

**UNIVERSITY OF AGRICULTURE, ABEOKUTA**  
**COLLEGE OF FOOD SCIENCE AND HUMAN ECOLOGY (COLFHEC)**  
**DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY**  
**B.Sc. Degree Examinations**  
**First Semester 2008/2009 Session**  
**October, 2009**

**FST 511: Food Machinery**

**Time: 2Hrs.**

**INSTRUCTION**

*Answer any four (4) questions. All questions carry equal marks.*

- 1(a) Highlight the general requirements of an ideal food machinery.
- (b) With the aid of a well-labelled diagram, describe the design and construction of a mechanical soybean dehuller.
- (c) State the Kuprit's formula for determining the efficiency of the dehuller in (b) above.
  
- 2(a) What are the various ways of classifying mixers?
- (b) Vividly explain the principle of dough mixing (labelled sketches are highly important).
  
3. Write a short note on the following:
  - (a) Preparation of food machinery design.
  - (b) Technological analysis of food production process.
  - (c) Location of mixing arms of a horizontal mixer.
  - (d) Lubricating system of a dough divider.
  - (e) Oven chamber length of an electric tunnel oven.
  
- 4(a) Explain the functions of oven flues.
- (b) Using well labeled sketches and mathematical expressions, describe the sectional configuration and dimensions of the baking chamber of an electric tunnel oven.
  
- 5(a) Explain the factors that affect the rehydration characteristics of dried food products.
- (b) What are the objectives of drying food commodities?
- (c) List the factors affecting the drying rate and final moisture content of a drum dryer dried food products.
  
- 6(a) Enumerate the principles of extrusion cooking.
- (b) With the aid of a well labelled diagram, describe the design consideration and advantages of a pulse combustion flash dryer.
- (c) List the variables that have significant effect on the performance of a cooking extruder.

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**First Semester 2008/2009 Session**  
**October, 2009**

**FST 513: Business Management for Food Technologist**

**Time: 2 Hrs.**

**INSTRUCTION**

*Candidates should attempt four questions only*

1. Discuss the role of management in a Food Industry and assess the relative importance of management as a resource.
- 2 (a) Discuss with reasons why line and staff functions in a Food Industry are complementary.  
  
(b) Discuss the implications of the application of the Gracunas theorem of relationships to a Food Industry.  
  
(c) Justify the statement that “The attempt to introduce Scientific methods into management is an evidence to corrupt its exact nature”.
3. Assuming that authority represents Institutionalised power, differentiate between:
  - a (i) Formal Authority Theory
  - (ii) Acceptance Theory
  - (iii) Competence Theory  
b. Discuss the relationship between Responsibility, Power and Accountability in a Food Industry.  
  
c. Discuss the probable reasons why a subordinate is usually willing and ready to submit himself to the influence of his superior.
4. Discuss:
  - (a) The steps involved in Planning and why it is important in a Food Industry
  - (b) The Natural Ingredients of Planning
  - (c) The Designs of Planning
- 5 (a) Write short notes on the basic types of production processes that can occur in a Food Industry.  
  
(b) Discuss how a manager can employ systems output in predicting all the possible effects of production variables in a Food Industry.

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**FST 501: Cereal and Tuber Technology**

**Time: 2Hrs.**

**INSTRUCTION**

*Answer any four (4) questions. All questions carries equal marks.*

- 1 (a) Explain post-harvest technology of maize under the following headings: (i) Treshing (ii) Winnowing (iii) Storage (iv) Inhibition of aflatoxin contamination (v) Wet milling  
(b) Highlight the differences between cereals and root/tuber.
- 2 (a) With the aid of well structured flow chart, explain the various stages involves in rice processing.
- 3 (a) Describe sorghum caryopsis.  
(b) Discuss the traditional preparations and uses of maize in Nigeria.
- 4 (a) Enumerate the role of roots and tubers in nutrition.  
(b) What are the objectives of cassava processing?  
(c) Describe the various ways of processing cassava for human consumption.
- 5 (a) Explain the general morphology and composition of yam tuber.  
(b) Explain the major unit operations involve in processing of yam.
- 6 (a) What do you understand by the term “Composite flour Technology”?  
(b) Discuss the problems and prospects of composite bread technology in Nigeria.  
(c) Describe the straight dough process and sponge dough process of making bread.

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**FST 503: Meat Science and Technology**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Answer and any four questions*

1. A large consignment of freshly processed beef was transferred from the abattoir to a supermarket for sales. Enumerate five (5) factors which could affect the quality of such beef at the sales/retail point.
- 2 (a) List the various types of stresses to which animals may be subjected prior to or during slaughter.  
(b) Explain the effects of each of the named stresses in (a) above and measures which could be taken to minimize them.
3. Draw a labeled flow chart of a modern slaughter-house operation and discuss briefly the significance of each stage of operation to the point of retailing.
4. Describe the occurrence of post-mortem changes in a carcass and explain the process and forms of rigor mortis likely to develop in such meat.
5. Give a brief account of the quality changes associated with heating of meat samples from about 35 to 90°C or higher.
- 6 (a) What is meat curing?  
(b) What are the basic principles by which curing extends the shelf life of muscle foods?  
(c) What are the effects of pH and temperature on water-holding capacity and oxygen diffusion in cured meat?  
(d) What are the undesirable effects of cured meat?

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**FST 507: Food Additives, Toxicology and Safety**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Answer any four (4) questions*

1. Mention the major Natural toxicants in the following commodities and aimed at detoxifying them:  
(a) Cassava (b) Cotton seed (c) Soyabean.
- 2 (a) Enumerate and explain briefly the principal functions of food additives, give appropriate examples for each function listed.  
  
(b) Name appropriate preservatives for the following Food Products and give reasons for your choice.  
  
(c) (i) Carbonated soft drinks (ii) Cakes (iii) Bread Sausage (iv) Wine
3. Write notes on the occurrence, chemistry, toxicological effects and control of the following toxicants:  
  
(a) Aflatoxins  
(b) Goitrogens  
(c) Paralytic Shellfish poison  
(d) Polycyclic Aromatic Hydrocarbon
- 4 (a) Define and explain the significance of the following terms:  
(i) NOAEL (ii) MTD (iii) LD<sub>50</sub> (iv) TD<sub>50</sub> (v) MRL (vi) GRAS  
  
(b) Enumerate the limitations of using experimental animals in safety evaluation tests.
- 5 (a) Explain the following terms and give one example of toxicants producing such effect:  
(i) Carcinogenicity (ii) Mutagenicity (iii) Teratogenicity  
  
(b) Explain how the following affect toxicity:  
(i) Dose (ii) Processing.

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**FST 509: Food Packaging**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Answer all question in Section A and any three (3) from section B*

**SECTION A**

- I) List four (4) major functions expected of a packaging material for a manufactured food product.
- II) Give three (3) examples of Nigerian traditional packaging materials of plant origin that are still in common use till date.
- III) Outline all the stages involved in package development process for a new food product.
- IV) Distinguish between flexible packaging and flexible film.
- V) What is the role/significance of plasticizers in the production of flexible films.
- VI) Give two (2) reasons for coating flexible films.
- VII) Name one (1) flexible film that can be coated.
- VIII) List five (5) coating materials
- IX) Mention three (3) advantage that co-extruded films has over other types of films.
- X) Name two (2) main methods of producing co-extrusions
- XI) Name six (6) types of sealers.

**SECTION B**

- 1 (a) Highlight the general properties of flexible films.  
(b) Write short notes on single films.
- 2 Describe the features and uses of the following packaging materials:  
  
(a) Metal foils (b) Metallized films (c) Paper
- 3 (a) Highlight the merits and various applications of metal can as a food packaging material.  
(b) Give the types of enamel coatings that are commonly used in food packaging and indicate the use of each coating.  
(c) What are the obstacles to large scale use of metal cans for packaging of food in Nigeria?
- 4. Write short notes on the following:  
(a) Food packaging and environmental pollution in Nigeria.  
(b) Shipping containers.  
(c) Quality assurance in package design.

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**FST 515: Food Irradiation Technology**

**Time: 2 Hrs.**

**INSTRUCTION**

*Answer all questions*

- 1 (a) In a clear and concise manner, explain the various types of ultraviolet radiation you know and its application in Food Irradiation.
- (b) What do you understand by dosimetry?
- (c) What are the differences between food irradiation and microwave treatment of foods?
- (d) Briefly explain the major applications of Food Irradiation
- (e) Clearly explain the direct effects of ionizing irradiation on microorganisms of food materials.
- (f) Briefly outline the effects of ionizing irradiation on carbohydrate, protein and fat components of food materials.
- (g) How important is radiation chemistry in food Irradiation.
- (h) Using equations only, show what happens in the primary process when ionizing radiation falls on a cassava root.
- (i) In what ways can radiolysis of water and fat be minimized in a food material?
- (j) Using well labeled diagrams only, show how material presentation can affect effectiveness of Food Irradiation in preserving foods.

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**December, 2008**

**FST 504: Technology of Miscellaneous Food Commodities**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Candidates should answer four questions only with at least a question from each section.*

**SECTION A**

1. Discuss the botanical characteristics of the cacao tree with emphasis on the commercial varieties.
2. (a) Differentiate between the various tea types  
(b) Describe the process involved in the production of Coffee.
3. Differentiate clearly between the following terms:
  - (a) (i) Cocoa cherelles  
(ii) Cocoa Pod  
(iii) Midges  
(iv) Cauliferous
  - (b) Enumerate the desirable kolanut qualities.
  - (c) Discuss the main uses of kolanut.

**SECTION B**

- 1(a) Highlight the sucrose sugar types based on their physical properties.  
(b) Explain the solubility property of sugars.  
(c) How can the variation of confection texture be achieved?  
(d) Define D.E. What are the functional uses of glucose syrup based on D.E. types?
- 2 (a) Briefly describe the following confectioneries:
  - (i) High boiled sweets
  - (ii) Honeycomb sweets
  - (iii) Lollipops
  - (iv) Fudges
  - (v) Fondants
  - (vi) Sugar panning
- (b) Differentiate between:
  - (i) Tablets and Lozenges
  - (ii) Gums and Jellies
  - (iii) Chewing gums and Bubble gums
- (c) Describe the production of glucose syrup.



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**FST 506: Process Control and Automation**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Candidates should answer **all** questions.*

1. A chilled ice cream pack was placed in a room which was kept at a constant temperature. The temperature of the cream falls at a rate of  $K\theta$  k/min where  $k$  is a positive constant and  $\theta$  is the difference in Kelvin between the temperature of the pack and that of the room at time  $t$  min.  
Express this information in form of differential equation and hence show that  $\theta = \theta_0 e^{-kt}$  where  $\theta_0$  is the temperature difference in Kelvin at time  $t = 0$ . If the temperature of the pack falls to 5K in the first minute and 4K in the second minute, show that the fall of temperature in the third minute is 3.2K.
2. A mercury thermometer having a time constant of 0.1min was placed in a water bath at 100F and allowed to come to equilibrium with the bath. At time  $t = 0$ , the temperature of the bath begins to vary sinusoidally about its average temperature of 100F with an amplitude of 2F. If the frequency of oscillation is  $\frac{10}{\pi}$  cydes/min, what is the phase lag?
- 3 (a) Find the inverse transform of  $f(s) = \frac{2S^2 - 7S - 24}{(S + 2)(S + 3)(S + 4)}$ 
  - (b) Using well defined mathematical relationships **only**, outline the responses of the following first order systems:
    - (i) Step response
    - (ii) Impulse response
    - (iv) Sinusoidal response
  - (c) Mention the basic steps in process control.
- 4 (a) What are the main components of a feedback control systems?
  - (b) Itemize the different types of control actions that you know with these distinguishing mathematical expressions.
  - (c) Give three advantages and two disadvantages of a feedback control system.
- 5(a) Find the laplace transform of:

- (i)  $L[t^4]$
- (ii)  $L[\cos 4t]$
- (iii)  $L[\sin \frac{1}{2}t]$
- (iv)  $L\left[\int_0^t \sin 4tdt\right]$
- (v)  $L[e^{2t}]$

- (b) The rate of cooling a fried yam chip is given by the equation  $\frac{d\theta}{dt} = -K(\theta - 10)$  where  $\theta$  is the temperature in degrees Celsius,  $K$  is a constant and  $t$  is the time in minutes. When the fried chip was initially removed from the fryer,  $\theta$  was  $90^\circ\text{C}$  and after five minutes,  $\theta$  was  $60^\circ\text{C}$ . Show that the temperature ( $\theta$ ) will be  $41.25^\circ\text{C}$  when  $t$  is 10 mins.
- (d) A proportional type pneumatic controller is used to control the temperature in a furnace at a desired value of  $750^\circ\text{C}$ . The range of the instrument is  $0 - 1000^\circ\text{C}$  and the proportional band is set to 15%. The controller has an output pressure range of  $20-100\text{kN/m}^2$  and the output pressure increase with increase in temperature. If the output pressure is  $600\text{ kN/m}^2$  when the furnace temperature is at the desired value, find:
- (i) The values of temperature corresponding to output pressure of  $20\text{ kN/m}^2$  and  $100\text{ kN/m}^2$ , respectively.
  - (ii) The value of output pressure for a deviation of  $15^\circ\text{C}$  downscale from the desired value.

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**Second Semester 2007/2008 Session**  
**December, 2008**

**FST 510: Nigeria's Food and Industrial Raw Materials**

**Time: 2½ Hrs.**

**INSTRUCTION**

*Candidates should answer four questions only with at least a question from each section.*

**SECTION A**

1. Discuss the origin, production and quality specifications of sesame seeds in Nigeria.
- 2 (a) Using the example of “Akaraogun” in the Forest of Ten Thousand Demons (Ogbojuode ninu Igbo Olodumare) among others, discuss the spiritual significance of kolanuts.
  - (b) Discuss the reasons why the quality of a finished product is directly proportional to the quality of its raw materials.
- 3 (a) Discuss the reasons why Nigerian Palm kernels depend largely on their quality and the various uses to which they are put.
  - (b) Discuss the limitations and ‘myths’ associated with the Cassava Crop.

**SECTION B**

- 1(a)
  - (i) Explain the methods of sourcing for raw materials in the food industry.
  - (ii) Highlight the qualities of a good raw material sourcing agent.
- (b) What are the major derived agricultural raw materials and discuss their availability?
- (c) Discuss the role of government in promoting local raw materials for food industries.
- 2(a) In a tabular form, show the 1<sup>o</sup>, 2<sup>o</sup> and 3<sup>o</sup> key raw materials required for the various sectors of industrial food products.
  - (b) Enumerate the recommendations required for improvement of local food processing equipment.
  - (c) What are the constraints and prospects of local raw material sourcing in food industries in Nigeria?
  - (e) What are the quality specifications required for raw material used in Bread baking industry.

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**FST 511: Food Machinery**

**Time Allowed: 2Hrs.**

**INSTRUCTION**

*Answer any four (4) questions*

- 1 (a) Enumerate the ideal features of the external and internal environment of a food plant.  
(b) What do you understand by the term “technological analysis of food production process”?
- 2 (a) What are the general requirements of a food machinery?  
(b) With the aid of a Schematic diagram, describe the general construction of a beating machine.  
(c) Describe the different ways of classifying mixers.
- 3 (a) What is extrusion processing?  
(b) Describe the design, construction and operation of a continuous screw extruder.
- 4 (a) With the aid of a schematic diagram, describe the main components, design considerations and advantages of a flash dryer.  
(b) What are the factors affecting reconstitution of dried products.
- 5 (a) With the aid of diagram only, highlight the various types of mixing tools of a beating machine.  
(b) Describe the construction and operation of a dough divider under the following headings:
  - (i) Dividing Head
  - (ii) Dividing Principle
  - (iii) Lubricating System.

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**FST 513:** Business Management for Food Technologist

**Time Allowed:** 3Hrs.

**INSTRUCTION**

*Answer question one (1) and three (3) other questions*

1. The University of Agriculture, Abeokuta, has a Tripodal mandate for Teaching, Research and Extension. The University has a consultancy unit that is involved in the production and sales of some food items such as UNAAB 'Fufu', UNAAB 'Gari', UNAAB Palm oil, UNAAB Pure water etc. Assuming these products suddenly become scarce due to technical problems and you were called in as a Consultant to overhaul the unit, proceed to answer the following questions:
  - (i) Construct a workable Organogram for the unit.
  - (ii) Distinguish between line and staff officers in the unit.
  - (iii) Suggest how to interview applicants and fill vacant posts in the said unit.
  - (iv) What system of operation will you institute in the unit to minimize the incidence of product rejects?
  
- 2 (i) Organisations employ various resources, man, machine, money and materials in order to achieve objectives. Discuss the role of management in a food industry and access the relative importance of management as a resource.
  - (ii) Distinguish between the 5 P's of Planning.
  
- 3 (i) Briefly discuss the elements that make up a proper system of stock control in a food industry.
  - (ii) Highlight the reasons why Personnel Management is often described as a "forgotten asset".
  
- 4 (i) Distinguish between Batch and Continuous Production
  - (ii) Discuss how a Manager can employ the Systems output to predict all the possible efforts of production variables.
  
- 5 (i) Do you agree that the attempt to introduce scientific methods into management is an evidence to corrupt it in the exact nature?
  - (ii) Discuss some useful business techniques that you know that can be employed for the growth of a small scale food industry.

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**FST 509:** Food Packaging

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

**INSTRUCTION**

*Answer all questions in section A and any three questions from section B*

**SECTION A**

- I. Explain the following terms as used in metal can manufacture:  
(i) Base plate (ii) Tin coating (iii) Enamel coating
- II. In a package-environment interaction, what do you understand by the term pertinent property?  
What is the pertinent property when the environmental factor is pressure of oxygen?
- III. Describe the following glass containers and illustrate your answer with an appropriate diagram:  
(i) Bottle  
(ii) Tumbler  
(iii) Carboys
- IV. List two (2) main advantages that coextruded films has over other types of film.
- V. Distinguish between “Callandering” and “Casting” methods used in the production of single films.
- VI. What type of film coating is required for each of the following purposes:  
(a) Provide moisture barner but retain oxygen permeability  
(b) Packaging meats before smoking and cooking?
- VII. What is the difference between metal foil and metallized films?
- VIII. Suggest an appropriate flexible packaging material for ‘moinmoin’ (steamed bean paste) as an improvement over the traditional leaves and give a reason for your choice.
- IX. List two (2) types of seal and two (2) types of sealer.
- X. List two (2) methods of applying wax to improve the barrier properties of paper.

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**SECTION**

1. Describe the properties, method of production and considerations in the production of:
  - (a) Laminated films
  - (b) Co-extruded films
  
- 2 (a) Distinguish between various types of paper and paperboards.
- (b) Describe briefly, the method of production and characteristics of paper and paperboard packages.

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**FST 505:** Fat and Oil Technology

**Time Allowed:** 2 hrs

**INSTRUCTION**

*Answer any four (4) questions*

1. Write short notes on the following:
  - (a) Cocoa butter substitutes
  - (b) Margarine manufacture
  
2. Write short notes on:
  - (a) Phytosterols and health
  - (b) Omega-3 fatty acids and health
  
- 3 (a) The Western press is dissuading people from planting palm oil. Give reasons why you disagree and why palm oil is a desirable fat.
  - (b) Describe the steps in the industrial Extraction of palm oil.
  
- 4 (a) How will you determine if a sample of bread spread is butter or margarine?
  - (b) Arrange the following fats in descending order of fatty acid size (those with the longest chains first) and defend your arrangement: Butter, fish oils, peanut oil, palm kernel oil, paraffin.
  - (c) You are given two samples of soybeans oil. How can you tell which of them has been hydrogenated if both are still fluid.
  
- 5 (a) Describe the processes palm oil will undergo to produce commercial shortning fat and liquid cooking oil.
  - (b) What are the functions of fats and oils in foods?



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**FST 503:** Meat Science & Technology

**Time Allowed:** 3Hrs.

**INSTRUCTION**

*Answer any five (5) 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) 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?
  
- 3 (a) An animal was chased around the courtyard for almost 2 hours before slaughter. Briefly describe the biochemical changes taking place in the muscles of such live-animals.  
(b) What is Postmortem Glycolysis in muscle foods and what are its effects?
  
- 4 (a) Sketch and describe a typical skeletal muscle.  
(b) Briefly explain the following:
  - (i) Water-holding capacity
  - (ii) Drip losses
  - (iii) Protein denaturation in muscles
  - (iv) Rancidity
  - (v) White and Red meats
  
5. How would the breed of animal, sex, age and growth conditions influence meat quality?
  
6. What are the effects of thermal processing at temperatures of 30 to 90°C on meat quality characteristics?
  
- 7 (a) Sketch and label a cross-section of an egg.  
(b) Discuss the structural composition of an egg.

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**FST 501:** Cereals and Tuber Technology

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer any four (4) questions*

- 1 (a) Highlight the main differences between cereals and tuber crops.
- 1 (b) Explain the following pre-processing operations of maize:
  - (i) Threshing
  - (ii) Winnowing
  - (iii) Drying
  - (iv) Storage
  - (v) Inhibition of aflatoxin contamination
- 1 (c) What are the factors that affect the viscosity of pounded yam?
  
- 2 (a) Describe the various ways of processing cassava for human consumption.
- 2 (b) Enumerate the changes occurring during rice parboiling.
- 2 (c) Briefly explain the nutritional value of cereals and cereal products.
  
- 3 (a) With aid of flow diagram only, highlight the various unit operations involved in rice processing.
- 3 (b) Describe in detail, the major unit operations involved in yam processing.
  
- 4 (a) Discuss the processing, quality control, storage and utilization of any three (3) industrial cassava products.
- 4 (b) Highlight the advantages and limitations of using sorghum for malting.
  
- 5 (a) What are the advantages and disadvantages of parboiling rice.
- 5 (b) Explain the following:
  - (i) Rice milling
  - (ii) Yam peeling
  - (iii) Glycoalkaloids in potato
  - (iv) Wet milling of maize
  - (v) Maize tortillas

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**B.Sc. Degree Examinations**  
**First Semester 2007/2008 Session**  
**July, 2008**

**FST 507:** Food Additives, Toxicology and Safety      **Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer any four (4) questions. All questions carry equal marks*

- 1 (a) Define the following;  
(i) Food    (ii) Food additives    (iii) Toxicology    (iv) Safety  
(v) Contaminants
- (b) Vividly describe Aflatoxin and Ochratoxin under the following headings:  
(i) Properties and sources    (ii) Analysis    (iii) Control measures.
- (c) List five examples of phycotoxin and name their sources.
  
- 2 (a) "There are positive correlations between certain nutrients combined and some established nutritional disorders" Discuss.
- (b) Describe in detail how the following could constitute a toxicological hazard:  
(i) Irradiation    (ii) Smoking    (iii) Pesticides residues    (iv) Packaging  
(v) Microorganisms
- (c) List any five recommendations that could improve the present situation on the use of food additives.
  
- 3 (a) What are the principal functions of food additives?
- (b) Describe the process of listing a food additive as GRAS
- (c) What do you understand by the following:  
(i) ELISA    (ii) MBA    (iii) NIV    (iv) RIA    (v) PSP
  
- 4 (a) Briefly discuss the side effects of food additives under the following headings:  
(i) Preservatives/antioxidants    (ii) Sweeteners    (iii) Allergy or intolerance  
(iv) Caramel.
- (b) What are the adverse effects of food additives on human health??
  
5. Write a short note on the following:  
(a) Colourants  
(b) Emulsifiers and stabilizers  
(c) Trichothecenes  
(d) Ciguatera toxin  
(e) paralytic shell fish poisons
  
- 6 (a) Describe the sources, health implications, means of detoxification and control measures of any five (5) plant anti-nutritional factors.
- (b) What are the disadvantages of using animals for Toxicological testing?

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**First Semester 2007/2008 Session**  
**July, 2008**

**FST 515:** Food Irradiation Technology

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

*Answer questions 1, 2 and ANY OTHER ONE (1).*

- 1 (a) Itemize the scientific disciplines that have contributed to the study of irradiated food materials
  - (b) Clearly mention the importance of irradiation chemistry as it relates to food irradiation.
  - (c) List the various steps involved in the secondary process when ionizing radiations falls on a food material.
  - (d) Briefly discuss the contribution of gamma irradiation as a pre-treatment operation prior to hot air drying of a food material.
- 
- 2 (a) Briefly discuss the effect of application of about 0.5kGy gamma irradiation on some physicochemical properties of fruits.
  - (b) What are the merits of the use of radiations generated from  $^{60}\text{Co}$  and  $^{137}\text{Cs}$  in food preservation.
  - (c) Mention clearly with respect to low dose in a tabular form, the effective dose range, purpose and typical products as it relates to food safety, processing and preservation.
  - (d) Irradiation of food has technical and economical limitations that prevents its use on all foods under all circumstances. Briefly explain this statement.
- 
- 3 (a) With the aid of clear diagrams, explain the various ways in which food materials can be presented to ionizing radiations for effective dose distribution.
  - (b) Taking into consideration, the misconception about irradiation of food material, justify its use in food preservation
  - (c) What are those factors that governs the effectiveness of a particular dose in destroying microorganisms.
- 
- 4 (a) Define dosimetry and clearly explain the basic factors that governs it during food irradiation process.
  - (b) What do you understand by the term stopping power? What factors determines its effectiveness.
  - (c) What are the advantages of the use of gamma irradiation over neutrons in preserving food materials.
  - (d) What are the contributions of W.K. Roentgen and H. Becquerel in the application of ionizing radiations in food processing?

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**B.Sc. Degree Examinations**  
**Second Semester 2006/2007 Session**  
**December, 2007**

**FST 510:** Nigeria's Food and Industrial Raw Materials      **Time Allowed:** 2 ½ Hrs

**INSTRUCTION**

- (i) *Answer 4 Questions only*
- (ii) *This question paper should not be transferred to any other candidate during the examination session.*

**SECTION A**

1. (a) Discuss the 'myths' that are wrongly associated with the Cassava Crop.  
 (b) What do you understand by the term Specification?  
 Construct a Specification sheet for Sodium Chloride.  
 (c) Highlight the reasons why the quality of a finished product is directly proportional to the quality of the raw material used.
2. (a) Discuss the quality defects of Ginger (*Zingiber officinale*)  
 (b) Write short notes on the importance of coffee as an export commodity.
3. (a) Discuss the reasons why 300 beans of cocoa are used as the final sample for cut tests and weight measurements.  
 (b) Below are two typical cocoa cut tests:-

% Mouldy	% Slatey	% Insect infested	% Flat	% Germinated	% Fully fermented	Wt of 300 beans	MC or LC	Grade
2 <sup>2</sup> / <sub>3</sub>	3 <sup>1</sup> / <sub>2</sub>	-	2	1		316		
3 <sup>1</sup> / <sub>2</sub>	2	-	3	-		310		

Determine the following for each of the tests:

- (i) % fully fermented beans
  - (ii) The grades to which they belong
  - (iii) The types of crops that they are (MC or LC).
- (c) Discuss with reasons why impurity is the most serious defect of Nigerian palm kernels.

## SECTION B

1.
  - (a) What are the major classes of raw materials for food industries?
  - (b) Highlight the 1<sup>o</sup>, 2<sup>o</sup> and 3<sup>o</sup> key raw materials required for the sectors of food products in the industry.
  - (c) Enumerate 10 major primary and derived agricultural raw materials and their availability.
  - (d) Mention 10 imported food raw materials and their substitutes.
  
2.
  - (a) Describe the methods of sourcing for raw material in the food industry.
  - (b) What are the qualities of a good raw material sourcing agent?
  - (c) Highlight the constraints and prospects of local raw material sourcing for food industries.
  - (d) Using a biscuit industry as a case study, write out all the quality specifications required for each raw materials used.
  - (e) Write three (3) food processing equipments each for two (2) unit operations based on the main treatments used in food industry.

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**December, 2007**

**FST 504:** Technology of Miscellaneous Food Commodities      **Time Allowed:** 2½ Hrs.

**INSTRUCTION**

- (i) *Candidates should attempt four (4) questions only.*
- (ii) *This question paper should not be transferred to any other candidate during the examination session.*

**SECTION A**

1. (a) Describe in details the steps involved in the processing of raw palm kernel to palm kernel oil and cake.  
(b) Distinguish between the various commercial varieties of cocoa.  
(c) Discuss the desired chewing quality of kola nut.
2. (a) Explain with reasons why spices are by themselves not very convenient to use in all food products.  
(b) Write short notes on the different types of spice products that you know.  
(c) Differentiate between the following tea types:  
(i) Black tea   (ii) Green tea   (iii) Oolong tea.
3. (a) Discuss the processing method of the most abundant coffee in Africa pointing out how it can be adulterated.  
(b) Differentiate between (i) Incipient/Fusion point (ii) Slip point and (iii) Clear point.  
(c) Write an essay on the spiritual significance of the kola tree.

**SECTION B**

1. (a) Briefly describe the production and purification of sugar from sugar cane, thus, highlight the a-point examination standards to be considered when purchasing sugar.  
(b) Describe the traditional degree of sugar boilings with the approximate temperatures.  
(c) Explain the following properties of sugar: (i) solubility (ii) bulkiness.

2. (a) Describe the types of sucrose sugar available for confectionery products.
- (b) What is D E? How will you produce glucose syrup using acid conversion method?
- (c) Briefly differentiate between the following confectionery products:
- (i) Laminate comb sweets and Lollipops
  - (ii) Fudges and fondants
  - (iii) Tablets and Lonzenges
  - (iv) Chewing gums and Bubble gums.



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**December, 2007**

**FST 506:** Process Control and Automation

**Time Allowed:** 2 Hrs.

**INSTRUCTION**

- (i) *Answer question 1 and any other 2*
- (ii) *This question paper should not be transferred to any other candidate during the examination session.*

1. (a) What are the basic steps in process control?
- (b) Define the following terms in relation to process control:
- (i) Steady state process
  - (ii) Control agents
  - (iii) Block diagram
  - (iv) Attenuation
  - (v) Damping
- (c) List six types of control actions you know?
- (d) Itemize the main components of a feedback control system.
- (e) The function of a sensor in a control system is.....
- (f) Tachometer measures a physical variable called.....
- (g) The controller of a control system performs what function?
- (h) Find the laplace transform of

(i)  $L\left[t^4\right]$

(ii)  $L[\sin 4t]$

(iii)  $L\left[\cos \frac{1}{2}t\right]$

- (i) Initially, the number of *Staphylococcus aureus* in a certain culture is,  $F_0$ . At a particular time  $t$ , the birth rate of *S. aureus* is half of the number of  $F$  living *S. aureus* and there is a constant death rate which is a quarter of the initial number of organism present. If  $F$  is a continuous

variable, form a differential equation for F and obtain F in terms of t. How long will it take for the number of living *S. aureus* to double.

2. (a) Using a well labeled block diagram **only**, show the components of a feedback control system.
  - (b) What do you understand by the term signals? Explain the various types you know in relation to process control?
  - (c) What are the objectives of introducing an integral and derivative control in a control system?
  - (d) The rate of moisture removal during deep fat frying of yam slices is given by the expression,  $\frac{dM}{dt} = -k(M - 10)$ , where M is the moisture content in %, k is a constant and t is the time of frying in min. When t = 0, the moisture content is 90% and when t = 5min, the moisture content was 60%. What will be the moisture content of the product when t = 10 min.
- 
3. (a) With the aid of a well labeled diagram **only**, clearly show the closed-loop of a typical convective drying process.
  - (b) What do you understand by the term control systems? Clearly distinguish between the various types you know.
  - (c) Clearly itemize the various factor that can introduce time delays in a control system.
  - (d) A vacuum fryer containing oil at 100°C after a frying experiment was placed in a room which has a constant temperature of 20°C. The rate of cooling at any moment is proportional to the difference between the temperature of the room and the frying oil. If after 5 min the temperature of the oil is 60°C, what will its temperature be after 10 min.
- 
4. (a) Using a well labeled diagram **only**, clearly show a closed-loop speed control system with valve, magnetic and rotating amplifiers.
  - (b) Give three advantages and two disadvantages of feedback in a control system.
  - (c) (i) Briefly discuss the various types of sensing elements you know.  
(ii) What do you understand by frequency response?
  - (d) Fried yam crisp was placed in a room which was kept at a constant temperature. The temperature of the fried yam crisps falls at a rate of kT K/min where k is a positive constant and T is the difference in Kelvin between the temperature of the crisp and that of the room at

time  $t$  min. Show the information in form of a differential equation and hence show that,

$T = T_0 e^{-kt}$  where  $T_0$  is the temperature difference in Kelvin at time

$t = 0$ . If the temperature of the crisp falls to 5K in the first minute and 4K in the second minute, what is the fall in temperature in the third minute?

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**B.Sc. Degree Examinations  
Second Semester 2006/2007 Session  
December, 2007**

**FST 502:** Fermented Foods Technology

**Time Allowed:** 2 ½ Hrs

**INSTRUCTION**

- (i) *Answer question 3 and any other three questions*
- (ii) *This question paper should not be transferred to any other candidate during the examination session.*

1. (a) Outline the process of tempeh preparation and discuss the biochemical processes involved in its fermentation as well as its current uses.  
  
(b) Discuss one other common Asian food, the biochemical processes involved in its fermentation, as well as its present common use.
2. Outline the process of preparing traditional cereal beers of Nigeria and explain the differences between these and conventional lager beer.
3. Discuss the biochemical basis and product recovery methods for the production of lysine and glutamic acid by fermentation.
4. (a) List the advantages and disadvantages of air-sparged fermenters.  
  
(b) What are the advantages and disadvantages of batch fermentations?
5. Aeration and Agitation are important in fermentations. Discuss the features of modern fermenters that ensure that these are provided for adequately.

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**B.Sc. Degree Examinations**  
**First Semester 2010/2011 Session**  
**February, 2011**

**FST 511: Food Machinery**

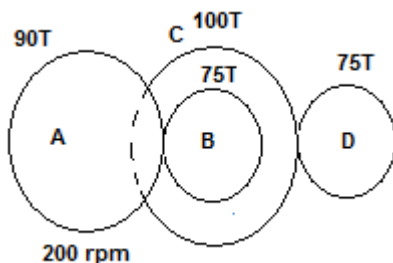
**Time: 2Hrs. 15 mins**

**Instruction**

Answer all questions in Section A and one question in Section B

**Section A**

1. a. Define the term machine.  
b. Simply state the functions of the following basic elements in a machine?  
(i.) Gear      (ii.) Belt and pulley      (iii.) Shaft      (iv.) Bearings  
Use simple schematics to describe examples of each of these machine elements.  
c. List the basic types of bearing used in machines. Explain the features, merits and/or demerits of any one type of bearing listed.  
d. List the different types of gears used in connecting:  
(i.) Parallel shaft      (ii.) Intersecting shaft
  
2. a. Why is hygienic design of machinery important?  
b. What are the basic considerations made by any food machinery designer to achieve hygienic design?  
c. State the basic principles of hygienic design of food machinery.
  
3. a. What are the dos and don'ts of food machine designs?  
b. Give reasons for the lubricating engine gears.  
c. Consider the gear system below. What type of gear system is it? Determine the speed of rotation of gears B, C, and D.



**Section B**

4.
  - a. Give reasons why food commodities are dried.
  - b. List five different types of drying equipment and give two examples of food handled in them.
  - c. Briefly discuss a named type of dryer **or** extrusion machine under the following headings: basic parts, energy consumption and conversion, motion transmission, operational condition and maintenance.
  
5.
  - a. Explain the main difference(s) between an oven and a dryer.
  - b. Give at least three examples of practical applications of ovens in food processing.
  - c. Briefly discuss a named type of oven under the following headings: basic parts, design variation, energy consumption and conversion, motion transmission, operational condition and maintenance.
  
6.
  - a. Why is mixing performed during food processing?
  - b. Give two examples each of the food processing concerns where dry mixing and wet mixing are performed.
  - c. What is/are the factor(s) that determine the capacity of a mixer?
  - d. Simply state the similarities between dough and batter?
  - e. Briefly describe the features and operation of a named type of mixing equipment or a dough divider.

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**B.Sc. Degree Examinations**  
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**February, 2011**

**FST 503: Meat Science and Technology**

**Time: 2½ Hrs.**

**Instruction**

**Answer any five (5) questions only**

- 1 (a) What is “Water-holding capacity” in meat?  
(b) How does it affect meat quality?  
(c) What processing conditions are required for improved water-holding capacity in poultry meat?
- 2 (a) An animal was chased around the courtyard for almost 2 hours before slaughter. Briefly describe the biochemical changes that took place during the exercise.  
(b) What is Post-mortem Glycolysis in muscle foods and what are its effects?
- 3 (a) Discuss the effect of thermal processing at temperatures of 30 to 90°C in meat characteristics.  
(b) Write a short note on the effect of moist heat on certain vitamins in meat and meat products,
- 4 (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.
5. How would the breed of animal, sex, age and growth conditions influence the quality of meat obtained from the carcass.
- 6 (a) Sketch and label a typical skeletal muscle.  
(b) Discuss briefly on the colour of meat with respect to oxygen supply to the muscles.
- 7 (a) What is stress as applied to animals prior to slaughter?  
(b) List and explain (5) of such stressful conditions.  
(c) What steps are needed to avoid stress on animals meant for commercial processing of meat for sales?

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**B.Sc. Degree Examinations**  
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**February, 2011**

**FST 501: Cereal and Tuber Technology**

**Time: 2 Hrs.**

**Instruction**

**Answer any four (4) questions only**

1. Explain critical unit operations in cereal processing.
2. Highlight at least six (6) traditional products from root and tuber crops. With the aid of flow charts, discuss stages in rice processing.
3. Critically examine nutritional importance of :
  - (a) Cereals
  - (b) Root and tuber crops
4. Differentiate the following terms:
  - (a) Roots and Tubers
  - (b) Parboiling and polishing
  - (c) HQCF and Lafun
  - (d) Glycoalkaloids and cyanogenicglycosides.
5. Explain the following:
  - (a) Malting
  - (b) Drying
  - (c) Winnowing
  - (d) Tapioca
  - (e) Pundo yam



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**B.Sc. Degree Examinations**  
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**FST 505:** Fats and Oils Technology

**Time:** 2 Hrs.

**Instruction**

**Answer any four (4) questions only**

- 1 (a) In addition to glycerides and free fatty acids, lipids may contain some other minor components. Discuss.
- (b) Explain the phenomenon of fat crystallization into different crystal forms.
  
2. The greater the attractive forces between molecules, the more easily they will associate to form a solid and the harder it is to separate them when they are in the crystalline form and convert them to a liquid. Discuss.
  
- 3 (a) Explain the processes involved in modifying fats.
- (b) Deterioration by rancidity may occur in two ways making fats undesirable for use in foods. Explain this and how it can be prevented.
  
4. Explain how acceptable quality oil can be extracted from a named harvested seed.
  
5. As a food Scientist, explain the effects of storage and climatic condition on the quality of fats and oils.

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**B.Sc. Degree Examinations**  
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**February, 2011**

**FST 509:** Food Packaging

**Time:** 2 Hrs.

**Instruction**

**Answer all questions in section A and any three questions from Section B**

1. Define Modified Atmosphere Packaging (MAP).
2. What is the primary objective of MAP in the packaging of each of the following types of products:
  - (a) low fat products with high moisture content
  - (b) high fat products with low moisture content
3. Mention three factors that could change the gas composition in a modified atmosphere package.
4. What is 'gas flushing'?
5. What is the advantage of adding plasticizers during the production of flexible films?
6. List two main advantages that co-extruded films has over other types of films.
7. Distinguish between 'callandering' and 'casting' methods used in the production of single films.
8. What type of chemical treatment is applied to pulp to produce each of the following type of papers:
  - (a) sulphate paper
  - (b) sulphite paper
9. How are metallized films made?
10. List four (4) major functions of a modern food packaging material.
11. Describe each of the following glass containers with an appropriate diagram:
  - (a) Bottle
  - (b) Carboys
12. List three (3) basic factors you would consider before choosing a glass container as a food packaging material.

13. Explain the terms:
  - (i) Convenience packaging.
  - (ii) Containerization
  - (iii) Aerosol containers
14. List three (3) limitations of paper as a packaging material.
15. Define the following and give an example to illustrate each of them;
  - (i) Primary package
  - (ii) Secondary package
  - (iii) Tertiary package
16. Describe three (3) main types of defects that could occur in a canned food.

### **SECTION 'B'**

- 1 (b). Highlight the general properties of flexible films.
  - (b) Write short notes on the following:
    - (i) Single films
    - (ii) Coated films
- 2 (a) Explain briefly five types of Modified Atmosphere Packaging (MAP)
  - (b) Give a comparison between the advantages and limitations of MAP.
3. Highlight the forms, uses and limitations of the Nigerian Traditional Food Packaging materials and suggest how to overcome the limitations.
- 4 (a) Distinguish clearly between Tin coating and Enamel coating.
  - (b) Highlight the various forms of semi-rigid packaging materials and their possible applications in the packaging and transportation of foods.
  - (c) What are the factors that can affect the choice of a packaging material and technique for a manufactured food?

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**B.Sc. Degree Examinations**  
**First Semester 2010/2011 Session**  
**February, 2011**

**FST 513:** Business Management for Food Technologists

**Time:** 2 Hrs.

**Instruction**

Candidates should answer four (4) questions only

- 1 (a) Construct an organogram for a named food company pointing out with reasons why staff and line officers are complementary.
- (b) Discuss the concept of Universality of management
- (c) Discuss the Gracuna's theorem of relationship.
  
- 2 (a) Differentiate between the three sources of Authority that you know.
- (b) Differentiate between Authority, Power, Influence, Responsibility and Accountability and bring out any relationship between them.
- (c) Explain with reasons why the subordinates usually submit themselves to the power influence of their managers.
  
- 3 (a) Explain how you can design a Planning Operation.
- (b) There is nothing as constant as change, yet people resist it. Briefly enumerate the reasons why people resist changes.
  
- 4 (a) Discuss the reasons why personnel administration is usually referred to as a forgotten asset.
- (b) Differentiate between the following:
  - (i) Job Specification
  - (ii) Job Analysis
  - (iii) Job Description
  - (iv) Job Evaluation
  
5. Discuss the reasons why a manager that is able to predict all the possible effects of production variables is said to be successfully employing the systems output.

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**B.Sc. Degree Examinations**  
**First Semester 2010/2011 Session**  
**February, 2011**

**FST 515: Food Irradiation Technology**

**Time: 2 Hrs.**

**Instruction**

Answer any four (4) questions

- 1 (a) Enumerate the factors that governs the choice of irradiation sources to be used for food preservation.
- (b) Clearly list the advantages and disadvantages of using gamma rays, electron beams and X-rays as sources for food irradiation.
- (c) Mention those factors that determines the effectiveness of ultraviolet radiation as a radiation sources in a beverage industry.
  
- 2 (a) In a very clean manner, explain the indirect effects of irradiation on micro-organisms.
- (b) Mention the important allied fields that aid the understanding of safety of irradiated food materials.
- (c) Outline the importance of Radiation chemistry.
  
3. Clearly explain the following as it relates to Food Irradiation:
  - (a) Sterilization (Raddappartization)
  - (b) Reduction of pathogens (Radicidation)
  - (c) Prolonged shelf life (Radurisation)
  - (d) Control of ripening
  - (e) Disinfestation
  
- 4 (a) Explain the important factors that governs the efficiency of a given dose in destroying food pathogens.
- (b) In what ways can radiolysis of water and fat can be minimized in a food industry?
- (c) Explain the various types of ultraviolet radiation you know with emphasis on wavelength and application.
  
- 5 (a) What is dosimetry?
- (b) Itemize the major differences between Food Irradiation and microwave treatment of foods.
- (c) Clearly show the effects of ionizing radiation on carbohydrate, protein and fat components of food materials.

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**B.Sc. Degree Examinations**  
**Second Semester 2009/2010 Session**  
**October, 2010**

**FST 510:** Nigeria's Food and Industrial Raw Material sourcing

**Time:** 2hours

**Instruction**

**Answer four questions only with at least one question from each section.**

**SECTION 'A'**

- 1 (a) Give two (2) examples of agricultural raw materials that are particularly produced in ten (10) states of Nigeria.
  - (b) With specific examples:
    - (i) explain the availability of 1<sup>o</sup> agricultural raw materials.
    - (ii) how much of derived food raw materials are required and produced in Nigeria.
  - (c) Give six (6) examples of imported food raw materials and their Nigerian alternative.
- 
- 2 (a)
    - (i) Explain the methods of sourcing for industrial food raw materials.
    - (ii) What are the qualities of a good sourcing agent.
    - (iii) Using Biscuit industry as a case study, write the quality specifications required for each ingredient.
  - (b) Enumerate the roles of government in sourcing for local raw materials for food industries.
  - (c) Highlight the constraints of sourcing for local food industry equipment.

**SECTION 'B'**

1. Discuss with reasons why some authors have described kola as the "Tree of life".
  2. The value of palm kernels depends largely on their quality and the various uses to which the kernels are used for. Discuss.
- 
- 3 (a) Design a specification sheet for refined granulated sugar.
  - (b) Discuss the production constraints associated with groundnut production.

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**B.Sc. Degree Examinations**  
**Second Semester 2009/2010 Session**  
**October, 2010**

**FST 504:** Technology of Miscellaneous Food Commodities

**Time:** 2Hrs. 15 mins.

**Instruction**

**Candidates should answer four (4) questions only with at least one question from a section.**

**SECTION 'A'**

- 1 (a) Describe the production of sugar from sugar cane.
  - (b) (i) Explain how the degree of sugar boilings are measured.  
(ii) Define the forms of sucrose sugar.
  - (c) Highlight the solubility property of sucrose sugar.
- 
- 2 (a) Explain the production of glucose syrup using the batch acid conversion.
  - (b) What are the functions of glucose syrup in the confectionery products, based on their DE types?
  - (c) Differentiate between: Caramels and Toffees, Fudges and fondants, Jellies and Pastilles, Tablets and Lozenges, Chewing gums and Bubble gums.

**SECTION 'B'**

- 1 (a) Briefly discuss the process of manufacture of cocoa powder and chocolate products.
  - (b) Discuss the melting behaviour of cocoa butter.
- 
- 2 (a) Justify the statement that "Colour in kola is a hereditary character" and elucidate the various types of kola based on colour.
  - (b) Briefly enumerate the desirable nut qualities.
- 
3. Write an essay on the main defects of green coffee.

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**FST 508:** Food Biotechnology

**Time:** 2hours, 15 minutes

**Instruction**

**Answer 4 Questions**

1. a. Discuss the current status of the application of food biotechnology into food processing in Nigeria.  
b. Enumerate different scope of biotechnology and explain five out of these.
2. a. Draw the structures of the DNA nucleotides.  
b. The information detailing the specific structure of the proteins inside of our bodies, is stored in a set of molecules called nucleic acids. Explain.
3. a. What is a plasmid?  
b. Highlight and explain the processes involved in DNA manipulation
4. a. Write briefly on the terms 'DNA' and 'RNA'  
b. The nucleic acids are very large molecules that have two main parts. Explain
5. The thermophiles are important organisms that can be use in the production of biogas from waste, explain how this can be achieved.



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**FST 502: Fermented Foods**

**Time: 2hours, 15 minutes**

**Instruction**

**Answer 4 Questions**

1. Using the following parameters: processing, microflora associated with production, physico-chemical and functional changes, discuss the fermentation process of the following :  
(a) 'Agadagidi' (b) Orogo (c) Ensette (d) Cassava beer
  
2. Write short notes on the following:
  - (a) Aeration and Agitation in a fermentor
  - (b) Temperature control in a fermentor
  - (c) Foam production and control in a fermentor
  - (d) Foaming pattern
  - (e) Foam control
  
3. Name and discuss the most important groups of micro-organisms involved in food fermentations.
  
4. Explain the technology of producing citric acid
  
5. Explain the technology of producing the following
  - a. Dawadawa
  - b. Tofu
  - c. Yoghurt

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**October, 2010**

**FST 506: Process Control and Automation**

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

**INSTRUCTION**

Answer question one (1) and any other three (3)

- 1 (a) Find the Laplace transform of the following:  
(b) Find the inverse transform of  
(c) Write out the responses of the following first order systems:  
    (i) Step response  
    (ii) Impulse response  
    (iii) Sinusoidal response  
(d) A mercury-in-glass thermometer is to be used to measure the change in temperature of water in a bath from 90°C to 100°C. What is the time needed for the thermometer to read 98°C if its time constant is 0.1 min.  
(e) The rate of cooling of a fried yam chip of dimension 3mx5mmx4mm fried at 120°C under vacuum pressure of 90u for 3 mins is given by the relationship  $\frac{dT}{dt} = -k(T-10)$   
where T is the temperature in degree celcius, k is a constant and t is the time in minutes. Initially, the temperature of the ship was 90°C and was then reduced to 60°C after t minutes. Show that the temperature of the chip will be 41¼°C where t is 10 mins.
- 2 (a) Define the following terms as it relates to Process control:  
    (i) Steady state process   (ii) Unsteady state process   (iii) Controlled device  
    (iv) Control system   (v) Controller  
(b) What are block diagrams as used in Food Process Engineering? Mention its advantages and give typical examples.  
(c) State clearly typical examples where automatic control was effectively applied as against manual control.
- 3 (a) Explain in details the major advantages and disadvantages of open and closed loop control systems.  
(b) Briefly explain the major parameters measured by sensors.
- 4 (a) Briefly discuss the following types of control systems with emphasis on important features and typical examples:  
    (i) Self controlled   (ii) Pneumatic   (iii) Hydraulic   (iv) Electrical   (v) Electronic  
(b) Using diagrams and mathematic representations **ONLY** explain in details the following industrial controllers based on their control actions:  
    (i) Two step   (ii) Proportional   (iii) Integral   (iv) Proportional plus integral   (v) Proportional plus derivative.

5. Fried yam crisp was placed in a room which was kept at a constant temperature. The temperature of the crisp falls at a rate of  $KT$  (k/mn) where  $k$  is a positive constant and  $T$  is the difference in Kelvin between the temperature of the crisp and that of the room at time  $t$  min. Show the information in form of a differential equation and hence, show that  $T = T_0 e^{-kt}$
6. where  $T_0$  is the temperature difference in Kelvin at time  $t = 0$ . If the temperature of the crisp falls to  $5k$  in the first minute and  $4k$  in the second minute, what is the fall in temperature in the third minute?