

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND CONSUMER**  
**STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**First Semester 2007/2008 Session**  
**January, 2009**

**FTD 709:** Food Engineering Operation 1

**Time Allowed:** 2½ Hrs.

**INSTRUCTION**

*Answer any four (4) questions.*

1.
  - a. With the use of schematic diagram, describe the basic components of a fluid flow system and their functions.
  - b. In what ways are centrifugal pumps different from positive displacement pumps?
  - c. Use a schematic diagram to show the direction of two fluid streams flowing in
    - (i) concurrent
    - (ii) Counter current and
    - (iii) Cross flow patterns.
  - d. What are the basic considerations you would make in choosing a suitable pump for use in a fluid transport system in a food manufacturing setup?
  
2.
  - a. What is/are the main purpose(s) of thermal processing of foods?
  - b. Explain the difference between sterilization and pasteurization
  - c. With the aid of a graphic sketch show how temperature affect the decimal reduction time (D-value) for an organism.
  - d. Determine the D-value for the microorganism when given the following thermal resistance data for a spore suspension. Use either graphical or calculation method.

Time (min)	Number of survivors
0	$10^6$
15	$2.9 \times 10^5$
30	$8.4 \times 10^4$
45	$2.4 \times 10^4$
60	$6.9 \times 10^3$

How long will it take the initial population of the same microorganism to reduce by 99.999%.

3.
  - a. The following empirical relationships are used to calculate the thermal conductivity (k) and specific heat (Cp):  
 Capacity (Cp)  

$$K = 0.25M_c + 0.155M_p + 0.16M_f + 0.135M_a + 0.58M_m$$

$$C_p = 1.424M_c + 1.549M_p + 1.675M_f + 0.837M_a + 4.187M_m$$
 Where subscript c, p, f, a and m represent carbohydrate, protein, fat, ash and moisture content respectively. Use above information to complete the table below:

Food Item	Water (%)	Protein (%)	Fat (%)	CHO (%)	Ash (%)	K ( $\frac{w}{m^{\circ}C}$ )	Cp ( $\frac{J}{kg^{\circ}C}$ )
Whole milk	87.4	-	3.5	4.9	0.7	-	-
Potatoes	79.8	2.1	0.1	17.1	-	-	-
White bread	-	8.7	3.2	-	1.9	0.514	3.906

- b. How much of heat energy would be required theoretically to heat 2kg of whole milk from  $4^{\circ}\text{C}$  to  $37^{\circ}\text{C}$ ?
4. a. (i) Write the mathematical expression of Fourier's law of heat conduction. What is the essential condition for this law to hold in a heat transfer process? State all the parameters in it and their SI units.
- (ii) Mention three examples of food procession operation where heat conduction is the main mode of heat transfer.
- b. A cold storage wall (3m x 6m) is constructed of 15cm thick concrete ( $k = 1.37\text{W/m}^{\circ}\text{C}$ ). An insulation of about 0.043m thick is required to the heat transfer rate across the wall at or below 500w. If the outside and inside surface walls are  $38^{\circ}\text{C}$  and  $5^{\circ}\text{C}$ , respectively, which of the following materials should be chose and why?
- (i) Insulator A ( $k = 0.05\text{ W/m}^{\circ}\text{C}$ ) (ii) Insulator B ( $k = 0.03\text{ W/m}^{\circ}\text{C}$ ).
5. a. (i) What is meant by forced convection?
- (ii) Write out all the important dimensionless numbers used in solving convective heat transfer problems. State all the parameters in each with their S.I units.
- b. Water flowing at a rate of 0.02kg/s is heated from 20 to  $70^{\circ}\text{C}$  in a horizontal pipe (inside dia. = 2.5cm). The inside pipe surface temperature is  $100^{\circ}\text{C}$ . Determine the heat transfer coefficient.

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STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FTD 707:** Human Nutrition I

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer any four (4) questions.*

1.
  - a. Define the following terms: Nutrition, Hyperglycemia, Glycogenolysis, Gluconeogenesis, Glycogenesis, Lipogenesis, Basal metabolism, RQ, Nitrogen Balance, Mental retardation.
  - b. Draw a well labeled diagram of the digestive tract.
2.
  - a. Of what importance is Nutrition?
  - b. Explain the carbohydrate metabolism
  - c. Group the 20 aminoacids into essentials and non-essentials.
3.
  - a. Explain the factors which leads to variation in energy requirement of individuals.
  - b. Convert: (i) 200kcal (ii) 40kcal to kilojoule,  
Convert: (i) 400 kilojoules (ii) 10500 kilojoules to kcal.
  - c. What are the RQ of starch, animal fat and protein
4.
  - a. What are the energy expenditure of the following activities: Ironing, standing at ease, digging, sweeping the floor and lying at ease.
  - b. Using the chemical equation of sugar (glucose) breakdown during respiration, calculate the amount of heat energy generated for 1gram of sugar and 1 litre of oxygen, given that heat generated during the reaction is equivalent to 2.78MJ.
5.
  - a. Write out the reaction products and the digestive enzymes of the following: starch, sucrose, maltose, fat and peptides.
  - b. If a food item contains 500g of carbohydrate, 300g of protein and 200g of fat, what is the availability percentage for each nutrient and total energy content of the food item to the body.
  - c. What are the differences between marasmus and kwashiorkor.
6.
  - a. Highlight the uses of Recommended Dietary Allowances.  
If 2 slices of toasted bread and 2 fried eggs could provide 110 calories and 220 calories; 4g and 14g protein; 4g and 16g fat; 32mg and 102mg calcium; 0.08mg and 0.12mg vitamin B<sub>i</sub> respectively. How much of these nutrients will 3 slices of toasted bread and 4 fried eggs provide.

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CONSUMER STUDIES  
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**Postgraduate Degree Examinations**  
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**FTD 705:** Food Microbiology

**Time Allowed:** 2 Hrs. 30mins

**INSTRUCTION**

*Answer any three (3) questions.*

1. a. Describe fully the principles and techniques of food preservation
2. a. Define the following:
  - (i) Microbiological specification
  - (ii) Microbiological standard
  - (iii) Microbiological guidelines
  - (iv) Microbiological criteria
  - (v) Microbiological quality
- b. Briefly explain why experimentation with anthrax as a biological weapon has been common.
3. Write a brief essay on some bacteria of importance in the food industry.
4. a. Enumerate the 10 least wanted food borne pathogens in the food industry.
- b. Compare and contrast the pathogenesis of
  - (i) *Campylobacter jejuni*
  - (ii) *Shigella spp*
  - (iii) *Listeria monocytogenes* and
  - (iv) *E. coli 0157:H7*

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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FTD 711:** Food Chemistry & Biochemistry      **Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer four questions in all. Two questions from each section.*

**SECTION A**

1.
  - a. Using equations ONLY, explain in details the mechanism of reaction of auto-oxidation in a fatty food material.
  - b. Briefly explain the various factors affecting non-enzymic browning in food materials.
  - c. What factors governs the rate of auto-oxidation common in a high fatty food materials.
2.
  - a. Clearly discuss the roles of the following enzymes in food processing:
    - (i) Ortho-diphenol oxygen oxidoreductase
    - (ii) Alkaline phosphatase (ALP)
    - (iii) Lipooxygenase (LOX)
    - (iv) Pectinase (PEC)
  - b. Itemize the major roles of lipids in food materials.
  - c. With the aid of equations ONLY, explain the basic steps in enzymic browning occurring in a yam tuber.
3.
  - a. Discuss briefly, the post mortem glycolysis in meat structure.
  - b. What are the various ways in which enzymic browning can be controlled in a food materials.
  - c. Explain briefly how browning causes deteriorative changes in dried fruits and vegetables.

**SECTION B**

1.
  - a. Draw the structures of glucose showing the Fischer Formula, Haworth Formula, Conformational Formula, D- & L- series and  $\alpha$ -D- and  $\beta$ -anomers.
  - b. Describe the properties and food applications of the following polysaccharides – starch, gums, pectic substances and cellulose.
2.
  - a. What is denaturation of proteins? Describe the causes and effect of denaturation.
  - b. Distinguish between animal proteins and plant proteins.
  - c. What are the functional properties of proteins?
3.
  - a. Distinguish between four (4) classes of food pigments.
  - b. Describe the properties of sugars.

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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FTD 701:** Seminar, Experimental Design and Report Writing      **Time Allowed:** 1Hr.30min.

**INSTRUCTION**

*Answer all questions.*

1. Enumerate the characteristics of the following audience types and mention how these should influence the style of communication (oral and written) by a Scientist
  - a. Peer audience
  - b. Non specialist audience
  - c. Mixed audience
  - d. International audience
  
2.
  - a. Mention and explain briefly 3 ways by which a research idea can be conceived.
  - b. Examine the different stages in a scientific research process and identify three stages you consider as most critical to the success of the research. Give reasons for your choice.
  
3. Differentiate between the following types of publication.
  - a. Journals and Text books
  - b. Bulletins and Newsletter
  - c. Reviews and Book of Abstracts
  - d. Proceedings and Reviews.
  
4.
  - a. What should be the contents of the following parts of a research report.
    - (i) Introduction
    - (ii) Results and Discussion
    - (iii) Abstract
  
  - b. Differentiate between the Havard system and Numbering style of reference citations.

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**Postgraduate Degree Examinations**

**First Semester 2006/2007 Session**

**September, 2007**

**FTD 703: Fundamentals of Food Processing      Time Allowed: 2 Hrs.**

**INSTRUCTION**

*Answer four questions in all. Two questions from either section.*

**SECTION A**

*Answer two questions only from this section.*

1.
  - a. Concisely explain the various stressful conditions to which animals may be subjected to prior to slaughtering. How could these stresses be avoided.
  - b. Using a clear and concise flow chart, discuss the major steps in the production of pasteurized milk from fresh whole milk.
2.
  - a. Sweetened yoghurt is a product obtained from fresh milk. Discuss in a clear manner, the major unit operations in its production.
  - b. Discuss in details the importance of roots and tubers to the inhabitants of the tropics.
3.
  - a. Clearly explain the various methods of animal slaughtering you know. Highlight various ways of meat preservation.
  - b. What are the factors affecting storability of roots and tubers.
  - c. What do you understand by primary and secondary deterioration in cassava. How do these conditions affects the usefulness of the crop.

*P.T.O*



## SECTION B

*Answer two questions only from this section.*

1. a. List five materials desirable for canning food.
- b. The following data were generated in a fish canning experiment to establish the  $F_0$  during a process for 80 min at 121.1°C within 10 min intervals:

Time (min)	Temperature (°C)
0	24.0
10	34.2
20	72.5
30	98.0
40	110.5
50	117.2
60	120.3
70	106.0
80	70.0

Using the data above, calculate:

- i. lethal rate and cumulative lethal rate at each time - temperature combinations.
  - ii.  $F_0$  values at each time - temperature combinations.
  - iii.  $F_0$  for the whole process.
2. a. Discuss in detail the potential of legumes in alleviating the problems of protein energy malnutrition in Nigeria.
  - b. Explain the following as used in food canning:
    - i. Maintaining colour and flavour in canned foods
    - ii. Advantages of hot packing
    - iii. Controlling head space
3. a. With the aid of well structured flow chart, describe in detail, the processing of the following:
    - i. Protein isolate from soybean.
    - ii. Any three traditional maize products.
  - b. What are the processing and nutritional merits of Quality Protein Maize (QPM).

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**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 705:** Dairy Products Technology

**Time Allowed:** 2 Hrs. 30mins

**INSTRUCTION**

*Candidates are to answer four (4) questions only.*

1.
  - a. Discuss the factors responsible for milk composition variations.
  - b. Discuss the importance of microflora in milk and dairy products.
2.
  - a. With the aid of flow chart diagrams only, differentiate the stages involved in yoghurt and warankashi production.
  - b. Describe 3 elemental mil testing techniques that you know.
3.
  - a. What are the problems and prospects of the Nigerian dairy industry? Offer suggestions on how to improve the performance of this sector of the Nigerian economy.
  - b. Write a short essay on milk analogues.
4.
  - a. Discuss the reasons why nutritionists have often claimed that “milk nearly approaches the perfect food for humans”.
5.
  - a. How would you make a comparatively cheap but competitively good quality ice-cream through choice manipulation of some of the ingredients of ice-cream.
  - b. Write a short essay on the nutritional aspect of milk proteins.

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CONSUMER STUDIES  
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**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 709:** Special topics in food microbiology

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Candidates are to answer four (4) questions only.*

1. Write an essay on microorganisms of importance in the food industry.
2. Discuss the nature, symptoms, pathogenesis and control of a named food intoxicant that can be encountered in the food industry.
3. a. Discuss the methods and techniques for the differential isolation of the following major group of organisms.
  - (i) *Coliforms*
  - (ii) *Staphylococci*
  - (iii) *Feacal streptococci* and
  - (iv) *Salmonella/shigella organisms*
- b. Discuss the ideal method of sampling of a cocoa warehouse.
4. Discuss the factors responsible for the growth and survival of microorganisms in foods.
5. a. Briefly differentiate between the following types of fermentation with specific food types.
  - (i) Alcoholic fermentation
  - (ii) Lactic acid fermentation
  - (iii) Solid substrate fermentation
- b. Discuss the health benefits of lactic acid fermented foods.

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CONSUMER STUDIES  
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**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 707:** Advanced Quality Control and Assurance

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer four (4) questions only.*

1. Explain the following terms:
  - a. Food Standards
  - b. Total Quality Management
  - c. HACCP
  
2. What would be your main considerations in the choice of quality test methods for the following items: (i) Bean cake (ii) Plantain chips (iii) Instant fufu flour (iv) Meat Sausage (v) Tomato puree.
  
3. A number of constraints that militate against effective food sanitation programme in Nigeria have been identified. What are these constraints and what preventive measures would you recommend?
  
4.
  - a. Highlight importance of statistical quality control in the food industry.
  - b. Explain differences from the following items:
    - (i) Variables and attributes
    - (ii) SQC and SPC
    - (iii) Random and assignable variations
    - (iv) QC and QA
    - (v) Single and double sampling plant
    - (vi) Variable and attribute charts.
  
5. Write short notes on Automation, Principles and Applications as applied to the Food Processing Industry.

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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 719:** Development in root crops and pulses technology      **Time Allowed:** 2 Hrs.30m

**INSTRUCTION**

*Answer four (4) questions only.*

1.    a.    Show the raw material characteristics of cassava and yam that are relevant to opportunity identification, in a tubular form.
- b.    Highlight the process transformation of roots and tubers.
- c.    What are the processing methods used to substantially detoxify HCN in cassava roots to a safe level before consumption.
  
2.    a.    Differentiate between cassava flour, cassava starch and cassava meal.
- b.    Describe the following cassava products: (i)      *Farinha de mandioca*  
          (ii)    Cassava bread            (iii)    Cassava rice
- d.    Enumerate the application speciality of potatoes starches, indicating the food product category and their functions.
  
3.    a.    Describe the AVEBE starch products and their main areas of applications.
- b.    Briefly explain the journey so far on cassava initiatives in Nigeria.

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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 703:** Advanced Food Technology      **Time Allowed:** 2 Hrs

**INSTRUCTION**

*Answer four (4) questions in all. At least one question from each section.*

**SECTION A**

1. a. Explain the following terms:
  - Freezing
  - Ice crystal formation
  - Solute concentration
  - Volume change
- b. Explain freezing equipment with at least 2 examples in each category.
2. Discuss the principles and applications of centrifugation and filtration in the food industry.

**SECTION B**

3. A fermented liquor with a specific gravity of 1.042 and a viscosity of  $1.40 \times 10^{-3} \text{Nsm}^{-2}$  contains 1.5% solids which have a density of  $1160 \text{kgm}^{-3}$ . It is clarified at a rate of  $240 \text{h}^{-1}$  in a bowl centrifuge which has an operating volume of  $0.09 \text{m}^3$  and a speed of 10,000 rev/min. The bowl has a diameter of 5.5cm and is fitted with a 4cm outlet. Calculate the effect on feed rate of an increase in a bowl speed to  $30000 \text{revmin}^{-1}$  and the minimum particle size that can be removed at the higher speed.
4. a. Use suitable diagrams to explain the theory of food dehydration.  
    b. Sketch and label any (one each) commercial dryer suitable for classification under:
  - (i) Solids and pastes
  - (ii) Solutions and slurries

**SECTION C**

5. a. Define the following unit operations and briefly explain their significance in Food processing and manufacture.

- (i) Mixing                      (ii) Forming
  - b. Describe briefly the operation of a named equipment each for mixing and forming.
- 6.
- a. What is emulsification? Name and describe the basic types of emulsion.
  - b. Discuss the application of emulsification in three food systems.

#### **SECTION D**

7. Using specific examples, discuss in details the effect of frozen storage on the physical, chemical, biochemical, nutritional and organoleptic properties of a food material.

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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 715:** Food Plant Design and Machinery

**Time Allowed:** 2 Hrs

**INSTRUCTION**

*Answer four (4) questions only.*

1. Discuss principles for selection of materials of construction for food processing equipment. What are the basic hygienic design of food plant?
2.
  - a. Explain Mixers
  - b. With schematic illustration, explain main features of (i) Hammer mill and Roller mill (ii) Anchor-gate agitator and Ribbon mixer.
3. Explain design, fabrication, operation and maintenance of cassava processing machinery.
4. How do you classify freezers? What are factors of importance for selection of freezers. Sketch features of plate freezer or Liquid-nitrogen freezer.
5. Draw the following food based machinery:
  - a. Flat-blade agitator
  - b. Drum driers
  - c. Vertical short-tube evaporator
  - d. Mechanical (compression-expansion) refrigerator
  - e. Pin and disc mill



**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
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CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 733:** Automatic Control Devices

**Time Allowed:** 2 Hrs

**INSTRUCTION**

*Answer four (4) questions only.*

1. Discuss the following terms:
  - a. Automation
  - b. Process control
  - c. Quality control
  - d. Sensors
  - e. Block diagram
  
2. Explain the following items;
  - a. Steady state
  - b. Unsteady state
  - c. Controller
  - d. Feed back control
  - e. Transient responses
  - f. Interacting and non-interacting system
  
3. Define laplace transformation.  
Find the laplace transform of (i)  $f(t) = k$  (ii)  $f(t) = \sin \omega t$   
Find the laplace transform of  $\cos \alpha t$  without carrying out the integration procedure.
  
4.
  - a. Find the inverse transform of:  $S / (S^2 - 2S + 5)$
  - b. Explain the following terms:
    - (i) Transfer functions
    - (ii) Forcing functions
    - (iii) Step function
    - (iv) Impulse function
    - (v) Ramp function
    - (vi) Sinusoidal function
  
5.
  - a. A mercury thermometer having a time constant of 0.1min is at steady state temperature of  $90^{\circ}\text{C}$ . At time  $t = 0$ , the thermometer is placed in a temperature bath maintained at  $100^{\circ}\text{C}$ . Determine the time needed for the thermometer to read  $98^{\circ}\text{C}$ .
  
  - b. A tank having a time constant of 1min and a resistance of  $1/9\text{ft}^3/\text{cfm}$  is operating at steady-state with an inlet flow of  $10\text{ft}^3/\text{min}$ . At time  $t = 0$ , the flow is suddenly increased to  $100\text{ft}^3/\text{min}$  for 0.1min by adding an additional  $9\text{ft}^3$  of water to the tank uniformly over a period of 0.1min. Plot the response in tank level and compare with the impulse response.

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**M.Sc. Degree Examinations**  
**First Semester 2006/2007 Session**  
**September, 2007**

**FST 721:** Topics in Raw Material Sourcing

**Time Allowed:** 3 Hrs.

**INSTRUCTION**

*Candidates are to answer four (4) questions only.*

1. Write an essay on:  
Food raw material sourcing – A potential source of employment for young food science and technology graduates.
2.
  - a. Define the term “sourcing policy” and highlight the expected characteristic features of a good food raw material sourcing policy.
  - b. Explain how the following forms/books may be used in relation to sourcing of an industrial food raw material:
    - (i) Local Purchase Order (LPO)
    - (ii) Product/Material Examination Report Form
    - (iii) Tenders Quote Form
    - (iv) Goods Received Note (GRN)
  - c. What is the importance of quality specification and assessment in food raw material sourcing.
3.
  - a. Describe the different methods of sourcing food raw materials and indicate their strengths and weaknesses. Give examples in the Nigerian food and agro-allied industries to illustrate your answer.
  - b. Highlight the qualities of a good food raw material sourcing agent.
  - c. As a food raw material sourcing agent, describe the steps you would take to ensure a good price and quality of maize grains meant for baby food.
4. Write short notes on the following:
  - a. Relevance of HACCP to food raw material sourcing.
  - b. Minimum stock re-order levels as related to industrial food raw material sourcing.
  - c. Differential pricing mechanism in food raw material sourcing.
5. Discuss in detail, the social, economic and technical implications of sourcing industrial food raw materials locally and through importation in Nigeria.

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STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
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**September, 2007**

**FTD 713:** Food Packaging Techniques

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer any four (4) questions.*

1.
  - a. Give a brief outline of various traditional packaging materials available in Nigeria.
  - b. What are the advantages and constraints involved in the use of leaf as a packaging material? Do you foresee a bright future for leaf as a food packaging material in Nigeria? Illustrate your answer with appropriate examples in food processing and packaging.
2. “Dimension and finish” are important factors used to choose a glass meant for food packaging.
  - a. Explain the term “Dimension and finish”.
  - b. Which other factor(s) apart from 2(a) above should be considered before choosing a glass container as a food packaging material? Indicate the relevant factors you would consider in choosing a glass container for (i) Pasteurized milk (ii) Beer (iii) Jam/Mamalade (iv) Carbonated fruit juice.
  - c. Highlight the merits and demerits of glass as a food packaging material.
3.
  - a. Polyethylene plastic films are among the most widely used packaging materials for retail food products in Nigeria today. Highlight the desirable properties of this group of packaging materials and indicate the problems associated with their usage.
  - b. Describe two(2) different laboratory tests that you would use to determine the physical stability of polyethylene films.
4.
  - a. Describe how you would select an appropriate package criteria and draft specifications for a newly developed food sample.
  - b. Discuss the various factors that can affect the choice of packaging technique for a manufactured food.
5. Write short notes on the following:
  - a. Limitations of paper as a food packaging material.
  - b. Can defects.
  - c. Quality assurance in package design.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**PDQ 710:** Operations Research

**Time Allowed:** 2Hrs.

**INSTRUCTION**

*Answer four (4)*

1. Explain the meaning, nature, uses, limitations and methodology of operations research in a food industry.
2. Briefly discuss the following terms:
  - (a) Modeling
  - (b) Classification of models
  - (c) Model constraints
  - (d) Steps in using models to solve problem
  - (e) Uses of linear programming

3. A farmer was instructed to supply the following minimum qualities of corn to UNAAB Consult flour miller: 180 tons of white corn, 149 tons of yellow, 96 tons of others. The farmer operates from 3 farms A, B, and C. The units of grains delivered on each trip from A, B and C are shown in the table below:

<b>Farm</b>	<b>White</b>	<b>Yellow</b>	<b>Others</b>
A	3	14	8
B	2	18	3
C	4	20	5

Given that each trip from A, B and C cost 500, 600 and 700, respectively. Formulate the linear programming problem involving number of trips for each of A, B and C that will minimize the total cost.

- 4 (a) State the objectives and assumptions of using the transportation model.
- (b) Using the North West Corner Method, allocate the cows in such a way as to minimize the cost of transportation and find the minimum cost using the table below:

<b>Sources</b>	<b>Lagos</b>	<b>Akure</b>	<b>Awka</b>	<b>Supply</b>
Sokoto	90	85	70	600
Kano	175	110	95	1400
Maiduguri	205	190	130	1000
Demand	1600	1050	350	

1. Discuss the objectives, phases and components of decision analysis in the food industry. Draw a decision tree of:

0.6

$$\begin{array}{l} d_1 \\ d_2 \end{array} \left[ \begin{array}{cc} 100 & -20 \\ 70 & 10 \end{array} \right]$$

Explain Bayes Decision rule. Quality control Department of UNAAB Foods has observed that defective items produced by a machine could be caused by human error or mechanical error. 75% of defective items are caused by mechanical error while the remaining 25% is caused by human error. 60% of defective items observed to be caused by mechanical problems have been identified while only 35% of those caused by human error has been detected. An item selected by the Quality Control Manager was found to be defective. What is the probability that the defective item was caused by (a) human error (b) mechanical error.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 714: Advanced Process Engineering**

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer four (4)*

1. Discuss the principles, operations and maintenance of pneumatic conveying system. A solid object of  $8\text{kg/m}^3$  is being conveyed pneumatically in a smooth pipe of  $15\text{m/s}$  and diameter of  $10\text{mm}$ . Calculate the fanning friction factor with velocity of  $2.8\text{ Pa.s}$  and  $n = 2$
  
2.
  - (i) Graphically explain a steam plant.
  - (ii) Explain the principle, operations and types of Boiler in the food Industry.
  - (iii) A boiler working at a pressure of  $1.4\text{ Mn/m}^2$  evaporates  $8\text{kg/kg}$  coal fired from feed water entering at  $39^\circ\text{C}$ . The steam at the stop valve is  $0.95$  dryness. Determine the equivalent evaporation, from and at  $100^\circ\text{C}$ , in  $\text{kg steam/kg coal}$ . Specific enthalpy of steam at  $1.4\text{Mn/m}^2$  and  $0.95$  dry is  $2689.9\text{KJ/kg}$  and at  $39^\circ\text{C}$  is  $163.4\text{KJ/kg}$ .
  
3. Define the following terms:  
  
Freezing, cold storage, mechanical refrigerator, Refrigerant, steam, Boiler thermal efficiency, Newtonia Fluids, Non-Newtonia fluids, Turbulent flow, properties of refrigerators.  
Calculate the minimum mass flow rate required to establish fully developed turbulent flow of a cleaning solution in a  $5\text{cm}$  dia stainless steel pipe. The cleaning solution has a density of  $1050\text{kg/m}^3$  and a viscosity of  $995 \times 10^{-6}\text{ Pa.s}$ .
  
4. With the aid of diagrams, explain the operations of (i) mechanical refrigeration (ii) Rotational Viscometer (iii) Cryogenic freezer.  
A boiler delivers  $5400\text{kg}$  of steam per hour at a pressure of  $750\text{kN/m}^2$  and with a dryness fraction of  $0.98$ . The feed water to the boiler is at a temperature of  $41.5^\circ\text{C}$ . The coal used for firing the boiler has a calorific value of  $31000\text{kJ/kg}$  and is used at the rate of  $670\text{kg/h}$ . Determine the thermal efficiency of the boiler when specific enthalpy of steam is  $2723.7\text{kJ/kg}$  and that of feed water is  $173.9\text{kJ/kg}$ .
  
5. Discuss factors responsible for sustaining quality of foods during storage. What are the main features of air blast freezer, fluidized bed freezer and plate freezer.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND CONSUMER  
STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 714:** Principle of Human Nutrition II

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer any four (4) questions.*

1. (a) Define Nutritional status and nutritional survey. What are the purposes of nutritional survey?
  - (b) Draw the schematic chart for the levels of nutrition.
  - (c) Highlight the techniques that can be used to assess nutritional status.
  
2. (a) (i) Differentiate between cross-section and longitudinal studies of nutritional assessment  
(ii) Define nutritional surveillance, Ectomorphs and Endomorphs.
  - (b) (i) How does existing records on agricultural data affect nutritional assessment?  
(ii) What are the short-comings of clinical nutritional assessment?
  
3. (a) Describe five (5) nutritional interview techniques.
  - (b) Enumerate the information that can emerge from Diet History.
  - (c) Define Protein Efficiency Ratio, True Digestibility and Nitrogen Balance.
  
4. (a) Discuss the mode of disposal of ingested foreign substances in the body
  - (b) What are the potential toxic effects of Spices?
  
5. (a) In a table, highlight the possible toxic effects of six (6) food types and their active agents.
  - (b) Name two (2) antivitamins and their sources.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**PDQ 704/734: Statistical Quality Control**

**Time Allowed: 105 mins.**

**INSTRUCTION**

*Answer any four (4)*

1. (a) Why is Statistical Quality Control (SQC) important in a food manufacturing set up?  
(b) What is meant by process capability and how is it determined?  
(c) Write short note on the following:
  - (i) Product characteristics
  - (ii) Statistical sampling
  
2. How would you determine if a process is under statistical control? Explain using pertinent examples and possible diagrammatic and mathematical illustrations.
  
3. (a) What is Total Quality Management (TQM)?  
(b) Outline the principles of TQM  
(c) Explain briefly how TQM can be achieved in a manufacturing set up.
  
4. (a) Outline the four (4) basic criteria in an approach used in implementing Statistical Process Control (SPC).  
(b) Discuss briefly the essential criteria you would use in selecting an appropriate software for running a SQC program in a manufacturing set up.
  
5. The following steps are normally taken in the planning for collection and use of quality data:
  - (i) Problem definition
  - (ii) Planning
  - (iii) Field activity
  - (iv) Analysis
  - (v) Reporting of the resultsDiscuss briefly **any three** of them.
  
6. (a) Explain the application of the following charts in SPC:
  - (i)  $\bar{x}$  and R charts
  - (ii)  $\bar{x}$  and S charts
  - (iii) p-charts
  - (iv) c-charts.  
(b) Set up  $\bar{x}$  and R charts for a production line with data given for filled weights of canned vegetables.



---

Sample	Filled weight			
	I	II	III	IV
1	540	544	548	545
2	541	543	542	542
3	542	540	546	543
4	540	545	545	544
5	540	546	546	543
6	545	543	544	541
7	546	540	543	545
8	540	541	544	541
9	543	542	546	542

Is the process within control?

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 718: Food Product Development**

**Time Allowed: 2 hrs.**

**INSTRUCTION**

*Answer any four (4)*

- 1 (a) Highlight the factors that drives success in product development.  
(b) With illustration, describe the Product Development Process.  
(c) Define the following terms in stage-Gate process of product development:  
State-Gate, Stages, Gates, Gate-keepers, Details, Mindset, Benefits and Expected results.
- 2 (a) Explain the detailed implementations of stage 4 and Gate 5 in Food Product Development.  
(b) What are the key questions to be answered all the way through stage-gate process.
- 3 (a) Define concept, protocept and prototype in detail.  
(b) Give the examples of experimental approach in planning for prototype development  
(c) Describe screening design and Respond surface design.
- 4 (a) In ideation testing, define the following terms: Perceptual map, Gap Analysis and product Attractiveness score.  
(b) Illustrate the product attractiveness scores for Reward and Technical Risk in tabular forms.
- 5 (a) Define Plant trial. When do you run a plant trial? What are the steps for a plant trial?  
(b) Define a flow sheet and give the objectives of a food process.  
(c) Draw a mass balance of a named fruit concentrate.
- 6 (a) Define the following: Project, Project management and Milestones.  
(b) What are forces behind project management?  
(c) Enumerate the process characteristics requirements for project management.  
(d) Draw the matrix organization for project management.
7. In detail, explain the principle of Rollout in product development.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 720: Food packaging and Transportation**

**Time Allowed: 3 hrs.**

**INSTRUCTION**

*Answer any four (4)*

- 1 (a) Define packaging and highlight its major functions. In your answer, indicate the interaction between a packaged food and its environment.
- (b) Discuss the constraints to adequate packaging in the Nigerian food industry. Suggest solution to the constraints identified.
- 2 (a) What are the advantages and disadvantages inherent in the use of most of the Nigerian traditional packaging materials for food packaging and transportation?
- (b) Discuss the trend of development within the Nigerian traditional food packaging industry.
- 3 (a) Describe the Gas flushing and compensated vacuum techniques of gas packaging. What are their benefits and limitations?
- (b) Discuss the various quality control checks that can be used to monitor gas packaging of a food product.
- (c) Explain how Gas packaging can be used to enhance the quality of stored fish.
- 4 . Write short notes on the following
  - (a) Intelligent packaging
  - (b) Transportation devices in the Nigerian Food Industry
  - (c) Waste disposal management and the Nigerian food industry.
5. Write an essay on what you would consider as challenges to food packaging and transportation system in Nigeria in the nearest future.

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COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 716: Food Laws and Legislation**

**Time Allowed: 90 mins..**

**INSTRUCTION**

*Answer any four (4)*

- 1 (a) Define and explain the scope of Food Laws.  
(b) Outline some typical examples of stakeholders and their role in evolution and enforcement of Food Laws using Nigeria as a case study.
  
- 2 (a) Discuss the Codex Alimentarius Commission under the following headings:
  - (i) Objectives
  - (ii) Specific roles
  - (iii) Limitations  
(b) What are the primary objectives of setting up the International Organization for Standardization (ISO).
  
- 3 (a) What are food standards?  
(b) Identify and describe briefly various types of food standards  
(c) What are the economic gains of standardization of food manufacturing activities?
  
- 4 (a) Identify the major concerns about Genetically Modified Organic (GMO) foods?  
(b) Why in your opinion is the issue of GMO not of great concerns in the developing countries?  
(c) Discuss briefly some existing policies on GMO in an identified country of the world.
  
- 5 (a) Identify important government agencies and the role played by each in enforcing food laws in Nigeria.  
(b) What roles do you think consumer education and awareness will play in enforcing food laws?  
(c) What is the importance of gazettes in food legislation?
  
6. Write briefly on any three of the followings:
  - (i) Food and Drug Administration (FDA) of the United States
  - (ii) Food standards Agency of United Kingdom
  - (iii) Food labelling
  - (iv) Religious food laws

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 708: Food Microbiology 2**

**Time Allowed: 1 hr. 45 mins.**

**INSTRUCTION**

*Answer all questions*

- 1 (a) What do you understand by the term 'sample'?
  - (b) What are the objectives of microbiological sampling?
  - (c) Why is Sample Handling and History important in microbiological analysis?
- 
- 2 (a) When is water said to be portable?
  - (b) Discuss the rationale for microbiological examination of drinking water.
  - (c) Discuss the coliform test for microbiological examination of drinking water.
- 
- 3 (a) Differentiate between the Pour and Spread Plate method in microbiological analysis.
  - (b) How can you differentiate yeast from moulds in a microbial culture?
  - (c) Describe the methods of cultivation of some food borne indicators that you know.

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COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 704: Food Rheology**

**Time Allowed: 2 hours**

**INSTRUCTION**

*Answer all questions in Section A and any other two (2) in Section B*

**SECTION A**

- 1 (a) What are ideal fluids? Explain briefly their basic characteristics and give at least two examples.
  - (b) Using a well labeled rheogram, differentiate between thixotropic and rheopectic types of fluid foods. Give at least two examples in each case.
  - (c) With the aid of diagram(s), what are the distinguishing features of turbulent and laminar flows.
  - (d) List those factors that governs the transition of flow from laminar to turbulent.
- 2 (a) Write out the relationship between the force and the flow rate for a spreadable food like mayonnaise and state what each represent
  - (b) Explain in clear terms the various classes of fluid foods called time independent Non-Newtonian fluids. Note: properties, examples and appropriate rheograms are important.
  - (c) Mention at least four types of viscometer that are used in measuring rheological data and six factors that might impede accurate measurement of such data.
  - (d) Milk at 20°C is being pumped through a 4cm diameter pipe at a rate of 1.5kg/s. What is the mean velocity for milk in the 4cm pipe and determine its new velocity if the pipe, diameter changes to 8cm (Density of milk = 1200kg/m<sup>3</sup>).

**SECTION B**

- 1 (a) Briefly highlight the importance of rheological measurement in food research and product development.
- (b) Discuss the application of rheology in the following:
  - (i) Margarines and spreads
  - (ii) Sensory evaluation methods for liquid foods
  - (iii) Cheese
  - (iv) Meat
  - (v) Consistency

**PTO**

- 2 (a) Explain the term Viscoelasticity and give five examples of viscoelastic foods

- (b) Enumerate the reasons for studying viscoelasticity
  - (c) Describe the dynamic method of measuring viscoelasticity.
- 3
- (a) (i) List the variables that affect food texture analysis
  - (ii) What are the advantages of food texture analyzers.
- (b) Explain the concept of Texture Profile Analysis (TPA).

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 706:** Food Analysis and Instrumental Techniques

**Time Allowed: 2½ hrs.**

**INSTRUCTION**

*Answer all questions in Section A and any other two (2) in Section B*

**SECTION A**

- I Define the following:
  - (a) Food analysis
  - (b) Dry matter
  - (c) Free moisture
  - (d) Proximate analysis
  - (e) Refractive index
  
- II List all the necessary steps you will take to analyse the chemical components of a food sample.
  
- III. The catalyst mixture used in Kjeldahl's method of protein determination consist of sodium sulphate and selenium oxide, in addition to copper sulphate pentahydrate. State the functions of both sodium sulphate and selenium oxide in the mixture.
  
- IV. Distinguish between macro and ultra-micro food analysis. Which of them is more suitable for instrumental analysis?
  
- V. List four (4) conditions required for titration.
  
- VI. What is the titratable acidity (as lactic acid) of a 2.5g sample of yoghurt which requires 16.5ml of 0.1M KOH for titration? (MW of Lactic acid = 90, k = 39, O = 16, H = 1).
  
- VII. List four(4) different types of titrations commonly used in food studies.
  
- VIII. Distinguish between free and absorbed moisture. Which of them is commonly found in powdered foods?
  
- IX. List four (4) reasons why moisture content determination is important in food studies.
  
  

**PTO**

- X. Give the mathematical expressions of the following terms:



- (a) Absorbance (b) Transmittance (d) Absorptivity.

Which of the above terms is characteristic of the substance being analysed?

XI. Indicate whether each of the following statements is True or False:

- (a) Precipitation, Distillation and Centrifugation are all methods of separation, useful in analytical chemistry but not in food analysis.
- (b) The ash figure obtained during crude fibre determination is equal to the ash figure obtained during mineral matter analysis.
- (c) Refractometric analysis is dependent on wavelength, pressure of gases, but independent of concentration of material and temperature of measurement. Hence, it is very useful for sugar analysis.
- (d) Vitamin content of a food is very important and must be accounted for in proximate composition of food.
- (e) The factor 6.25 used to multiply %N in crude protein determination by Kjeldahl's method is universal for all foods.

## SECTION B

- 1 (a) Briefly explain the chemical principles behind Acid-base and oxidation-reduction types of titration.
- (b) What are the applications of Acid-base titrations in food studies?
- (c) Discuss in detail, the uses of spectrophotometers in food analysis.
- 2 (a) Distinguish clearly between protein and non-protein Nitrogen of foods.
- (b) Describe the Kjeldahl's method of nitrogen and crude protein determination of a food sample. Why is this method often used as a reference for other methods of protein estimation?
- (c) Discuss the use of crude fibre as an index of food quality.
3. Write short notes on the following:
- (a) Choosing appropriate method of food analysis
- (b) Colourimetric methods of protein determination
- (c) Quality assessment of edible fats/oils
- (d) Application of refractometric method as an analytical technique of food.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 712: Food Engineering Operation II**

**Time Allowed: 2½ hrs.**

**INSTRUCTION**

*Answer any four (4) questions*

- 1 (a) What are the major difference(s) between sieving and filtration?
  - (b) Outline the relative advantage(s) and disadvantage(s) of using sedimentation as a means of separation in food manufacturing.
  - (c) State Stoke's law governing settling of particles in a fluid and what determines its applicability?
  - (d) What are the important fluid properties that determine the settling velocity of solid particles and how do they affect it?
- 
- 2 (a) Explain in your own words, how temperature changes can affect the following:
    - (i) Dissolution of solutes in solid-liquid equilibria.
    - (ii) Diffusion of gases in gas-liquid equilibria.
  - (b) (i) State Henry's law of gas-liquid equilibria.
    - (ii) If air contains 23% Oxygen and 77% Nitrogen by weight and Henry's constant for oxygen in water is  $36.4 \times 10^3$  kPa per mole fraction at 20°C. Calculate the solubility of oxygen in water as % by weight.
- 
- 3 (a) Derive a mathematical relationship between the concentration of a component in the underflow and overflow in a multistage Contact Equilibrium Separation (CES) process.
  - (b) A continuous deodorizing unit uses a single stage steam stripping of taint from cream having a taint concentration of 10ppm. Calculate the concentration of taint in the leaving stream if the steam is passed through the contact stage at a rate of 0.75kg to 1kg cream and equilibrium distribution of a taint is 1 in the cream and 8 in the steam.

**PTO**

- 4 (a) What is the order of a biochemical reaction?
- (b) Using mathematical relationships, differentiate between a first and zero order reaction.
- (c) List five typical examples of changes in food systems that follow first order reaction model.
- (d) The changes in firmness of a protein gel as a function of heating time (t) is modeled using the following equation:

$$\ln \left( \frac{F}{F^*} \right) = -kt$$

Where k is the rate constant while F is the firmness at time t.

Assuming the limiting firmness (F\*) is 10.2g and the rate constant (k) is 0.0042, determine the time it will take the firmness to be 9.75g and 8.41g respectively.

- 5 (a) State two examples of practical application of the following in the food industry.
- (i) Crystallization
  - (ii) Distillation
  - (iii) Sedimentation
  - (iv) Gas adsorption
- (b) Comment on the efficiency and safety of mechanical and solvent extraction of oil from a named oilseeds.
- (c) List three uses of carbon-dioxide in the food system.
- (d) Determine the mole fraction of water in the following:
- (i) 2.5% (w/w) ethanol solution
  - (ii) 10.2% (w/v) sucrose solution
  - (iii) Moist air containing 76.5% N<sub>2</sub>, 22% CO<sub>2</sub>, 1.5% water vapour.

$$(C = 12, H = 1, O = 16, N = 14)$$

- 6 (a) A continuous separating tank designed to separate water from oil receives oil/water mixture from a washing plant which contains 4kg water to 1kg oil. The oil leaving the water on separation is oil free. If the feed rate is 1000kg/h, density of oil is 890kg/m<sup>3</sup> temperature of oil and water is 40°C. Determine the relevant physical properties of water in the oil/water mixture and use it to calculate the terminal velocity of oil consisting of 5.2 x 10<sup>-5</sup> in dia.
- (b) Suggest two ways by which the efficiency of the process in 6 (a) can be increased.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 710: Sensory Evaluation of Foods**                      **Time Allowed: 2 hrs.**

**INSTRUCTION**

*Answer all questions in Section A and two questions in Section B*

1. List 2 textural characteristics of food and give the descriptive terms in each case.
2. List 4 applications of sensory evaluation.
3. List 3 senses employed in sensory evaluation and name the sensory cell(s) in each case.
4. Distinguish between the thresholds of taste sensation.
5. Identify the major constraint of consumer oriented testing and suggest an alternative option.
6. A sensory panel must be treated as a \_\_\_\_\_ to produce reliable and valid results.
7. To produce a consistent and reproducible sensory data, use appropriate experimental designs, \_\_\_\_\_ and \_\_\_\_\_.
8. Product-oriented tests provide information on the specific sensory characteristics of a food while consumer-oriented tests provide information on consumer \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
9. Complete the following table:

S/N		Product-oriented Testing	Consumer-Oriented Testing
10.	Location		
11.	Type of Panel		
12.	Size of Panel		

1. True or False? In-house panel may be used to predict product performance in the market place. Give a reason for your answer.
2. Distinguish between 3 features of experimental designs.
3. List the measurement scales used to quantify sensory information.

**PTO**

4. List 5 'different test' methods used in sensory evaluation of food products.
5. Name one method widely used to indicate presence of statistical difference.
6. List 4 statistical methods used to compare means of a sensory data.
7. List 4 statistical methods employed when relationships among a number of different measurements or tests are being investigated.

## **SECTION B**

1. Describe the tasks involved (in the right order) in establishing sensory panels.
2. A triangle test was adopted in determining if there is any detectable difference in the sweetness of two soup samples prepared with knorr cube as a flavour enhancer. An in-house panel of 36 judges evaluated the soup samples, which were served in coded dishes in a randomized order. Assuming that the panelists marked correct (+) when the odd sample was correctly identified or incorrect (-), provide a table of triangle test data and draw conclusions from statistical analysis of the data (statistical table provided).
3. Outline the steps involved in planning sensory evaluation experiments.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FTD 702: Food Hygiene, Legislation and Quality Control      Time Allowed: 2 hrs.**

**INSTRUCTION**

*Answer all questions*

- 1 (a) Define the following terms:  
(i) Quality    (ii) quality control    (iii) Quality Assurance
- (b) What are the major reasons why quality assurance is necessary and important to plant operation?
- (c) Briefly discuss the major constraints of application of quality control.
- (d) Outline the various examples of internal failure cost.
  
- 2 (a) What do you understand by Quality cost?
- (b) Explain briefly, the concept of Total Quality Management (TQM)
- (c) Briefly discuss the essential requirements for the successful implementation of TQM.
- (d) Outline the sequences involved in quality control.
  
- 3 (a) What do you understand by Food Standards and Specification?
- (b) Mention various types of standards based on the means by which standardization is achieved.
- (c) List the various levels of standard you know and mention two regulatory agencies under each.
- (d) Define the following terms:  
(i) Critical control Point  
(ii) Hazard  
(iii) Critical control point decision tree  
(iv) Control Point  
(v) Sensitive ingredients
  
- 4 (a) Outline in a clear manner, the basic principles for hygienic design of food plant.
- (b) What do you understand by CIP? Briefly mention the various CIP techniques you know.
- (c) Explain concisely, the fundamental types of sensory tests.
- (d) Outline the importance of statistical quality control in the food industry.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 706: Research Methods**

**Time Allowed: 2½ hrs.**

**INSTRUCTION**

*Answer all questions*

1. Define the term “Research” and discuss briefly the key elements of research methods and procedures. Also indicate clearly the peculiarities of scientific method of research.
- 2 (a) Distinguish between a research problem and a research objective. What are the purpose and characteristics of a good research objective?
  - (b) Describe the steps you would take to identify and select a research problem for investigation.
  - (c) Read the introductory part of a journal paper attached to your question paper (Appendix I) and answer the following questions:
    - (i) Identify the research problem
    - (ii) Identify the research objectives
    - (iii) Suggest an appropriate title for the paper
- 3 (a) State the major parts of an experimental research report and briefly describe the content of each part.
  - (b) Discuss briefly, the application of statistics in data analysis as related to food studies.
4. Discuss in detail, each factor you would consider necessary for selecting a research project.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 710: Selected Topics in Food Chemistry**

**Time allowed: 2½ hrs.**

**INSTRUCTION**

*Answer any four (4) questions*

- 1 (a) Discuss the condensation and dehydration mechanisms involved in Maillard reaction type of non-enzymic browning of foods. Use structural equations to illustrate your answer.
- (b) Highlight the factors that may affect the condensation mechanism in 1 (a) during food processing.
- (c) What are the practical applications of non-enzymic browning of foods?
- 2 (a) Explain the following terms:
  - (i) Flavour fatigue
  - (ii) Flavour blends
- (b) How are sweet and sour notes of taste sensation influenced by chemical composition of a food sample?
- (c) How would you control flavour of foods during processing?
- 3 (a) List the Whey proteins and discuss the nutritional and physiological properties of each them.
- (b) Describe the role of k-casein in the stabilization of milk protein miscelles.
- (c) What are the nutritional and physiological effects of lactose in man?
4. Write an essay on **one** of the following topics:

**EITHER**

- (a) The Chemistry and application of emulsifiers in the preparation and processing of foods.

**OR**

- (b) The Chemistry and application of bulk and intense sweeteners in food processing.

5. Write short notes on the following:

- (a) Soya proteins
- (b) Flavour intensifiers and extracts
- (c) Chemistry of Ascorbic acid and type of non-enzymic browning.



**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc Degree Examinations**  
**Second Semester 2006/2007 Session**  
**February, 2008**

**FST 726: Heat and Mass Transfer**                      **Time allowed: 2½ hrs.**

**INSTRUCTION**

*Answer any four (4) questions*

- 1 (a) Distinguish between “Parallel flow” and “Counter flow” heat exchangers.
- (b) Water at the rate of 68 kg/min is heated from 35 to 75°C by an oil having a specific heat of 1.9 kJ/kg °C. The fluids are used in a counter-flow double pipe heat exchanger, and the oil enters the heat exchanger at 110°C and leaves at 78°C. The specific heat of water may be taken as 4.18kJ/kg °C.
- Calculate:
- (i) the rate of heat transfer in the exchanger
  - (ii) the logarithmic mean temperature difference
  - (iii) the heat exchanger area when the overall heat transfer coefficient is 350W/m<sup>2</sup> °C.
- 2 (a) Distinguish between “steady and unsteady state” heat transfer
- (b) What are the technological advantages of forced convection heat transfer over natural convection in heat transfer processes?
- (c) List the factors influencing the rates of heat transfer to foodstuffs.
- 3 (a) List the various types of heat exchangers typical of food industry.
- (b) Describe the basic principles of food dehydration using appropriate sketches.
- (c) Distinguish between “Constant Rate” and “Falling Rate” in food dehydration.
- 4 (a) Explain the general phenomenon of “Nucleate” and “Film” boiling heat transfer under pool conditions for organic liquids. Use relevant sketch to support your answer.
- (b) Explain the pool boiling behaviour under the “Film” conditions, indicating the shortcomings associated with such behaviour.

**P.T.O.**

- 5 (a) What are the assumptions made in the development of graphical solutions using the “Gurney and Lurie” charts for unsteady state heat transfer in foodstuffs?
- (b) A 2 kg beef joint initially at 15 °C is placed in an oven at a temperature of 175 °C. Assuming a heat transfer coefficient of 15W/m<sup>2</sup>°C
- (i) Estimate the time required for the centre temperature of the beef to reach 95 °C .
- (ii) What is the surface temperature at the end of the heating process?

Data:

Assume the beef is spherical

Thermal conductivity = 1 W/m °C

Specific heat of beef = 4 kJ/kg °C

Density of beef = 1000 kg/m<sup>3</sup>

(You are allowed to use relevant Gurney and Lurie chart).

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc Degree Examinations**  
**Second Semester 2006/2007 Session**  
**March, 2008**

**FST 728: Energy sources, Utilization and Conservation**

**Time allowed: 2½ hrs.**

**INSTRUCTION**

*Answer four (4) questions*

- 1 (a) What is Energy Audit?
- (b) Assuming that you are appointed as an Energy Manager of a medium-scale food processing company, outline some practical ways of energy conservation in the Confectionery section of the factory bearing in mind cost effectiveness.
2. Write short notes on the following:
  - (i) Degree Days
  - (ii) Specific Energy
  - (iii) Preliminary Energy Audit
  - (iv) Energy Survey
  - (v) Audit Year
- 3 Distinguish between “Normalised Performance Indicators (NPI)” and “Seasonal/Monthly Usage Patterns” in the assessment of energy performance of a food factory.
- 4 (a) Enumerate the various energy sources available to food processors, indicating their relative advantages or disadvantages.
- (b) Discuss briefly the use of alternative fuel sources, such as industrial or agricultural wastes/by-products for food industry as a way of saving or reducing energy cost.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 703:** Advanced Food Technology

**Time Allowed:** 3 Hrs

**INSTRUCTION**

*Answer five (5) questions in all. At least one question from each section.*

**SECTION A**

- 1 (a) Discuss in detail, the physical and chemical changes that may accompany each unit operations involved in *gari* manufacture. Use a flow chart to illustrate your answer.
- (b) How would you utilize the changes identified in question 1(a) above to enhance the quality of *gari*?

**SECTION B**

*Instruction: Give concise answers to the questions.*

- 1 (a) What are the primary objectives of mixing food materials?
  - (b) List some of the factors that may be important in modeling the performance of mixing systems.
  - (c) Using pertinent mathematical models, differentiate between Newtonian and non-Newtonian fluids.
  - (d) Briefly explain how the following affect the agglomeration of solid particulates:
    - (i) Moisture
    - (b) Electrostatic
    - (iii) Temperature
- 2 (a) Briefly describe various types of flow that could be instituted when mixing foodstuffs.
  - (b) What are the important consideration made in the choosing equipment for mixing foodstuff?
  - (c) Sketch the configuration of the three types of mixing unit for low viscosity materials.
  - (d) Outline various methods of determining mixing time. Explain two of them.

**P.T.O**

- 3 (a) Write out the Empirical Equation relating the Energy consumed to the dimensional change in solid particulate during milling operation. With appropriate assumptions, show the final solution of the Empirical equation and describe the constants of each.
- (b) Briefly explain the steps you would take in achieving particle size distribution analysis of solid meal obtained from a milling operation.
- (c) During milling of cassava chips, explain how varying feed moisture affects the following:
- (i) Gross Energy consumed
  - (ii) Mean particle size
  - (iii) Bulk density
- (d) Briefly outline possible physicochemical or functional change(s) that could occur during milling of a named solid particulate foodstuff and how could it be controlled?
- 4 (a) Discuss briefly, relative advantage(s) and/or disadvantage(s) of mechanical extraction of oil from oilseeds compared to solvent extraction.
- (b) Give possible explanation for the following experimental observation(s)
- (i) Finely ground oilseeds gave higher oil yields than coarsely ground particles.
  - (ii) Increasing heating temperature of oilseeds meal caused increased oil yield.
- (c)
- (i) What is an instant food?
  - (ii) Outline the instant properties of powdered food beverages
  - (iii) How does sugar content of powdered cocoa beverage affects its instant behavior?

## SECTION C

- 1(a) Explain the mechanism of heat transfer in food freezing with respect to quality.
- (b) What is "Leidenfrost Phenomenon"?
- (c) How does a cryogenic freezer using liquid nitrogen operate?
- (d) What are the relationships among pool boiling of organic liquids, Leidenfrost phenomenon of droplets of liquid nitrogen and cryogenic freezing mechanism?

## SECTION D

- 1 (a) Explain some of the technological reasons for drying foodstuff.
- (b) Using a generalized concept, describe briefly stages that could be encountered during drying of a foodstuff.
- (c) Why is psychrometry important to any drying operation?
- (d) List some of the criteria used in classifying drying systems.
- (e) List at least seven factors considered in selection of dryers.

- (f) Indicate with reason, the type of dryer that you would suggest for drying the following food stuffs:
- (i) Meat
  - (ii) Mixture of egg white and cassava starch ( a slurry)
  - (iii) Whole milk.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 711:** Advanced Meat and Fish Processing Technology

**Time Allowed:** 2Hrs.

**INSTRUCTION**

*Answer any four (4) questions*

1. (a) Distinguish briefly between the “Kosher” and “Modern” methods of livestock processing.  
(b) Describe with the aid of relevant flow chart, the stages involved in a modern meat processing abattoir.
2. (a) An animal was chased around the courtyard for almost 3 hours before slaughter. Briefly describe the biochemical changes taking place in the muscles of such live-animals.  
(b) How would the breed of animal, sex, age and growth conditions influence meat quality?
3. (a) What is stress as applied to animals prior to slaughter?  
(b) List and explain five (5) of such stressful conditions  
(c) What steps are needed to avoid stresses on animals meant for commercial processing of meat for sales?
4. (a) Sketch and describe a typical skeletal muscle.  
(b) Briefly explain the following:
  - (i) Water-holding capacity
  - (ii) Protein denaturation in muscles
  - (i) Rancidity
  - (vi) Drip losses
  - (vi) White and Red meats
5. (a) Sketch and label a cross-section of an egg.  
(b) Discuss the structural composition of an egg.
6. (a) What are the effects of thermal processing at temperatures of 30 to 90°C on meat quality characteristics?  
(b) What is Postmortem Glycolysis in muscle foods and what are its effects?

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 721:** Topics in Raw material Sourcing

**Time Allowed: 3Hrs.**

**INSTRUCTION**

*Answer any four (4) questions only*

- 1 (a) Define the term “Food raw material” and give the different types that are available.
- (b) How is quality of a manufactured food product related to the price and quality of the raw material?
- (c) What is the importance of quality specification and assessment in food raw material sourcing?
2. Discuss in detail, the opportunities open to a fresh Food Science and Technology graduate in the food raw material sourcing business.
- 3 (a) Define the term “sourcing policy and state the purposes which a good food raw material sourcing policy is expected to serve.
- (b) Explain how the following forms/books may be used in relation to sourcing of an industrial food raw material:
  - (i) Local Purchase Order (LPO)
  - (ii) Product/Material Examination Report Form
  - (iii) Price Comparison Form
  - (ii) Payment Voucher
- (c) Discuss briefly the criteria you will use to assess the good performance or otherwise of a Food Raw Material Sourcing Policy?
4. What are the social, economic and technical implications of sourcing industrial food raw materials locally and through importation in Nigeria?
5. Write short notes on the following:
  - (a) Forward buying
  - (b) Minimum stock re-order levels as related to industrial food raw material sourcing
  - (c) Concept of alternative food raw material



**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FTD 705:** Food Microbiology

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer any three (3) questions only*

1. a. Describe fully the principles and techniques of food preservation
2. a. Define the following:
  - (vi) Microbiological specification
  - (vii) Microbiological standard
  - (viii) Microbiological guidelines
  - (ix) Microbiological criteria
  - (x) Microbiological quality
- b. Briefly explain why experimentation with anthrax as a biological weapon has been common.
3. Write a brief essay on some bacteria of importance in the food industry.
4. a. Enumerate the 10 least wanted food borne pathogens in the food industry.
- d. Compare and contrast the pathogenesis of
  - (i) *Campylobacter jejuni*
  - (ii) *Shigella spp*
  - (iii) *Listeria monocytogenes* and
  - (iv) *E. coli 0157:H7*

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 705:** Dairy Products Technology

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer all questions*

1. What are the problems and prospects of the Nigerian Dairy Industry? Offer suggestions on how to improve the performance of this sector of the Nigerian Economy.
- 2 (a) Discuss the reasons why nutritionists have often claimed that “milk nearly approaches the perfect food for humans”  
  
(b) Write a short essay on milk analogues.
- 3 (a) Discuss with reasons why the “composition of ice-cream is said to be dictated by market demand and taste”  
  
(b) Distinguish between:  
(i) Butter;  
(ii) Margarine; and  
(iii) Ghee.
4. Write an essay on the nutritional aspect of milk proteins pointing out the importance of milk.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 709:** Special Topics in Food Microbiology

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer all questions*

1. “Species of the great group *Aspergillus* together with the *Penicillia* and *Mucors* furnish the “Weeds” of the culture room”. Discuss the relevance of this statement in the light of your knowledge of microorganisms of importance in the food industry.
  
2. Discuss the nature, symptoms, pathogenesis and control of *Clostridium botulinum* infection.
  
3. Briefly distinguish between:
  - (i) Alcoholic
  - (ii) Lactic and
  - (iii) Butanediol fermentations.
  
4.
  - (i) What are the objectives of microbiological sampling?
  - (ii) Differentiate how you would sample between:
    - (a) Bulk fluids
    - (b) Dry or semisolid food
    - (c) Frozen bulk foods.
  - (iii) Briefly explain why experimentation with Anthrax as a biological weapon is often common?

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 707:** Advanced Quality Control and Allowance

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer four questions only*

1. The current concept of quality assurance in the food industry centers around Hazard Analysis Critical Control Points (HACCP). Discuss the principles and applications using three (3) different types of processed foods.
2. Explain the following terms:  
(a) GMP (b) Food Specifications (c) Food Standards  
(d) Total Quality Management
3. Write short notes on Automation, Principles and Applications as applied to the Food Processing Industry.
4. Thousands of businesses are implementing ISO9000. How important is it? Who sets the standard? Is it difficult to achieve accreditation? What are the benefits?
- 5 (a) Highlight the importance of statistical Quality control in the Food Industry.  
(b) Explain the differences between the following items:
  - (i) Variables and attributes
  - (ii) SQC and SPC
  - (iii) QC and QA
  - (iv) Concern and Risk
  - (v) HACCP plan and HACCP system
  - (vi) Variable and attribute charts
  - (vii) Internal failure cost and external failure cost.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**Postgraduate Examinations**  
**Second Semester 2007/2008 Session**  
**September, 2008**

**FTD 708: Food Microbiology 2**

**Time Allowed: 1 hr. 45 mins.**

**INSTRUCTION**

*Answer all questions*

- 1 (a) What do you understand by the term 'sample'?
  - (b) What are the objectives of microbiological sampling?
  - (c) Why is Sample Handling and History important in microbiological analysis?
- 
- 2 (a) When is water said to be portable?
  - (b) Discuss the rationale for microbiological examination of drinking water.
  - (c) Discuss the coliform test for microbiological examination of drinking water.
- 
- 3 (a) Differentiate between the Pour and Spread Plate method in microbiological analysis.
  - (b) How can you differentiate yeast from moulds in a microbial culture?
  - (c) Describe the methods of cultivation of some food borne indicators that you know.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**

COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES

**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**

**Postgraduate Degree Examinations**

**First Semester 2007/2008 Session**

**September, 2008**

**FTD 703: Fundamentals of Food Processing**      **Time Allowed: 2 Hrs.**

**INSTRUCTION**

*Answer four questions in all. Two questions from either section.*

**SECTION A**

*Answer two questions only from this section.*

1.
  - a. Concisely explain the various stressful conditions to which animals may be subjected to prior to slaughtering. How could these stresses be avoided.
  - b. Using a clear and concise flow chart, discuss the major steps in the production of pasteurized milk from fresh whole milk.
2.
  - a. Sweetened yoghurt is a product obtained from fresh milk. Discuss in a clear manner, the major unit operations in its production.
  - b. Discuss in details the importance of roots and tubers to the inhabitants of the tropics.
3.
  - a. Clearly explain the various methods of animal slaughtering you know. Highlight various ways of meat preservation.
  - b. What are the factors affecting storability of roots and tubers.
  - c. What do you understand by primary and secondary deterioration in cassava. How do these conditions affects the usefulness of the crop.

*P.T.O*

## SECTION B

*Answer two questions only from this section.*

1. a. List five materials desirable for canning food.
- b. The following data were generated in a fish canning experiment to establish the  $F_0$  during a process for 80 min at  $121.1^\circ\text{C}$  within 10 min intervals:

Time (min)	Temperature ( $^\circ\text{C}$ )
0	24.0
10	34.2
20	72.5
30	98.0
40	110.5
50	117.2
60	120.3
70	106.0
80	70.0

Using the data above, calculate:

- i. lethal rate and cumulative lethal rate at each time - temperature combinations.
  - ii.  $F_0$  values at each time - temperature combinations.
  - iii.  $F_0$  for the whole process.
2. a. Discuss in detail the potential of legumes in alleviating the problems of protein energy malnutrition in Nigeria.
  - b. Explain the following as used in food canning:
    - i. Maintaining colour and flavour in canned foods
    - ii. Advantages of hot packing
    - iii. Controlling head space
3. a. With the aid of well structured flow chart, describe in detail, the processing of the following:
    - i. Protein isolate from soybean.
    - ii. Any three traditional maize products.
  - b. What are the processing and nutritional merits of Quality Protein Maize (QPM).

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 733:** Automatic Control Devices

**Time Allowed:** 2Hrs.

**INSTRUCTION**

***Answer ALL questions***

1. (a). Critically examine the goals of automation in the Food Industry.  
(b). Compare the application of programmable Logic Controllers (PLC's) and distributed control systems (DCS) in food processing.  
(c). what is the purpose of sensors? Give three important properties of a good sensor.  
(d). With the aid of a well labeled diagramme only, show a typical closed-loop diagramme of a drying process.
  
- 2 (a). Mention three advantages and two disadvantages of a feedback in a control system.  
(b). A temperature control system is found to have zero error to a constant tracking input and an error of 0.5°C to a tracking input that is linear in time, rising at the rate of 40°C/sec. what is the system type of this control system and what is the relevant error constant.  
(c) What are the major objectives of introducing an integral control and derivative control in an automatic system?  
(d) Discuss briefly, the input and output of a controller.
  
3. With the aid of suitable figures and mathematical expressions, discuss the following type of controllers:
  - (a) Two position or on-off Controllers.
  - (b) Proportional Controllers
  - (c) Integral Controllers.
  - (d) Proportional – plus – Integral Controllers.
  - (e) Proportional – plus – derivative Controllers.
  - (f) Proportional – plus – Integral – plus – derivative Controllers.
  
4. (a) With the use of relevant figures, discuss clearly the major differences between open and closed loop control systems.
  - (a) Clearly x-ray the application of process controllers in the food industry and suggest practicable ways of overcoming some inherent problems.
  - (b) In a concise manner, highlight the major advantages and disadvantages of open-loop systems.
  - (c) Briefly discuss the various benefits of distributed control systems as used in the food industry.



**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**

**Postgraduate Degree Examinations**

**First Semester 2007/2008 Session**

**September, 2008**

**FTD 711: Food Chemistry & Biochemistry**

**Time Allowed: 2 Hrs.**

**INSTRUCTION**

*Answer four questions in all. Two questions from each section.*

**SECTION A**

1.
  - a. Using equations ONLY, explain in details the mechanism of reaction of auto-oxidation in a fatty food material.
  - e. Briefly explain the various factors affecting non-enzymic browning in food materials.
  - f. What factors governs the rate of auto-oxidation common in a high fatty food materials.
  
2.
  - a. Clearly discuss the roles of the following enzymes in food processing:
    - (i) Ortho-diphenol oxygen oxidoreductase
    - (ii) Alkaline phosphatase (ALP)
    - (v) Lipooxygenase (LOX)
    - (vi) Pectinase (PEC)
  - d. Itemize the major roles of lipids in food materials.
  - e. With the aid of equations ONLY, explain the basic steps in enzymic browning occurring in a yam tuber.
  
3.
  - a. Discuss briefly, the post mortem glycolysis in meat structure.
  - b. What are the various ways in which enzymic browning can be controlled in a food materials.
  - c. Explain briefly how browning causes deteriorative changes in dried fruits and vegetables.

**SECTION B**

1.
  - a. Draw the structures of glucose showing the Fischer Formula, Haworth Formula, Conformational Formula, D- & L- series and  $\alpha$ -D- and  $\beta$ -anomers.
  - b. Describe the properties and food applications of the following polysaccharides – starch, gums, pectic substances and cellulose.
  
2.
  - a. What is denaturation of proteins? Describe the causes and effect of denaturation.
  - b. Distinguish between animal proteins and plant proteins.

- c. What are the functional properties of proteins?
3.
  - a. Distinguish between four (4) classes of food pigments.
  - b. Describe the properties of sugars.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 715:** Food Plant Design and Machinery                      **Time Allowed: 2Hrs.**

**INSTRUCTION**

***Answer Four (4) questions only***

1. Discuss the principles and applications of Freezers and Mixers.
2. Explain with appropriate illustrations; materials of construction for food processing equipment and industrial plant layout for a specific food product.
3. Draw the following food based machinery:
  - (a) Flat – blade agitator
  - (b) Drum driers.
  - (c) Vertical short – tube evaporator
  - (d) Disc mill.
4. What are the basic hygienic designs of food plant? Sketch the features of mechanical refrigerator and liquid – nitrogen freezer.
5. Explain the design, fabrication, operation and maintenance of evaporators.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**September, 2008**

**FST 717:** Special Topics in Sensory Analysis

**Time Allowed:** 2Hrs.

**INSTRUCTION**

***Answer ALL questions***

- 1(a) Explain the basic principles of Sensory evaluation of foods and indicate its scope and limitations.
- (b) What are the necessary precautions/controls needed to standardize a sensory analytical work.
- 2 (a) Distinguish clearly between a difference and a preference test. Give examples to illustrate your answer.
- (b) Discuss in detail, the use of descriptive sensory analysis in the determination of sensory profile of a sample of food.
1. Discuss in detail, the use of regression models in sensory evaluation. Illustrate your answer with relevant applications in food studies.
2. Write short notes on:
  - (a) Product profiling
  - (b) Hedonic test
  - (c) Ranking test.

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**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**PDQ 710: Operation Research**

**Time Allowed: 2Hrs.**

**INSTRUCTION**

**Answer four (4) questions only**

1. Define Operation Research. What are the natures of Operation Research? Enumerate the uses and limitations of Operation Research.
2. Briefly describe the following terms: Linear programming, Transport Model, Assignment Model, Queue Theory Model, Network Analysis, Replacement Analysis, Inventory Model, Decision Analysis.
3. Enumerate steps in using models to solve problems. State Bayes decision rule. A cassava processing plant is about to start assembling two brands of products and has set up modern production assembly, the assembly time requirement, the inspection time, the storage space and the unit profit. These products as given by the decision and manufacturing department and the liability of the company resources are shown below:

	Brand 1	Brand 2	Amount Available
Assembly time/unit	3 hrs.	8 hrs.	80 hrs.
Inspection time/unit	2 hrs.	1 hr.	30 hrs.
Storage space/unit	3 cubit feet	3 cubic feet	40 cubic feet
Unit profit	N250	N200	

The management wishes to be advised on the number of each brand to produce. Formulate a linear programming model for this situation.

- 4 (a) Explain major terms used in network analysis.
- (b) Highlight the steps in construction of network analysis
- (c) Draw a network of the table below and identify the critical path. Calculate the forward and backward passes for all the events. Calculate the floats.

Activity	Duration
1 – 2	7

2 – 4	8
1 – 3	9
4 – 6	6
3 – 4	11
1 – 5	7
5 – 6	8

5. Explain payoff and dominance criterion as used in the food industry. You are given pay off table on demand for office space below:

Decision alternatives	States of Nature	
	d1 Build Bungalow	10
d2 Build Duplex	15	9
d3 Build Flat	30	-16

Use the maximum criterion to select the optimal decision for the table.

The table on supply and demand of cows from 3 locations in the Northern and demand from 3 locations in the Southern Nigeria is shown below. The quantities inside the cell represent the unit cost, in Naira of transporting one cow from the source to another location. Use the North West Corner method to allocate the cows in such a way as to minimize the cost of transportation and the find the minimum cost.

Source	Lagos	Akure	Awka	Supply
Sokoto	90	85	70	600
Kano	175	110	95	1400
Maiduguri	205	190	130	1400
Demand	1600	1050	350	-

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**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 732: Food Freezing and Cold Storage**

**Time Allowed: 2½ Hrs**

**INSTRUCTION**

**Answer all questions**

- 1 (a) Describe in clear terms, the effects of freezing/thawing on the microstructure and the texture of a smoked fish sample.
- (b) Critically compare the effect of air blast freezing and pressure shift freezing (PSF) on the microstructure of fish fillets.
- (c) Lettuce was vacuum-cooled and then loaded into a refrigerated car for shipment to a market. The trip will last 48 hrs. Calculate the total amount of heat removed and the peak refrigeration load (maximum heat removal rate) if:  
the amount of lettuce loaded is 3000kg, the temperature in the truck is 2°C, the temperature of lettuce when loaded is 5°C and will drop to 2°C in 2 hrs, the heat capacity of lettuce is 4.02kJ/kg °C, the area of the walls of the truck is 80m<sup>2</sup>, the overall heat transfer coefficient for the walls is 0.3W/m<sup>2</sup>°C, the outside air temperature is 20°C, and the heat of respiration of lettuce in the temperature range of 2 to 5°C is 35x10<sup>-3</sup>W/kg.
- 2 (a) With a clear and well labeled diagram, fully discuss the operation of a mechanically powered domestic refrigerator.
- (b) What are the major difference(s) between absorption and mechanical refrigeration system?
- (c) The cooling in a refrigeration process is provided by a mechanical refrigeration system using HFC – 134a (tetrafluore ethane) refrigerant with the evaporator temperature being -5°C and the condenser temperature is 40°C. Plot a diagram of the refrigeration system, present the conditions at the main points of the system on a pressure-enthalpy chart and a temperature entropy chart; and calculate the coefficient of performance (COP). Assume the refrigeration unit operates at saturation conditions. Neglect the heat load from fans and other components.

NOTE: Pressure, enthalpy and entropy values of HFC – 134a at various points are shown below:

**Pressure**

**Enthalpy**

**Entropy**

1	243kPa	396kJ/kg	1.73kJ/kgK
2	1018kPa	426kJ/kg	1.73kJ/kg K
3	1018kPa	257kJ/kg	1.19kJ/kgK
4	243kPa	257kJ/kg	1.21kJ/kgK

**PTO**

- 3 (a) A domestic refrigerator operates on the reverse carnot cycle working at ambient temperature  $40^{\circ}\text{C}$  and  $-20^{\circ}\text{C}$  on the high temperature and low temperature sides, respectively. The refrigerator is capable of producing 850kg of ice per hour at  $-5^{\circ}\text{C}$  from a constant water supply at a temperature of  $20^{\circ}\text{C}$ . If the specific heat capacity of water and ice and the latent heat of fusion of ice are  $4.25\text{kJ/kg}^{\circ}\text{C}$ ,  $2.1\text{Kj/Kg}^{\circ}\text{C}$  and  $333\text{kJ/kg}$ , respectively:
- sketch the equivalent carnot cycle or a temperature/entropy diagram.
  - Calculate the COP of the cycle on a carnot basis.
  - Calculate the power required to drive the compressor.
  - Calculate the actual COP of the refrigerator if the power required to drive the compressor was 30kW.
- (b) Briefly discuss the factors that affect the quality of food materials during cold storage.
- (c) List those factors that govern the selection of freezing methods as a method of food preservation.



**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 704:** Special Topics in Cereal Technology

**Time Allowed: 2 Hrs**

**INSTRUCTION**

**Answer all questions**

- 1 (a) Acrylamide is claimed to be a carcinogen in human. Briefly give an up-to-date account of studies conducted on its carcinogenicity in human.
  - (b) How is acrylamide formed via maillard's reaction?
  - (c) Explain how any two of the following factors can be used to mitigate acrylamide formation in named cereal products:
    - (i) Raw material
    - (ii) production formulation and composition
    - (iii) Process technology
    - (iv) Additives
- 
- 2 (a) Give detailed accounts of biochemical changes taking place during cereal fermentation.
  - (b) Discuss any two fermented cereal-based foods/beverages under the following emphases:
    - (i) Production description
    - (ii) Substrate
    - (iii) Microbial species involved in the fermentation process
    - (iv) Regions where consumed.
- 
- 3 (a) List exhaustively properties of rice that are affected by ageing during storage.
  - (b) Outline method(s) used in monitoring the changes in any six of the properties mentioned in 3 (a).
  - (c) How do storage temperature and time affect any two of these properties in 3(b)?

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 716:** Food Laws and Legislation

**Time Allowed: 2 Hrs**

**INSTRUCTION**

**Answer any four (4) questions**

1. "Food Technology and the Law". Discuss and highlight the meeting points and conflict zones.
2. What are Food standards? Explain the relationship between Food Legislation and standards.
3. What do you understand by CODEX Standards? Explain how the CAC functions in its role of coordinating International Food Standards.
4. Trace the history and developments which led to enactment of Food Laws, highlighting the major issues of concerns which need legislative control
5. Mention and describe briefly the required infrastructure for effective Food Law Administration by any Food regulatory Agency.

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**COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND**  
**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 718:** Food product Development

**Time Allowed: 2 Hrs**

**INSTRUCTION**

**Answer four (4) questions**

- 1 (a) What is a product development process and how does it work?  
(b) Why product development process?  
(c) Explain the 3 components of a product development process  
(d) Illustrate a typical stage-gate process.
  
- 2 (a) Enumerate the key questions and key decisions to be taken during a food product development.  
(b) Briefly highlight the stage 2 and gate 3 of a product development process.  
(c) (i) In ideation testing, define perceptual map, Gap and product attractiveness score.  
(ii) Illustrate the product attractiveness scores for commercial risk.
  
- 3 (a) Highlight 10 points that drives product success.  
(b) Define: Concept, prototype, project and project milestone. What are the objectives and forces behind management module?  
(c) Describe the roles of a project manager.
  
- 4 (a) Define product specifications, give their sources and examples.  
(b) What is a product flow chart? List the elements needed to define a product processing.  
(c) Write the mass and energy balance equation, then illustrate the mass balance for concentrated fruit juice.  
(d) What are the steps involved in scale-up process?
  
- 5 (a) Define plant trial, its objectives and basic steps. When do you run a plant trial?  
(b) Explain the WHAT, WHERE, WHEN, WHO and HOW of a manufacturing process.  
(c) In the marketing mix, what are the objectives of the 4 P's.
  
6. In detail discuss the principle of Rollout.

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**CONSUMER STUDIES**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 706:** Research Methodology

**Time Allowed: 2 Hrs**

**INSTRUCTION**

**Answer any four (4) questions**

1. What do you understand by Experimental design? Elaborate on the benefits of planning to the success of any research.
2. Highlight the major sections of a research report and give details of the relevant information required under each section.
3. Distinguish between the following:
  - (a) Research hypothesis and statistical hypothesis.
  - (b) Research ethics and Research concept.
  - (c) Applied and Basic Research
  - (d) Research objectives and Research focus.
4. Name and briefly discuss the various stages in the Scientific Research Process.
5. Enumerate some common research constraints in a developing country like Nigeria and suggest ways of overcoming them.

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COLLEGE OF AGRICULTURAL MANAGEMENT, RURAL DEVELOPMENT AND  
CONSUMER STUDIES  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**Second Semester 2007/2008 Session**  
**January, 2009**

**FST 714:** Advanced Food process Engineering

**Time Allowed: 2 Hrs**

**INSTRUCTION**

**Answer four (4) questions**

1. Discuss principles, operations and maintenance of various pumps being used in the food industry.

A solid object of  $8\text{kg/m}^3$  is being conveyed pneumatically in a smooth pipe of  $15\text{m/s}$  and dia of  $10\text{mm}$ . Calculate the fanning friction factor with viscosity of  $2.8\text{ Pa}\cdot\text{s}$  and  $n = 2$ .

- 2 (a) Explain the principles behind 1<sup>st</sup> and 2<sup>nd</sup> law of thermodynamics.  
(b) State Kelvin-Planck and Clausius statements.  
(c) What are the important parts of a boiler.  
(d) A boiler working at a pressure of  $1.8\text{ MN/m}^2$  evaporates  $10\text{Kg H}_2\text{O/kg coal}$  from feed water entering at  $41.5^\circ\text{C}$ . The steam at the top valve is 0.98 dry. Determine the equivalent evaporation from and at  $100^\circ\text{C}$  in  $\text{kg steam/kg coal}$ .  
 $H_2 = 2756.59\text{KJ/kg}$ .  $h_1 = h_f$  at  $41.5^\circ\text{C} = 173.9\text{KJ/kg}$ .
3. Schematically explain four choices specifying a pneumatic conveying system. A boiler delivers  $60\ 000\text{kg}$  of steam/hr at a pressure of  $140\text{KN/m}^2$ ,  $X_{\text{dfraction}}$  of 0.95. The feed water to the boiler is the temperature of  $54^\circ\text{C}$ . The coal used for firing the boiler has a calorific value of  $30\ 000\text{ KJ/kg}$  and is used at the rate of  $650\text{kg/h}$ . Determine the thermal efficiency of the boiler and the equivalent evaporation of the boiler in  $\text{Kg/coal}$ .  
 $h_f = 458.4\text{KJ/kg}$   $h_{fg} = 2231.9\text{KJ/kg}$  specific enthalpy of feed water =  $226.0\text{KJ/kg}$ .
4. Explain the following terms used in process control:  
(a) Microcomputers (b) Sensors (c) Architectural style (d) The human interface (e) Process plant requirements.  
Discuss the differences between process control and Quality control in the food processing industry.
5. Discuss principles and operations of Food freezing and cold storage.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA  
COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY  
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY  
M.Sc. Degree Examinations  
First Semester 2008/2009 Session  
January, 2010**

**FST 707: Advanced Food Quality Control & Plant Sanitation Time Allowed: 2½Hrs.**

**INSTRUCTION**

**Answer four (4) questions only**

1. Compare and contrast HACCP and ISO 22000 systems.
2. Discuss the following terms:
  - Food Safety management system
  - Management responsibility
  - Communication system
  - Resources Management
  - Validation, verification and improvement of FSMS
3. Discuss the following terms:
  - (a) Sampling and Acceptance Sampling
  - (b) Types of Quality Control charts
  - (c) Raw and finished products specifications
  - (d) Food Standards
4. It is desired to obtain process capability index. Five samples were selected at 30 minutes' interval within a four-hour production period and inspected.

1	2	3	4	5	6	7	8
31.0	30.5	29.8	31.7	28.6	30.5	29.5	29.8
30.3	31.3	29.4	30.5	29.5	29.9	30.3	30.5
28.3	30.3	30.8	29.5	31.0	29.5	29.3	29.6
30.1	29.3	30.3	28.5	30.5	31.3	28.4	30.1
28.8	30.5	28.5	30.8	29.2	31.8	30.1	31.3

Prepare the average and range control charts for the process. Calculate the process capability index and discuss your result, if the specification tolerances are 28.5 to 32

- 5 (a) What roles can effective food plant sanitation play in the food industry?
- (b) Discuss various trends in the implementation of total quality management in the food industry.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA  
COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY  
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY  
M.Sc. Degree Examinations  
First Semester 2008/2009 Session  
January, 2010**

**FST 705:** Dairy Products Technology

**Time Allowed: 2Hrs.**

**INSTRUCTION**

**Candidates should answer four questions only**

- 1 (a) Describe the unit operations involved in the processing of “warankasi” from the raw material to the finished product.  
(b) Explain the problems and prospects of “warankasi” production in Nigeria.
  
- 2 (a) What are the problems and prospects of the Nigerian dairy Industry? Offer suggestions as to how to improve the performance of this sector of the Nigerian economy.  
(b) Describe the two tests for confirming the effectiveness of pasteurization in the dairy Industry.
  
- 3 (a) What is the principle involved in the manufacture of yoghurt from skimmed milk?  
(b) With the aid of a flow-chart diagram, illustrate the stages involved in yoghurt production.
  
- 4 (a) Explain the following terms showing clearly the differences between them:  
(i) Butter  
(ii) Margarine  
(iii) Ghee  
(b) Discuss the problems associated with milk analogues.
  
- 5 (a) How would you make a comparable cheap but competitively good quality ice-cream through choice manipulation of some of the ingredients of ice-cream.  
(b) Explain in details the essence of measuring the freezing point of milk.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2008/2009 Session**  
**January, 2010**

**FST 725:** Advanced Food Irradiation Technology

**Time Allowed: 2Hrs.**

**INSTRUCTION**

**Answer All questions**

- 1 (a) Discuss clearly the major factors to be considered in the choice of food irradiation sources.
  - (b) In a clear and concise manner, compare the different types of ionizing radiation available for food preservation.
  - (c) Explain in detail, the use of ultraviolet radiation in food preservation.
- 
- 2 (a) Why is radiation chemistry important to a food technologist?
  - (b) Using clearly written equations, explain the direct and indirect actions that take place in a secondary process when ionizing radiations falls on a food material.
  - (c) Mention different allied disciplines and their roles as it relates to safety of irradiated foods.
- 
3. Clearly explain in details, the different types of doses applicable in food irradiation as it relates to purpose, effective dose range and common applicable products.
- 
- 4 (a) Explain in full, the direct and indirect effects of irradiation on microorganisms present in a food material.
  - (b) List those factors that determine the bactericidal efficiency of a given dose of ionizing radiation.



**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**M.Sc. Degree Examinations**  
**First Semester 2008/2009 Session**  
**January, 2010**

**FST 703:** Advanced Food Technology

**Time Allowed:** 2½ Hrs.

**INSTRUCTION**

**Answer at least one question from each section. Answer 4 questions in all.**

**SECTION 'A'**

- 1 (a) Why do we process food? In a table, itemize what are to be controlled and comments on the major approaches.
- (b) Describe the occurrence of the most undesirable physical change in Powdered food and how can this be avoided.
  
- 2 (a) Highlight the chemical changes in a processed and package food in terms of their sensory qualities.
- (b) What are the factors that can cause changes in quality of canned beef?
- (c) Describe the physical and chemical changes that occur during the production of cheese.

**SECTION 'B'**

- 1 (a) What do you understand by the term 'dehydration'? What is/an the relationship(s) between drying and 'dehydration'?
- (b) Explain how the following properties relate with each other and effect air as a fluid during any drying operation:  
(i) Dry bulb temperature (b) Humidity (iii) Specific volume
- (c) Using a generalized drying curve, explain what takes place during drying of a solid food particle?
- (d) List the possible criteria used in classifying of industrial dryers.
- (e) List at least eight things that could be considered in determining a suitable industrial dryer for any material.
  
- 2 (a) Explain how the following affect selection of a size reduction equipment:  
(i) Mechanical properties of the Feed (ii) Moisture content of the feed (iii) Temperature sensitivity of the feed.
- (b) Give the empirical equation governing the particle size reduction of a solid food material with appropriate assumptions, show the final solution of the equation and describe completely the parameters in each case.
- (c) Briefly explain how you would determine the particle size distribution of a solid meal after a milling operation.

- (d) During an experiment (Shittu et al., 2002), the relationship between the moisture content of feed and cassava flour properties modeled as:

$$Y = A + B X$$

Where Y is the flour property while X is the moisture content. A and B are linear regression parameters. Use the information in the table to discuss how moisture affects each property.

Flour property	Parameters			
	A	B	r <sup>2</sup>	Sig.P
Mean particle size (mm)	0.589	0.01975	0.701	0.019
Surface area (µm <sup>2</sup> )	237.195	-6.313	0.785	0.008
Bulk density (g/cm <sup>3</sup> )	0.679	0.01453	0.972	0.000

- 3 (a) Outline various reasons for separation of components in food materials  
 (b) Write very short notes with examples on the following as methods of separating mixtures of food materials:  
 (i) Filtration (b) Chrystallization (iii) Sedimentation (iv) Centrifugation.  
 (c) (i) What is Leaching?  
 (ii) List the factors affecting rate of extraction during leaching and discuss any **B one** of them.  
 (d) List typical applications of leaching in food processing and discuss briefly any **one** of them.

### SECTION 'C'

1. Discuss theoretical aspects of the following:  
 (a) Freezing  
 (b) Ice Crystal formation  
 (c) Solute concentration  
 (d) Effect of freezing  
 (e) Effects of frozen storage
2. How do you classify freezers? Five-centimetre potato cubes are individually quick frozen in a blast freezer operating at -40°C and with a surface heat transfer coefficient of 30Wm<sup>-2</sup>K<sup>-1</sup>. If the freezing point is -1.0°C, density is 1180kgm<sup>-3</sup>, calculate the expected freezing time for each cube. If the cubes are then packed into a cardboard carton measuring 20cm x 10cm x 10cm, calculate the freezing time. Also calculate the freezing time for IQF freezing of 2.5 cm cubes. Thickness of the card = 1.5mm  
 Thermal conductivity of the card = 0.07Wm<sup>-1</sup>k<sup>-1</sup>  
 Thermal conductivity of potato = 2.5Wm<sup>-1</sup>k<sup>-1</sup>  
 Latent heat of crystallization = 2.74 x 10<sup>5</sup> J kg<sup>-1</sup>

**UNIVERSITY OF AGRICULTURE, ABEOKUTA  
COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY  
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY  
M.Sc. Degree Examinations  
First Semester 2008/2009 Session  
January, 2010**

**FST 733:** Automatic Control Devices

**Time Allowed: 2 Hrs.**

**INSTRUCTION**

**Answer All questions**

- 1 (a) Clearly explain the advantages and disadvantages of the application of automation in the food industry.  
(b) Explain briefly the basic steps in a process control.  
(c) What is a block diagram? Mention its importance in process design.
- 2 (a) Using well labeled diagrams, explain the major differences between open loop and closed loop control systems.  
(b) What are the advantages and disadvantages of the types of systems mentioned above?
- 3 (a) Explain the following types of control actions with clear examples in a food processing setting. Note: use of diagrams and mathematical representations will be credited.
  - (i) Two step actions
  - (ii) Proportional actions
  - (iii) Integral control actions
  - (iv) Proportional plus integral control actions
  - (v) Proportional plus derivative control actions
- 4 (a) What are sensors?  
(b) Highlight the different classes of parameters measured by sensors.  
(c) Give three examples of application of wireless sensors in the food industry.
5. Clearly explain the technical advantages of using:
  - (a) a machine vision system for automatic data grading
  - (b) computer vision in evaluating meat quality.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA  
COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY  
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY  
M.Sc. Degree Examinations  
First Semester 2008/2009 Session  
January, 2010**

**FST 719: Development in Root Crops and Pulse Tech. Time Allowed: 1Hr. 20 mins**

**INSTRUCTION**

**Answer any two questions**

**SECTION 'A'**

- 1 (a) Show in a table, the proximate composition and the antinutritional factors of the 5 common root and tuber crops.
- (b) What are the primary and secondary root and tuber products?
  
- 2 (a) Enumerate 10 applications of specialty potato starches, indicating the food product category and their functions.
- (b) (i) Briefly describe Cassava bread and *farinhade madioca*.
- (ii) Differentiate between cassava flour and cassava starch.
- (c) Explain the processing methods used to detoxify HCN in Cassava roots to a safe level.
  
- 3 (a) Highlight the achievements on the cassava initiative in Nigeria.
- (b) Describe the AVEBE starch products and their main areas of applications.

**UNIVERSITY OF AGRICULTURE, ABEOKUTA  
COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY  
DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY  
M.Sc. Degree Examinations  
First Semester 2008/2009 Session  
January, 2010**

**FST 717:** Special Topics in Sensory Evaluation      **Time Allowed: 2Hs.**

**INSTRUCTION**

**Answer any three questions**

1. Write an essay to critically appraise the use of Electronic Nose and Tongue in Food Analysis. Highlight the strengths and weaknesses of these advances in Sensory Science.
  
2. Discuss in detail, giving practical steps to incorporate Sensory Evaluation in Research and Development of new food product.
  
- 3 (a) What differentiate product-oriented tests from consumer-oriented tests?  
  
(b) Describe in detail how a Triangle test can be used in the Screening of Sensory Panelists.
  
- 4(a) Enumerate and discuss briefly Common pitfalls which affect the validity of Sensory data.  
  
(b) Suggest practical ways to avoid such pitfalls.