

## **FOOD PROCESSING AND VALUE ADDITION**

### **PREAMBLE**

The Centre offers both M. AgSE and PhD.AgSE degrees in Food Processing and Value Addition. The Masters programme was designed to produce competent food processors and value addition experts by combining sound knowledge of food processing technologies and value addition techniques with high entrepreneurial skills in livestock processing and value addition to products derived from meat, chicken, milk, egg and fish. The programme involves a combination of both taught, seminar, internship and practical courses. The PhD. AgSE was designed to produce competent researchers who can conduct independent research in the diverse area of Food Processing and Value Addition. Such graduates will be able to formulate a problem and apply suitable techniques to produce results that further the state of understanding about the problem. It shall be by a combination of taught and seminar courses as well as conducting problem solving research. Every PhD student is expected to take and obtain satisfactory performances in all outlined courses in addition to Seminars and Internship.

### **PHILOSOPHY**

The current changes in the food industries is the shift of their mode of operation from supply-oriented into demand-oriented processing activities leading to substantial value addition to raw agricultural products. This is especially important in a changing environment like ours where satisfying consumers' demands is becoming of higher priority. In addition, global demand for safe food is predicated by rapid demographic changes worldwide. In order for the food and its allied industries to cope with these changes, there is need to improve the capacity of graduates in the specialized areas of Food Processing and Value Addition in the sub-region of West Africa. The processing of the raw agricultural materials is expected to add substantial value to the livelihood of all stakeholders in the products value chain and ensure value added products are made from livestock primary products like meat, chicken, milk and fish are available all year round in varieties, the right quality and quantity.  **Holders of these degrees will be competent enough to solve problems associated with processing, quality, safe and nutritious value added products from livestock and also equipped with entrepreneurial skills to manage such business venture.**

### **OBJECTIVES**

1. To produce graduates with **comprehensive knowledge, skills, understanding and competences in Food Processing and Value Addition**
2. To produce graduates with high entrepreneurial skills in advancing Food Processing and Value Addition
3. To produce practical oriented graduates that can identify and solve problems in the sector
4. To produce graduates with competences and skills in formulating problems and turning them into research activities thereby proffering the required solutions

5. To produce graduates with competences in identifying research problems, carry out the research and write out the research results

## **RESEARCH FOCUS OF FOOD PROCESSING AND VALUE ADDITION PROGRAMME OF CEADESE**

It is a well-known fact that all the food that we produce and consume undergoes one form of processing or the other. The manufacture of composite food products, which have distinct properties to their constituent ingredients, requires a complex series of processing operations. However, even ready-to-eat fresh foods undergo processing to facilitate distribution to consumers, maximize shelf-life, and ensure food quality and safety. Our research focus is tailored towards examining the biochemical and physicochemical transformations that occur in food materials particularly from animal sources during processing and how processing parameters affect the fulfilment of food quality, shelf-life, and safety objectives. We also conduct research on (1) processing to modify food structure; (2) processing for preservation; and value-adding, focused on (3) healthier food and (4) fermentation as interesting case studies in food processing. We also conduct research on food analysis and apply scientific approaches to investigating the relationships between food composition, functionality, processing conditions, and end-product properties. These helps to develop a sound understanding of the scientific principles underpinning food processing decisions and outcomes. This is usually well appreciated in the food industry, particularly fast moving consumer good (FMCG) and manufacturing, as the ability to systematically characterize, analyze, and troubleshoot processes can be applied to a wide range of industrial situations.

## **PROGRAMME STRUCTURE**

The Masters Programme in Food Processing and Value Addition is structured to have general Centre courses of 10 units, programme courses of 38 units, dissertation (6 units), seminars (2 units) and internship (4 units) while the PhD programme is also is structured to have general center courses of 10 units (for non-CEADESE graduates), programme courses of minimum of 28 units or maximum of 28 units, thesis (10 units), seminars (4 units) and internship (4 units).

### **M.AgSE**

The following courses must be taken and passed at 50% or higher grade before graduation.

#### **Centre/general courses**

Course Code	Title	Unit	Status of the course
<b>First Semester</b>			
ACE 801	Climate and Agriculture	2 (2-0)	C
GED 803	Short French Language Course	2 (2-0)	C
<b>Second Semester</b>			
ACE 802	Information Systems and Agricultural Knowledge Management	3 (3-0)	C
ACE 804	International Trade and Commercial Policy	3 (3-0)	C

The core and elective courses are as follow:

### First Semester

Course Code	Title	Unit	Status of the course
FPV 803	Food Processing and Preservation Technology	3 (2-1)	C
FPV 805	Advanced Food Chemistry	3 (2-1)	C
FPV 807	Special Topics in Food Microbiology, quality and safety	3 (2-1)	C
FPV 809	Food Product Design	3 (2-1)	C
FPV 811	Livestock Processing Practical I	2	C
FPV 813	Research Methodology and Biostatistics	2	C
FPV 815	Techniques in Food Analysis	2	C
	Elective	2	E
	<b>TOTAL</b>	<b>20</b>	
	<b>Elective Courses</b>		
FPV 817	Food Laws, Legislation and Policy	2	E
FPV 819	Advanced Quality Management	2	E

C-Compulsory; E-Elective

### Second Semester

Course Code	Title	Unit	Status of the course
FPV 802	Food Product Development and Quality Evaluation	3 (2-1)	C
FPV 804	Food Packaging Technology	3 (2-1)	C
FPV 806	Special Topics in Sensory Evaluation	2 (1-1)	C
FPV 808	Traditional Value Added Products	2	C
FPV 810	Management of By-products and waste	2	C
FPV 812	Livestock Practical Processing II	2	C
FPV 814	Food Business Management and Entrepreneurship	2	C

	Elective	2	E
	<b>TOTAL</b>	<b>18</b>	
	<b>Elective Courses</b>		
<b>FPV 816</b>	Topics in Raw Material Sourcing	2	E
<b>FPV 818</b>	Process and Plant Design for the Food Industry	2	E

C-Compulsory; E-Elective

### Elective Courses

Apart from the programme core courses, students pursuing Masters Programme in Food Processing and Value Addition are expected to take, and pass at 50% or higher grades, a minimum of two (2) units of elective courses selected as shown in the tables above.

### Seminar courses, Internship and Dissertation

In addition to the Centre, core and elective courses, students pursuing Masters Programme in Food Processing and Value Addition are expected to develop and conduct a research to address some identified problems in the various areas of Food Processing and Value Addition sub-sector particularly as it concerns livestock. In this pursuit, each student is expected to achieve satisfactory performance (50% or higher), in each of the following dissertation related/supporting courses:

<b>Course Code</b>	<b>Course Title</b>	<b>Unit</b>
ACE 893	Internship 1	2
ACE 894	Internship 2	2
ACE 895	Pre-data Seminar	1
ACE 896	Post-data Seminar	1
ACE 899	Dissertation Defense	6
	<b>TOTAL</b>	<b>12</b>

Above courses (ACE 893, ACE 894, ACE 895, and ACE 896) will be defended before CEADSE Board and students at the Centre, while the final dissertation (ACE 899) shall be defended before a Board of External and Internal Examiners but open for whosoever wish to attend.

In line with the regulations of the Centre, the following guides are to be adhered to by all M.AgSE students for a seamless study programme.

**First Semester of Year 1:** Submission of Research Concept Note. This is expected to be done within 6 weeks of resumption to enable the Programme Leader appoint appropriate supervisory committee for the student.

**Second Semester of Year 1:** Presentation of pre-data seminar. Dissertation proposal should ideally be of no more than 30 pages, and should be structured into the following: Chapter 1-present Background Information, Problem Statements, Research Questions and/or Hypotheses,

and Research Objectives; Chapter 2 should be devoted to a comprehensive Review of Literature while Chapter 3 should present the methodology.

**First Semester of Year 2:** Presentation of the Post-Data Seminar.

**Second Semester of Year 2:** Open Dissertation Defense

**PhD. AgSE**

**First Semester**

<b>Course Code</b>	<b>Title</b>	<b>Unit</b>	<b>Status of the course</b>
FPV 903	Advances in Food Processing Technologies	3 (2-1)	C
FPV 905	Advances in Dairy and Food Packaging	3 (2-1)	C
FPV 907	Advances in Research Methodology	3	C
FPV 909	Advanced Experimental Design	3	C
	Elective	2	E
	<b>TOTAL</b>	<b>14</b>	
	<b>Elective Courses</b>		
FPV 911	Advances in Food Additives and Preservatives	2 (2-0)	E
FPV 913	Advances in Industrial Drying of Foods	2 (2-0)	E

**Note:** Centre Core Courses (ACE 801 GES 801/GES 803) are compulsory for non-ACE graduates in the first semester; C-Compulsory; E-Elective

**Second Semester**

<b>Course</b>	<b>Title</b>	<b>Unit</b>	<b>Status of the course</b>
FPV 902	Advances in statistical methods in Food Processing	3 (2-1)	C
FPV 904	Sustainable Food and Bioprocessing	3	C
FPV 906	Advances in Technology of Processed Meat	3 (2-1)	C
FPV 908	Food Legislations, Standards and Safety Quality Managements Systems	3	C
	Elective		
	<b>TOTAL</b>	<b>14</b>	
	<b>Elective Courses</b>		
FPV 910	Advances in Technology of Frozen Foods	2 (2-0)	E
FPV 912	Advances in Physical and Engineering Properties of Foods and Biomaterials	2 (2-0)	E

**Note:** Centre Core Courses (ACE 802, ACE 804) are compulsory for non ACE graduates in the second semester. C-Compulsory; E-Elective

### Seminar Courses, Internship and Thesis

Course Code	Course Title	Unit
ACE 993	Internship 1	2
ACE 994	Internship 2	2
ACE 995	Seminar 1 (Pre-data )	1
ACE 996	Seminar 2 (Progress report)	1
ACE 998	Seminar 2 (Post-data)	2
ACE 999	Thesis Defense	10
	<b>TOTAL</b>	<b>18</b>

All PhD.AgSE students are encouraged to follow the following schematic guide in the presentation of the various seminars and Thesis defense.

**First Semester of Year 1:** Submission of Research Concept Note. This should be done within 6weeks of resumption to enable the Programme Leader appoint appropriate supervisory committee for the student

**Second Semester of Year 1:** Presentation of Non-Thesis Seminar. The Non-Thesis seminar is first step for presentation of pre-data seminar by all PhD AgSE students. It should ideally be of no more than 30 pages, and should present Background Information, Problem Statements, Research Questions and/or Hypotheses, and Research Objectives in Chapter 1. A comprehensive Review of Literature should be in Chapter 2, while Chapter 3 should present the methodology. The essence of the non-thesis is for the student to be able to demonstrate their understanding on the model, theories and literature they intend to use.

**First Semester of Year 2:** Presentation of Proposal/Pre-data Seminar. This should be done alongside with the student Internship 1. Thesis proposal should ideally be of no more than 30 pages, and should present Background Information, Problem Statements, Research Questions and/or Hypotheses, and Research Objectives in Chapter 1. A comprehensive Review of Literature should be in Chapter 2, while Chapter 3 should present the methodology.

**Second Semester of Year 2:** Data collection, analysis, report writing and presentation of progress report

**First Semester of Year 3:** Presentation of the Post-Data Seminar.

**Second Semester of Year 3:** Thesis Defense

#### 3.3.5 SYNOPSIS OF COURSES

**FPV 802: Food Product Development and Quality Evaluation** **3 (2-1)**

Market survey and design of questionnaire to find consumer needs for a product or a concept. Developing a Product to Meet the Requirements. Product life cycle. The SWOT analysis. New Food Product Development (NPD) process and activities, The Stage-Gate model NPD success

factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; use of novel food ingredients and novel processing technologies. Process design, equipment needed; establishing process parameters for optimum quality; Sensory Evaluation; Lab requirements; different techniques and tests; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis. Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Pre-launch trial, steps in product launch, Evaluation of the Launch, product performance testing, developing test market strategies, Case Studies of some successes and failures, food choice models and new product trends.

### **FPV 803: Food Processing and Preservation Technology**

**3 (2-1)**

Processing and preservation of Food by heat, newer methods of thermal processing – batch and continuous. Processing and preservation by low temperature. Food irradiation, history and mechanism, the electro-magnetic spectrum, forms of radiant energy. Processing and preservation by drying, concentration and evaporation. Physical and chemical changes during drying, control of chemical changes, desirable and undesirable changes. Food Concentration- methods of food concentration, freeze concentration, Ultra-filtration, reverse osmosis. Processing and preservation by non-thermal methods. GRAS and legal aspects for gamma irradiation. Permissible limits for chemical preservatives. Use and application of enzymes and microorganism in processing and preservation of foods; food fermentations, pickling, smoking; Food additives; Definition, types and functions, permissible limits and safety aspects. Chemical Preservatives- type I and type II.

**Practical:** Blanching and browning control in Foods; dehydration of food products such as meat, egg and milk; application of freeze concentration and reverse osmosis; use of approved preservatives to preserve traditional food materials based on GRAS; preparation and standardization of traditional Nigerian fermented and smoked foods.

### **FPV 804: Food Packaging Technology**

**3 (2-1)**

Food Packaging terminologies and definition. Functions of food packaging, Packaging environment. Selection of packaging materials based on food characteristics. Different packaging materials and their properties: Glass, Paper and paper board, Corrugated fibre board (CFB), Metal containers: Tin Plate and Aluminum, Composite containers, Collapsible tubes, Plastic Films, Laminations, Metalized films, Co extruded films. Testing of packaging material. Methods and systems of packaging such as Vacuum Packaging, controlled atmospheric packaging, Modified atmospheric packaging, Aseptic Packaging, Retort processing, Microwave packaging, Active Packaging, intelligent packaging, ecofriendly Edible packaging, Shrink and stretch packaging. Packaging of fresh and processed foods: Packaging of meat, Poultry and sea foods, Dairy Products, Packaging Design & Environmental Issues in Packaging: Food marketing and role of packaging- bar coding, Migration in food packaging. Regulations for packaging and food labeling.

**Practical:** Determination of WVTR and GTR in different packaging materials, Application of anti-microbial packaging for moisture sensitive foods, Application of MAP packaging in selected foods, Study of time temperature indicators, Determination of oxidative changes in packaged foods, Comparative evaluation of flexible and rigid packages for fragile foods, Packaging of foods under inert atmosphere, study textural characteristics of selected food materials under MAP storage, Shelf life evaluation of packaged food product. Visit to food packaging material manufacturing industry

### **FPV 805: Advanced Food Chemistry**

**3 (2-1)**

Physical and Chemical Properties of Water-Structure; principles, measurement, control, effects of water activity; physical properties of proteins in relation to protein structure, analytical methods (brief overview), basic properties: hydration, ionization, colloidal behavior, functional properties, effects of food processing on chemical, functional & nutritional properties of proteins, Factors affecting reaction rate of enzymes, characteristics of enzymatic and non-enzymatic reactions, deleterious enzymes in food systems: phenoloxidase example, reactions catalyzed by enzyme, non-enzymatic formation of melanin, chemical, nutritional and physical properties of lipids, processing of fats and oils, Physical, chemical and nutritional properties of simple and complex sugars; notable reactions and effects of processing on such properties

**Practical:** Water activity and moisture isotherm, emulsions and foaming properties of proteins, maillard Reaction, qualitative test for protein, quantitative estimation of protein by biuret method, factors affecting protein quality, Fehling's test for reducing sugars, Microscopic examination of starch, Starch Gels, Viscosity curves of starch pastes, Lipids: Solubility, specific gravity and refractive index of fats, water absorption and plasticity of fats, Oxidative rancidity

### **FPV 806: Special Topics in Sensory Evaluation**

**2 (1-1)**

Introduction to sensory analysis; general testing conditions, Organizing sensory evaluation program, Development of sensory testing, human subjects as instruments (test design, instrumentation, interpretation of results). Sensory attributes of food products, Human senses (sense of vision, sense of touch, olfactory sense, sense of taste, sense of hearing). Sample preparation, supplies and equipment, materials, preparation procedure, sample preparation, order, coding, number of samples, product sampling. **Panelist control, Panel training orientation, Factors affecting sensory verdicts, physiological factors, psychological factors, poor physical condition.** Different tests for sensory evaluation, Difference (Qualitative test: Paired comparison, Duo-Trio, Triangle test). Rating (Quantitative: Ranking, single, two and multiple sample, hedonic, Numerical scoring, composite), Sensitivity (Threshold, dilution). Applications and Advances in Electronic-Nose Technologies, Aroma Types and Characteristics, Conceptual Development of the Electronic Nose and instrumentation, Data Analysis for Electronic Noses, E nose applications. **Computer-aided sensory evaluation of food & beverage, statistical analysis of sensory data.**

**Practical:** Selection and training of sensory panel, detection and threshold tests, study of paired comparison test, study of duo-trio test, ranking tests for taste, aroma colour and texture, study of hedonic rating test, sensory evaluation of various food products using hedonic scales, Objective



estimation of color and texture, subjective estimation of colour and texture, study of single and two sample tests as well as statistical analysis

**FPV 807: Special Topics in Food Microbiology, quality and safety**

**3 (2-1)**

History and development of Microbiology-Importance and significance of microorganisms in Food Science. Factors affecting the growth of micro-organisms in food – Intrinsic and Extrinsic parameters. Determination of microorganisms and their products in food: Sampling, sample collection, transport and storage, sample preparation for analysis. Microscopic and culture dependent methods- Direct microscopic observation, culture, enumeration and isolation methods; Food spoilage: characteristic features, dynamics and significance of spoilage of different groups of foods - meat poultry and sea foods, milk and milk products, packed and canned foods. Food borne diseases: *Bacterial food borne diseases (Staphylococcal intoxication, Botulism, Salmonellosis, Shigellosis, Enteropathogenic Escherichia Coli Diarrhoea, Clostridium Perfringens gastroenteritis, Bacillus cereus Gastroenteritis)* *Food Borne Viral Pathogens (Norwalk virus, Norovirus, Reovirus, Rotavirus, Astrovirus, Adenovirus, Parvovirus, Hepatitis A Virus)* *Food Borne Animal Parasites Protozoa –Giardiasis, Amebiasis, Toxoplasmosis, Sarcocystosis, Cryptosporidiosis. Cysticercosis/Taeniasis. Roundworm – Trichinosis, Anisakiasis. Mycotoxins: Aflatoxicosis, Deoxyvalenol Mycotoxicosis, Ergotism. Drug resistance - phenomena and mechanism. Indicators of water and food safety and quality: Microbiological criteria of foods and their Significance. The HACCP and ISO systems for food safety.*

**Practical:** Preparation of common laboratory and special media, staining: Gram's staining methods, acid-fast, spore, capsule and flagellar staining, Motility of bacteria, Staining of yeast and molds, Identification of important molds and yeast. Microbiology of milk, meat and egg, Microbiology of water, Microbiology of hand and effect of sanitation on the hand microbiology in a small food joint, Microbiological analysis of typical processed food. Microbiological analysis of some common traditional unprocessed food

**FPV 808: Traditional Value Added Products**

**2 (2-0)**

Present status of traditional food products in Nigeria and West Africa; Globalization of traditional food products; Plans and policies of the Government and developmental agencies. Overview of heat-desiccated, coagulated, fried, fermented traditional food products from Animals especially poultry. Process technology for common Nigerian products, Process technology for Nigerian fried foods; Process technology for fermented traditional food and its improvement; Process technology for convenience traditional food products (ready to eat and serve); Use of natural and permitted synthetic preservatives and new packaging systems for traditional food products; Techno-economic aspects for establishing commercial units for traditional products

### **FPV 809: Food Product Design**

**3 (3-1)**

Basic concept of experimentation: experimental variables and statistical procedure, data description, random variable and some distributions. Sampling distribution concept. Principles of experimental design. Analysis of variance, single factor experimental design, multifactorial designs, Fractional Factorial Design, Nested Design and Response Surface Methodology (RSM). Process optimization and control limits. The course will emphasize design concepts and the presentation of results. Application of **different rheological models to food products from different sources with case studies**, concept of Food structuring in the development of complex food products and quantitative prediction of quality parameters of developed food products using existing models

**Practical:** Design and development of new or improved products from a consumer perspective. Modeling of new product concepts or processes and predicting food quality attributes in a quantitative way. Structuring of new food materials using locally available raw materials based on consumer's perspectives.

### **FPV 810: Management of By-products and waste**

**2 (2-0)**

Waste generation in the food industry; Classification of waste from food industry-fruits and vegetable processing; baking industry; grain processing industry; snack food industry; meat processing abattoir; BOD and Technologies for separation of Waste-Physical, chemical and advance technologies. Physical- screening; sedimentation; flotation; centrifugation; filtration; adsorption; hydro-cyclones etc. Chemical- precipitation; coagulation etc. Advanced Processes-reverse osmosis, ion-exchange; electro-coagulation; ultrafiltration; electro-dialysis; supercritical fluid extraction. Process optimization to minimize water use in food processing. Super critical extraction and other technologies for extraction of high-value food processing co-products. Membrane and filtration technologies and the separation and recovery of food processing waste.

### **FPV 811: Livestock Processing Practical I**

**2 (0-2)**

This course will be taken at TUNS Farms, Osogbo, Nigeria and Obasanjo Farms, Ota, Ogun, Nigeria.

Meat industries in Nigeria and West Africa, slaughtering technique of animal and slaughtering practices, meat cuts and portions of meat. Post mortem changes in meat (Rigor Mortis), colour of meat. Meat processing-smoking and curing, prepared meat products including fermented meats, sausages, bacon. Frozen meat and meat storage, Packaging of meat products. Meat microbiology and safety, Meat plant hygiene – GMP and HACCP, By-products from meat industries and their utilization. Processing of poultry meat and eggs. Spoilage and control. By-product utilization, Value Added Products (Frozen chicken, dehydrated powders, Salami, Sausages). Egg Types and composition, quality check and grading of eggs, value added products (Frozen eggs, canned egg whites/yolks, pasteurized egg products, dried eggs, pickled eggs)

### **FPV 812: Livestock Processing Practical II**

**2 (0-2)**

This course will be taken at WAMCO Friesland Plc, Ibadan, Nigeria.

Status of dairy industry in Nigeria and West Africa. Pasteurization, Homogenization and Standardization of milk, manufacture of condensed milk, milk powder, cheese, ice-cream, cream, butter, ghee, Lactone, malted and flavoured beverages, lactose, evaporated and dried products, their evaluation and quality parameters, defects encountered during production, packaging and storage. Substitutes for milk and milk products. Casein and caseinates, lactose, whey protein concentrates and isolates, milk co-precipitates, and other by-products. Technology of baby foods, weaning foods, therapeutic foods. Fortification and enrichment. Probiotic milk product. Lactose free Milk Products, TQM in Food Industry. Technology of milk and dairy products.

### **FPV 813: Research Methodologies and Biostatistics**

**3 (3-0)**

Research Methodology: Meaning, objectives and types of research, research approaches, Significance of research, Research and scientific methods, research process and criteria of good research definition and identification of a research problem – Selection of research problem, Justification, theory, hypothesis, basic assumptions, limitations and delimitations of the problem. Study of relationship between variables – correlation: Simple, Partial, Multiple Correlation (three variables); Regression – Simple, Multiple (three Variables). Measures of association – Chi square test for goodness of fit & contingency table. Basic concept of hypothesis testing - Type I and type II errors. Tests based on Means & Proportions on Normal. Two-way analysis of variance (RBD), LSD, - Multiple comparison tests, t test for independent samples, paired samples, F test two sample variances: One-way ANOVA, two-way ANOVA, Correlation & Regression (three variables). Framing Proposal for acquiring grants: The question to be addressed – Rationale and importance of the question being addressed – Empirical and theoretical framework – Presenting pilot study / data or background information - Research proposal and time frame – Specificity of methodology – Organization of different phases of study – Expected outcome of study and its implications – Budgeting - Available infra-structure and resources - Executive summary.

### **FPV 814: Food Business Management and Entrepreneurship**

**2 (2-0)**

Management peculiarities of food industries. Marketing concept and marketing mix. Food business law. Preparation of feasibility studies for food – based industries. Business analysis, financial and cost analyses, technology selection, marketing analysis, product management, food safety and regulation, waste management in food industries, proposal preparation, general management and project management, management of information system. **The Evolution of E-Commerce in the Retail Industry, Behind the Web Store: The Challenges of Infrastructure and Fulfilment, Constructing the Web Store and Consumer behaviour.** The evolving role of mobile and social commerce. Understand how digital technologies have shaped the evolution of contemporary marketing, Describe the major waves of digital technology and their contributions to practice 3. Recognise the major techniques and actual systems used in integrated e-marketing.

Practical time are spent at the University's incubation centers under the supervision of Centre of Entrepreneurship studies.

**FPV 815: Techniques in Food Analysis****2 (2-0)**

Introduction, Food Regulations and Standards - Sampling methods - Sample preparation for analysis; Official Methods of Food Analysis. Moisture in foods - determination by different methods – determination of ash content of foods, determination of dietary fiber and crude fiber. Determination of Total fat in foods by different methods; Analysis of oils and fats for physical and chemical parameters, Quality standards, and adulterants; different methods of determination of protein and amino acids in foods; determination of total carbohydrates, starch, disaccharides and simple sugars in foods. Basic Principles- Spectrophotometric analysis of food additives and food Components -IR Spectroscopy in online determination of components in foods; AAS and ICP-AES in mineral elements and toxic metals analysis; Chromatographic Techniques- Basic principles and types of: Paper chromatography, thin layer chromatography, column chromatography, Ion exchange chromatography, HPTLC, HPLC, UHPLC, GC, GC-MS, Types of detectors, Uses and applications of chromatographic techniques.

**FPV 816: Topics in Raw Material Sourcing****2 (2-0)**

Raw material source – implications in food processing. Raw material needs of different sectors of the food industry. Developments in local sourcing of raw materials in Nigeria's food industry. Raw materials alternatives.

**FPV 817: Food Laws, Legislation and Policy****2 (2-0)**

Food law, its philosophy and development. Food standards, codes to practice and statutory regulations. Food export and regulations. Legislations on food additives. Toxic substances in food. Detoxification of food and avoidance of contamination. Legislation on pesticide application to food raw materials and products. Food, Nutrition and Economic development. Conceptual framework for food policy development. Food and Nutritional situation appraisal. Policy formulation and implementation. Organization and coordination, monitoring and evaluation of food and nutrition policy. Review of Agricultural Policy in Nigeria.

**FPV 818: Process and Plant Design for the Food Industry****2 (2-0)**

Principles of process design including material and energy balance, flow sheeting, utilities systems, equipment specification and materials selection. Technical and economic aspects of plant design. Optimization of process and plant design. Students are required to undertake an independent investigation of a food processing system.

**FPV 819: Advanced Quality Management****2 (2-0)**

Evolution of quality concepts, customer focus, total quality management, operational quality management, quality control and quality improvement. Evolution of quality management methodologies, i.e. statistical technique, Hoshin management. Quality function deployment, standards on quality management system i.e. ISO 9000 Standard. Effects of raw material quality and the various types of food processing on yield and quality of product. Sanitation in the food industry.

### **FPV 902: Advances in Statistical Methods in Food Processing**

**3 (2-1)**

Applications of statistical procedures in food processing, Descriptive statistics, Analysis of differences, Types of significance test, Association, correlation and regression and Experimental design. Sensory and consumer data: Introduction, The quality and nature of sensory and consumer data, Experimental design issues, Consumer data (sensory and survey), Trained panel sensory data, Analysis of relationships. Instrumental data: Introduction, Quality and nature of instrumental data, Sampling and replication, Experimental design issues, Statistical analysis of instrumental data, Chemical analysis applications, Analysis of relationships. Food product formulation: Introduction, Design application in food product development, Single ingredient effects, Two or more ingredients, Screening of many ingredients, Formulation by constraints. Statistical quality control: Introduction, Types of statistical quality control, Sampling procedures, Control charts, Acceptance sampling. Multivariate applications: Introduction, Multivariate methods and their characteristics, Multivariate modes, Relationship of consumer preference with sensory measures Principal component analysis, Chemometrics, Partial least square, Response surface methodology, Mixture design, Fractal analysis, Cluster analysis, ANN and Fuzzy logic

**Practical:** Applications of dimensionality reduction and discriminant function analysis, Nonparametric tests, Analysis of qualitative data, Analysis of data having random effects using Linear mixed effects models, Classification and prediction using artificial neural networks, Analysis of data with missing observations, Multiple linear regression analysis, Partial regression coefficients, Residuals and their applications in outlier detection, Study on robust parameter design and process robustness, Practice with Statistical Softwares

### **FPV 903: Advances in Food Processing Technologies**

**3 (2-1)**

Emerging technology in food processing- Active and intelligent packaging, membrane technology, high pressure processing, pulsed electric field intensity, Ultra sound. Supercritical fluid extraction: Concept, property of near critical fluids. Application of SCFE in food processing. Microwave and radio frequency, IR drying: Definition, Advantages, mechanism of heat generation, inductive heating in food processing and preservation. Application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application. High Pressure processing: Types of equipment, mechanism of microbial inactivation. Effect of HPP on meat products, jam. Ultrasonic processing: Properties of ultrasonic, types of equipment, effect of ultrasonic treatment on microbial inactivation of food products etc. High intensity light generation system, Application of high intensity light in food processing, Pulse electric field-mechanism of inactivation, PEF generation system, PEF treatment chambers, Mechanism of ohmic heating and its application in liquid food processing, Principle of cold plasma technology and its generation systems and its application. Nanotechnology: Principles and its applications in foods.

**Practical:** evaluate the characteristics of treated water using RO system, study microwave system and to evaluate the effect of different power on drying characteristics of selected food

product, study microwave blanching of food materials and determination of blanching efficacy, visit food industries utilizing advance food processing techniques

### **FPV 904: Sustainable Food and Bio-processing**

**3 (3-0)**

Challenges of producing high quality food products from environmentally friendly and efficient natural resources in Nigeria and West Africa; Factors affecting choice of production methods; Application of new milder methods resulting in efficient use of raw materials and enhancement of product distribution; use of alternative ingredients for similar existing products and its effect on better use of land, energy and water; evaluation of existing and new processing technologies for optimal use of resources; use of different instruments to evaluate and sustain process system design (from large scale supply chain, factory level, down to product and unit operation level) on efficient use of raw materials, energy, and water; use of Sankey diagrams to visualize mass, water and energy balances over complex systems; fundamental concepts of the quality of different stream (exergy) using Grassman diagrams.

### **FPV 905: Advances in Dairy and Food Packaging**

**3 (2-1)**

Status of current packaging in Nigeria and West Africa; types of packaging materials; criteria for selection of proper packaging; testing of packaging materials. Adhesives; graphics; coding, and labeling used in food packaging. Protective packaging of foods; packaging of food products sensitive to oxygen, light, moisture; active packaging; special problems in canned foods. Packaging of dairy products; packaging of convenience foods, packaging of meat and poultry; packaging of fish and other sea foods. Modified atmosphere packaging, controlled atmosphere packaging, shrink and stretch Packaging. Retort pouch technology, microwavable, biodegradable, and edible packages. Industrial packaging: unitizing, palletizing, containerizing, distribution systems for packaged foods including prevention of shock damage to articles during transportation Safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials.

**Practical:** Testing of packaging materials for quality assurance such as determination of thickness, GSM, grease resistance, bursting strength, tearing resistance, water vapour transmission, puncture resistance; estimation of shelf life of meat and poultry products; packaging of powdered poultry and meat products, vacuum packaging of dairy products. Visit to relevant packaging industries

### **FPV 906: Technology of Processed Meat**

**3 (2-1)**

Meat: Handling, transportation and storage. Curing of meat: Curing ingredients and curing methods. Meat smoking: Purpose, production, deposition of smoke on meats, methods of smoking, liquid smoke preparation and its application. Meat cookery and cooked meat products. Meat cooking: Sausages, classification, fermented meat products, sausage formulations, casings, extruders & additives. Herbs, spices & condiments in processed meats. Types of cured & smoked meats. Reduced & low fat meat products. Canned meat formulations, restructured meat products,

procedures, raw materials & formulations. Development of functional meat products. Cold storage, food freezing of meat. Quality control and sanitation. Sensory analysis of meat, New developments in decontaminating raw meat. Visits to the meat industries.

**Practical:** Local meat products and cookery: Beef stews, chili, sausages, meat balls with gravy, sliced dried beef, potted meat, smoked meat & other meat products, restructured meat products.

### **FPV 907: Advances in Research Methodology 2 (2-0)**

Basic concepts of research, Planning and organization of experiments for data acquisition and analysis. Type of research methods, experimental designs, equipment and principles underlying their uses. Scientific periodicals and literature related to the subject. Form and style of writing research papers, review articles, research reports and thesis. Selection of research problem and preparation and submission of research projects. Interpretation and evaluation of research data, considerations and requirements for setting up a research laboratory.

### **FPV 908: Food Legislations, Standard and Safety Quality Management Systems 3 (3-0)**

Introduction to food - its nutritional, technological and safety aspects. Introduction to Nigerian legal system, an overview of food regulations in Nigeria. Food safety and standards act and role of NIS, SON, NAFDAC. Various food plant inspection bodies and legislations. International Standards: Codex Alimentarius: Structure of organization, standards related to Nigerian foods. Introduction to food safety: definition, food safety issues, factors affecting food safety, importance of safe foods. Shelf life of food products: factors affecting shelf life and methods to check the shelf life. Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Food Safety Plan, Food Safety Management Risk Analysis. Traceability, food product recall. Food safety Management Systems: ISO 22000: Importance of implementing a HACCP system and how it can be applied to various products, develop a HACCP plan including a HACCP team, produce product workflow diagrams for a range of products and their verification processes etc. Audits: Introduction, objectives, documentation, responsibilities, management review, audit certification and its importance etc. ISO 14000: Introduction, various standards among 14000 series, certification and its importance, various clauses of 14001. ISO 17025 - General requirements for the competence of testing and calibration laboratories. World Trade Organization (WTO), Sanitary and Phytosanitary Measures and Technical Barriers to Trade, Food and Agriculture Organization (FAO), World Health Organization (WHO), World Animal Health Organization, International Plant Protection Convention (IPPC) Export – Import of Food.

### **FPV 909: Advances in Experimental Designs 3 (3-0)**

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control. Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations,



crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design - concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

### **FPV 910: Advances in Technology of Frozen Foods**

**2 (2-0)**

Glass transitions in frozen foods and biomaterials, Microbiology of frozen foods, Thermo-physical properties of frozen foods, freezing loads and Freezing time calculation, Innovations in freezing process. Freezing methods and equipment, Cold store design and maintenance, Transportation of frozen foods, Retail display equipment and management, Household refrigerators and freezers, Monitoring and control of the cold chain. Quality and safety of frozen dairy products. Quality and safety of frozen meat and meat product, Quality and safety of frozen poultry and poultry products, Safety and quality of frozen fish, Shellfish, and related products, Quality and safety of frozen eggs and egg products. Chemical Measurements, Sensory analysis of frozen foods, Foodborne illnesses and detection of pathogenic microorganisms, Shelf-life prediction of frozen foods. Introduction to frozen food packaging, Plastic packaging of frozen foods, Paper and card packaging of frozen foods, packaging of frozen foods with other materials, Packaging machinery.

### **FPV 911: Advances in Food Additives and Preservatives**

**2 (2-0)**

Introduction- what are food additives, role of food additives in food processing, functions, classification, intentional and unintentional food additives, toxicology and safety evaluation of food additives, beneficial effects of food additives/toxic effects, food additives generally recognized as safe (GRAS), tolerance levels and toxic levels in foods-LD 50 values of food additives. Naturally occurring food additives, classification, role in food processing, health implications, food colors, natural and synthetic food colors, types, their chemical nature and their impact on health. Preservatives, what are preservatives, natural preservation, chemical preservatives, their chemical action on foods and human system, Antioxidants and chelating agents, their role in foods, types of antioxidants – natural and synthetic, chelating agents, their mode of action in foods with examples. Surface active agents, their mode of action in foods with examples, stabilizers and thickeners with examples and their role in food processing, bleaching and maturing agents, examples of bleaching agents, what is maturing, examples of maturing agents and their role in food processing. Starch modifiers, chemical nature, their role in food processing, buffers- acids and alkalis, examples, types, their role in food processing, Sweeteners, what are artificial sweeteners and non-nutritive sweeteners, their health implications, role in food processing Flavoring agents, natural and synthetic flavors, examples and their chemical nature, role of flavoring agents in food processing, Anti-caking agents, their role in food processing, Humectants- definition, their role in food processing.

### **FPV 912: Advances in Physical and Engineering Properties of Foods and Biomaterials**

**2 (2-0)**

- Topics involve concept in physical and engineering properties of food and biomaterials, i.e. physical characteristics, surface, functional, mechanical, thermal, electrical and optical properties; Phase transition of properties of Food during processing; Measurements and



application of these properties to food processing system including harvesting, handling, processing, storage and quality evaluation; -Practical application in relevant food processing operation

**FPV 913: Advances in Industrial Drying of Foods**

**2 (2-0)**

Fundamental principles of drying; thermodynamic properties of air-water mixtures and moist solids; equilibrium moisture content, drying kinetics and mathematical modeling of drying process; classification and selection of industrial dryers; dryers for particulate solids, slurries and sheet-form materials; drying of selected food products: grains, fruits, vegetables and meat products; innovation in drying technologies