

## Food Safety and Technology

National Center for Food Safety and Technology  
IIT Moffett Campus  
6502 S. Archer Road  
Summit-Argo, IL 60501  
708.563.8271  
708.563.8274 (fax)  
www.iit.edu/ncfst

**NCFST Vice President and Director:**  
Robert Brackett, Ph.D.

**NCFST Graduate Program Director:**  
Jason Wan, Ph.D.

The National Center for Food Safety and Technology (NCFST), with IIT faculty, U.S. Food and Drug Administration (FDA) scientists, and food industry experts, provides a unique training ground for individuals seeking graduate education in food safety and technology and food process engineering. Courses are offered at NCFST with the strong support of the following IIT departments: Biological, Chemical, and Physical Sciences (BCPS) and Chemical and Biological Engineering (ChBE).

The master's degree programs in Food Process Engineering (FPE) are designed as flexible programs to educate food technologists and engineers in aspects relating to

food processing and safety. Students can specialize in food processing and packaging, food microbiology and safety, compositional safety of food (chemistry), and foods for health (nutrition). Graduates of the program will be prepared to assume responsible positions in food manufacturing operations, research and development, food safety, compliance and regulatory affairs, and quality assurance in the processing, retail, and food service segments of the food industry. Other career options include positions with federal, state or local health and agri-food agencies, and in policy-making, regulatory, or research roles with organizations associated with food manufacturing operations.

The teaching faculty is drawn from NCFST/IIT faculty and NCFST/FDA scientists, and is augmented by IIT faculty from several departments, together with scientists and experts from the private sector. In addition to the formal course requirements, students may participate in food safety and technology research projects at the NCFST under the supervision of IIT faculty and FDA scientists. The FDA presence provides a unique opportunity for students to understand the synergy of scientific philosophy and legal issues involved in the regulatory process governing the safety and wholesomeness of the food supply.

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### Degrees Offered

Master of Science in Food Safety and Technology  
(Thesis Option)  
Master of Food Safety and Technology (Professional,  
Non-Thesis Option)  
Master of Science Food Process Engineering  
(Thesis Option)\*

Master of Food Process Engineering (Professional,  
Non-Thesis Option)\*

*\* Please refer to Chemical and Biological Engineering Department*

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### Certificate Programs

Food Safety and Technology  
Food Process Engineering\*  
Food Processing Specialist\*

*\* Please refer to Chemical and Biological Engineering Department*

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### Facilities

The NCFST facilities include a 2,692 square meter industrial scale pilot plant. The pilot plant houses state of the art equipment such as computer-controlled retorts, high temperature-short time plate pasteurizer, high pressure food processors for pasteurization and sterilization studies, equipment for aseptic processing of particulate foods, pulsed electric field apparatus, ozone processor, UV food processors, homogenizers, and high power ultrasound. A separate Biosafety Level-3 (BSL-3) Biocontainment Pi-

lot Plant (BCPP) provides an opportunity to conduct studies on control of pathogenic microorganisms using pilot-scale equipment. Further, microbiological, food engineering, chemical and packaging laboratories support the pilot plant facilities. NCFST's food science and technology library provides both physical and systems access to current and retrospective research and technical publications.

## Faculty

Robert E. Brackett, Professor and Vice President and Director, National Center for Food Safety and Technology, B.S., M.S., Ph.D. University of Wisconsin-Madison. Microbiological food safety; growth and survival of psychrotrophic pathogens in foods; physical/chemical controls for pathogens in foods; and microbial ecology of plant products.

Britt Burton-Freeman, Research Assistant Professor of Biology, Director of Nutrition, NCFST IIT. B.S. California State University, Chico, M.S. and Ph.D. University of California, Davis. Appetite and obesity management and vascular disease. Research emphasizes on the effects of bioactive food components on mechanistic and behavioral processes of food intake and body weight regulation. Properties of fibers, micro- and macro-molecule interactions, and food matrix effects in the gut to alter metabolic and endocrine systems. Effects of dietary constituents on vascular diseases including evaluation of endothelium function, platelet activation, inflammatory and oxidative stress responses during acute and chronic interventions. The research approach includes human and basic science methodology.

Jack Cappozzo, Director of Chemistry, NCFST/IIT. M.S., Illinois Institute of Technology. Analytical chemistry with emphasis on separation science using high performance liquid chromatography (HPLC) and gas chromatography (GC) coupled to mass spectrometry (MS). Interest has been on new methods of analysis using HPLC-MS/MS to detect ultra-low levels of vitamins, flavonoids, and other phenolic antioxidants in foods and clinical serum samples to support clinical trials. In addition, core work is also performed in the areas of allergen cleaning and methods.

Indika Edirisinghe, Senior Scientist and Research Assistant Professor, NCFST/IIT, Clinical Nutrition Research Center. Ph.D., University of California at Davis. Effect of polyphenolic compounds on endothelial function, blood pressure regulation, platelet function, insulin resistance, inflammatory and oxidative stress responses during acute and chronic interventions. The research approach includes human cell culture, animal models and human clinical trials.

Kathiravan Krishnamurthy, Engineer and Research Assistant Professor, NCFST/IIT. Ph.D., Pennsylvania State University. Novel food processing technologies for sterilization, pasteurization, and/or value adding; mathematical modeling; high pressure processing; ultrasound applications; non-thermal plasma processing; microwave heating; continuous and pulsed ultraviolet light processing; gamma irradiation; infrared heating; and engineering design, control and optimization.

Alvin Lee, Director of Microbiology and Research Associate Professor. B. App. Sci. (Hons), Ph.D., RMIT University (Australia). Research Interest: Microbial food safety, food virology, molecular detection and quantification of enteric pathogens; molecular characterization of virulence mechanisms, cell culture, intervention strategies for foodborne pathogens.

Jason Wan, Research Professor and Director of Education and International Outreach, NCFST/IIT. B.S., M.S., Ph.D., Deakin University (Australia). Molecular microbiology including development of DNA-based methods for detection, differentiation and tracking of foodborne pathogens in food systems and environment. Emerging nonthermal processing technologies, including high pressure processing (HPP), pulsed electric field (PEF), ultrasound, UV and non-thermal plasma, for microbial inactivation, shelf-life extension and food safety enhancement. Dairy processing, protein chemistry, and development and evaluation of bioactive dairy ingredients for functional food applications.

Darsh Wasan, Professor of Chemical Engineering, Vice President for International Affairs, and Motorola Chair. Ph.D., University of California, Berkeley. Interfacial colloidal phenomena, foams, emulsions and dispersions, and food and environmental technologies.

Wei Zhang, Assistant Professor of Biology, B.En., M.S., Huazhong Agricultural University, (China); Ph.D., Pennsylvania State University. Microbial food safety and security; PCR detection and molecular tracking of foodborne pathogens; comparative genomics; study of bacterial pathogenesis, epidemiology, evolution and emergence of new pathotypes; identification of novel bacterial virulence factors; DNA microarray analysis of global gene expressions of foodborne pathogens under environmental or food processing stresses; MALDI-TOF mass spectrometry analysis of bacterial proteomes; applications of DNA fingerprinting technology; development of high-throughput SNP genotyping for foodborne disease surveillance and bioterrorism investigations.

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## Adjunct Faculty

Rich Schell, Adjunct Professor, Food Law and Regulation, NCFST/IIT. B.A., Illinois Wesleyan University J.D., Southern Illinois University. International food and agriculture; agricultural and food entrepreneurship,

including organics and green/sustainability initiatives; food and farm traceability; farmland ownership; legal and regulatory compliance as a competitive advantage for food companies and entrepreneurs.

## Admission Requirements

Cumulative undergraduate GPA minimum: 3.0/4.0  
1100 for Master of Science Degree (quantitative +  
verbal) and 2.5 analytical writing  
Thesis required  
950 for Professional Master (Non-Thesis Option)  
TOEFL minimum: 550/213/80\*

\* Paper-based test score/computer-based test score/internet-based test score.

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## Program Descriptions

Students in the Food Safety and Technology programs should consult with their faculty advisor to plan a program of study best suited to their background and interests. The Food Safety and Technology program is directed toward students with backgrounds in food science and related fields. The Food Process Engineering (FPE) programs are directed toward students with background and career objectives in engineering-related disciplines. Students enrolled in FST Master of Science programs must register for six to eight credit hours of research. This work will usually be conducted at the Moffett Cam-

pus; research topics will be selected from food safety, food process engineering, food biotechnology, or related topics. Attendance will also be required in a graduate seminar where students are expected to actively participate and present reports on their research. Students enrolled in Master of Food Safety and Technology and Master of Food Process Engineering are strongly encouraged to do an independent project. Details on food process engineering program requirements are in the section on the Department of Chemical and Biological Engineering.

## Master of Science in Food Safety and Technology

### Thesis Required

32 credit hours

M.S. Thesis Defense (Written Thesis Report and Oral Defense Required)

Candidates are required to take a total of 32 credit hours, 18 of which must be selected from the core food safety and technology courses listed below, 6-8 credit hours must be in research and thesis work and 6-8 credit hours from electives. Courses are offered at NCFST and via the internet, with the exception of FST 506, FST 593, FST 594, and FST 597.

### Core Course Requirements (18 credit hours)

FST 505 Food Microbiology

FST 506 Food Microbiology Laboratory

FST 507 Food Analysis

FST 521 Food Process Engineering

FST 524 Fundamentals of Food Science and Technology

FST 541 Principles of Food Packaging

### Core Research Thesis Requirement (6-8 credit hours)

FST 591 Research and Thesis for M.S. Degree

Research for the thesis must be carried out under the direct supervision of a participating faculty member. Based on the requirements of the research project, thesis committee members may be chosen from IIT faculty members from BCPS and various departments, NCFST/FDA scientists and the food industry scientists. The final thesis examination consists of submission of a written thesis followed by an oral presentation open to all NCFST staff and the university community. As a part of the thesis, the student is expected to contribute to one or

more high quality peer-reviewed journal article(s). The student is also encouraged to present the research at a national professional society meeting.

### Electives (6-8 credit hours)

FST 504 Food Biotechnology

FST 511 Food Law and Regulation

FST 531 HACCP Planning and Implementation

FST 593 Seminar Series

FST 594 Special Projects (dependent upon number of thesis credits taken, please consult NCFST Academic Advisor)

FST 597 Special Problems (dependent upon number of thesis credits taken, please consult NCFST Academic Advisor)

Students may enroll in FST 594 and FST 597 up to a maximum of 2 credit hours between both courses when enrolled in 6 credits of thesis; or 1 credit hour when enrolled in 7 credit hours of thesis. However, if the 597 is used as a short course, the student can register up to 4 credits in 597 with NCFST Advisor approval. Students may not enroll in FST 594 or 597 when using 8 credits of thesis unless 597 is used as a short course (up to 4 credits with NCFST Advisor approval).

Students must have a minimum grade point average of 3.0/4.0. In addition to the core courses required and electives of all students, further courses may be selected from the Biological, Chemical, and Physical Sciences Department (BCPS) and the Chemical and Biological Engineering Department (ChBE) with the approval of the NCFST advisor, to fit the background and needs of the individual student.

## Master of Food Safety and Technology

### Professional, Non-Thesis Option

32 credit hours

Candidates are required to take a total of 32 credit hours, 15-18 credit hours of which must be selected from the core food safety and technology courses listed below, and 14-17 credit hours must be selected from electives. Courses are offered at NCFST or via internet with the exception of FST 506, FST 593, FST 594, and FST 597.

#### Core Courses (15-18 credit hours)

- FST 505 Food Microbiology
- FST 506 Food Microbiology Laboratory (Required unless student has enough professional background experience to substitute, decision will be made by the NCFST Graduate Program Director.)
- FST 507 Food Analysis
- FST 521 Food Process Engineering
- FST 524 Fundamentals of Food Science and Technology
- FST 541 Principles of Food Packaging

#### Electives (14-17 credit hours)

- FST 504 Food Biotechnology
- FST 511 Food Law and Regulation
- FST 522 Advanced Food Process Engineering
- FST 531 HACCP Planning and Implementation
- FST 593 Seminar Series
- FST 594 Special Projects
- FST 597 Special Problems

Students can enroll in FST 594 and 597 with a maximum of 6 credit hours total between both courses with an NCFST advisor approval. However, when 597 is used as a short course, the total credit hours must not exceed 8 between 594 and 597 combined. The student must have a minimum grade point average of 3.0/4. In addition to the core courses required of all students, further courses from BCPS or ChBE may be selected with the approval of the NCFST advisor to fit the background and needs of the individual student.

## Certificate Programs

### Food Safety and Technology (FST)

12 credits

The certificate program provides a student with post baccalaureate knowledge of food safety and technology and its applications in the food industry, and in federal and state public health agencies. The program requires a set of three to four courses that must be completed in three years with minimum GPA of 3.0/4.0. Students who are admitted to masters degree programs may apply coursework previously taken in a certificate program towards the requirements for the masters degree. Courses are offered at NCFST and via the internet, with the exception of FST 506.

#### Four Courses from the following (12 credit hours)

- FST 504 Food Biotechnology
- FST 505 Food Microbiology
- FST 506 Food Microbiological Laboratory
- FST 507 Food Analysis
- FST 511 Food Law and Regulation
- FST 521 Food Process Engineering
- FST 524 Fundamentals of Food Science and Technology
- FST 531 HACCP Planning and Implementation
- FST 541 Principles of Food Packaging

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### Food Process Engineering (FPE)

#### Food Processing Specialist

12 credit hours

Students should refer to the Department of Chemical and Biological Engineering for additional details.

## Course Descriptions

Numbers in parentheses indicate class, lab and credit hours, respectively.

### FST 504

#### Food Biotechnology

Introduction of biotechnology in the food industry including genetic engineering of microorganisms. Fundamentals of microbial genomics and proteomics. Practice of a variety of software and bioinformatics tools including database search, sequence alignment, phylogenetic and cluster analyses, gene prediction, genomic map construction, structural and functional prediction of proteins. Applications of DNA fingerprinting techniques in food safety and public health. Prerequisite: Biology or Microbiology.

(3-0-3)

### FST 505

#### Food Microbiology

Microorganisms of importance to food safety, spoilage, and food fermentations. Principles of occurrence and control of microbiological contaminants, methods for detection, mechanisms of microbial inactivation, and importance of sanitation and prevention of public health problems. Prerequisites: Introductory Microbiology or Food Science.

(3-0-3)

### FST 506

#### Food Microbiology Laboratory

Basic microbiological techniques and safe laboratory practices. Introductory Food Microbiology, including isolation of pathogenic bacteria, spoilage microorganisms, sporeformers, fermentation, environmental monitoring and rapid identification methods. Prerequisites: Introductory Microbiology and Biochemistry.

(0-3-3)

### FST 507

#### Food Analysis

Techniques for analyzing food toxins, food constituents of public health concern, intentional and unintentional food additives, and modern separation and analytical techniques. Prerequisites: Chemistry or Analytic Chemistry.

(3-0-3)

### FST 511

#### Food Law and Regulation

Legal and scientific issues in regulating the nations food supply and nutritional status. Rules of regulatory agencies, Federal Food, Drug and Cosmetic Act, and definitions and standards for food and adulterated foods. Manufacturing processed foods in compliance with regulations.

(3-0-3)

### FST 521

#### Food Process Engineering

Food engineering fundamentals, heat transfer in food processing, food rheology, freezing of foods, food dehydration, kinetics of chemical reactions in foods, refrigeration and thermal process calculations, alternative methods of food processing.

(3-0-3)

### FST 522

#### Advanced Food Process Engineering

Process calculations for food processing methods such as canning, aseptic processing, ohmic heating, microwave processing and pulsed energy processing. Extrusion techniques in food processing, and discussions of new food processing techniques and safety implications. Prerequisite: FST/FPE 521.

(3-0-3)

### FST 524

#### Fundamentals of Food Science and Technology

The science and chemistry of food as related to storage and processing of major food commodities including meats and poultry, seafood, fruits and vegetables, cereal grains and baked goods, eggs, dairy, and confectionaries. The effects of food-related unit operations such as drying, freezing, sterilization and radiation treatment on chemical and physical properties of food. An introduction to the global control of food quality and safety is also covered.

(3-0-3)

### FST 531

#### HACCP Planning and Implementation

An introduction to good manufacturing practices (GMP) and other prerequisite programs, examination of the hazard analysis and critical control point (HACCP) concept, including an introduction to HACCP-regulated industries in the U.S. and international HACCP requirements, development and implementation of HACCP programs, generic HACCP modules, and hands-on development of individual and team HACCP plans.

(3-0-3)

### FST 541

#### Principles of Food Packaging

Type and application of packaging materials. Migration theories and food package interaction, package testing to ensure safety, and recycling of packaging materials.

(3-0-3)

### FST 591

#### Research and Thesis

Students conduct research on a particular topic and write a thesis. Students are also required to write manuscripts from thesis work for publication. Prerequisite: consent of instructor.

(Credit: Variable (6-8 hours))

### FST 593

#### Seminar on Food Safety and Technology

Students attend seminars offered during the semester. Each student is also required to give a 20 minute presentation on a topic of interest or a research project on which he/she has worked.

(Credit: 1 hour)

### FST 594

#### Special Projects

Advanced projects involving analysis of food safety processing, packaging and biotechnology systems. Please refer to program requirements for permitted credit hours. Prerequisite: NCFST advisor approval.

(Credit : 1-6 hours)

### FST 597

#### Special Problems

Independent study focusing on current problems, issues of professional relevance. Topics selected from food process engineering, food safety, packaging and biotechnology. Please refer to program requirements for permitted credit hours. Prerequisite: NCFST advisor approval.

(Credit : 1-6 hours)

## Undergraduate Courses Available to Graduate Students

With the approval of their NCFST advisors, students in the Food Process Engineering (FPE) graduate programs may apply up to 6 credits hours to their program from the following 400- level undergraduate courses.