

Shivaji University Kolhapur
Syllabus for PhD Coursework in Food Technology Engineering 2020-21
Paper I (Compulsory)
Research Methodology
(Common for Engineering/ Technology/ Pharmacy)

Teaching Scheme:

Theory: 4 Hrs/ Week

Examination Scheme:

Theory Examination: 100 Marks

Objectives:

- To get introduced to research philosophy and process in general
- To be able to formulate the problem statement and research plan for the problem under investigation
- To be able to apply various numerical/ quantitative techniques for data analysis
- To be able to communicate the research findings effectively

Unit I: Introduction

Concepts of Research, Meanings and Objectives of Research, Research process, Types of Research, Criteria of Good Research, Research Problem- Identifying and Defining, Research Proposals- Types, contents, Sponsoring agency's requirements, Ethical aspects, IPR issues like patenting, copyrights etc.

Unit II: Research design

Meaning, Need and Types of research design, Literature Survey and Review, Research Design Process, Measurement and scaling techniques, Data Collection- concepts, types and methods, Processing and analysis of data, Design of Experiments etc.

Unit III: Quantitative Techniques

Sampling fundamentals, testing of hypothesis using various tests like ANOVA, Chi square test, Multivariate analysis and applications of various statistical software's.

Unit IV: Computer Applications

Pre-writing considerations, Principles of Thesis Writing, Formats of Report Writing and Publication in Research Journals, Documentation and presentation tools- LATEX, Microsoft Office with basic presentations skills, Use of Internet and advanced search techniques.

Reference:

1. 'Management Research Methodology' by K.N. Krishnaswamy, Appa Iyer Sivakumar & M. Mathirajan, Person Education.
2. 'Research Methodology. G.C. Ramamurthy, Dream Tech Press, New Delhi
3. 'Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, 2nd Edition
4. 'Research Methodology: An Introduction for Science and Engineering Students', by Stuart Melville and Wayne Goddard
5. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville
6. 'Research Methodology: Methods and Techniques', by Dr. C.R. Kothari, New Age International Publisher

Paper II (Compulsory)

Recent Developments in Food Process Engineering

Teaching Scheme:

Theory: 4Hrs/ Week

Examination Scheme:

Theory Examination: 100 Marks

UNIT- I

Emerging food processing techniques in non-thermal processing: Membrane technology, High hydrostatic pressure (HHP) technique, Ultrasound, Ionizing radiation, Pulsed electric field (PEF) preservation technique, Hurdle technologies etc.

UNIT-II

Emerging technology in food processing and extraction: Active and Modified Atmosphere Packaging (MAP), Control Atmosphere Packaging (CAP). Supercritical fluid extraction (SCFE): Concept, property of Near Critical Fluids (NCF) and extraction methods (Cold extraction, Microwave assisted extraction), Application of SCFE in food processing.

UNIT-III

Extrusion cooking: recent developments, methods, equipments, design criteria of extruders, engineering aspects of single and twin screw extrusion cooking, applications of extrusion.

Recent trends in freezing systems: frozen food properties, freezing time calculations, slow and fast freezing methods. Refrigeration systems used in food processing and storage.

UNIT- IV

Novel evaporation/ dehydration techniques: Fluidized bed drying, freeze drying, rotary drying, and vacuum drying. Emerging food processing techniques in thermal processing: Dielectric, ohmic and infrared heating, Ultra high-temperature (UHT)/aseptic processes etc.

Reference:

1. Barbosa-Canovas 2002. Novel Food Processing Technologies. CRC.
2. Dutta AK & Anantheswaran RC.1999. Hand Book of Microwave Technology for Food Applications.
3. Earle, R. L. (2013). Unit operations in food processing. Elsevier.
4. Fellows, P. J. (2009). Food processing technology: principles and practice. Elsevier.
5. Frame ND. (Ed.). 1994. The Technology of Extrusion Cooking. Blackie. Gould GW. 2000. New Methods of Food Preservation. CRC.
6. Geankoplis, C. (1993). Transport Process and Unit Operations, PTR Prentice Hall. Inc.: Englewood Cliffs, NJ, 401.

7. Henderson S. M. and Perry R. L. Agricultural Process Engineering. Avi Publishing Co Inc.; 3rd Revised edition (1976)
8. Jowitt, R. (1984). Extrusion cooking technology.
9. McCabe, W. L., Smith, J. C., & Harriott, P. (1993). Unit operations of chemical engineering (Vol. 5, p. 154). New York: McGraw-hill.
10. Simpson, R. (2009). Engineering aspects of thermal food processing. CRC Press.
11. Singh, R. P., & Heldman, D. R. (2009). Introduction to food engineering. Academic Press
12. Toledo, R. T., Singh, R. K., & Kong, F. (2007). Fundamentals of food process engineering (Vol. 297). New York, NY: Springer.

Paper III (Elective I)

Advances in Food Analytical Techniques

Teaching Scheme:

Theory: 4hrs/ week

Examination Scheme:

Theory Examination: 80 Marks

Term Work: 20 Marks

Unit I

Gas liquid chromatography: principle; different types of detectors and its applications: discharge ionization detector (DID), electron capture detector (ECD), flame photometric detector (FPD), Hall electrolytic conductivity detector (ELCD), helium ionization detector (HID), Nitrogen phosphorous detector (NPD), mass selective detector (MSD), photo-ionization detector (PID), pulsed discharge ionization detector (PDD), various applications of GLC.

High performance liquid chromatography (HPLC): different types of HPLC and their principles; Normal phase chromatography, Reverse phase chromatography, Size exclusion chromatography, Ion exchange chromatography, Bioaffinity chromatography, various Applications of HPLC.

Unit II

Blanching adequacy, non enzymatic browning, Analysis of fats and oil (FFA, PV, RM value) Sensory evaluation: different scales, training, skills and importance for consumer acceptance. Quantification of sensory attributes, artificial tongue, Artificial Nose. Texture analysis, Differential Scanning Calorimetry(DSC), Scanning Electron Microscopy (SEM) and Rapid methods of thermal analysis.

Unit III

Differential scanning calorimetry: principles and its applications, Atomic absorption: principles and its applications.

Gas chromatography-mass spectrometry (GC-MS): principles and applications in foods; Liquid chromatography-mass spectrometry (LC-MS): principles and applications; Electrophoresis: Principles and different types, current tools used to assess the safety of food.

Unit IV: Application of modern techniques including spectroscopy, flame photometry, X-ray analysis of foods, Mass spectroscopy, Infrared (IR), Nuclear magnetic resonance (NMR) and

Refractometry. Enzymes in food analysis. Supercritical fluid extraction in food analysis. Rapid methods for detection of food pathogens, biosensors, automation and use of computers in food analysis.

Reference:

1. Doyle, M. P., & Buchanan, R. L. (Eds.). (2012). *Food microbiology: fundamentals and frontiers*. American Society for Microbiology Press.
2. Grob, R. L., & Barry, E. F. (Eds.). (1977). *Modern practice of gas chromatography* (Vol. 2). New York: Wiley.
3. Lawrence Jack Bradshaw, *Introduction to Molecular Biological Techniques*, Prentice-Hall, 1966
4. Niessen, W. M. (2006). *Liquid chromatography-mass spectrometry*. CRC press.
5. Rouessac, F., & Rouessac, A. (2013). *Chemical analysis: modern instrumentation methods and techniques*. John Wiley & Sons.
6. Singh, U. S., & Singh, R. P. (2017). *Molecular methods in plant pathology*. CRC Press.
7. Tagu, D. (2006). *Techniques for molecular biology*. Science Publishers.
8. Watson, J. D. (2012). *The polymerase chain reaction*. Springer Science & Business Media.
9. Welz, B., & Sperling, M. (2008). *Atomic absorption spectrometry*. John Wiley & Sons.

Paper III (Elective II)

Recent Trends in Nutraceuticals and Functional Foods

Teaching Scheme:

Theory: 4hrs/ week

Examination Scheme:

Theory Examination: 80 Marks

Term Work: 20 Marks

Unit I

Introduction to Nutraceutical and Functional Foods

Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, functional foods and phytonutraceuticals. Scope involved in the industry, Indian and global scenario.

Unit II

Concept, Biochemistry of nutrition and dietetics

Classification of food components based on nutritional value, nutritional assessment of carbohydrates, proteins and fats, recommended dietary intake, acceptable dietary intake, nitrogen balance, protein efficiency ratio, net protein utilisation. Basics of energy balance - Basal Metabolic Rate (BMR), Body Mass Index (BMI) and Standard Dynamic Action (SDA) with special reference to nutraceutical industry.

Unit III

Nutrition related diseases and disorders

Carbohydrates, Protein, amino acids, Fat, vitamins and minerals - Excess and deficiency, symptoms, prevention and management, Role of nutraceuticals with special reference to diabetes mellitus, hypertension, hypercholesterolemia, cancer, glands in the prevention and treatment, Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation.

Unit IV

Measurement of functional component and their bioavailability

Need for measurement, safety quality assurance and cost — bioavailability: definition, factor affecting, chemical measurement and physical testing and microbiological testing- functional foods and vitro studies.

References:

1. Goldberg, I. (2012). *Functional foods: designer foods, pharmafoods, nutraceuticals*. Springer Science & Business Media.

2. Klaenhammer, T. R. (2007). Probiotics and prebiotics. In *Food Microbiology: Fundamentals and Frontiers, Third Edition* (pp. 891-907). American Society of Microbiology.
3. Lockwood, B. (2007). *Nutraceuticals: a guide for healthcare professionals*. Pharmaceutical Press.
4. Maffei, M. (Ed.). (2003). *Dietary supplements of plant origin: a nutrition and health approach*. CRC Press.
5. Mazza, G. (Ed.). (1998). *Functional foods: biochemical and processing aspects* (Vol. 1). CRC Press.
6. Neeser, J. R., & Bruce German, J. (2004). *Bioprocesses and biotechnology for functional foods and nutraceuticals*. Marcel Dekker.
7. Tracy, Timothy S., Kingston, Richard L. (Eds.) . (2007) *Herbal Products Toxicology and Clinical Pharmacology*
8. Wildman, R. E. (2016). *Handbook of nutraceuticals and functional foods*. CRC press.
9. Young, J. (1996). *Functional foods: strategies for successful product development*. Financial Times Retail & Consumer Pub..