**Department of Food Science & Technology**

**University of Kashmir, Hazratbal Srinagar-190 006.**

***(NAAC Accredited Grade – A+)***

**Programme Objectives:**

* To enable the students to identify researchable issues in food and agro-processed industry.
* To formulate, monitor and undertake research projects independently
* To generate reproducible meaningful data and interpret the same in the form of scientific

The pre-Ph.D course work is part of integrated Ph.D programme in Food Technology. It comprises of three papers (courses) each having weightage of 100 marks. Paper I (Advance in Food Science) and Paper II (Research Methodology) are compulsory to all the students admitted to the programme. In addition to these two papers student have to take Paper III which is based on the area of research of the student.

**Paper I: Advances in the subject Marks: 100**

**UNIT I: Advances in Food Processing/ Emerging Technologies in Food Processing**

* Pulse Electric Field; Principle, Mechanism, Application of PEF.
* Mordern techniques in extraction of food components: Supercritical fluid extraction, Negative pressure cavitation extraction.
* Nano-Technology: Method of encapsulation, characterization of Nano particles (DLS, Zeta Potential), and its applications
* Terahertz spectroscopy: Principal and application

**UNIT II: Food Biotechnology**

* Recent applications of Probiotics in Food science
* Genetically modified foods (B.T Corn, B.T Brinjal, Flavr Savr, Golden Rice), their safety concerns.
* Use of nanobiosensors as nondestructive method of GMO foods.
* Emerging trends in aptamer based technique in food analysis.

**UNIT III Food Packaging**

* Edible and biodegradable films: Film ability of biomaterials, Mechanical strength, active functions, and trends in the use of edible films and coatings.
* Recent Advances in Food packaging with a focus on Nano Coating (chitosans, starch and PLA)
* Radio Frequency Identification tag; application in food technology.
* Emerging techniques in cold chain logistics

**UNIT IV: Advances in Food Safety & Quality**

* Non-destructive assessment of food quality: ultrasound as food processing and preservation technique and impact of food properties.
* RAPD: Random Amplified Polymorphic DNA (RAPD) assay
* Pulse light technology for microbiological safety

**Suggested Readings:**

1. Rehman, S. (2007). Handbook of Food Preservation. Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742.
2. Arya, P.P. and Pal , Y. (2001).Research Methodology in Management: Theory and Case
3. Chap T. Le., (2003).Introductory Biostatistics. A John Wiley & Sons Publication.
4. Aggarwal BL. 2003. *Basic Statistics*. New Age.
5. Introductory statistics by Prem S. Mann
6. Food Analysis by Pomernz.
7. The chemical Analysis of Food and Food Products by Jacobs.

**PAPER II: Research Methodology**  **Marks: 100**

**Unit I: Methods of Data Collection:**

* Primary data and secondary data, methods of primary data collection, classification and organization of data.

**Sampling Methods:**

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

**Normal Distribution:**

* Measures of Central Tendency (Mean, Median and Mode). Measures of dispersion (Range, Standard Deviation, Standard Error, Coefficient of Variation).

**UNIT II: Statistical Analysis of Experimental Data**

* Correlation Analysis: concept and significance Karl Pearson’s coefficient correlation.
* Regression analysis: Lines of regression and regression equation
* Analysis of Variation (ANOVA)
* Testing of Hypothesis; (Tests of significance, ‘t’ Test,)

**Unit III. Research Techniques in Food Technology**

* Principles and applications of atomic absorption spectroscopy- components of atomic absorption spectroscopy.
* X-ray analysis of foods – Properties, Production and Detection, X ray tubes, Detectors, Sources, Applications in food industry[[1]](#footnote-1).
* FTIR spectroscopy- Principles and application

**Unit IV**

* Differential scanning colorimetry.
* Nuclear Magnetic Resonance; principle and applications
* High pressure liquid Chromatography (HPLC) ; principle, instrumentation and applications
* Advances in Food Rheology and applications

**Suggested Readings:**

1. Kothari C.R., (1985) Research Methodology Methods and Techniques by New Age International Publishers, 2nd Edition.
2. Arya, P.P. and Pal , Y. (2001).Research Methodology in Management: Theory and Case
3. Chap T. Le., (2003).Introductory Biostatistics. A John Wiley & Sons Publication.
4. Aggarwal BL. 2003. *Basic Statistics*. New Age.
5. Introductory statistics by Prem S. Mann
6. Food Analysis by Pomernz.
7. The chemical Analysis of Food and Food Products by Jacobs.

**PAPER-III (Rice Science and Technology) for Numan Shafee Marks: 100**

**Unit I:** Introduction and General Overview

* Introduction to pesticide residues; Definition and historical background
* Current status of Pesticide residue prevalence in fruits and vegetables; National and International
* Types of pesticide residues; Chemical classes
* Mode of action for Pesticides on target organisms
* Regulation of Pesticide Residues in Food (Codex MRL and the world food code)
* Recommended methods of sampling for the determination of pesticide residues for compliance with MRLs
* Recent advances in pest control (chemosterilants and repellents)
* Green advance chemistry of pests (Bio efficacy of Neem as a pest control measure)

**Unit II:** Analysis of Pesticide Residue

* Methods of detection and estimation; Bio assay (ELISA)
* Spectroscopic Methods
* Chromatographic methods (HPLC)
* Electrochemical technique
* GC/MS Analysis
* Other quick Kit methods

**Unit III:** Pesticide Residue and Public health

* Introduction to Potential health hazards
* Acute and chronic toxicity by pesticide residue in fruits and vegetables(cancer, reproductive abnormalities ,asthma and diabetes)
* Specific Toxicity profile by various chemical classes of pesticides.
* Exposure assessment studies; Human health risk assessment

**Unit IV:** Effect of storage and processing

* Prolonged storage in pesticide reduction: mechanism of action
* Effect of various processing techniques on the pesticide reduction of fruits and vegetables.

**Suggested Readings:**

1. Fernandez-Alba, A. R., Nollet, L. M. (2017). Multiresidue Methods for the Analysis of Pesticide Residues in Food. United States: CRC Press.
2. Pesticide Residue in Foods: Sources, Management, and Control. (2017). Germany: Springer International Publishing.
3. Hikal, Wafaa & Baeshen, Rowida & Said-Al Ahl, Hussein. (2017). Botanical insecticide as simple extractives for pest control. Cogent Biology. 3. 10.1080/23312025.2017.1404274.
4. Kaushik, G., Satya, S. and Naik, S., 2009. Food processing a tool to pesticide residue dissipation – A review. *Food Research International*, 42(1), pp.26-40.

**PAPER-III (Bioactive Compounds) for Rubiya Rashid Marks: 100**

**Unit I:** **Introduction to bioactive compounds present in fruits and vegetables.**

* Classification of various bioactive compounds present in fruits and vegetables
* Health benefits of bioactives from fruits and vegetables.
* Potential uses of bioactives extracted from fruit vegetable waste in food.

**Unit II:** **Extraction techniques for bioactives from fruits and vegetables.**

* Maceration type of extraction :Principle and its application in food
* Ultrasound assisted extraction: Principle, mechanism and extraction method
* Microwave assisted extraction: Principle and its applications

**Unit III:** **Nanoencapsulation technique for bioactive compounds**

* Techniques for preparation of Nano delivery Systems (Nanoemulsification, Coacervation, Nano-precipitation, Nano-spray drying, Electrospinning and Electro spraying)
* Benefits of encapsulation technique in food.
* Various characterisation techniques for nanoparticles.

**Unit IV:** **Analytical techniques for bioactives characterisation.**

* High Pressure Liquid Chromatography: Principle, Types and applications
* Differential Scanning Calorimetry: Principle, Mechanism and applications
* FT-IR: Principle and mechanism of analysis and applications

**Suggested Readings:**

1. Yahia, E. M. (Ed.). (2017). *Fruit and Vegetable Phytochemicals: Chemistry and Human Health, 2 Volumes*. John Wiley & Sons.
2. Axelos, M. A., & Van de Voorde, M. (Eds.). (2017). *Nanotechnology in agriculture and food science*. John Wiley & Sons.
3. Pomeranz, Y. (Ed.). (2013). *Food analysis: theory and practice*. Springer Science & Business Media.
4. Paré, J. R. J., & Bélanger, J. M. (Eds.). (1997). *Instrumental methods in food analysis*. Elsevier.
5. Zhang, Q. W., Lin, L. G., & Ye, W. C. (2018). Techniques for extraction and isolation of natural products: a comprehensive review. *Chinese medicine*, *13*(1), 20.

**PAPER-III (Fats and Oils) for Shazia Marks: 100**

**Unit I: Introduction to Fats and Oils**

* Structure and composition of oils commonly consumed in india, Major and minor components of oils
* Fatty Acids, Classification of fatty acids and Isomerism of unsaturated fatty acids
* Transfatty acid : sources, alternatives and their negative impact on health, Regulation of transfats in India

**Unit II: Chemistry of Deep Frying**

* Chemical reactions of oil during deep-Fat Frying, hydrolysis of oil, oxidation of oil, polymerization of oil
* Factors affecting the quality of oil during deep-fat frying
* Nutritional quality changes of oil during frying
* Performance of different natural antioxidant compounds in frying oil.

**Unit III: Analysis of Oils**

* Frying and oxidative stability analysis of oils
* Gas chromatography, principle ,working and applications
* Fourier transformation –infra red spectroscopy, principle ,working and applications

**Unit IV: Interestrification**

* Methods of immobilization of enzymes ,Application of Immobilized Enzyme in the Food Industry
* Enzymatic intesterification of oils and application of interestrified fats
* Characterisation of interestrified fats/oils using NMR

**Suggested Readings:**

1. O'brien, R. D. (2008). *Fats and oils: formulating and processing for applications*. CRC press.
2. Choe, E., & Min, D. B. (2007). Chemistry of deep‐fat frying oils. *Journal of food science*, *72*(5), R77-R86.
3. Macrae, A. R. (1983). Lipase‐catalyzed interesterification of oils and fats. *Journal of the American Oil Chemists' Society*, *60*(2Part1), 291-294.
4. Pomeranz, Y. (Ed.). (2013). *Food analysis: theory and practice*. Springer Science & Business Media.
5. Yahia, E. M. (Ed.). (2017). *Fruit and Vegetable Phytochemicals: Chemistry and Human Health, 2 Volumes*. John Wiley & Sons.

**PAPER-III (Fruits and Vegetable Tech) for Gh. Geelani Raja Marks: 100**

**Unit I**

* Postharvest losses in fruits and vegetables- causes and methods of prevention.
* Chemical composition and nutaceutical potential of stone fruits.
* Maturity indices of fruits and vegetables with special reference to potential maturity indices of stone fruits.
* Changes during storage, Factors influencing storage-temperature, humidity, oxygen, carbon dioxide, ethylene.

**UNIT II**

* Morphological characteristics of fruits and its development, Fruit deterioration factors- water loss, chilling injury (CI) or internal breakdown (IB).
* Introduction to Novel Food preservation technique -Liposome microencapsulation technique. High-intensity light – Introduction, process and equipment, microbial inactivation; Sentinel Wraps: Real-Time Monitoring of Food Contamination during storage.
* Irradiation and sources of irradiation used in food preservation- Electron Beams, X-Ray Irradiation and Gama Irradiation.

**UNIT III**

* Introduction to enzymes, nomenclature of enzymes, specificity of enzymes.
* Factors affecting enzyme activity, Activation energy and the transition state theory.
* Law of mass action and order of reaction, The Henri and Michaelis-Menton equations.
* Enzymes in Fruit and vegetable processing- Pectinase, Lipooxygenase, Pectin methylesterase (PME), Polyphenol oxidase.

**Unit IV:**

* Stone fruit deterioration factors - water loss, chilling injury (CI) or internal breakdown (IB), degree of woolliness
* Post-harvest treatments to reduce deterioration in stone fruits - heat treatment, edible coatings, chemical treatments, gaseous treatments
* Fruit cooling methods in stone fruits - Room cooling, Hydro cooling, Forced-air cooling (pressure cooling), Serpentine forced-air cooling.
* Hypobaric Storage- Introduction, technology, effects of hypobaric storage.
* Hyperbaric storage- Introduction, technology, effects of hyperbaric storage.

**Suggested Readings:**

* 1. Agricultural and Food Biotechnologies of Olea europaea and Stone Fruit Innocenzo Muzzalupo and Sabrina Micali.
  2. Food Preservation Techniques P. Zeuthen and Leif Bogh-Sorensen.
  3. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Trevor Palmer and Philip L. Bonner.
  4. Enzymes in Food Technology Robert J Whitehurst, Maarten Van Oort.
  5. Controlled Atmosphere Storage of Fruits and Vegetables A. Keith Thompson.
  6. Novel Postharvest Treatments of Fresh produce Sunil Pareek

1. [↑](#footnote-ref-1)