



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Agriculture and Veterinary Science Department of Food and Biotechnology

SYLLABUS

**MASTER OF SCIENCE -FOOD SCIENCE & TECHNOLOGY
(M. Sc. FST)**

SESSION – 2022-23

DURATION – 2 YEARS (IV SEMESTER)

**SYLLABUS FOR:
I-IV SEMESTER**



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

PROGRAM DETAIL

Name of Program	-	Master of Science (M. Sc.)
Program Code	-	M. Sc. FST
Mode of Program	-	Semester
Duration of Program	-	2yrs/ 4Semester
Total Credits of Program	-	95
Curriculum Type and Medium Choice	-	English

Program Outcomes Students will be able to gain knowledge of Food Microbiology, Food Analysis, Food Safety, Post Harvest Technology of Fruits, Vegetables and Plantation Crops, Nutrition. Students also Understand the properties and reactions of Food Chemistry, Cereal Science & Technology; all the basics of Food Additives. Students will also learn about New Food Product Development, Novel Food Packaging and Food Processing and Preservation.

Specific Program Outcomes Student will Understand the composition of food, the role of each component and their interaction, their roles in food processing. Student will be able to describe the importance of microbiology to food production and food safety. Students will be able to identify the instruments required for processing by understanding principles followed by preservation techniques. Student will also able to think and prepare new food product development through innovations.



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I SEMESTER

S. No.	Credit	Name of Course
1	3	Statistical Methods
2	1	Statistical Methods Lab
3	2	Food Microbiology
4	1	Food Microbiology Lab
5	3	Advances in Food Analysis
6	1	Advances in Food Analysis Lab
7	3	Food Safety & Quality Assurance
8	1	Food Safety & Quality Assurance Lab
9	4	Advances in Post Harvest Technology of Fruits , Vegetables and Plantation Crops
10	1	Advances in Post Harvest Technology of Fruits, Vegetables and Plantation Crops Lab
11	4	Food Nutrition
Total	24	

II SEMESTER

S. No.	Credit	Name of Course
1	3	Food Chemistry
2	1	Food Chemistry Lab
3	3	Advances in Cereal Science & Technology
4	1	Advances in Cereal Science & Technology Lab
5	3	Food Additives and Contaminants
6	1	Food Additives and Contaminants Lab
7	1	New Food Product Development
8	1	New Food Product Development Lab
9	3	Novel Food Packaging
10	1	Novel Food Packaging Lab
11	3	Food Processing and Preservation
13	1	Industrial Visit
Total	22	



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III SEMESTER

S. No.	Credit	Name of Course
1	3	Advanced Milk And Milk Products Technology
2	1	Advanced Milk And Milk Products Technology Lab
3	3	Food Process Engineering
4	1	Food Process Engineering Lab
5	3	Food Plant Layout and Management
6	4	Advanced Meat, Fish, Poultry and Egg Technology
7	4	Research Methodology
8	4	Nutraceuticals and Functional Foods
9	2	Pre Dissertation Training (60 Days) (After II Sem during summer vacation)
Total	25	

VI SEMESTER

S. No.	Credit	Name of Course
1	25	Dissertation/ Project-New Product Development (NPD)
Total	25	



I Semester

Course Name: Statistical Methods

Total- 4 (3T+1P)

Courses Outcome- The objective of this course is to (1) Describe the basic concepts and principles of statistics. (2) Understand the role of statistics and computer applications to conduct research studies. (3) Apply statistical techniques to research data for analyzing. (4) Interpreting the data meaningfully and differentiate between the qualitative and quantitative methods of analysis of data. (5) Suitably apply data reduction strategies and illustrate data using various graphical methods. (6) Use appropriate parametric and non-parametric statistical tests. (7) Draw the conclusions and interpretations from the analysis of data using various statistical softwares.

UNIT I (Basics of Tabulation of Data & Central Tendency)

Theory (1 Credits)

Classification and tabulation of data, Frequency distribution, Histogram, Frequency polygon and frequency curve, cumulative frequency curves, Measures of central tendency: mean, median, mode; Measures of dispersion: range, mean deviation, variance and standard deviation.

Practicals: (1 credits)

Sr. no.	Name of practical	Nature
1	To find out Mean	Practical/Practice
2	To find out Median	Practical/Practice
3	To find out Mode	Practical/Practice

UNIT II (Probability, Correlation, Regression & Sampling)

Theory (1.0 Credits)

Elementary Probability Distribution, Correlation: Positive and negative correlation and calculation of Karl Pearson's coefficient of correlation. Regression, Sampling: concept of population and sample, Sampling distribution and standard error.

UNIT III (Vital Statistics & ANOVA)

Theory (1.0 Credits)

Hypotheses testing: null and alternative hypothesis, T-test, Chi-square test, goodness of fit test and homogeneity of samples, F-test. ANOVA: one way and two way analysis of variance, Design of experiments. Use of statistical packages for data analysis (SPSS).

Text Books:

1. Elements of Mathematical Statistics; S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi
2. Elements of Biostatistics; S. Prasad; Rastogi Publications, Meerut

Suggested Readings:

1. Basic Statistics:-B.L.Agarwal
2. Principles and Procedure of Statistics:-A Biometrical Approach:-R.G.D. Steel and J.H.torrie



3. Fundamentals of Applied Statistics, S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi.

References/Correlation with Ancient Indian Literature:

1. Sankhyā: The Indian Journal of Statistics Published by: Indian Statistical Institute <https://www.springer.com/statistics/journal/13171>
2. The Sulba Sutras http://www-history.mcs.st-and.ac.uk/Projects/Pearce/Chapters/Ch4_2.html
3. History of Hindu Mathematics, Asia Publishing House, Bombay, 1962 <https://link.springer.com/article/10.1007/BF02836134>

Food Microbiology

3(2T+1P)

Courses Outcome- The objective of this course is (1) To know the important genera of microorganisms associated with food and their characteristics. (2) To comprehend the role of the microorganisms in spoilage of foods and methods of their control.

Unit – I Theory(1)

General characteristics of microorganisms: Classification and identification of yeasts, molds and groups of bacteria important in food industry.

Source of contamination: Air, water, soil, sewage, post processing contamination. Intrinsic and extrinsic factors influencing growth of microorganisms in foods.

Classification of foods and general principles involved in their preservation:

Effects on Microbes: Low temperature preservation, lethal effects of chilling, freezing and thawing

; high temperature preservation. Heat resistance of microorganisms, heat penetration and thermal processing. Pasteurization, sterilization, canning and dehydration; chemical preservation and its toxic effects, irradiations.

Practical (0.5)



Unit – II Theory (0.5)

Food Fermentation: Bacterial, yeast and mold cultures; single and mixed cultures, propagation, maintenance and evaluation of cultures; factors effecting activity of cultures, bacteriophages, residual antibiotics and chemicals.

Microbiology of Fermentation: Fermented milks. Cereal foods, vinegar, oriental foods, alcoholic beverages. Therapeutic value of fermented foods. Technology of Alcoholic beverages

Food Spoilage: Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins.

Practical (0.5)

Practical
Detection of pathogen/ toxins and antibiotic
Dye reduction Test & MBRT.
Determination of thermal resistance of enzymes and microorganisms.

Unit –III Theory (0.5)

Pathogens in foods: Microbial infections and intoxications, Growth and survival of pathogens in food.

Food borne diseases: Investigations and control. Role of Biotechnology in Food Microbiology. Role of Oligosaccharide in Food Microbiology Probiotics and Prebiotics.

Recommended Books: 1. James M.J. (2000) Modern Food Microbiology, 5th edition, CBS Publishers.

Reference Books:1. Adams M. R. & Moss, M.O (1995) Food Microbiology, New age International Pvt. Ltd Publishers.

Practical
Determination of microbial counts: Total viable, Psychrotrophic, Thermophilic, Thermoduric, Proteolytic lipolytic Aerobic & Anaerobic spore farmers, Coliform counts, Yeast and mold count.



ADVANCES IN FOOD ANALYSIS

4(3T+1P)

Courses Outcome- The objective of this course is (1) To develop an understanding and methodologies of instrumental techniques in food analysis. (2) To understand the mechanisms and principle behind various analytical techniques.

UNIT-I (Overview of Spectroscopy & Chromatography)

(Theory 1)

Spectroscopy: UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometry, Fluorescence spectroscopy, Emission spectroscopy, Mass-spectroscopy, Fourier Transform Infra-Red.

Methods of separation and analysis of biochemical compounds and macromolecules: Principles and applications of Gas Chromatography, High Performance Liquid Chromatography, Thin layer chromatography.

(Practicals 0.5)

S.No.	Practicals
1	Determination of titratable acidity in foods using a potentiometric titration
2	Diastatic activity of honey, determination of hydroxymethylfurfural in honey
3	UV-Visible Spectro-photometric analysis of a carotenoid

UNIT-II (Overview of instrumentation)

(Theory 1)

Microscopic techniques: Light microscopy, Scanning electron microscopy, Transmission electron microscopy, particle size analysis, Thermal techniques in food analysis: Differential scanning calorimetry and Thermo gravimetric analysis.

(Practicals 0.25)

S.No.	Practicals
1	thin layer chromatography (TLC) of food colors,
2	Microstructural and partical size analysis of starch
=3	Determination of thermal properties of food samples

UNIT-III (2-0.5) (Molecular Analysis)

(Theory 1)

Electrophoresis: Different kinds of electrophoresis, western blotting, gel documentation, DNA analysis: DNA purification, PCR-based analysis, DNA fingerprinting.

(Practicals 0.25)

S.No.	Practicals
1	Extraction of different types of proteins and identification using electrophoresis
2	DNA Extraction of Plant Tissue

Recommended text books:

1. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier
2. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* (3 ed.): CBS Publications, New Delhi

Reference Books

1. Winton, A. L. (2001). *Techniques of Food Analysis*: Agrobios, Jodhpur.



2. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
3. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
4. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons

FOOD SAFETY AND QUALITY ASSURANCE

4(3T+1P)

Courses Outcome- The objective of this course is to (1) Understand various areas of Food Safety & Quality Assurance. (2) Grasp knowledge of the quality assessments of food products.

UNIT-I (Food Quality Management)

(Theory 1)

Sampling, specification, labeling, safety and quality assessment of fruits and vegetable, cereals, dairy products, meat, fish, poultry and processed food products, Sensory evaluation: Introduction, panel screening, selection methods, interaction and thresholds

Developments, objective and functions of food safety and quality assurance, Quality enhancement models, Statistical Quality Control for food industry, Food Quality Management Systems, implementation of quality control programmes, Quality control tools, Quality control charts for food plant sanitation, Food Safety Management Systems, Causes of failure of Food Safety Programs

(Practical 0.5)

S.No.	Practicals
1	Measurement of the water activity (aw) of raw and cooked food using AWmeter
2	Assessing the texture of raw and cooked food using penetrometer
3	Extraction of pigments from various fruits and vegetables and influence of heating time and pH
4	Performance of the sensitivity tests for four basic tests (Sweet, salty, sour and bitter)
5	Identification and ranking of food product attributes using Sensory evaluation scales (Hedonic rating, Ranking difference, Triangle test)

UNIT-II (Indian Food Law & Regulations)

(Theory 1)

Indian food laws and regulations, Food safety acts, Regulations for waste disposals, Codex alimentarius, ISO series, World Trade Organization, Food and Agricultural Organization, World Health Organization, Food safety and legislation in USA and Europe, Technical Barriers in Trade, Enforcers of food laws approval process for food additives, additives food labeling, Intellectual Property Right, HACCP and its application.

(Practical 0.25)

S.No.	Practicals
1	Sensory evaluation of milk and detection of flavor defects in milk
2	Qualitative tests for fats and oils, spices and condiments
3	Determination of thermal properties of food samples



UNIT-III (Food Adulteration)

(Theory 1)

Food adulteration: Types of adulterants, Common adulterants for foods like milk and milk products, honey, wheat flours, edible oils, cereals, condiments (whole and ground) pulses, coffee, tea, confectionery, baking powder, non-alcoholic beverages, vinegar, besan and curry powder

(Practical 0.25)

S.No.	Practicals
1	Detection of adulteration in food products viz. honey, other sweetening agents, spices (whole and powder)
2	Detection of adulteration in food products viz. pulses, oils, cereals, sweets, tea, coffee

Recommended text books:

1. Lawless, H. T. and Heymann, H. (2013). *Sensory Evaluation of Food: Principles and Practices*: Springer, New Delhi.
2. Shapton, D. A. and Shapton, N. F. (1993). *Principles and Practice for the Safe Processing of Foods*: Heinemann, Oxford.

Reference Books

1. Schmidt, R. H. and Rodrick, G. E. (2003). *Food Safety Handbook*: John Wiley, New Jersey.
2. Rees, N. and Watson, D. (2000). *International Standards for Food Safety*: Aspen, America.
3. Anjaneyulu, Y. and Marayya, R. (2009). *Quality Assurance and Quality Management in Pharmaceutical Industry*: Pharma, Hyderabad.
4. Ho, S. K. M. (1999). *Operations and Quality Management*: ITP, London.

ADVANCES IN POST-HARVEST TECHNOLOGY OF FRUITS, VEGETABLES AND PLANTATION CROPS

5(4T+1P)

Courses Outcome- The objective of this course is to (1) Gain knowledge on different pre-processing operations involved before processing of fruits and vegetables. (2) Develop an understanding on various post-harvest disorders and diseases of fruits, minimising the losses by suitable packaging and minimal processing operations.

UNIT-I (Production & Assessment of Fruit Quality)

(Theory 1)

Fruit and vegetable production, classification, structure and composition; Importance and scope of post-harvest management of fruits and vegetables in Indian economy, Pre-harvest factors affecting post-harvest quality, post-harvest losses, Maturity indices and standards for selected fruits and vegetables, instrumental methods of maturity determination, standards and specifications for fresh fruits and vegetable, Assessment of Fruit Quality, advances in non-destructive quality measurement of fruits and vegetables.

(Practical 0.25)

S.No.	Practicals
1	Studies on morphological features of some selected fruits and vegetables, maturity indices and quality evaluation of fresh fruits
2	Effects of pre-cooling and types of storage on quality of fruits and vegetables
3	studies on use of chemicals for ripening and Studies of regulations of ripening of banana, mango, papaya



UNIT-II (Advanced Harvesting & Post Harvesting Operations)

(Theory 1)

Advanced harvesting tools and their design aspects, advances in Post-Harvest Handling operations; Cleaning, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Sorting and grading: Sorting, grading, methods of grading, Size grading, color grading, specific gravity grading, screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance, Separation: Magnetic separator, de stoners, electrostatic separators, pneumatic separators.

(Practical 0.25)

S.No.	Practicals
1	Effects of pre-processing treatments on shelf-life of fruit, edible coating, preparation of fruit juice concentrate powders and their quality evaluation
2	estimation of browning and various pigments in pulp and products
3	estimation of chemical additives in processed fruit products

UNIT-III (Effects of Post Harvesting on Fruits & Vegetables)

(Theory 1)

Post-harvest physiological and biochemical changes in fruits and vegetables; ripening of climacteric and non-climacteric fruits; changes during ripening; Role of ethylene in fruit ripening, ripening chambers, Field heat of fruits and vegetables and primary processing operations Post harvest treatments, advances in pre-cooling, equipment Commodity pretreatments-chemicals, types of coating, pre-packaging, irradiation, blanching, peeling and other pre-processing operations; transportation and storage operations, Mechanism and Advances in CA and MA, hypobaric storage, cold storage design, Zero energy cool chamber

Post-harvest disorders chilling injury and diseases, Biological, Physical and Chemical Control of postharvest Diseases, advances in drying and packaging of fruits and vegetables, cushioning materials used in packaging of fresh fruits, Minimal processing.

(Practical 0.25)

S.No.	Practicals
1	dehydration of fruits and measurements of dehydration and rehydration ratio
2	Rehydration of Fruits and Vegetables

UNIT IV (Post Harvest Technology of Ornamental Crops):

Processing and properties of major and minor spices, essential oils & oleoresins, adulteration. Processing of Tea, Coffee and Cocoa, Variety and Products.

(Practical 0.25)

S.No.	Practicals
1	Adulteration Determination in Spices
2	Adulteration Determination in Tea and Coffee

Recommended text books:

1. Haard, N.F. and Salunkhe, D.K. (1975). *Postharvest Biology and Handling of Fruits and Vegetable*: AVI, Westport.



2. Kader, A. A. (1992). *Post-harvest Technology of Horticultural Crops*, (2ed.): University of California, Division of Agriculture and National Resources, California.

Reference Books

3. Salunkhe, D.K. and Kadam, S.S. (2005). *Handbook of Fruit Science and technology, Production, Composition, Storage, and Processing*: Marcel Dekker, USA.

4. Thompson, A.K. 1995. *Post-Harvest Technology of Fruits and Vegetables*: Blackwell publication.

5. Wills-Ron B.H. and Golding, J.B. (2015). *Advances in Postharvest Fruit and Vegetable Technology*: Taylor and Francis, CRC Press.

6. Siddiqui, M. W., (2015). *Post-Harvest Biology and Technology of Horticultural Crops: Principles and Practices for Quality Maintenance*: Apple Academic Press Inc.

Course Name: Food Nutrition:

Total-4

Courses Outcome- The objective of this course is to (1) Better understanding on the physiological and metabolic functions of nutrients. (2) Gain in-depth knowledge of the physiological and metabolic role of macronutrients, and their importance in human nutrition.

UNIT - I (Human Nutritional Requirements & Body composition)

Theory (2 Credits)

Human Nutritional Requirements – Development and Recent Concepts: Methods of determining human nutrient needs, Description of basic terms and concepts in relation to human nutritional requirements, Guidelines and Recommendations. Development of International and National Nutritional Requirements, Translation of nutritional requirements into Dietary Guidelines.

Body Composition: Significance of body composition and changes through the life cycle. Methods for assessing body composition (both classical and recent) and their applications.

Energy: Components of energy requirements: BMR, RMR, thermic effect of feeding, physical activity. Factors affecting energy requirements, methods of measuring energy expenditure. Estimating energy requirements of individuals and groups. Regulation of energy metabolism and body weight: Control of food intake – role of leptin and other hormones.

UNIT - II (Carbohydrates & Proteins)

Theory (1)

Carbohydrates

Review of nutritional significance of carbohydrates and changing trends in dietary intake of different types of carbohydrates and their implications. Dietary fibre: Types, sources, role and mechanism of action. Resistant starch, fructo-oligosaccharides, other oligosaccharides: Chemical composition and physiological significance. Glycemic Index and glycemic load.



Proteins

Overview of role of muscle, liver and G.I tract in protein metabolism. Amino acid and peptide transporters. Therapeutic applications of specific amino acids. Peptides of physiological significance. Proteins, amino acids and gene expression

UNIT - III (Lipids & Special condition Nutrition)

Theory (1)

Lipids

Nutritional significance of fatty acids – SFA, MUFA, PUFA: functions and deficiency, Role of n-3 and n-6 fatty acids, Prostaglandins, Trans Fatty Acids, Conjugated linoleic acid, Nutritional Requirements and dietary guidelines (International and National) for visible and invisible fats in diets. Lipids and gene expression

Nutrition in Special Conditions: Space, Travel, High Altitudes, Low Temperature, Submarines

Recommended Text Books:

1. Srilakshmi B (2006), Nutrition Science, New Age International
2. Swaminathan MS (1985), Essentials of Food & Nutrition, Bangalore Print & Publication Company
3. Mudambi SR (2001). Fundamentals of Food & Nutrition New Age International

Reference Books:

Committee on Military Nutrition. Nutritional Needs in Cold and High-Altitude Environments, National Academies Press.

Fink HH, Lisa A. Burgoon AE. Mikesky. Practical Applications in Sports Nutrition

References/Correlation with Ancient Indian Literature:

1. Prasna Upanishad 1-5 <https://esamskriti.com/Prasnopanishad-TNS-Complete.pdf>
2. Brihadaranyaka Upanishad (V.12) <https://www.swami-krishnananda.org/brdup-audio.html>
3. Chhandogya Upanishad (VII. 26) http://sivanandaonline.org/public_html/?cmd=displaysection§ion_id=588

II Semester

Food Chemistry

Courses Outcome-The objective of this course is (1) To understand the chemistry of foods - composition of food, role of each component and their interaction. (2) To understand the general chemical structures of the major components of foods (water, proteins, carbohydrates, and lipids).

Unit – I (Theory 1)



Carbohydrates: Classification, structure and properties of carbohydrates. Role of carbohydrates in food industry. Sugar, starch, cellulose, glucans, hemicelluloses, gums, peptic substances, polysaccharides. Modified starch.

Lipids: Classification and physico-chemical properties of food lipids. Refining of crude oils, hydrogenation and winterization. Vegetable and animal fat, margarine, lard, butters. Frying and shortening. Flavor changes in fats and oils, lipid oxidation, factors affecting lipid oxidation.

Practical 0.5

Preparation of Reagents (Standard Solutions).
Determination of moisture,
Determination of protein,
Determination of fat,
Determination of total ash,
Determination of crude fiber and
Determination of carbohydrate.
Determination of minerals.
Estimation of reducing, non-reducing, total sugars
Estimation of starch.

Unit – II(Theory 1)

Proteins: Classification, structure, properties, purification and denaturation of proteins. Protein interaction and degradation, protein-protein interaction, protein-lipid complexes and protein-carbohydrate complex. Major protein systems and factors affecting them, the nature of interaction in proteins derived from milk. Egg proteins, meat proteins, fish muscle proteins, oil seed proteins and cereal proteins. Metabolic antagonist and allergens associated with food proteins. Modified protein.

Vitamins: Role of vitamins in food industry, effect of various processing treatments and fortification of foods.

Minerals: Role of minerals in food industry, effect of various processing treatments.

Practical 0.5

Determination of ascorbic acid.
Determination of pH and acidity of foods.

Unit – III(Theory 1)

Biological Changes in Food: Plant Pigments and their role in Food Industry: Bitter substance and tannins.

Enzymes: Nature, classification and properties of food enzyme, enzyme activity in different food systems, commercial availability. Food enzyme technology, immobilization of enzymes, removal of toxicants through enzymes, flavor production by enzymes.



Browning reaction in foods: Enzymatic and Non-Enzymatic browning in foods of vegetable and animal origin during storage and processing of foods. Single cell Protein.

Recommended Text Books:

1. Satyanarayana U & Chakrapani U (2006), Textbook of Biochemistry, 3rd Edition
2. Talwar GP, Textbook of Human Biochemistry by G.P. Talwar

ADVANCES IN CEREAL SCIENCE AND TECHNOLOGY

Courses Outcome-The objective of this course is to (1) Comprehend the recent advancement in the major cereal grains quality and processing aspects. (2) Grasp the basic and advanced milling methods for wheat, rice, maize.

UNIT-I (Status & Future of Cereal Grains in India)

Theory (1)

Present status and future prospects of cereal grains in India, food grain production and consumption trends. Coarse grain processing. Wheat kernel structure, wheat grading, roller flour milling, influence of wheat type and grain quality on flour yield, grain hardness and its relevance to end product quality, advances in wheat cleaning, conditioning and milling, wheat flour component interactions (protein-starch, protein-lipid and starch-lipid) and their influence on end product quality, advances in isolation, biochemical characterization, micro-structural and functionality of wheat gluten proteins.

(Practical 0.5)

S.No.	Practicals
1	Grading of wheat varieties, milling quality of hard and soft wheat varieties
2	effect of conditioning on the flour extraction rates
3	effect of grains parameters on the flour yield and quality
4	quality assessment of wheat gluten

UNIT-II (Advances in role of wheat proteins) Theory (1)

Advances in role of wheat proteins in dough and gluten visco-elasticity, micro-structure of dough, conversion of dough foam structure to bread sponge structure during bread baking, concept of gas retention in wheat dough during fermentation and baking, advances in bread making processes, effect of wheat components and ingredients on the growth of yeast during fermentation operation, bread staling and its prevention, production of variety biscuits, breads and pasta products.

(Practical 0.25)

S.No.	Practicals
1	damaged starch and bread flour quality
2	effect of damaged starch of flour on biscuit quality
3	factors affecting water absorption of wheat flour
4	effect of ingredients and processing parameters of yeast growth

UNIT-III (Paddy, Rice & Barely varieties, their composition) Theory (1)

Paddy varieties, their composition and quality characteristics, advances in methods of paddy parboiling, advantages and limitation of parboiling, paddy dehulling processes, Rice ageing, accelerated ageing, modern



rice milling, factors affecting head rice yields and losses at different stages of milling, rice mill machinery, Rice based products and their quality. Methods of rice bran oil extraction and refining.

Dry and wet milling of maize, modern methods of maize processing, gluten and starch separation, maize starch conversion into value added products, acid hydrolysis, enzyme hydrolysis, processing for dextrose, malto-dextrin and other products, Barley varieties, composition and quality characteristics, malting process and industrial applications of barley malt and malt products.

(Practical 0.25)

S.No.	Practicals
1	assessment of dough rheology using doughLab and mixolab, bread, biscuits, noodles making potential of different wheat flours
2	quality assessment of bakery products

Recommended text books:

1. Kulp K. & Ponte J. G. (2014). *Handbook of Cereal Science & Technology, 2nd edition*: CRC press.

Reference Books

2. Wrigley C.W. & Batey I. L. (2010). *Cereal grains, assessing and managing quality*, CRC press.
3. Dendy D. A. V. & Dobsasoczyk B. J. (2001). *Cereal and Cereal Products, Chemistry and Technology*: An ASPEN publication.
4. Owens G. (2000). *Cereal Processing Technology*: CRC Press.
5. Faridi H. & Faubin J. M. (1997). *Dough Rheology & Baked product Texture*: CBS Publishers.

FOOD ADDITIVES AND CONTAMINANTS

4(3T+1P)

Courses Outcome-The objective of this course is to (1) Understand the role of food additives in manufacturing of food products. (2) Have the knowledge regarding permissible additives and their limits in the processed food.

UNIT-I (Properties & Functions of Additives)

(Theory 1)

Additives in food processing and preservation: Classification, need, properties, functions and safety, quality evaluation of additives, Food labeling, Laws and regulations for food additives

Chemistry, uses and functions: Chemical preservative, bio-preservatives, fortification, antioxidants, emulsifiers, humectants, stabilizers, chelating agents, pH control agents and acidulants, texturizing agents, plasticizers, flavor enhancers, enzymes, coloring agents, sweeteners, flavoring agents

UNIT-II (Food contaminants)

(Theory 1)

Food contaminants: biological, chemical, physical and environmental contaminants, Inorganic and organometallic food contaminants, Sources and their impact on human health

(Practical 0.5)

S.No.	Practicals	Credit
1	Detection of non-permitted food additives in market food samples, sweets, ice-creams and beverages products	0.4



2	estimation of antioxidants	0.2
3	Estimation of residual sulphur dioxide in beverages	0.2
4	Estimation of benzoic acid in tomato sauce and fruit beverage	0.2

UNIT-III (Food contaminants from industrial wastes)

(Theory 1)

Food contaminants from industrial wastes: Heavy metals, polychlorinated polyphenyls, dioxins, Toxicants formed during food processing polycyclic aromatic hydrocarbons, nitrosamines, veterinary drug residues and melamine contaminations, Pesticide residues in food

(Practical 0.5)

S.No.	Practicals	Credit
1	Analysis of edible common salt for moisture content and total chlorides	0.2
2	Identification of natural colors, Isolation and estimation of synthetic food colors	0.1
3	Estimation of contaminants, chemical residues and aflatoxins, pesticides and heavy metals contaminants in foods	0.1
4	Estimation of pesticide residues in food/water	0.1

Recommended text books:

1. Branen, A. L., Davidson, P. M. and Salminen, S. (2002). *Food Additives*: Marcel Dekker, New York.

Reference Books

2. Wood, R., Foster, L., Damant, A. and Pauline, K. (2004). *Analytical Methods for Food Additives*: Boca Raton, New York.
3. Watson, D. H. (2014). *Food Chemical Safety: Additives*: WP, New Delhi.
4. Steinhart, E., Doyle, M. E. and Cochrane, B. A. (1995). *Food Microbiology and Toxicology*: Marcel Dekker, New York.

New Food Product Development

Total Credit 2 (1T+1P)

Courses Outcome-The objective of this course is to (1) understand the essential principles, theories, processes and techniques that are applicable to food product development. (2) Appraise food regulations, food sensory evaluation and statistical analysis in food product development.

Unit –I (Basics of Food product development) (0.25)

Definition, concept, Importance, objectives & Need of product development

Unit – II (Challenges and Reasons) (0.25)

Challenges and Reasons of failure of new product, Types and Steps of new food product development, Product development Tools and their use

Unit- III (Development of various new food products) (0.5)

Concept of development of new food products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods



Practical (1)

1	Market and literature survey to identify the concepts of new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.
2	Screening of product concept on the basis of techno-economic feasibility.
3	Development of prototype product and Standardization of formulation process.
4	Proximate Analysis of New Product
5	Packaging, labeling and shelf-life studies
6	Cost analysis and Final Project Report

Book References-

- Fuller, Gordon W. (2004). New Product Development- From Concept to Marketplace. CRC Press.
- Moskowitz, Howard. Saguy ,R. &I. Sam. (2009). An Integrated Approach to New Food Product. CRC Press.

NOVEL FOOD PACKAGING

4(3T+1P)

Courses Outcome-The objective of this course is to (1) Grasp advance knowledge on the properties and production of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality 2. Understand various types of scavengers and emitters for improving the food shelf life.

UNIT-I (Active and intelligent packaging techniques)

(Theory 1)

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: Oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

Advantages of non-migratory bioactive polymers, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, defining and classifying time temperature indicators (TTIs), requirements for TTIs, development of TTIs, maximizing the effectiveness of TTIs to monitor shelf-life during distribution, use of freshness indicator in packaging: Compounds indicating the quality of packaged food products, pathogen indicators, moisture regulation: Silica gel, clay, molecular sieve, humectants, irreversible adsorption.

UNIT-II (Modified atmosphere packaging)

(Theory 1)

Developments in modified atmosphere packaging (MAP): Novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, Applying high O₂ MAP. Combining MAP with other preservation techniques, packaging-flavour interactions: Factors affecting flavour absorption, role of the food matrix, role of differing packaging materials.

(Practical 0.5)

S.No.	Practicals
1	Testing of properties of different packaging materials (paper, plastic, glass and metal)
2	Study of symbols and labels used on food packages
3	Vacuum packaging, form-fill- seal packaging
4	Determination of changes in packaged foods



UNIT-III (Modern packaging systems)

(Theory 1)

Modern packaging systems: Green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, Integrating intelligent packaging: role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and time temperature indicators, traceability: radio frequency identification, recycling packaging materials: recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, methods for testing consumer responses to new packaging concepts.

(Practical 0.5)

S.No.	Practicals
1	Packaging of foods under different conditions
2	Preparation and application of edible coatings
3	Comparative evaluation of different packages for fragile foods
4	Estimation of shelf life of food under different packaging materials

Recommended text books:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.

Reference Books

2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*: CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.

Food Processing and Preservation

Total credit- 3

Courses Outcome-The objective of this course is to (1) Understand about various processing and preservation techniques. (2) comprehend the technologies used in effect preservation.

UNIT-I (Basic concept of food processing and preservation) (1)

Reason of food Spoilage and Scope of food processing preservation; principles of food processing and preservation. Principle and preservation by low temperature: (refrigeration, freezing, and dehydro freezing; cold storage, frozen food), changes during freezing-physical and chemical changes. Processing and preservation by drying: factors affecting drying rate, types of dryer – (kiln, tray, drum, spray, tunnel, fluidized bed drying), types of drying technique (freeze drying, vaccum drying)

UNIT-II (Processing and preservation by heat) (1)

Blanching, pasteurization, sterilization, UHT processing, heating, dehydration, canning, Microwave cooking-(principle, changes during microwave cooking, advantages), difference between microwave and conventional heating, Use of Nano technology in food. Concentration and evaporation-(flash evaporator, falling film evaporator and multiple effect evaporators), changes during Concentration

UNIT-III (Processing and preservation by non-thermal method) (1)

Irradiation, high pressure, pulsed electric field, high hydrostatic pressure, Hurdle technology: concept of hurdle technology and its application, Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques, ohmic heating, IR heating; Food processing equipments: material handling,



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cleaning and grading, conveyors, size reduction, food grain storage, milling, Separation Technique: filtration, agitation and mixing. Baking, Roasting, Frying.

References

1. Arsdel WB, Copley MJ & Morgan AI. 1973. Food Dehydration. 2nd Ed. Vols.I, II.AVI Publ.
2. Desrosier NW & James N.1977. Technology of Food Preservation.4th Ed. AVI.Publ.
3. Fellows PJ. 2005. Food Processing Technology: Principle and Practice. 2nd Ed. CRC.



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III Semester

Course Name: Advanced milk and milk products technology

TOTAL=4(3T+1P)

Courses Outcome-The objective of this course is to (1) Understand the processes related to storage, processing and distribution of milk and milk Products. 2. Perceive the different properties of milk and milk products.

UNIT-I (Technology of Market Milk & fat rich dairy products) (1- 0)

Theory (1.0 credits)

Technology of Market Milk:Dairy Industry in India: present status and scope; Milk: definition, composition and nutritive value; grading of milk; factors affecting composition of milk; physico-chemical properties of milk; FSSAI standards and legislations for market milk. Liquid milk processing: filtration/clarification; bacto-fugation; standardization; homogenization; pasteurization (LTLT, HTST); sterilization; UHT processing; aseptic packaging; storage and distribution. Technology of special milks: Technology of sterilized/ flavored milk, acidophilus milk, bulgarian milk, kumis, kefir; reconstituted & recombined milk, toned, double toned milk. Technology of fat rich dairy products: Cream: definition and legal standards, consumer cream products, standardization & production of cream, processing of cream (neutralization & pasteurization), butter: definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream & butter, defects in cream & butter. Ice-cream: definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

UNIT-II (Technology of condensed and dried milk, yoghurt and cheese) (1-0.5)

Theory (1.0 credits)

Technology of condensed and dried milk: Definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, concept of heat stability & its control, defects in condensed and evaporated milks, Quality of raw milk for dried milks, definition and legal standards for dried milks, milk drying system (film, roller, drum, spray, foam spray drying), method of manufacture of dried milks (WMP & SMP), defects in dried milk,Technology of yoghurt and cheese: Yoghurt - Definition and technology of yoghurt manufacturing, technology of different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening of cheese, yield of cheese; manufacture of processed cheese, defects in cheese, accelerated ripening of cheese.

Practical: (0.5 credit)

S. No.	Practical
1	Determination of SNF (Solids Not Fat), specific gravity, total solids of milk.
2	Determination of moisture & fat content of milk powder
3	Study of familiarization with various parts and working of cream separator

UNIT-III (Technology of indigenous dairy products) (1-0.5)

Theory (1.0 credits)

Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets, miscellaneous traditional dairy foods, Dairy industry by-products and sanitation: By-products: introduction, definition, composition, Importance and food applications, whey protein concentrates & isolates, Dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

Practical: (0.5 credit)



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S. No.	Practical
1	Preparation of ice cream
2	Determination of fat by garber method
3	Detection of adulterants in milk like water, urea, neutralizers, preservatives sucrose storch

Recommended text Books:

1. Winton, A. L. and Winton, K. B. (2000). *Milk and Milk Products*: Agrobios, India.
2. Kutty, C. I. and Khamer, S. (2004). *Milk Production and Processing*: Daya, Delhi.

Reference books:

1. Fox, P. F. and McSweeney, P. L. H. (1998). *Dairy Chemistry and Biochemistry*: Kluwer Academic, New York.

Food Process Engineering

4(3T+1P)

Courses Outcome-The objective of this course is (1) To Emphasis the various properties of the raw material used in food processing. (2) Understand engineering properties of foods, their significance in equipment design.

Unit - I (1)

Energy in Food Processing: Steam generation, thermodynamics of phasechange. Steam tables. Steam utilization. Fuel utilization. Electric powerutilization, Electric motors, Electrical controls, Electric lighting.

Crystallization: Solubility, types of crystallizers – tank crystallizer, scraped surfacecrystallizer, circulating–liquid evaporator–crystallizer, circulating–magma vacuumcrystallizer, Nucleation theories.

Practical (0.5)

1	Determination of viscosity of liquid foods.
2	Determination of Reynolds number and nature of fluid flow in a pipe.
3	Determination of pressure drop using manometer.
4	Study of dehydration characteristics of food materials using Cabinet drier.
5	Study of dehydration characteristics of food materials using Fluidized bed drier.

Unit- II (1)

Distillation: Vapour–liquid equilibrium relations, Raoult's law, boiling point diagram,classification of distillation– Equilibrium or Flash distillation, Simple batch orDifferential distillation, Simple steam distillation and Distillation with reflux.

Leaching: Rates of leaching, types of leaching equipment– Fixed bedleaching, Moving– bed leaching, Agitated solid leaching.

Practical (0.5)

1	Study the working principle and operation of a spray drier.
2	Study the working principle and operation of a freeze drier.
3	Study of a distillation operation.
4	Study of a filtration operation.
5	Study of a mixer.
6	Study of psychrometrics–use and applications.



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Unit- III (1)

Drying: Theory of drying, free moisture content, bound moisture content, critical moisture content, equilibrium moisture content, constant rate drying period, falling rate drying period; heat transfer in drying; types of driers- tray drier, tunnel drier, roller drum drier, fluidized bed drier, spray drier, pneumatic drier, rotary drier, trough drier, bin drier, vacuum drier and freeze drier.

Recommended Books:

1. Fundamentals of Food Process Engineering by R.T. Toledo, 1993.
2. Transport Processes and Unit Operations (3rd Edition) by Christie J Geankoplis, Prentice- Hall of India Pvt Ltd, New Delhi, 1999.
3. Unit Operations of Chemical Engineering (5th Edition) by Warren L McCabe, Julian C Smith, Peter Harriott; McGraw-Hill, Inc., New Delhi, 1998.
4. Fundamentals of Food Engineering by Radha Charan Verma and Sanjay Kr Jain; Himanshu Publications, Udaipur, 2002.

Food Plant Layout and Management (T)

Total credit- 3

Courses Outcome-The objective of this course is (1) gain knowledge to design and setting up of new food processing plant. (2) Understanding implementation of the food safety standards in food industries.

Unit – I (1)

Food Plant Organization and management. Organization Chart, Factors in plant location, selection of site, design, layout, Food plant layout and facilities, equipments, machinery and building.

Unit- II (1)

Corrosion in food processing. Types of corrosion (bimetallic corrosion, cavitation corrosion, crevice corrosion, corrosion fatigue, erosion corrosion, fretting corrosion, galvanic corrosion, pitting corrosion, intergranular corrosion, stress corrosion, selective corrosion). Corrosion by non, mildly and highly corrosive food. Corrosion by service fluids- steam, water, alkaline and acidic detergents, sanitizing agents, cooling brines, insulating materials.

Unit- III (1)

Good Laboratory Practices. Quality Circles and Quality Culture Concept, Six Sigma Concept. Government regulatory agencies and their relationship to food industries.

Plant maintenance, Objectives and importance, Types of maintenance – corrective or Breakdown maintenance, scheduled maintenance, preventive maintenance and Inspection.

Recommended Books:

1. Plant Layout and Design - James M Moore
2. Industrial Engineering and Management - O P Khanna
3. Food Processing Operations and Scale Up - Leon Leuine and Peter Clerk
4. Production Operations and Management - B S Goel



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Course Name: Advanced Meat, Fish, Poultry and Egg Technology

Courses Outcome-The objective of this course is to (1) Understand the technology for raw material characteristics, handling, processing, and preservation. (2) Grasp by-product utilization of meat, poultry, fish and egg products

UNIT-I (Introduction about Meat Technology) (1.5-0)

Theory (1.5 credits)

Production, Processing and consumption trends, Prospects of meat industry, Meat spoilage, Endogenous and exogenous infections, Hygiene and sanitation, Meat composition from different sources, Post-mortem muscle chemistry and composition, Intramuscular fat, Rigor mortis, The conversion of muscle into meat: Animals' stunning methods, ante-mortem and post-mortem examination, Design of handling facilities: Slaughtering and dressing, Consequences of circulatory failure, Proteolytic and other chemical changes, Operational factors affecting meat quality, Effects of processing on meat tenderization, Chilling, freezing and preservation, prepared meat products, intermediate moisture and dried meat products, The eating quality of meat: color, flavors and retention, water holding capacity, juiciness, texture and taste, meat eating and health, Inedible by-products

UNIT-II (Quality characteristics of poultry products) (1.5-0)

Theory (1.5.0 credits)

Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products

Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling

UNIT-III (Commercially important marine products) (1-0)

Theory (1.0 credits)

Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks, Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other by-products

Recommended text Books:

1. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6 ed.): Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology*: Champan & Hill, London.

Reference books:

1. Carmen, R. O. and George, J. M. (1997). *Poultry Meat and Egg Production*: CBS Publications, New Delhi.
2. Winton, A. L. and Barberwinton, K. (1999). *Fish and Fish Products*: Agrobios, Bikaner.
3. Winton, A. L. and Winton, K. B. (1993). *The Structure and Composition of Animal Product*: Agro Botanical, Bikaner.

Course Name: Research Methodology

Courses Outcome-The objective of this course is to (1) Understand the methods and role of scientific approach to research. (2) Understand the various experimental designs, methods of sampling their analysis and data collection.

UNIT - I (Introduction & Types of research) (1.5-0)



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Theory (1.5 Credits)

Research methodology: Introduction & meaning of research, Objectives of research, motivation in research. Types of research & research approaches. Research methods vs. methodology, Criteria for good research.

Research problem: Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem.

UNIT - II (Research design) (1.5-0)

Theory (1.5 Credits)

Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.

Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.

UNIT - III (Methods of data collection) (1-0)

Theory (1 Credits)

Methods of data collection: collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules.

Report Writing

Recommended Text Books:

1. Kothari CR (2004). Research Methodology: Methods and Techniques, New Age International.
2. Bhattacharya DK (2009). Research Methodology, Excel Books.

Reference Text

1. Annals of Food Science & Technology
2. Journal of Nutrition
3. Journal of Food Science & Technology

Course Name: Nutraceuticals and Functional Foods

Courses Outcome-The objective of this course is to (1) Acquire knowledge on various bio molecules showing health benefits. (2) Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

UNIT-I (Basics of Nutraceuticals and functional foods) (2-0)

Theory (2.0 credits)

Nutraceuticals and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc.

Photochemical and their usefulness: Antioxidants and Flavonoids, Omega-3 Fatty Acids, Carotenoids, Dietary fibres, Phytoestrogens, Glucosinolates, Organosulphur Compounds etc. their effectiveness in specific disease conditions; other functional ingredients in foods such as peptides, fatty acids, Cereal products as functional foods - oats, wheat bran, rice bran etc, Functional vegetable products, oil seeds, sea foods and sea weeds, antimicrobial compounds, Coffee, tea and other beverages as functional foods/drinks and their protective effect, Effects of processing, storage and interactions of various environmental factors on the potentials of such foods, health benefits.

UNIT-II (Phyto-chemicals and development of functional foods) (1-0)

Theory (1.0 credits)

Extraction of Phyto-chemicals and development of functional foods: Extraction methods for maximum recovery, Stability studies, Developing functional foods, Use of bioactive compound in appropriate form with protective substances and activators, Effect of environmental conditions in food matrix on activity of bioactive compound, Effects of processing conditions and storage,



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Development of biomarkers to indicate efficacy of functional ingredients, delivery of immunomodulators/vaccines in functional foods.

UNIT-III (Prebiotics and Probiotics) (1-0)

Theory (1.0 credits)

Prebiotics and Probiotics: Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits, Examples of useful microbes and their benefits, Prebiotic ingredients in foods, types of prebiotics and their effects on gut microbes, Probiotic foods and their functional role, Marketing and regulatory issues for functional foods and nutraceuticals.

Recommended text Books:

Recommended text Books:

1. Mine, Y and Fereidoon, S. (2006). *Nutraceutical Proteins and Peptides in Health and Disease*: TF, Boca Raton.
2. Bagchi, D. (2008). *Nutraceutical and Functional Food Regulations in United States and Around the World*: Elsevier, London.

Reference books

1. Shi, J. (2007). *Functional Food Ingredients and Nutraceuticals: Processing Technologies*: CRC Press, London.
2. Guo, M. (2009). *Functional Food: Principles and Technology*: WP, New Delhi.

IV Semester

Details of Training/Visit/Dissertation/Internship/Project-New Product Development:

Dissertation or Project – New Product Development Applicable

Courses Outcome-The objective of this course is to (1) Gain an understanding of the processes involved in the invention process, formulation, and development of new food products. (2). Prepare a dissertation document/ project report based on research process/ project work done.