock-P with H_2SO_4 ? [2 Marks]
 - c. What are the components of the fertilizer produced in (a) above? [2 Marks]
 - d. What are the advantages and disadvantages of the fertilizer produced in (a) above? [2 Marks]

6. Soil testing is an important component of soil fertility evaluation.
- What is soil testing? [2 Marks]
 - Explain what is meant by a soil sample being representative and how this is achieved. [4 Marks]
7. Explain:
- How lime ameliorates soil acidity and improves crop growth. [10 Marks]
 - Why limed soils acidify again under field conditions? [5 Marks]
8. Distinguish between management practices for the reclamation of saline and sodic soils. [5 Marks]
9. A soil with an ECEC of $15 \text{ cmol}(+) \text{ kg}^{-1}$ tested $0.1 \text{ cmol K}^+ \text{ kg}^{-1}$. Calculate how much K_2O kg ha^{-1} must be added to the soil in order to increase the K saturation to 7%. Assume a soil bulk density of 1.3 g cm^{-3} in the plough layer. [10 Marks]
10. Calculate the amount of acidity (kg H^+) that would be produced by the nitrification of 100 kg of ammonium nitrate applied to the soil. [8 Marks]

END OF EXAMINATION

UNIVERSITY OF ZAMBIA EXAMINATIONS
AGS 431
SOIL MINERALOGY AND MICROMORPHOLOGY

August 2007

INSTRUCTIONS

Time: 3 hours.

Answer all questions.

1. Define the following terms: (10 marks)

- a. Anisotropic mineral
- b. Crystal habit
- c. Trioctahedral 1:1 layer silicate
- d. The crystallographic angle β
- e. Differential Thermal Analysis
- f. Refractive Index
- g. Crossed polarized light
- h. Anhydrous mineral
- i. Long Range order mineral
- j. Crystal form

2.

Answer the following questions briefly and concisely (30 marks)

- a. Discuss the principles employed in the analysis of minerals by Differential Thermal Analysis (DTA) and Thermal Gravimetric Analysis (TGA) (7.5 marks)
- b. Describe the procedure for preparing soils for mineralogical analysis up to the stage of separating the sample into sand silt and clay fractions. Indicate the different stages, and reagents used and explain why these reagents are used. (7.5 marks)
- c. Describe how K_{α} radiation is produced in an X-ray Diffractometer. (7.5 marks)
- d. A phyllosilicate mineral has the formula $\text{Ca}_{0.2}(\text{Al}_{1.6}\text{Mg}_{0.4})\text{Si}_4\text{O}_{10}(\text{OH})_2$. What phyllosilicate mineral is it? Describe its major physical and chemical properties. (7.5 marks)

3

A phosphate rock deposit was recently discovered in Sinda, in the Eastern Province of Zambia. Mineralogical analysis of the rock samples revealed that hydroxyapatite ($\text{Ca}_5(\text{PO}_4)_3(\text{OH})$) is the dominant mineral in this deposit. Results of mineralogical tests carried out on the hydroxyapatite are presented below: (20 marks)

Crystal system: Hexagonal; *Crystallographic axes:* $a = 9.37 \text{ nm}$, $c = 6.33 \text{ nm}$
Lowest refractive index = 1.647; *Highest refractive index* = 1.651

Answer the following questions:

- a. What are the values of angles α , β , and γ for this mineral? (3 marks)

- b. Draw a schematic diagram of the unit cell of this crystal, showing the various angles and crystal axes. (2.5 marks)
- c. What is the axial ratio of the apatite from Sinda? (2.5 marks)
- d. Is this mineral isotropic or anisotropic with respect to light? Give reasons to support your answer. (2.5 marks)
- e. What are the minimum and maximum speeds of light in this mineral? (4 marks)
- f. At what 2θ value on the diffractogram would you expect to find the (001) spacing of this mineral if you use X-rays with a wavelength of 0.154 nm to analyze the mineral? (3 marks)
- g. Would crossed polarized light passing through this mineral reach the eye of the observer studying it with a petrographic microscope as the mineral is rotated? Give reasons to support your answer. (2.5 marks)

4

- a. Describe the following:
 - i. Water of constitution (1 mark)
 - ii. Coordination water (1 mark)
 - iii. Structural water (1 mark)
 - iv. Zeolitic water (1 mark)
 - v. Adsorbed water (1 mark)
- b. Explain the roles played by the following in chemical weathering of soils:
 - i. Leaching (2 marks)
 - ii. Chelation (2 marks)
 - iii. Hydrogen ion (2 marks)
- c. Discuss the development of oxide minerals in soils, their characteristics and their effect on soil fertility management. (8 marks)

5

- a. There are different groups of silicates minerals, among which are the phyllosilicates.
 - i. Describe the building block of phyllosilicates (5 marks)
 - ii. Distinguish three (3) types of phyllosilicates and discuss their characteristics (6 marks)
- b. Attached is a diffractogram of the clay fraction of a soil from UNZA Farm, analyzed using CoK_α radiation with $\lambda = 0.179$ nm.
 - i. Calculate the d-spacings of the 5 peaks on the diffractogram (5 marks)
 - ii. Give the names and chemical formula of the minerals present in the clay fraction of this soil? Give reasons to justify your answer. (5 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS – SEPTEMBER 2007

AGS 511: SOIL CHEMISTRY

TIME: THREE HOURS

INSTRUCTION: ANSWER ALL QUESTIONS

(POINTS IN PARENTHESIS)

1. A farmer has brought in a soil sample for analysis. Upon reading the pH, you suspect that it is an alkaline soil. When you suspend the soil in solution, it remains dispersed and cannot be filtered.
- How would you confirm that this is an alkaline soil? (2 points)
 - What is causing this alkaline soil to be dispersed? (4 points)
 - Using your understanding of ionic strength, dielectric constant, temperature and valence, among others, how would you go about flocculating this soil suspension?

$$DDL = \left(\frac{\epsilon DKt}{8\pi\mu} \right)^{\frac{1}{2}}$$

where, D = dielectric constant, and t = temperature (4 points)

2. Oxidation and reduction reactions are considered to be very important in soils.
- Define redox. (2 points)
 - Given a wet-land soil and a well drained soil, how would you explain their redox states and soil weathering processes/stages? (4 points)
 - Discuss the use of pe in evaluating the redox status of soils. (2 points)
 - Draining submerged soils can make them useful for crop production by raising oxidation status. However, in the case of acid sulphate soils this is not so. Explain. (2 points)
3. A solution contains 0.01 M CaSO_4 , 0.02 M NaCl and 0.04 M CaCl_2 .
- What is the ionic strength of this solution? (5 points)
 - What is the activity of Ca in the solution? (5 points)
($A = 0.509$, $B = 0.328 \times 10^8$, $d = 6 \times 10^{-8}$)
- 4a. Cation exchange process and ion adsorption process are moderated by either ion concentration or ion ratio. Match one with the other and discuss. (5 points)
- 4b. Explain Schofield's ratio law (5 points)

5. When urea is burned at constant pressure it yields gaseous carbon dioxide, liquid water and nitrogen gas. Show that the heat evolved is consistent with the heat of formation values given in Appendixes I and II. (10 points)
6. Crystalline silicate minerals found in clay soils are normally made up of layers:
- a. Indicate the two basic building blocks of layer silicates? Use labeled diagram (4 points)
 - b. How do these building blocks combine in layer silicates? (2 points)
 - c. Indicate how soil charge comes about in these structures (5 points)
 - d. What are the sources of soil charge in these LACs? (4 points)
7. Define or briefly explain the following terms: (10 points)
- a. Surface charge
 - b. Redox parameter of an equilibrium system
 - c. Lime requirement
 - d. Negative adsorption of ions
 - e. Entropy
8. Use the free-energy data of Appendixes I and II to explore the possible spontaneity of formation of
- a. Gibbsite from aluminium and hydroxyl (5 points)
 - b. Variscite from aluminium, phosphate and water (5 points)

END OF EXAMINATION

UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS, AUGUST 2007
AGS 531: LAND EVALUATION AND IMPROVEMENT

TIME: 3 HOURS

MARKS: 94

INSTRUCTIONS: ANSWER ALL QUESTIONS. CALCULATORS ALLOWED

1. Explain in detail the main steps involved in carrying out a land use plan. (10 Marks)

2. A project involves growing of tea and coffee in Kawambwa district. Having clearly established the objectives, costs and work schedules explain:
 - (a) What would be done in the next stage of the evaluation. (10 Marks)
 - (b) Why are the procedures explained in (a) important? (4 Marks)

3. Given that a firm has planned to engage in large scale irrigated sugarcane production:
 - (a) List at least eight (8) environmental impacts that would be associated with this land utilization type. (8 Marks)
 - (b) For each of the listed concerns in (a) above, what are the possible mitigation measures? (6 Marks)
 - (c) Why are social and economic concerns important in land evaluation? (6 Marks)

4. Discuss the role of soil and water in enhancing specified biological activities that support agricultural production. (10 Marks).

5. Describe the management options for the reclamation of:
 - (a) Acid soils
 - (b) Sodic soils
 - (c) Saline-sodic soils
 - (d) Saline soils(10 Marks)

6. You are given soil profile Pedon 4 at the University of Zambia Farm.
 - (a) Use the information provided by the profile to assess the land capability of the land unit according to the Zambian system. (8 Marks)
 - (b) Use the same profile to assess the irrigation suitability of the land unit according to the Zambian system. (8 Marks)
 - (c) What are the main shortcomings of the Zambian land capability classification system? (4 Marks)

7. Although qualitative and quantitative land evaluation methods are quite different from each other, their operations involve some similar steps. Suggest any such similarities in the way the two methods operate. (10 Marks)

END OF EXAMINATION

UNIVERSITY OF ZAMBIA

SCHOOL OF AGRICULTURAL SCIENCES

UNIVERSITY FIRST SEMESTER EXAMINATIONS -
AUGUST 2007

AGS 551 IRRIGATION AND DRAINAGE PLANNING AND
DEVELOPMENT

TIME: THREE (3) HOURS (30 MINUTES EACH
QUESTION)

TOTAL MARKS: 60

INSTRUCTION: ANSWER ALL QUESTIONS

UNIVERSITY OF ZAMBIA

AGRICULTURAL SCIENCE

- Q1. Explain why crops do better under irrigation both in terms of yield and quality even when the total seasonal rainfall is adequate to meet the consumptive use of the crop.

Include in your discussion aspects of crop physiology and the role of water in crop performance. (10 Marks)

- Q2. There are three (3) recognised gravity or surface methods of carrying out irrigation.

Discuss each of these methods explaining what is involved, when the method is appropriate and what are its advantages over the other methods both gravity and sprinkler or overhead.

Explain how one ensures better uniformity of distribution of water with these methods. (10 marks)

- Q3. In step three (3) of sprinkler system design "sprinklers" are selected.

Discuss the factors which are considered in this selection due to their influence on irrigation efficiency.

In addition, explain the differences and similarities between group A and group B sprinkler types (10 marks)

Q4. Discuss why drip irrigation systems are gaining popularity. What are the major advantages of this type of irrigation system over other systems? (10 marks)

Q5. The Control Head of a drip irrigation system is considered its heart and head. Why?

Describe the Control Head, its components and how it is put together. (10 marks)

Q6. Given the ellipse equation

$$S = \sqrt{4k(h^2 + 2ah)/q}$$

Using a diagram explain each of the components.

Explain why the ellipse equation is sometimes modified. (10 marks)

**THE UNIVERSITY OF ZAMBIA
FIRST SEMESTER UNIVERSITY EXAMINATIONS**

AUGUST-SEPTEMBER 2007

AGC 6531 – Fungi & Bacteria as Plant Pathogens

Theory Paper

TIME: *Three Hours*

ANSWER: *Any Five Questions*

1. What diseases are caused by *Pythium* and *Phytophthora*? Identify these diseases by their common name and the pathogen species associated with them. Describe symptoms and control of *Phytophthora* disease in plants cultivated in Zambia.
2. What is the cause of downy mildew disease in monocot and dicot plants? What disease symptoms are diagnostic of downy mildews in monocots and dicots? Suggest measures of control of downy mildews.
3. Describe causal organism, disease symptoms and methods of control of Peach leaf curl.
4. Write a detailed essay on Market Pathology and explain the mechanism of rotting in post-harvest agricultural produce.
5. Explain and discuss biological control of plant diseases.
6. What are vascular wilts of plants? Identify pathogens of vascular wilts caused by bacteria and fungi and explain the mechanism of wilting.
7. Discuss bacterial diseases of plants in relation to symptoms, causal organisms and the way they cause infection. Suggest measures of their control.
8. Write short notes on any FOUR of the following:
 - a. Vertical resistance
 - b. Anamorph
 - c. *Ustilago*
 - d. *Puccinia*
 - e. Bean Anthracnose
 - f. *Helminthosporium* on maize

END OF EXAMINATION



THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES

ANATOMY OF FARM ANIMALS - AGA 211
2007 FIRST SEMESTER FINAL EXAMINATION

**INSTRUCTIONS: EACH SECTION MUST BE WRITTEN
IN SEPARATE BOOKLETS**

SECTION I: ANSWER ALL QUESTIONS AS INDICATED

1. **Anatomy is a term meaning structure and form. (30 points)**
 - i. Epithelium is one such structure. Where is epithelia found?
 - ii. What are its functions?
 - iii. With aid of a diagram briefly describe structure and form of different types of epithelia giving places where they are found in an animal's body?
 - iv. Differentiate between tissue and organ.

2. **The respiratory tract serves many functions. (30)**
 - i. What are the functions of the respiratory tract?
 - ii. Provide a sketch of the upper and lower respiratory tract labeling the parts.
 - iii. Briefly describe the muscular control of the respiratory process.

3. **Describe the structures of any 5 of the following. (25)**
 - i. Plasma membrane
 - ii. Deoxyribonucleic Acid (DNA)
 - iii. Lumbar vertebrae
 - iv. Cardiac muscle
 - v. Areolar tissue
 - vi. Bone

4. **Write short notes on three (3) of the following. (15)**
 - i. Bone formation
 - ii. Vertebral Formula of a pig.
 - iii. Definition of the terms indigenous and exotic cattle
 - iv. Muscles of the forelimbs

SECTION II: ANSWER ALL QUESTIONS

QUESTION 5 (25 Points)

(a) Draw a basic sketch of the Central Nervous System (CNS) and label the following:

- Cerebrum
- Cerebellum
- Pons
- Medulla oblongata
- Optic Chiasm
- Thalamus
- Hypothalamus
- Hypophysis
- Medullary body

(b) The brain has three coverings generally referred to as meninges. Briefly describe each of them.

QUESTION 6 (20 Points)

(a) With the help of a diagram, briefly describe the anatomy of a mammalian heart.

(b) Briefly describe the anatomy of pulmonary circulation.

QUESTION 7 (30 Points)

(a) Sketch the mammary gland of a cow and show the following parts:

- Streak canal
- Teat cistern
- Gland cistern
- Major duct
- Smaller duct
- Lobe
- Lobule
- Alveoli
- Epithelial cells

(b) In what position of the body do we find the mammary glands in the following species:

- (i) Sow
- (ii) Cow
- (iii) Goat
- (iv) Human

(c) The mammary gland is classified as a compound tubulo-alveolar gland consisting of a stroma, parenchyma, ducts, vessels, and nerves. Discuss the changes in the type of epithelium from the surface of the teat all the way to the alveoli.

QUESTION 8 (25 Points)

(a) With the help of diagrams, describe the anatomy of the uterus in the following domestic animals:

- (i) Mare
- (ii) Ewe
- (iii) Sow

(b) Describe the anatomy of the uterine wall.

END OF EXAMINATION
THANK YOU FOR BEING WITH US IN THE COURSE

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
2007 ACADEMIC YEAR FIRST SEMESTER FINAL EXAMINATIONS**

AGA 351 – ANIMAL SCIENCE FOR ENGINEERS

TIME : THREE (3) HOURS

INSTRUCTIONS: ATTEMPT ALL QUESTIONS

ANSWER THE TWO PARTS IN SEPARATE ANSWER

BOOKS

THE MARK FOR EACH QUESTION IS INDICATED

PART I

1. Identify the main anatomical differences between the digestive systems of a cow, a pig and a chicken. (15 marks)

2. Give an account of a female bird's reproductive system explaining how it is structured and how it functions. (15 marks)

3. Discuss sorghum as a livestock feed. (15 marks)

4. Identify and explain the potential negative attributes associated with the following ingredients for poultry feeding:
 - (a) Soybean meal
 - (b) Cottonseed meal
 - (c) Groundnut meal
 - (d) Fish meal
 - (e) Blood meal (15 marks)

PART II

1. i). Discuss the feeding of ;
a. Dry and Pregnant sows
b. Lactating sows

Please give reasons as to why the animals are receiving the stated amount of feed at each give stage of the reproductive cycle.

- ii). Explain the management of piglets from the time they are farrowed until weaning.

- iii). Why, how and when are the following operations are carried out in layers

- a. De-beaking
b. Culling

- iv). It is a well known fact that temperature regulation if very important to ensure optimum growth of broilers. What are the optimum temperature requirements and what practical things can you do to maintain the required temperature at each time.

(20 marks).

2. i). Name three common beef cattle breeds found in Zambia.
ii). What are the factors to consider when selecting cows and bulls for breeding?
iii). How can you know that a dairy cow is ready for mating.
iv). A farmer in Kasisi has been keeping his beef bull in the herd for the last 8 years and he has been mounting his daughters. What kind of breeding is this farmer practicing and what are the effects? What would you recommend and give reasons for your recommendations.

(20 marks)

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA
UNIVERSITY FIRST SEMESTER EXAMINATIONS.
SEPTEMBER 2007.
AGA 511 - TECHNIQUES IN ANIMAL SCIENCE.

TIME: 3 HOURS

INSTRUCTIONS: ANSWER ALL QUESTIONS. ANSWER EACH SECTION IN A SEPARATE ANSWER BOOK.

SECTION A

1. There has been a surge of interest in aquaculture in Zambia. This appears to have arisen following the commissioning of a new canning factory in Lusaka which has opened up possibilities for processing fish and presenting it as a canned product to consumers.

The Fisheries department has commissioned a study to test the response of the most famous local Tilapia species to locally manufactured pelleted fish feeds on fish yield. A fish biologist has advised that water temperature does affect fish growth and hence final yield. He then suggested that the study should be done in aquariums in which water will be maintained at 15^oC, 20^oC, 25^oC, 30^oC, and 35^oC. The suggested range of water temperature regimes for the study were for the purpose of simulating the probable temperatures the fish will be subjected to during culture. There are **five** local fish feeds to be tested in this research trial.

- a) Design an experiment that will provide information to the Fisheries Department
- b) State the null and alternative hypotheses and give the form of the ANOVA
- c) Comment on why you have chosen this type of design for this research trial.
- d) Suppose you decide to use six (6) replications, Give a complete form of the ANOVA giving sources of variation and degrees of freedom.
- e) Suppose at the time of harvest it has been observed that the number of fish in some aquariums has reduced from the **50** Fingerlings you originally placed in each treatment combination, clearly explain the statistical analyses you would use to take this variation in fish populations into account in data analysis
- f) How many aquariums would you need for this study?

SECTION B

3. You have just graduated with a bachelor of Agricultural Sciences Degree and you want to go into farming as a business.
 - a. How would you go about organizing the financing of your enterprise? Define a project cycle and explain its major components.
 - b. What part does the project/research proposal fit in when considering a project cycle?
 - c. Define a research or project proposal and briefly describe the importance of each component.
 - d. What are the major considerations when deciding the research topic?

SECTION C

4. You have been employed by Excellent Enterprises as the company Animal Nutrition and Production Specialist.
 - a. One of your responsibilities is to supervise the collection of samples of feed ingredients from delivery trucks. What procedure do you expect your workers to follow when collecting the samples? How do you expect the samples to be stored after collection and why should the samples be stored in the expected manner?
 - b. Another of your responsibilities is to ensure that good quality pig and poultry feed is produced at the feed mixing plant. The Zambia Bureau of Standards has formulated national standards which serve as minimum requirements for pig and poultry feeds. Write briefly on any five specifications and regulations you will expect to adhere to when producing the feeds.
 - c. Excellent enterprises also has a pig production out-grower unit. You are expected to give advice to farmers on the establishment and management of your clients' piggery units. Write on any five factors you expect to advise your clients to consider when establishing a piggery.

SECTION D

5.
 - a. Explain the merits and de-merits of using the nylon bag technique in assessing the value of animal feeds.
 - b. Body condition scoring is a subjective measurement based on the visual assessment of the animal:
 - i) What is the significance of body condition scoring cattle instead of monitoring weight changes in cattle through the use of scales?

- ii) What would be the condition score of beef cattle in Figures 1, 2 and 3? Discuss the factors that made you arrive at the scores. What do you think is the best score for beef cattle? Give reasons.
- c. Explain why the knowledge of blood, its composition and analysis is important in your training as a livestock specialist

SECTION E

6. a. The following livestock species have been known around the world to provide draught power: cattle, donkey, horses, mules, swamp buffaloes, camels, yaks. Make a comparison of the first three mentioned above as sources of animal draught power on farms in Zambia.
- b. What are the strategies for feeding work cattle to ensure they provide maximum amount of draught power?
- c. Free Fatty Acids and glucose are used during work. In a study of work animals, it was found that both these metabolites were used simultaneously during the first hour of work. Explain this finding.
- d. Oxen are said to work for less than 90 days in a year. Give suggestions as to how you would change things to make oxen more productive.

END OF EXAMINATION

THE UNIVERSITY OF ZAMBIA

THE SCHOOL OF AGRICULTURAL SCIENCES

2007 ACADEMIC YEAR – FIRST SEMESTER FINAL EXAMINATIONS

COURSE AGA 531 – TOPICS IN ANIMAL NUTRITION

TIME ALLOWED: THREE (3) HOURS ONLY

INSTRUCTIONS TO CANDIDATES:

- Answer question 1 and any three (3) others.
- Question 1 carries 40 marks and the rest carry equal marks (20 each).
- Clearly show all the calculations.

Q.1 Formulate a ration for beef cattle, with the help of the Pearson Square, containing 14% DCP and 75% TDN which must include 15% Natural Grass/Stylo Hay, 10% Maize Bran, 5% Sugarcane Molasses, 3% Soyabean Straw and 1% slack space for mineral premix, 1% slack space for salt (NaCl), 1% slack space for DCP, on dry matter basis. The table below may be used to answer the question (The feed analyses are on dry matter basis, i.e. moisture free):

FEED	DM%	DCP%	TDN%	Ca	P
Natural grass/Stylo	92	22.5	58	1.90	0.20
Maize bran	90	12.5	70	0.07	1.62
Molasses	75	-	85	1.19	0.11
Soyabean straw	88	25.0	65	0.69	0.06

Other available feedstuffs are:

Maize meal	89	10.0	88	0.03	0.31
Groundnut meal	95	43.0	90	0.18	3.62
Groundnut haulms	87	12.0	62	0.07	0.17
Lucerne hay	90	15.0	60	0.27	0.03

or

As a self-employed stock-feed consultant you have been requested by an emergent commercial broiler farmer who wishes to compound his own stock-feeds on the farm by use of the locally available feed ingredients. The decision was made upon acquiring a hammer-mill. Formulate a Broiler Ration for the second phase feeding in the three-phase feeding programme. The broiler ration should contain 2, 800 Kcal/kg metabolisable energy (ME), 20% digestible crude protein (DCP), 1% Lysine, 0.6% Methionine, 3.5% Calcium, 0.85% Phosphorus, 1% Broiler Premix (vitamins and minerals) and 0.5% Salt.

Provided is the following information on the available feed ingredients:

Ingredient	Composition					
	ME (Kcal/kg)	CP%	LYS%	Met%	Ca%	P%
Maize Meal	3,050	8.6	0.24	0.20	0.02	0.28
Soya-bean Cake	2,250	42.0	2.93	0.63	0.29	0.65
Tallow	8,000	-	-	-	-	-
Di-calcium Phosphate	-	-	-	-	26.0	18.0
Limestone Flour	-	-	-	-	38.0	-

(40 Marks)

2. The technicians at the Animal Science Field Station recently compounded Dairy Meal consisting of 60% Maize Meal, 20% Cottonseed Cake, 10% Sugar-cane Molasses and 10% Cassava Meal for the dairy cows. Calculate the quantity of the Dairy Meal that should be fed to provide sufficient energy to maintain a 530 kg empty Holstein cow that is losing 0.5 kg body weight per day two weeks post-partum and is being fed on 20 kg/day star-grass (*Cynodon plectostarchyus*) silage. The cow is producing 23 kg/day milk containing 3.8% butterfat (BF) and 9.2% solids-not-fat (SNF) per kg?

The following information may be used to answer the question:

	DM (g/Kg)	ME (MJ/Kg DM)
Sugar-cane Molasses	770	14.5
Cottonseed Cake	920	13.0
Maize Meal	870	12.5
Cassava Meal	870	12.0
Star-grass Silage	300	8.5

- b) Calculate the anticipated peak milk yield of the cow above.
- c) If the Cow in 1 a) above was actually in mid-lactation and there was no live-weight change in her body weight, how much concentrate mixture should she be fed?
- d) If the Cow in 1 a) above was actually in late lactation and was gaining 0.25 kg per day, how much concentrate mixture should she be fed?
- e) Using the Rapid Formulation Method calculate the forage and concentrate dry matter intake of the Holstein cow in 1 a) above?

(20 Marks)

- Q.3 The digestibility of forages affects the dry matter intake (DMI) of such forages by ruminant animals. However, the DMI of such forages determines the ruminant animals' productivity. Discuss the following:

- The methods that can be used at Liempe Farm to increase the digestibility of hay during the dry season;
- The advantages fore-stomach fermentation as opposed the hind-gut fermentation; and
- Discuss the characteristics of ruminant digestion and the functions of rumen microbes.

(20 Marks)

Q.4 a) Chemical and biological methods are used to assess the protein value of protein feeds. The following data was recently collected from the Animal Science Field Station upon the feeding of fish meal to rats:

- ✓ Daily dry matter intake = 6.00 grams
- ✓ Percent nitrogen in the feed, on dry matter basis (dmb) = 1.043
- ✓ Daily urinary output = 10.0 mls containing 3.25 mg total nitrogen per ml and 2.2 mg endogenous nitrogen per ml.
- ✓ Daily dry matter faecal output = 5.0 grams containing 4.18 mg per gram total nitrogen and 2.14 mg per gram metabolic faecal nitrogen, on dry matter basis.

Calculate the True Biological Value of the fish meal supplement.

- Feedlot fattening is commonly adopted in commercial beef production in order to ensure that steers finish on time with adequate muscles and some fat cover. How much is a Brahman steer weighing 320 kg expected to perform (grow) in the feedlot if it is fed on a daily ration consisting of the following feed-stuffs:

10.0 kg Maize Silage (300 g/kg DM, 8.6 MJ/kg DM)
 7.0 kg Maize Meal (850 g/kg DM, 12.5 MJ/kg DM)
 3.0 kg Cane Molasses (270 g/kg DM, 13.0 MJ/kg DM)

- A beef steer on dry season grazing (September) will lose weight unless it is supplemented. From the information below calculate the minimum amount of the concentrate mixture consisting of 60% Corn and Cob Meal, 20% Soya-bean Meal, 10% Cassava Meal and 10% Sugar-cane Molasses that is needed to maintain its body weight given the following:

The weight of the beef steer is 300 kg
 Dry matter intake (DMI) is 1.5% of its' body weight.

FEED COMPOSITION:

	DM%	ME (MJ/Kg DM)
Dry season grazing	90	5.8
Corn and Cob Meal	96	12.0
Soya-bean Meal	96	13.0

Cassava Meal	87	12.0
Sugar-cane Molasses	77	13.5

(20 Marks)

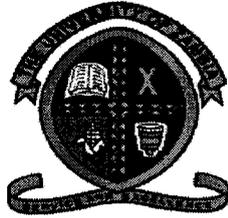
Q. 5 Write notes on the following:

- a) The limitations in the use of any five commonly used local feed ingredients in pig and poultry rations;
- b) The causes of Hypocalcaemia and the methods of prevention and treatment on farms;
- c) The Tilley and Terry Method of estimating the digestibility of forages; and
- d) The effects of Cyanogenetic glucosides and glucosinolates in animal feeds.

(20 Marks)

The following may be used to answer the questions:

- i. $EVI = 0.0386 BF + 0.0205 SNF - 0.236$
- ii. $DMI = 0.025 W$
- iii. $Eg = \frac{MEP \times 0.0435 M/D}{1.05}$
- iv. $LWG = \frac{Eg}{6.28 + 0.3 Eg + 0.0188 W}$
- v. $DMI = 0.025 W + 0.1 Y - 2.5$
- vi. $FD = \frac{DMI (MC - M/D)}{(MC - MF)}$
- vii. $Mm = 8.3 + 0.091 W$
- viii. $MI = \frac{EVI \times 1.05}{0.62}$
- ix. $KI = \frac{0.0435 M/D}{1.05}$ or $0.0414 M/D$
- x. $DMI = 0.025 W + 0.1 Y$



THE UNIVERSITY OF ZAMBIA
SCHOOL OF AGRICULTURAL SCIENCES
DEPARTMENT OF CROP SCIENCE
FIRST SEMESTER EXAMINATIONS, AUGUST 2007
AGC 211: PRINCIPLES OF CROP PRODUCTION

TIME ALLOWED: 3 HOURS

INSTRUCTIONS

- (1) Answer all Questions**
 - (2) Marks as indicated**
-

Question 1 (15 Marks)

- A. How is Goal 6 of Millennium Development Goals likely to be achieved with improvements in agricultural production?
- B. Briefly describe:
 - i. Nutrient depletion,
 - ii. Root absorbing and nutrient absorbing power.
- C. What is the importance of the following in plant growth and development:
 - i. Temperature,
 - ii. Water.
- D. Briefly describe the major mechanisms of plant nutrient uptake.

Question 2 (25 Marks)

- A.
 - i. Describe three methods for soil moisture measurement and state their advantages and disadvantages.
 - ii. Describe the underlying principles in the soil measurement methods.
- B. Table 1 shows water content distribution profiles for two different crops in the same field, Crop 1 and Crop 2. Plant nutrition status as well as physical and chemical characteristics of the soil were identical for the two crops. Initially, both sites were adequately irrigated and the soil water content was brought to field capacity.
 - i. Explain why soil moisture measurements are taken at a depth greater than 10 cm.
 - ii. Calculate the change in water storage of the two crops after 2 weeks
 - iii. Which crop was drawing more water and at what depth?

Table 1: Soil water distribution profiles under different crops.

Depth Z (cm)	Initial Θ (cm ³ /cm ³)	After 2 weeks Θ (cm ³ /cm ³) Crop 1	After 2 weeks Θ (cm ³ /cm ³) Crop 2
10	0.50*	0.40	0.38
20	0.55	0.44	0.39
30	0.54	0.46	0.36
40	0.52	0.48	0.40
50	0.52	0.48	0.40
60	0.52	0.52	0.44
70	0.50	--	0.46
80	0.47	--	0.46
90	0.45	--	0.46
100	0.45	--	--

*Measured using gravimetric method

Question 3 (20 Marks)

- Describe the role of nitrogen, boron and molybdenum in plant growth and development.
- How is their uptake by plants affected by soil pH?
- With the aid of a diagram explain why there is greater primary root elongation (mm) of young wheat plants within 72 hours in nutrient solution at a lower pH of 4.0 compared to a higher value of 4.5 as shown in Table 2 below.

Table 2: Effect of aluminium in nutrient solution on wheat root growth

pH	Al (ppm)			
	0	2	4	6
4.0	85	41	20	7
4.2	89	36	7	2
4.3	88	31	0	0
4.5	81	2	0	0
4.7	87	38	31	25

Question 4 (20 Marks)

- Some 85 – 95% of the dry matter of plants is carbonaceous. How is this plant material derived from photosynthesis?
- How can the process be optimized under small-holder and commercial farming conditions?

Question 5 (20 Marks)

- Give the family and scientific names of the crops maize, cotton and common beans
- What are their places of origin?
- What adaptations of the given crops were required for Zambian climatic conditions?
- Briefly describe their morphological features.
- What is the importance of these crops to the country?

END OF EXAM