



UNIVERSITY EXAMINATIONS

NJORO CAMPUS

SECOND SEMESTER 2011/2012

FOURTH YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF

SCIENCE IN AGRICULTURAL ENGINEERING

AGEN 443: AGRICULTURAL PROCESS ENGINEERING II

STREAM: 2008 (Y4) AGEN

TIME: 2 hours

DAY/TIME: THURSDAY, 08.00 – 11.30 AM

DATE: 10/05/2012

INSTRUCTIONS:

1. The paper consists of **FOUR (4)** questions.
 2. Attempt **ALL** questions.
 3. All questions carry equal marks.
 4. Marks for each question are shown in parenthesis.
 5. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE.**
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QUESTION ONE

(a) Define the following terms used in agricultural process engineering.

- (i) PHFL. (3 marks)
- (ii) Post-harvest.
- (iii) Processing. (3 marks)

(b) Briefly explain the food processing and preservation systems constraints and the possible solutions in developing nations, Kenya included. (3 marks)

(c) Discuss the economic, social and technological implications of PHFL. (6 marks)

(d) Differentiate between the terms drying and dehydration. (2 marks)

(e) Briefly discuss the operation of any two commonly used types of dryers in the current market stating the advantages and disadvantages of each. (6 marks)

QUESTION TWO

(a) Discuss how the following drying parameters affect the rate of drying.

- (i) Wet bulb temperature.
- (ii) Relative humidity (RH).
- (iii) Air flow rate.
- (iv) EMC.

(8 marks)

(b) A baffle dryer for dehydrating corn flakes takes in air at 20 °C into its heating unit from the ambient air. At the exit of the heating chamber the air is at 32 °C and 0.013% moisture content. The corn flakes for dehydration are put in the chamber and they are dehydrated with the hot air. The exhaust air is at a temperature of 24 °C.

- (i) Comment on the suitability of the drying temperature.
- (ii) Deduce the RH of ambient air.
- (iii) Deduce the RH of the exit air.
- (iv) Calculate the amount of heat required for this processing task.
- (v) Calculate the moisture change of the drying air.

(2 marks)

(2 marks)

(2 marks)

(3 marks)

(3 marks)

QUESTION THREE

(a) Briefly discuss the following steps in sugar cane processing

- (i) Evaporation.
- (ii) Crystallization.

(6 marks)

(b) What is maceration in tea processing and what is its importance?

(1 mark)

(c) Quality starts from the farm to the fork. Discuss this statement with reference to tea processing.

(4 marks)

(d) Explain the importance of trade organizations such as Oxfam and Fairtrade in the long term sustainability of exported processed commodities from third world countries such as coffee.

(2 marks)

(e) A resistance transducer used for analysis of moisture content of ground coffee has the following relationship with the sample weights. The initial weight of the samples before the analysis was 34.6 g.

Sample	1	2	3	4	5	6	7	8
Weight (g)	24.5	22.6	26.1	24.8	27.9	25.2	23.8	27.8
Transducer(Ω)	700	900	400	600	200	500	800	300

- (i) Briefly explain the suitability of this moisture transducer for measuring moisture content detailing its shortcomings. **(2 marks)**
- (ii) Detail how you would go about converting this transducer into a coffee moisture meter.
(Hint: calibration test results should be shown). **(5 marks)**

QUESTION FOUR

- (a) Briefly describe the oil extraction process in Olive oil processing. **(3 marks)**
- (b) Discuss the operation of the crucial components of a cold storage system. **(8 marks)**
- (c) How does a cold atmospheric storage (CA) system help in post-harvest operations of perishable agricultural products? **(2 marks)**
- (d) What safety considerations should be built in the design of a cold store? **(2 marks)**
- (e) A fish cold storage facility has the following design parameters specified by the manufacturer.
- The dimensions are 25 m by 4 m by 10 m.
 - The insulation foam is of a thickness of 0.25 m with an external surface area of 771.5 m².
 - The maximum ambient temperature for the region is 35 °C.
 - The cold store is to operate at a temperature of -30 °C.

Calculate the heat load in the cold store based on the assumptions that:

- The conductivity of insulation foam is 0.033 kcal/m-hr-°C.
- An average of 2.7 air changes is done every 24 hrs.
- 5 lights with a rating of 200 W are on during a working day.
- No persons are present during a working day.
- No defrost heat recovered.
- AC fans are off.
- 5.5 kcal/kg for fish load at an average temperature of -20 °C.
- Fish loaded per day 35,000 kg. **(5 marks)**