# Advanced Heat and Mass Transfer in Food Processing Training Course

Professional Development Training Course Outline

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|---|---|---|---|
| **Category** | Food processing and Technology | **Duration** | 10 Days |
| **Base Fee** | $3,000 USD | **Delivery Mode** | Online / On-site Hybrid |

## Course Introduction

The food processing industry is constantly evolving, driven by innovations in engineering, sustainability, and consumer demand for high-quality, safe, and nutritious products. Advanced heat and mass transfer processes play a pivotal role in modern food manufacturing, ensuring efficiency, energy optimization, and product consistency. By mastering these principles, professionals can enhance process design, improve thermal efficiency, minimize waste, and develop sustainable food production systems that meet global standards. Advanced Heat and Mass Transfer in Food Processing Training Course provides in-depth knowledge of advanced heat and mass transfer mechanisms and their applications in food processing operations such as drying, freezing, evaporation, pasteurization, and novel thermal technologies.

Training Course emphasizes practical applications, research-driven insights, and real-world case studies. Participants will explore simulation techniques, computational modeling, and experimental methods used in food engineering, along with strategies for industrial scale-up. By integrating cutting-edge knowledge with process optimization tools, learners will be equipped to solve complex industry challenges, achieve compliance with food safety standards, and contribute to sustainable production practices in line with current market trends.

## Programme Curriculum

**Advanced Heat and Mass Transfer in Food Processing Training Course**

**Introduction**

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**Course Objectives**

1. To analyze the fundamentals of heat and mass transfer in food systems
2. To apply advanced thermodynamics in food process engineering
3. To enhance energy efficiency in food manufacturing operations
4. To explore drying, freezing, and thermal processing techniques
5. To integrate computational fluid dynamics (CFD) in food process design
6. To evaluate transport phenomena in multiphase food systems
7. To study membrane-based separation and evaporation techniques
8. To optimize food preservation methods through mass transfer principles
9. To assess environmental and sustainability impacts in thermal processing
10. To understand novel thermal and non-thermal food technologies
11. To utilize simulation tools for process validation and scaling-up
12. To strengthen compliance with food safety and quality standards
13. To develop innovative solutions for process optimization and cost reduction

**Organizational Benefits**

- Improved food product quality and safety
- Enhanced operational efficiency and productivity
- Reduction in energy consumption and processing costs
- Competitive advantage through adoption of advanced technologies
- Strengthened compliance with international food safety standards
- Greater innovation in food product development
- Minimized environmental impact and sustainable production practices
- Access to state-of-the-art computational and modeling tools
- Increased workforce expertise in specialized food engineering domains
- Long-term cost savings through optimized heat and mass transfer processes

**Target Audiences**

1. Food process engineers
2. Research scientists in food technology
3. Quality assurance professionals
4. Production and operations managers
5. Food safety compliance officers
6. Energy and sustainability managers
7. Graduate students in food engineering

8. R&D professionals in food manufacturing

**Course Duration:** 10 days

**Course Modules**

**Module 1: Fundamentals of Heat Transfer in Food Systems**

- Conduction, convection, and radiation in food processing
- Heat exchangers and thermal equipment analysis
- Steady and unsteady state heat transfer models
- Applications in pasteurization and sterilization
- Energy efficiency challenges in food systems
- Case study: Heat exchanger optimization in dairy processing

**Module 2: Mass Transfer Principles in Food Engineering**

- Diffusion and osmosis mechanisms in food systems
- Mass transfer coefficients and correlations
- Concentration gradients and driving forces
- Applications in drying and fermentation
- Process control through mass transfer modeling
- Case study: Mass transfer in osmotic dehydration of fruits

**Module 3: Drying Technologies in Food Processing**

- Conventional hot air drying
- Freeze drying and spray drying techniques
- Fluidized bed drying and hybrid drying methods
- Kinetics of moisture removal in foods
- Quality impacts of drying on food texture and nutrients
- Case study: Freeze-drying applications in instant coffee production

**Module 4: Freezing and Refrigeration Systems**

- Freezing curves and phase change phenomena
- Ice crystallization and its impact on food quality
- Advanced freezing technologies (IQF, cryogenic freezing)
- Cold chain management and logistics
- Design of refrigeration equipment for food plants
- Case study: IQF freezing of seafood for export markets

**Module 5: Evaporation and Concentration Processes**

- Single and multiple effect evaporators
- Energy-saving evaporation techniques
- Film and flash evaporation in food industries
- Process integration and optimization
- Concentration effects on food stability
- Case study: Concentration of fruit juices in beverage plants

**Module 6: Membrane Separation Processes**

- Principles of ultrafiltration and reverse osmosis
- Membrane fouling and cleaning mechanisms
- Applications in dairy, beverages, and edible oils
- Hybrid membrane and thermal processes
- Advances in nanofiltration for food applications
- Case study: Reverse osmosis in whey protein concentration

**Module 7: Novel Thermal Food Processing Technologies**

- Ohmic heating and microwave processing
- Infrared and radiofrequency heating
- High-pressure thermal processing innovations
- Thermal inactivation of microorganisms
- Integration of novel heating systems in industry
- Case study: Microwave-assisted pasteurization in ready meals

**Module 8: Non-Thermal Emerging Technologies**

- Pulsed electric field (PEF) processing
- High-pressure processing (HPP) applications
- Ultrasound-assisted mass transfer in foods
- Cold plasma processing in microbial inactivation
- Role of non-thermal methods in sustainable processing
- Case study: PEF in juice preservation

**Module 9: Computational Fluid Dynamics (CFD) in Food Processing**

- Introduction to CFD models in food engineering
- Heat and mass transfer simulation in equipment design
- Numerical modeling for process optimization
- CFD for drying, mixing, and freezing applications
- Integration of CFD with experimental validation
- Case study: CFD modeling of airflow in a drying chamber

**Module 10: Transport Phenomena in Multiphase Food Systems**

- Heat and mass transfer in porous food structures
- Transport in emulsions, foams, and suspensions
- Phase transitions in multiphase systems
- Multiphase modeling approaches
- Applications in bakery and dairy systems
- Case study: Multiphase transport in bread baking

**Module 11: Energy Efficiency and Sustainability in Food Processing**

- Energy balance in thermal and mass transfer operations
- Sustainable energy integration in food plants
- Life cycle assessment of processing methods
- Renewable energy in food processing facilities
- Strategies for reducing carbon footprint
- Case study: Solar-assisted drying of tropical fruits

**Module 12: Process Control and Automation**

- Sensors for heat and mass transfer monitoring
- Process automation and control systems
- Advanced process analytical technologies (PAT)
- IoT applications in food manufacturing
- Smart manufacturing for process optimization
- Case study: Automation in dairy pasteurization

**Module 13: Food Safety and Quality Assurance**

- Thermal validation and microbial safety
- HACCP in thermal processing lines
- Quality assurance through heat and mass transfer monitoring
- Shelf-life prediction models
- Compliance with international regulations
- Case study: Pasteurization validation in beverage industry

**Module 14: Scale-up and Industrial Applications**

- Challenges in scaling laboratory processes
- Industrial pilot plant design
- Heat and mass transfer equipment scale-up strategies
- Process intensification in large-scale food systems
- Industrial integration and cost considerations
- Case study: Industrial-scale spray drying for milk powder

**Module 15: Future Trends in Heat and Mass Transfer Applications**

- Advances in simulation and modeling tools
- Integration of AI in food process engineering
- Smart sensors and digital twins in processing plants
- Sustainable thermal and non-thermal approaches
- Research-driven innovations and collaborations
- Case study: AI-based predictive modeling in food drying

**Training Methodology**

- Instructor-led interactive lectures
- Group discussions and peer learning sessions
- Real-world industry case studies and applications
- Simulation exercises and software-based demonstrations
- Practical problem-solving workshops and project work

**Register as a group from 3 participants for a Discount**

**Send us an email: info@fineskilltrainingcenter.org or call** *+254769199797*

***Certification***

*Upon successful completion of this training, participants will be issued with a globally- recognized certificate.*

***Tailor-Made Course***

*We also offer tailor-made courses based on your needs.*

**Key Notes**

**a.** The participant must be conversant with English.

**b.** Upon completion of training the participant will be issued with an Authorized Training Certificate

**c.** Course duration is flexible and the contents can be modified to fit any number of days.

**d.** The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

**e.** One-year post-training support Consultation and Coaching provided after the course.

**f.** Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

## Upcoming Scheduled Sessions

| Start Date | End Date | Location | Price |
|---|---|---|---|
| **23 Nov 2026** | 04 Dec 2026 | Online | $2,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $3,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $6,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $6,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $12,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $9,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $12,000 |
| **23 Nov 2026** | 04 Dec 2026 | Physical | $12,000 |

Ready to enroll or request a customized program? Book online or contact us:

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