

Syllabus for PhD (Food Science / Food Technology) - PART I Examination

G0 1 - Research Methodology

UNIT I Over of Research

Research and its types, Identifying and Defining Research Problem, Introduction to different Research Designs. Basic principles of experimental design, selection of experimental material, Essential Constituents of Literature Review. Basic Principles of Experimental design.

UNIT II Methods of Data Collection

Primary data and secondary data, methods of primary data collection, classification and summarization of data. Presentation of Data - Diagrams and Graphs.

UNIT III Sampling Methods

Sampling, Need for sampling, unit, population, sample, sampling error, sampling methods; Simple Random Sampling, Probability Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling and Multistage Sampling. Sample size, Standard Error.

UNIT IV: Instrumental Methods of Food Analysis

Use of Analytical Techniques in Food Science; Basics, Principles and Applications of UV – Vis Spectrophotometer, Gas Chromatography(GC), High Pressure Liquid Chromatography (HPLC), Atomic Absorption Spectroscopy (AAS), Fourier Transform Infrared Spectroscopy (FTIR), Differential Scanning Calorimetry (DSC) and Thermo Gravimetric Analysis (TGA).

UNIT V: Statistical Analysis of Experimental Data

Normal Distribution; Measures of Central Tendency (Mean, Mode Median); Measures of Central Dispersion (Range, Standard Deviation, Standard Error, Coefficient of Variation); Tests of Significance – ‘t’ Test (One Sample and Two Sample Tests), Testing of Hypothesis; Analysis of Variation (ANOVA), Correlation Analysis.

References:

1. Kothari C.R., (1985) Research Methodology Methods and Techniques by New Age International Publishers, 2nd Edition.

2. Chap T. Le., (2003).Introductory Biostatistics. A John Wiley & Sons Publication.
3. Douglas C. Montgomery., (2001).Design and Analysis of experiments, Fifth Edition, John wiley & sons, INC.
4. S.S.Nielsen, (1998). Introduction to Food Analysis. Aspen Publishers-The Best General overview of Food Analysis Techniques Currently Available.
5. Y.Pomeranz and C.E. Meloan. Food Analysis: Theory and Practice. Chapman and Hall-General overview of Food Analysis Techniques.
6. D.W.Gruenwedel and J.R. Whitaker. Food Analysis: Principles and Techniques. Marcel Dekker-General Overview of Food Analysis Techniques.
7. C.S.James. Analytical Chemistry of Foods. Blackie Academic and Professional - General Overview of Food Analysis Techniques.

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G02 Trends in Food Science

UNIT I: Microbiology of Food:

History of microbiology of food. Types of micro-organism normally associated with food-mold, yeast, and bacteria, Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms.

Micro-organisms in natural food products and their control. Biochemical changes caused by micro-organisms, deterioration and spoilage of various types of food products, microbial food fermentation

Food poisoning and microbial toxins, standards for different foods. Food borne intoxicants and mycotoxins.

UNIT II: Food Chemistry:

Food chemistry-definition and importance, Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods. Protein and amino acids: structure, classifications, sources, denaturation and functional properties of proteins. Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties. Vitamins and Minerals, Effect of processing on vitamins and minerals. Enzymatic browning in foods and industrial applications of enzymes. Water in food, water activity and shelf life of food.

UNIT III: Principles of Food Processing and Preservation:

Principles of Preservation methods. Dehydration: Terminology, novel evaporation / dehydration techniques, spray drying. Vacuum drying- osmotic dehydration - efficient drying systems, infrared heating Freezing of foods, freeze concentration and drying, methods of freeze concentration. High Temperature operations, sterilization and pasteurization, Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of microorganisms, lethality function, thermal process calculation. Hurdle Technology: Principles and basic aspects of hurdle technology, different hurdles, and hurdle effect, application of hurdle technology

UNIT IV: Food Packaging:

Introduction to packaging. Packaging operation, package-functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods for prevention, shelf life of packaged foodstuff, methods to extend Shelf-life. Food containers-rigid containers, Flexible packaging materials and their properties.

Special problems in packaging of food stuff, consideration in the packaging of perishables and processed foods. Evaluation of packaging, and package performance, packaging equipment, package standards and regulation, bar coding material.

Shrink packaging. Aseptic and retortable pouches. Flexible and laminated pouches, Biodegradable packaging. Active packaging. Modified Atmosphere Packaging

UNIT V: Food Quality and Food Laws

Objectives, Importance and functions of quality control. Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products. Sanitation and hygiene - HACCP - Integrated Food Laws

Reference:

1. William C Frazier & Dennis C Westhoff (2008). Food Microbiology Fourth Edition, Tata McGraw-Hill Education Publication.
2. Bibek Ray., (2003) Fundamental Food Microbiology, 3rd edition. CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.
3. Owen R. Fennema., (2007) Food Chemistry, Fourth Edition by CRC Press - 1,160 Pages Editors Srinivasan Damodaran, *University of Wisconsin-Madison, USA*; Kirk L. Parkin.
4. Norman w. Desrosier, James N. Desrosier. (1987). The Technology of Food Preservation. Fourth Edition, CBS Publishers & Distributors-Delhi.
5. Richard Coles., (1998) Food Packaging Technology, Blackwell Publishing CRC Press.
6. Gordon L. Robertson., (2009) Food Packaging and Shelf Life. Publishing CRC Press.
7. Rees, J.A.G., Bettisan, J., & Cardan Blackie., (1991) Processing and Packaging of Heat Preserved Foods.
8. Gordon L. Robertson., (1991) Food Packaging-Principles & Practices.
9. Holdsworth, S.D., (1992) Thermal Processing & Packaged Foods, Blackie Academic & Professional Publication.
10. Donald Holds worth. & Ricardo Simpson., (2007) Thermal Processing of Packaged Foods, Second Edition, Springer Publication.

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G03 Special Paper* - Nonthermal Food Processing Technology

UNIT I: Microwave Processing

Microwave Processing: Microwave, properties, heating mechanism, difference between conventional and microwave heating, microwave oven, factors affecting the heating of food in microwave oven, applications of microwave in food processing, effect of microwave on food nutrient

UNIT II: Food Irradiation Technology

Food Irradiation Technology: General aspects of irradiation, ionizing radiation, irradiation process, units, mechanism, advantages and disadvantages of irradiation process, general purposes of irradiation process; inactivation of micro-organisms, inhibition of sprouting, delay of ripening and senescence and miscellaneous effects on food properties.

UNIT III: Ultrasound in Food Processing

Ultrasound in food processing and preservation: Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, heat transfer and homogenization and emulsification. Effect of sonication on microorganisms and enzymes. Thermosonication and its application in food processing.

UNIT IV: Pulsed Electric Field Processing (PEF) of Foods

Pulsed Electric Field Processing (PEF) of foods – Introduction, Fundamental aspects of microbial membrane electroporation, Microbial inactivation by Pulsed Electric Fields, Effect of Pulsed Electric Fields on enzymes and food constituents, Application of Pulsed Electric Fields Technology in Food Processing.

UNIT V: High Pressure Technique

High Pressure Technique: Principles, mechanism, applications of high pressure technique in food processing, effect of high pressure processing on microorganisms, enzymes and nutrients.

- Pertaining to the area of specialization chosen by the candidate under a Guide

References:

1. Barbosa-Canovas, G.V., & Gould, G.W. (2000). Innovation in Food Processing. Lancaster, UK: Technomic Publication.

2. Mason, T.J., & Lorimer, J.P. (2002). *Applied Sonochemistry. The uses of power ultrasound in chemistry and processing*. Weinheim, Germany: Wiley-VCH Verlag GmbH.
3. Shoh, A. (1988). *Industrial Applications of Ultrasound*. In K.S.Suslick (ED.), *Ultrasound, its chemical, physical and biological effects*. New York: VCH Publishers, Inc.
4. Tang, J., Hao, F., & Lau, M. (2004). *Microwave Heating in Food Processing*. World Scientific Publishing Co.pte.Ltd.
5. Barbosa-Canovas, G.V., Gongora-Nieto, M.M., Pothakamury, U.R., & Swanson, B.G. (1999). *Preservation of Foods with Pulsed Electric Fields*. London: Academic Press Ltd.
6. Vega-Mercado, H., Gongora-Nieto, M.M., Barbosa-Canovas, G.V., & Swanson, B.G. (1999). *Nonthermal Preservation of Liquid Foods using Pulsed Electric Fields*. In M.S. Rahman (Ed.).
7. Raso, J., & Heinz, V., (2006). *Pulsed Electric Fields Technology for the Food industry- Fundamentals and Applications*. Springer Publication.
8. Richardson, P., (2000) *Improving the Thermal Processing of Foods*, CRC Press Publication.