Accredited Syllabus for PhD Food Science and Technology
Department of Food Science and Technology
College of Science
KNUST

1. Course Description:

Year 1 Ph.D. Food Science and Technology

Ph.D. 1 Semester 1

Code	Title of course	T	P	C
FST 751	Graduate Skills Development I	1	6	3
FST 753	Advanced Non-Thermal Food Processing	3	0	3
FST 755	Special Topics I	1	6	3
FST 757	Research Project I	0	6	2*
FST 759	Research Seminar I	0	6	2*
	Electives (Take at least two)			
FST 761	Advances in Product Development and Sensory Evaluation	3	0	3
FST 763	Advances in Food Commodities Processing Technology	3	0	3
FST 567	Food Biotechnology	3	0	3
FST 573	Advanced Food Microbiology	2	3	3
FSA 753	Advanced Food Toxicology	3	0	3
	Minimum Total credits	**11**	**10**	**15**

Ph.D. 1 Semester 2

	Core			
FST 752	Graduate Skills Development II	1	6	3
FST 754	Special Topics II	1	6	3
FST 756	Research Project II	0	6	2*
FST 758	Research Seminar II	0	6	2*
	Electives (Take at least Three)			
FST 768	Advances in Food Microstructure and Rheology	3	0	3
FST 780	Advances in Functional Food and Nutraceuticals	3	0	3
FST 782	Advances in Food Mycology	3	0	3
FST 584	Advanced Postharvest Technology	3	0	3
FST 586	Modelling in Food Technology	3	0	3
FSA 752	Food Systems Risk Assessment	3	0	3
	Minimum Total credits	**8**	**8**	**12**

Year 2 Ph.D. Food Science and Technology

Code	**Title of course**	**T**	**P**	**C**
	Core			
FST 851/852	Research Project 2/3	0	18	6*
FST 855/857	Research Seminar	0	18	6*
	Total Credits	0	**36**	**12***

Year 3 Ph.D. Food Science and Technology

Code	**Title of course**	**T**	**P**	**C**
	Core			
FST 853/854	Research Project 4/5	0	18	6*
FST 859/860	Research Seminar	0	18	6*
	Total Credits	0	**36**	**12***

Year 4 Ph.D. Food Science and Technology

Code	**Title of course**	**T**	**P**	**C**
	Core			
FST 951/952	Research Thesis 1/2	0	18	6*
FST 953/955	Thesis Seminar	0	18	6*
	Total Credits	0	**36**	**12***

*Credits of Research and Seminar not included in total credits achieved.

2. Detailed Course Description

Provide a short description of the content of the courses in the programme to include:

(a) Objective
(b) Content
(c) Mode of delivery
(d) Reading materials

FST 751/752 Graduate Skills Development (I, II) (1 6 3)

The Graduate Skills Development Programme is designed specifically for postgraduate researchers to have a broad awareness, knowledge, and understanding of critical elements involved in carrying out research work effectively.

a) Objective

- To provide training in discipline-specific, generic, and transferable skills and training.

b) Learning outcome

Students are expected to:

- apply ethical conduct, laid down regulations and theoretical skills to accomplish research objectives.
- advance in relevant skills required in research, data analysis, leadership, management, safety, and scientific communication

c) Content

Course content includes:

- Guidelines for Postgraduate Programme – Rules and Regulations –Timelines
- Ethics of Research
- Introduction to Intellectual Property and Copyright
- Graduate Assistantship – Introduction to Teaching Small Groups and Large Classes
- ICT (Information and Communication Technologies) - Some useful E-Learning Resources
- Introduction to Supporting Disabled Students
- Fire Safety Training
- First Aid Training.
- Literature Review and Referencing using Software (e.g. EndNote, Mendeley)
- Some Selected Software for Data/Statistical Analysis of your Research –Practical and Scientific Interpretations (e.g. SPSS, MINITAB, MATLAB, Risk Analyser, FAO/IN FOODS -Food Composition Course; Design Expert, e.t.c)
- Food Composition – Data Analysis (FAO/IN FOODS)
- Developing Effective Communication and Presentation (Seminar/Workshops/Conferences – Oral/PowerPoint and Poster Presentations)
- Developing Effective Presentation Skills (Seminar/Workshops/Conferences – Oral/PowerPoint and Poster Presentations)
- Developing Effective Leadership and Management Skills
- Preparation for Viva Voce and Interviews
- Guide to Writing Thesis – Standard Format
- Guide to Writing CV/Resume and Application for Jobs
- Proposal Writing for Grants/Funding your Research
- Publication – Publishing your Research

d) Mode of delivery

- The mode of delivery shall be a seminar organized in connection with stakeholders/resource persons.
- Practicals
- Candidates shall be awarded a certificate after successful participation.

e) Reading materials

1. Parker, R. (2012). Skill Development in Graduate Education, Mol. Cell. 46(4).
2. Cleary, M., Flynn, R., Thomasson, S., Alexander, R. and McDonald, B. (2007). Graduate Employability Skills, Commonwealth of Australia.
3. Smith, E.E. and Krüger, J. (2008). A critical assessment of the perceptions of potential graduates regarding their generic skills level: An exploratory study. South African Journal of Economic and Management Sciences, 11 (2): 121-138
4. Chaita, M. V. (2016). Developing Graduate Employability Skills: Your Pathway to Employment, Universal Publishers.
5. Denicolo, D. and Reeves, J. (2013). Developing Transferable Skills Enhancing Your Research and Employment Potential, SAGE Publications Ltd; 1st edition.

FST 753 Advanced Non-Thermal Food Processing 3 0 3

This course focuses on alternatives to thermal operations, emphasizing retaining the quality and organoleptic properties of food products and presenting engineering focus on non-thermal food processing technologies.

a) Objective

- To demonstrate engineering focus on non-thermal food processing technologies;
- To use mathematical modelling and numerical simulations to explain outcomes of treatments.

b) Learning outcomes

- iStudents should be able to explain the principles and application of named non-thermal food processing technology.

c) Content

High Pressure-Based Food-Processing; Pulse Electric Fields; Ultrasound Processing; Osmotic Dehydration; Pulsed Light Technology; Membrane Technology; Irradiation Technology; Cryogenic Freezing; Nanofiltration: Principles, Process Modeling, and Applications; Atmospheric Pressure Non-Thermal Plasma.

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments.
- Critique of research papers.

e) Reading materials

1. Dash, K. K. and Chakraborty, S. (Eds.). (2021). Food Processing: Advances in Non-Thermal Technologies. CRC Press.
2. Sonawane, S. K. and Patil, S. (2020). Non-thermal plasma: An advanced technology for food industry. Food Science and Technology International, 26(8), 727-740.
3. Chauhan, O. P. (Ed.). (2019). Non-thermal processing of foods. CRC Press.
4. Ohlsson, T. and Bengtsson, N. (2002). Minimal processing of foods with non-thermal methods. Minimal processing technologies in the food industry., 34-60.
5. Tewari, G. and Juneja, V. (Eds.). (2008). Advances in thermal and non-thermal food preservation. John Wiley and Sons.
6. Barba, F. J., Saraiva, J. M. A., Cravotto, G. and Lorenzo, J. M. (Eds.). (2019). Innovative thermal and non-thermal processing, bioaccessibility and bioavailability of nutrients and bioactive compounds. Woodhead Publishing.

FST 755/754 Special Topics I, II (1 6 3)

This course allows special in-depth knowledge and study for individuals or small group of students. It is designed to advance knowledge in specialized topics in food science and technology where students would wish to progress. Primarily, the course is student-centred and based on a literature review. Facilitators will initially guide students in systematic review or meta analysis methods and current presentations trends. Articles writing processes are enforced. The course shall initially be assessed at the end of the first semester and a full assessment at the end of the second semester.

a) Objective

- To examine or explore current issues relating to the student's research area of specialization and relevance.

b) Learning outcome

By the end of the lessons should should be able to:

- explore current and relevant research literature collect in-depth information in their area of individual research to enrich skills;
- build more robust capacities towards international best-practice in their area of specialization.

c) Content

Emerging trends in Food Carbohydrates/Food Biopolymers; Food Proteins; Food Fats; New Product Development; Food Microbiology and Fermentation; Food Microstructure and Rheology, Food Ingredients/ Additives; Functional Foods and Nutraceuticals; Human Nutrition and Health; Mycology and Mycotoxins; Food

Biotechnology; Postharvest Technology and Management; Food Quality and Safety Management.

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments/Term paper.
- Critique of research papers.
- Manuscript preparations/writing.
- Practicals.

The course shall initially be assessed at the end of each semester and a full assessment at the end of one academic year.

End of Semester 1 – The supervisor/ supervisory team will score the student (over 100%)
End of Semester 2 – Student will indicate and submit evidence for the stage reached per the development and publication of the review topic chosen. The deadline for evidence submission will be communicated to students. Grading of performance shall be based on category/ stage reached and these are as follows:

Stage/Category reached	If at the end of the academic year, the student submits evidence	Grade earned	Marks equivalent range (NOTE: The actual mark to be earned shall be based on the submission timeliness factor and the range point difference; penalty applies for late submission of evidence)
1	1st draft write-up on a special topic chosen and in article/ manuscript format	C-	50.00-54.99
2	Draft of manuscript/ article on the special topic reviewed by the supervisor with COMMENTS/ EDITS/ CORRECTIONS to be addressed	C+	55.00-59.99
3	Submission and acknowledgment of receipt of the manuscript article by peer-reviewed journal/ editor/ Editorial team	B-	60.00-64.99
4	Manuscript/ article reviewed with minor corrections suggested/ reviewers' comments and an indication of acceptance for publication in the named peer-reviewed journal	B+	65.00-69.99
5	Acceptance for publication after peer review, a PROOF copy of the revised/ edited manuscript (from the journal editorial office) returned to the authors for final review	A-	70.00-74.99
6	Edited/ corrected manuscript on the special topic article chosen FINALLY PUBLISHED in the named peer-reviewed journal	A/A+	75.00-100

e) Reading materials

Recommended journals, books and internet resources in the subject areas

1. Journal of Food Biochemistry, Online ISSN:1745-4514, Wiley Periodicals, Inc.
2. Journal of Food Safety, Online ISSN:1745-4565, Wiley Periodicals, Inc.
3. Food Quality and Safety, ISSN 2399-1402, Print ISSN 2399-1399, Oxford University Press
4. Food and Chemical Toxicology, ISSN: 0278-6915, Elsevier Ltd.
5. Comprehensive Reviews in Food Science and Food Safety, IFT Scientific Journals.
6. International Journal of Food Safety, Nutrition, and Public Health, ISSN online 1479-392X, ISSN print 1479-3911, Inderscience Enterprises Ltd.
7. EFSA Journals**,** Online ISSN:1831-4732, Wiley and Sons, US

FST 761 Advances in Product Development and Sensory Evaluation (1 6 3)

This course will broaden students' knowledge with the scientific discipline required to create quality foods essential in food industries and ensure that the food being produced is acceptable to the consumer.

a) Objective

- To critique skills on the food development process among different scenarios of food industries.

b) Learning outcomes

- By close of the lessons students should be able to design food development processes for different scenarios in food industry.

c) Content

Overview of the role and functionality of food constituents and ingredients: proteins, carbohydrates, lipids, and additives. Introduction to food product development. Classification of food products as the basis for innovation, the sociological and technological aspects of food product development. Concepts of new product development, developing an innovation strategy, criteria for new products, critical factors in product success. The role of the consumer in product development. The food product development process. Food standards. Food standards.

Recent methods of discrimination test methods, descriptive analysis methods and consumers' test methods in sensory evaluation of foods.

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments.

- Term paper.
- Critique of research papers.
- Laboratory work/Demonstrations/ Practical Sessions.

e)Reading materials

1. Kemp, S. E., Hollowood, T. and Hort, J. (2011). Sensory Evaluation: A Practical Handbook, John Wiley and Sons Ltd. USA.
2. Stone, H., Bleibaum, R. and Thomas, H. A. (2012). Sensory evaluation practices. Academic Press.
3. Næs, T., Brockhoff, P. B. and Tomic, O. (2010). Statistics for Sensory and Consumer Science. John Wiley and Sons Ltd. USA.
4. Bordiga, M. and Nollet, L.M. (2019). Food Aroma Evolution: During Food Processing, Cooking, and Aging. CRC Press. US.
5. Stone, H., Bleibaum, R. and Heather, T. (2012). Sensory Evaluation Practices. 4th Edition, Academic Press. USA.

FST 763 Advances in Food Advances in Food Commodities Processing Technology (3 0 3)

This course aims at deepening food processing technologies skills and methods used to process food commodities while encouraging innovation.

a) Objective

- To innovatively integrate different technological methods required to process food commodities.

b) Learning outcomes

- It is expected that students will design technological methods to demonstrate their skills in processing food commodities.

c) Content

Fruits and vegetables: Nutritional composition and classification; Principles and methods of preservation; Quality factors for processing; Minimal processing; Canning; fruit and vegetable product; Pectins and applications; Quality control

Cereals and legumes: Milling and extraction processes of cereals; Baking technology; Malting; Impacts of the processing; Ready-to-eat breakfast cereals; Bulk storage; (e.g., in silos); Biodegradable films.

Meat and fish: Production, economic importance; Anatomy and histology; Post-mortem biochemical changes. Rigor mortis, Autolysis, Tenderness, Spoilage, Zoonosis. Quality and safety; Storage and preservation methods; Fishand meat processing (sausage, corned beef, meat, and fish analogs); Nutritional value; Local and international legislation;

Roots and tubers: Nutritional quality; Production trends; Storage; Processing

d) Mode of delivery

- Lectures.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.

- Assignments.
- Term paper.
- Critique of research papers.

e) Reading materials

1. Arvanitoyannis, I. S. (2010). Irradiation of food commodities: techniques, applications, detection, legislation, safety, and consumer opinion. Academic Press. USA.
2. Pan, Z., Zhang, R. and Zicari, Z. (2019). Integrated Processing Technologies for Food and Agricultural By-Products. Elsevier. USA.
3. Sommers, C. H. and Fan, X. (2008). Food irradiation research and technology. John Wiley and Sons. USA.
4. Yahia, E.M. (2019). Postharvest Technology of Perishable Horticultural Commodities. 1st Edition, Woodhead Publishing. UK.
5. Fellows, P.J. (2009). Food processing technology: principles and practice. Elsevier. The Netherlands.

FST 567 Food Biotechnology (3 0 3)

This course in Food Biotechnology provides an opportunity to learn the concepts and theory of the experimental techniques used in food biotechnology. It is intended to provide an advanced understanding of key concepts and current applications of biotechnology in the production and processing of foods.

a) Objective

To exemplify biotechnological applications relating to:

- transgenic foods, biotechnological food additives;
- Biotechnological food diagnosis and regulations.

b) Learning outcomes

Students should be able to:

- Apply the interdisciplinary sciences relevant to food biotechnology;
- Demonstrate how molecular biotechnology is being used to address major challenges associated with healthier and safer food production, and processing;
- Describe the fundamental principles in implementing biotechnologies in various aspects of food production and processing.

c) Content

Microorganisms for Food Production; Enzymes in Food Production; Genetic Engineering Tools; Genetic Modification of Bacteria, Plants and Animals; Social, Economic, Ecological Issues of Food Biotechnology.

d) Mode of delivery

- Lectures/ PowerPoint Presentation.
- Audio-visuals (videos and infographics).
- Group discussions and presentations.
- Assignment

e) Reading materials

1. Byong, H. L. (2015). Fundamentals of Food Biotechnology. 2nd Edition. Wiley- Blackwell. USA.
2. Shetty, K., Paliyath, G., Pometto, A. and Levin, R. E. (2006). Food biotechnology.
3. Taylor and Francis Group, LLC.
4. Applications of Biotechnology to Traditional Fermented Foods.
5. Report of an Ad Hoc Panel of the Board on Science and Technology for International Development. National Academy Press. Washington D.C., 1992.
6. Shetty, K., Paliyath, G., Pomentto, A., and Levin, E. R., (eds). Food Biotechnology.
7. 2nd Ed. Tatlor & Francis Group, LLC, 2006.
8. Smith, E. J. Biotechnology. 5th Edition. Cambridge University Press, UK. 2009.

FST 573 Advanced Microbiology (2 3 3)

This course is designed to understand the important principles and current issues in Food Microbiology for industrial applications.

a) Objective

To apply control measures in food contaminations.

To apply microbial ecological principles for industrial operations for commercial benefits.

b) Learning outcomes

Students are expected to:

- evaluate microbial ecology relating to food safety;
- integrate microbial activities for specific industrial food processing operations.

c) Content

Microbial ecology in foods. Contemporary issues in food microbiology. Emerging foodborne pathogens and toxigenic moulds. Advanced techniques in detection and typing of foodborne pathogens and mycotoxins. Foodborne Parasites, Food Production Practices Relative to Foodborne Parasites and Climate Change, Control, Transmission, Socioeconomic Burden of Foodborne Parasites, Apicomplexan Protozoa, Non- Apicomplexan Unicellular Parasites, Nematodes, Cestodes, Trematodes, Microbial modelling (Predictive microbiology in risk assessment). Biofilms. Microorganisms in food processing waste management.

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments.
- Term paper.
- Critique of research papers.

e) Reading materials

1. Adams, M. R. and Moss, M. O. (2008). Food Microbiology. 3rd Edition, RSC Publishing. Cambridge.
2. Banwart, G. (2012). Basic Food Microbiology. Springer Science and Business Media. NY.
3. Matthews, K., Kniel, K. E. and Montville, T. J. (2017). Food Microbiology: An introduction. 4th Edition. ASM Press. USA.
4. Osman E., Bozoglu, F. T. (2016). Food Microbiology: Principles into Practice. John Wiley and Sons, Ltd. NY.
5. Ray, B. and Bhumia, A. (2013). Fundamental Food Microbiology. 4th Edition, CRC Press. London.
6. Gajadhar, A. A. (Ed.). (2015). Foodborne parasites in the food supply web: occurrence and control. Woodhead Publishing.

FSA 753 Advanced Food Toxicology (3 0 3)

The toxicology of food materials seeks to integrate knowledge of physiology, chemistry, and the pathology of organic systems imposed by the adverse hazards that are ingested. in food is investigated. The adverse impact of hazards is largely seen when they are converted into metabolites which are often potentiated relative to the parent compounds. The aim of this course is to advance knowledge and the training required tobuild such skills to gain deeper understanding of these hazards along the food chain.

a) Objective

i. To evaluate the toxicology of the critical foodborne hazards along the food chain.

ii. To gain mastery of the skills required to assess the dynamics of foodborne hazards from the identification, characterization, exposures and evaluation of their adverse health risks.

b) Learning Outcomes

Students would be able to:

i. Evaluate the hazards of paramount concern;

ii. Demonstrate competence in the identification, characterization, exposure and evaluation of adverse risks foodborne hazards.

c) Content

Current advances in food toxicology and xenobiotic metabolism; Chemical Hazards: Ingredient-Related Chemical Hazards; Pesticides, Animal drug residues, Toxic Heavy metals, Environmental contaminants, Mycotoxins and other natural toxins, Hazardous Chemical Adulterants; Melamine, Lead chromate, Lead oxide, Sudan dyes. Food allergens, Food Processing Contaminants: Acrylamide, Dioxins, PAHs, Nitrosamines, Heterocyclic amines, Radiological hazards, Food additives, Migrants from packaging materials. Physical Hazards; Metal, Glass and Hard Plastics.

d) Mode of delivery

i. Lectures.
ii. Tutorials and workshops.
iii. Independent study.
iv. Flipped classroom/Problem-based learning.
v. Blended learning/ hybrid learning.
vi. Student-led.

e) Reading materials

1. Luz, Y. and Toro, S. (1996). Toxicology and Risk Assessment, 1st ed. Marcel Dekker, Inc, New York.
2. de W Blackburn, C. and McClure, P. J. (Eds.). (2009). Foodborne pathogens: hazards, risk analysis and control. Elsevier.
3. Omaye, S.T. (2009). Introduction to food toxicology, 2nd ed, Pesticide, Veterinary and Other Residues in Food. Elsevier Inc. https://doi.org/10.1016/B978-1-85573-734-1.50005-8
4. Ramesh, G. (2015). Handbook of Toxicology of Chemical Warfare Agents, 2nd ed, Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis. Elsevier Inc., London.
5. Sun, Y.J. (2005). Handbook of Industrial Chemistry and Biotechnology, 13th ed, Control, and Cybernetics. Springer Nature, Cham, Switzerland.

PhD Year 1 Semester 2

FST 768 Advances in Food Microstructure and Rheology (3 0 3)

This course presents food microstructure and its impact on rheology for batter systems to enable students to apply them in closely related courses.

a) Objectives

- To evaluate major principles and methods underlying food rheology.
- To exemplify solid, viscous, and viscoelastic behavior of foods.

b) Learning outcomes

- At the end of the lessons, the students should be able to hypothesize the structure of food products based on the viscosity and texture of the data collected.

c) Content

Introduction to rheology; Principles of deformation elasticity and flow; shear; Newtonian and Non-Newtonian flows; Viscometry of fluid food materials - dilute and concentrated systems; Rheopexy (thixotropy); Viscoelasticity; Rheological methods and properties; Empirical methods; Texturalmeasurement; Measuring instruments-practical aspects; Applications (Emulsions, Gels, Selected Products). Food microstructure

d) Mode of delivery

- Lectures.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.

- Assignments.
- Term paper.
- Critique of research papers.

d) Reading materials

1. Ngamwonglumlert, L. and Devahastin, S. (2018). Microstructure and its relationship with quality and storage stability of dried foods. In Food Microstructure and Its Relationship with Quality and Stability. Woodhead Publishing. UK.
2. Ahmed, J., Ptaszek, P. and Basu, S. (2016). Advances in food rheology and its applications. Woodhead Publishing. UK.
3. McClements, D. J. (2007). Understanding and controlling the microstructure of complex foods. Elsevier. USA.
4. Morris, V. and Groves, K. (2013). Food Microstructures. Microscopy, Measurement and Modelling. 1st Edition, Woodhead Publishing. UK.
5. Ahmed, J., Ptaszek, P. and Basu, S. (2016). Advances in Food Rheology and Its Applications. 1st Edition, Woodhead Publishing. UK.

FST 780 Advances in Functional Foods and Nutraceuticals (3 0 3)

This course is designed to understand the origin, classification, mechanism of action, and chemical properties of potential and established nutraceutical compounds and their applications in functional foods.

a) Objective

- To critique the application of nutraceutical compounds in functional foods.
- To exemplify the sources, profiles, mechanism of action, and chemical properties of potential and established nutraceutical compounds.

b) Learning outcomes

At the end of the lessons students should be able to integrate nutraceutical compounds sourced from functional foods into food products.

c) Content

Origin, classification, mechanism of action and chemical properties of potential and established nutraceutical compounds and applications in functional foods: Vitamins A, C, E, Folic acids; Minerals: Potassium, calcium, magnesium; Carotenoids: Lutein, lycopene, terpenes; Flavonoids, Anthocyanidins, Catechins, Tannins, Lignin, Soluble and insoluble fiber, Allicin, Beta-glucan, Fructo-oligosaccharides, Probiotics and prebiotics, Long-chain omega 3 fatty acids. Foods for prevention and treatment of cancer, cardiovascular diseases, hypertension, osteoporosis, Cannabinoids

d) Mode of delivery

- Lectures/ PowerPoint Presentation/Assignment.
- Audio-visuals (videos and infographics).
- Group discussions and presentations.

e) Reading materials

1. Aluko, R. E. (2012). Functional foods and nutraceuticals. New York, NY, USA: Springer.
2. Corredig, M. (2009). Dairy-derived ingredients: food and nutraceutical use. Elsevier. USA.
3. Venugopal, V. (2008). Marine products for healthcare: functional and bioactive nutraceutical compounds from the ocean. CRC press. USA.
4. Gupta, R.C., Srivastava, A. and Lall, R. (2018). Toxicity potential of nutraceuticals. In Computational Toxicology (pp. 367-394). Humana Press, New York, NY.
5. Shahidi, F. and Weerasinghe, D.K. (2003). Nutraceutical Beverages: Chemistry, Nutrition, and Health Effects. American Chemical Society. USA.

FST 782 Advances in Food Mycology (3 0 3)

Understanding the vast body of knowledge about Food Mycology demands regular reviews of latest advances of original research articles or reviews. This course addresses the different roles related to the impact of fungi biomas on food product.

a) Objective

To address the development and application of new strategies for detecting fungal invasion, mycotoxins, and fungal volatiles responsible for the characteristic quality and safety properties of food products.

b) Learning outcomes

Students are expected to:

- Demonstrate current and emerging mechanisms of fungal invasion, of food materials;
- Attribute emerging mycotoxins and fungal volatiles;
- Integrate emerging properties of fungal biomas for characteristic quality and safety of food products.

c) Content

Current advances in edible fungal biomass, their industrial food applications, and their safety concerns; Fungal biomass extract fermentations and food applications; Current knowledge in fungal volatiles and mycotoxins; Current advances in molecular techniques to evaluate mycotoxins and fungal volatiles.

d) Mode of delivery

- Tutorials and workshops on review methods
- Student centrered reviews
- Independent study.

- Flipped classroom/Problem-based learning.
- Blended learning/ hybrid learningmycotoxins and fungal volatiles.

e) Reading materials

1. Mycotoxin Research, www.springer.com/journal/12550
2. World Mycotoxin Journal - www.wageningenacademic.com/loi/wmj
3. Advances in Mycotoxin Research: www.mdpi.com/journal/toxins/special_issues/mycotoxins-toxins
4. Taniwaki, M. H., Silva, J. J., and Niessen, L. (2023). The use of big data in the field of food mycology and mycotoxins. In Harnessing Big Data in Food Safety (pp. 65-91). Springer, Cham.
5. White, L. P., and Price, J. S. (2021). Recent advances and novel approaches in laboratory-based diagnostic mycology. Journal of Fungi, 7(1), 41. doi: 10.3390/jof7010041

FST 584 Advanced Postharvest Technology (3 0 3)

This course is designed to understand and apply technologies that maintain the quality and extend the shelf-life of fresh produce.

a) Objective

- To learn the technologies that maintain fresh produce through the supply chain to guarantee optimum quality and extended shelf-life.

b) Learning outcomes

- It is expected that students design technologies required to maintain fresh produce throughout the supply chain to guarantee premium produce.

c) Content

A critical review of the literature concerning post-harvest losses of agriculturalproducts and Post-harvest handling system of perishable crops; Current methods in Postharvest Physiology and Technology; Life extension of perishable commodities, techniques; Emphasis on the effects of storage facilities and techniques; Quality evaluation as related to physiological mechanism controlling the maturation; Ripening and senescence of perishable commodities; Principles of storage of fruits and vegetables; Types of storage: natural, ventilated low-temperature storage controlled atmosphere (CA) and modified atmosphere storages (MA).

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments.
- Term paper.
- Critique of research papers.

e) Reading materials

1. Florkowski, W. J., Banks, N., Prussia, S. E., Shewfelt, R. L. and Brueckner, B. (2009). Post-harvest handling: a systems approach. Academic press. USA.
2. Golob, P., Farrell, G. and Orchard, J. E. (2002). Crop post-harvest: science and technology. Blackwell Science. USA.
3. Lieberman, M. (2012). Post-harvest physiology and crop preservation (Vol. 46). Springer Science and Business Media. The Netherlands.
4. Paliyath, G., Murr, D. P., Handa, A. K. and Lurie, S. (2009). Post-harvest biology and technology of fruits, vegetables, and flowers. John Wiley and Sons. USA.
5. Sudheer, K. P. and Indira, V. (2007). Post-harvest technology of horticultural crops (Vol. 7). New India Publishing. India.

FST 586 Modelling in Food Technology (3 0 3)

This course is designed to equip students to use mathematical tools for design and predictive food models and to interpret such predictive models' outcomes.

a) Objective

- To learn the mathematical or statistical tools for predictive and interpreting food models.

b) Learning outcomes

- Students should be able to design food models based on data collected and interpret the outcomes of such predictive models.

c) Content

Basis of fundamental mathematical principles; Matrices, Algebra, Calculus, Set theory, Fuzzy set, and logic; Linear programming, Mathematical models and data sets in the area of food science and the outcomes of the research cycle: Data, Models, software, data analytics, visualization methods relevant for modelling in food science. Modelling in Food Safety, Food Quality, Food control, Food Defense, and Food Designs.

d) Mode of delivery

- Lecturer/student Interactions.
- Audio-visuals analysis of concepts (videos and infographics).
- Group discussions and presentations.
- Assignments.
- Term paper.
- Critique of research papers.

e) Reading materials

1. Datta, A. K., Sablani, S. S., Mujumdar, A. S. and Rahman, M. S. (2006). Handbook of food and bioprocess modeling techniques. CRC Press. USA.
2. Shi, J. and Le Maguer, M. (2002). Osmotic dehydration of foods: mass transfer and modeling aspects. Food Reviews International, 18(4): 305-335.
3. Helmroth, E., Rijk, R., Dekker, M. and Jongen, W. (2002). Predictive modelling of migration from packaging materials into food products for regulatory purposes. Trends in Food Science and Technology, 13(3):102-109, Elsevier. The Netherlands.
4. Ozilgen, M. (2011). Handbook of Food Process Modeling and Statistical Quality Control. CRC Press. USA.
5. Tijskens, L. M. M., Hertog, M. L. A. T. M. and Nicolaï, B. M. (2001). Food process modelling (Vol. 59). Woodhead Publishing. USA

FSA 752 Food Systems Risk Assessment (3 0 3)

With the advancement in the sensitivity of most equipment, it is expected that scientists can quantify toxic substances in great detail. By quantifying the presence of these hazards in the food chains, it is possible to arrive at decision-making geared towards safeguarding public health. Consequently, information obtained would help advise risk managers on the likely levels of risks associated with foods. Thus, this course is aimed at equipping students to gain mastery in analyzing data to predict hazardous properties of food products.

a) Objective

i. To classify hazardous dietary chemicals, microbial and environmental agents as they engage food chains;
ii. To learn risk assessment skills as resting on core toxicological principles;
iii. To learn to use risk assessment as a primary prevention tool and the most effective risk management approach.

b) Learning outcomes

Students should be able to:

i. Attribute the primary information sources and databases useful for risk assessment purposes;
ii. Interpreting and synthesize results from a risk assessment perspective;
iii. Plan oral and written communication skills in scientific and risk assessment.

c) Content

Overview of food risk analysis: Food risk assessment: Hazard and risk, risk assessment framework. Hazard Identification, Hazard Characterization, Exposure Assessment, Risk Characterization. Concepts of microbial and chemical risk assessments: Deterministic Approach, Probabilistic Approach, Tiered Approach, uncertainty and variability, limitations and challenges of risk assessment in foods; Risk Metrics: quantifying the impact of adverse health effects. Mixture Risk Assessment. Modelling and Simulation Tools, Monte-Carlo Simulations to Integrate Variability and Characterize Uncertainty, Prioritizing the different sources of uncertainty; Sensitivity Analysis Methods in Quantitative Risk Assessment. Risk–Benefit Assessment of Foods: the need for risk-benefit assessment, food safety and nutrition applications. Qualitative and Quantitative Risk–Benefit Assessment Approaches; Food Component Risk–Benefit Assessment; Risk communication.

d) Mode of delivery

i. Lecturer/student Interactions.
ii. Audio-visual's analysis of concepts (videos and infographics).

iii. Group discussions and presentations.
iv. Assignments.
v. Term paper.
vi. Critique of research papers.

e) Reading materials

1. Luz, Y. and Toro, S. (1996). Toxicology and Risk Assessment, 1st ed. Marcel Dekker, Inc, New York.
2. Nielsen, E., Ostergaard, G. and Larsen, J.C. (2008). Toxicological Risk Assessment of Chemicals, Toxicological Risk Assessment of Chemicals. Informa Healthcare USA, Inc. https://doi.org/10.1201/9781420006940
3. Omaye, S.T. (2009). Introduction to food toxicology, 2nd ed, Pesticide, Veterinary and Other Residues in Food. Elsevier Inc. https://doi.org/10.1016/B978-1-85573- 734-1.50005-8
4. Ramesh, G. (2015). Handbook of Toxicology of Chemical Warfare Agents, 2nd ed, Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis. Elsevier Inc., London.
5. Sun, Y.J. (2005). Handbook of Industrial Chemistry and Biotechnology, 13th ed, Control, and Cybernetics. Springer Nature, Cham, Switzerland.

FST 756	**Research Project**	**1**	**(0**	**6**	**2)**
FST 851/852	**Research Project**	**2**	**(0**	**18**	**6)**
FST 853/854	**Research Project**	**3**	**(0**	**18**	**6)**
FST 951/952	**Research Thesis**		**(0**	**18**	**6)**

These courses are designed to first allow for the assessment of the student's preparedness. Secondly, it allows for the assignment of suitable supervisors for the project. At the beginning (Research Project 1), there is a preliminary assessment of the students' ability to outline their research interests. It progresses to give solid directions students would carry out their studies (Research Project 2). Progressing (Research Project 3) candidates are requested to make publications of the report at best, and at least draft articles, to show the course of their research. Also, progress reports are delivered to track the course of the research. Ultimately, a complete thesis is written to complete all the reports and articles of the publication into a dissertation (Research Thesis).

a) Objective

- To demonstrate scientific literature search skills by reviewing articles in food science and technology.
- To conduct food science and technology-based research.
- To deliver satisfactory papers and talk sessions in food science and technology communities.

b) Learning outcome

- It is expected that candidates would ultimately gain competence and become productive food science and technology research scholar.

c) Content

The content is primarily be based on the areas of specialization of students. The content will progress through the semesters as Research Project 1, 2, 3, through to the final year as Research Thesis.

d) Mode of delivery

- Initially, each student shall write a proposal/synopsis for presentation and submit a report based on the approved format for assessment by the supervisor and a Board of examiners. Subsequently, progress reports shall be turned in as the student/candidate progresses.
- The research Thesis is expected to be the final write-up of the project. The project shall be publishable manuscript(s) in appropriate peer-reviewed journals. The supervisors/ team of examiners shall assess the quality of the research thesis based on a format prepared for the exercise.
- A final presentation based on the approved format for oral examination and assessment by the supervisor and a team of examiners shall be made.

e) Reading materials

1. Anderson, J. and Poole, M. (2002). Assignment and Thesis Writing. Wiley
2. Parija, S.C. and Kate, V. (2018). Thesis writing for Masters and Ph. D. Springer
3. Kushkowski, J.D., Parsons, K.A. and Wiese, W.H. (2003). Master's and doctoral thesis citations: Analysis and trends of a longitudinal study. portal: Libraries and theAcademy, 3(3), 459-479.
4. Masanja, N. (2019). Practical Handbook to Dissertation and Thesis Writing. NMM Printers.
5. Rowland, C. (2004). Communication matrix. Oregon Health and Science University.

FST 759	**Research Seminar I**	**(0**	**6**	**2)**
FST 855/856	**Research Seminar II**	**(0**	**18**	**6)**
FST 859/860	**Seminar III**	**(0**	**18**	**6)**
FST 953/955	**Thesis Seminar**	**(0**	**18**	**6)**

These courses are designed to strengthen communication skills. At the beginning(Seminar I), a synopsis is delivered to assess students' ability to handle communication intheir respective research interests. Research communication development progresses to firm up the skills of students (Seminar II) using poster presentation techniques.

Progressing (Seminar III) candidates are requested to make a more profound presentation of their reports at one-day mini-conferences (Ph.D. Week), to interact with all faculty, cross-appointed academic staff, post-docs, and students. Ultimately, (Thesis Seminar) 30-min seminar on thesis work is made followed by 30 min question period during a one-day mini-conference (Ph.D. Week).

a) Objective

- To communicate research output in the food science and technology community.

b) Learning outcome

- It is expected that candidates would ultimately gain the competence to deliver public lectures in the food science and technology community.

c) Content

- The content is primarily based on the areas of specialization of students. The content will progress through Seminar 1, 2, 3, through to the final year as Thesis Seminar.

d) Mode of delivery

- Oral examination of students shall be conducted during seminar presentations based on a format prepared for the assessment as the candidate progresses a report based on the approved format for assessment by the supervisor and a Board of examiners.
- Delivery shall be student-cantered, and presentation shall either be by poster presentations or timed oral presentations specially organized as a one-day Ph.D. week mini-conference.

e) Reading materials

1. Germano, W. (2014). From dissertation to book. University of Chicago Press.
2. Bunton, D. (2014). Generic moves in Ph. D. thesis introductions. In Academic discourse (pp. 67-85). Routledge.
3. Rowland, C. (2004). Communication matrix. Oregon Health and Science University.
4. Kushkowski, J.D., Parsons, K.A. and Wiese, W.H. (2003). Master's and doctoral thesis citations: Analysis and trends of a longitudinal study. portal: Libraries and the Academy, 3(3), pp.459-479.
5. Masanja, N. (2019). Practical Handbook to Dissertation and Thesis Writing. NMM Printers.

13. Requirements for graduation:

Provide information on the following requirements for graduation:

a. **Course Requirements**;

Candidates are deemed to have satisfied all requirements for graduation when all the core courses plus the compulsory electives have been duly passed. Courses with asterisks are core courses.

FST 751	Graduate Skills Development I
FST 753	Advanced Non-Thermal Food Processing
FST 755	Special Topics I
FST 752	Graduate Skills Development II
FST 754	Special Topics II
FST 761	Advances in Product Development and Sensory Evaluation
FST 763	Advances in Food Commodities Processing Technology
FST 567	Advanced Postharvest Technology
FST 565	Food Mycology
FST 768	Advances in Food Microstructure and Rheology
FST 780	Advances in Functional Foods and Nutraceuticals
FSA 753	Foodborne Hazards and Toxicology
FST 584	Food Biotechnology
FST 586	Modelling in Food Technology

b. Credits Requirements;

At the end of the programme, a successful candidate should have completed a minimum of 27 credit hours.

c. Any additional requirements for graduation, e.g. attendance.

A successful candidate must have completed all registered courses, successfully defended his/her thesis and at least evidence of submission of at least 2 papers out of the thesis

14. Assessment Regulations:

a. Students' performance and achievement

According to the handbook from the Graduate School, the pass mark for any course shall be 50%. However, a cumulative Weighted Average (CWA) of 55.00 shall be obtained at the end of the taught courses to proceed with the thesis. If a student does not maintain the minimum CWA of 55.00 and trails one or more courses, they shall be required to write supplementary examinations to be in good academic standing before starting the research work or taking the oral examinations/Viva Voce the case may be. Students will be given relevant handbooks/policy documents.

b. Mode of certification

All candidates would be deemed to have satisfactory performance for graduation when they have been graded for continuous assessment throughout the programmeand have qualified for Mid-Semester (30%) and End-of-Semester examinations (70%) for each course.

c. The certificate awarding institution

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

15. Library and other sources of information:
Provide details of sources of relevant information available to both students and staff.

The Department uses the main College of Science library, where a section is assigned. The University Library is also available for all students on campus. Internet facility is also provided.