

COURSE STURCTURE
Of
2 YEARS DEGREE
M.Sc. (Food Science)
Department of Food Processing and Technology



SCHOOL
Of
VOCATIONAL STUDIES & APPLIED SCIENCES
GAUTAM BUDDHA UNIVERSITY
GAUTAM BUDH NAGAR, GREATER NOIDA
2023

M.Sc. Food Science- 2 Years (4 Semesters)
CBCS Based Course Structure
(Effective from Session 2023 Onwards)
SEMESTER- I

S. No.	Course Code	Course Name	Category	L-T-P	Credits
1	ES-513	Research Methodology	C	3-0-0	3
2	FS-401	Food Process Technology	C	3-0-0	3
3	FS-403	Food Microbiology	C	3-0-0	3
4	FS-405	Food Chemistry and Nutrition	C	3-0-0	3
5	FS-407	Technology of Food Processing & Preservation	C	3-0-0	3
6	FS-409	Food Safety and Quality	C	3-0-0	3
7		Generic Elective	GE	3-0-0	3
8	FS-411	Food Chemistry Lab	C	0-0-4	2
9	FS-413	Food Microbiology Lab	C	0-0-4	2
Total Credits				21-1-8	25
Total Contact Hours				30	

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M.Sc. Food Science- 2 Years (4 Semesters)
CBCS Based Course Structure
(Effective from Session 2023 Onwards)
SEMESTER-II

S. No.	Course Code	Course Name	Category	L-T-P	Credits
1	FS-404	Cereals, Legumes and Oil Crop Technology	C	3-0-0	3
2	FS-406	Fruits and Vegetables Technology	C	3-0-0	3
3	FS-408	Technology of Meat, Fish and Poultry Products	C	3-0-0	3
4	FS-410	Technology of Functional Foods and Nutraceuticals	C	3-0-0	3
5	FS-424	Post-Harvest Technology	SEC1	3-0-0	3
6		DSE-I	DSE	3-0-0	3
7		DSE-II	DSE	3-0-0	3
8	FS-517	Cereals, Legumes and Oilseed Analysis Lab	C	0-0-4	2
9	FS-519	Fruits and Veg. Tech Lab	C	0-0-4	2
10	FS-515	Seminar	SEC2	0-0-2	1
Total Credits				21-0-10	26
Total Contact Hours				31	

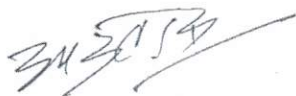






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M.Sc. Food Science- 2 Years (4 Semesters)
CBCS Based Course Structure
(Effective from Session 2023 Onwards)
SEMESTER- III

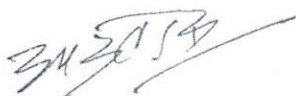


S.No.	Course Code	Course Name	Category	L-T-P	Credits
1	FS-501	Advances in Food Process Technology	C	3-0-0	3
2	FS-503	Food Packaging Technology	C	3-0-0	3
3	FS-505	Techniques in Food Analysis	C	3-0-0	3
4	FS-507	Technology of Milk and Milk Products	C	3-0-0	3
5	FS-509	Technology of Fermented Foods	C	3-0-0	3
6		DSE-III	DSE	3-0-0	3
7	FS-521	Advance Food Processing Lab	C	0-0-4	2
8	FS-523	Dairy Technology Lab	C	0-0-4	2
9	FS-555	Training (4-6weeks Summer Training after II semester)	SEC2	0-0-0	2
Total				18-0-8	24
Total Contact Hours				26	

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M.Sc. Food Science- 2 Years (4 Semesters)
CBCS Based Course Structure
(Effective from Session 2023 Onwards)
SEMESTER- IV

S. No.	Course Code	Course Name	Category	L-T-P	Credits
1	FS-556	Project	-	0-0-0	20
Total					20
Total Credits for all semester					95




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M.Sc. Food Science- 2 Years (4 Semesters)
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ELECTIVE SUBJECTS					
S. No.	Course Code	Course Name	Category	L-T-P	Credits
*Generic Elective (GE)					
1	ES-507	Waste Management	GE	3-0-0	3
2	CH-407	Characterization Techniques-I	GE	3-0-0	3
Discipline Specific Electives (DSE-I)					
1	FS-412	Food Additives	DSE	3-0-0	3
2	FS-414	Technology of Plantation Crops and Spices	DSE	3-0-0	3
3	FS-416	Snack Food Technology	DSE	3-0-0	3
Discipline Specific Electives (DSE-II)					
1	FS-418	Technology of Oilseeds and Fats	DSE	3-0-0	3
2	FS-420	Innovative Techniques in Food Processing	DSE	3-0-0	
3	FS-422	Food Supply Chain Management	DSE	3-0-0	3
Discipline Specific Electives (DSE-III)					
1	FS-511/ CH 505	IPR and Patent Laws in Food Sector/ Patent Law and IPR Issues	DSE	3-0-0	3
2	FS-513	Food Plant Design and Sanitation	DSE	3-0-0	3
3	FS-525	Technology of Beverages	DSE	3-0-0	3
<i>*New course structure will be effective from academic session 2023 onward. School/Department will not be bound to run all the courses. Minimum number of students may be fixed to run any elective course.</i>					

**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester I**

ES 513: Research Methodology (3-0-0)

OBJECTIVE

To explain the concept of research, steps in and methods of research, report writing, presentation and research ethics

Unit-I

Basics of Research: Definition, Objectives, Motivation, Types, Approaches (Positivism and Post positive approaches), Significance; Research methods vs Methodology; Research Planning Characteristics of good research, What to do? How to do?, Problems encountered by a researcher in India; Hypothesis Meaning, Types, Construction of hypothesis Research Formulation Definition, Sources of research problem, Considerations in selecting a research problem, Formulation of research objectives.

Unit-II

Review of Literature: Importance, Primary and secondary sources, Web as a source of literature and searching the web; Organization of literature and identifying gap areas from review of literature; Writing research proposal or synopsis Research Design and Methods Meaning, Importance, Basic principles; Features of a good research design; Important concepts relating to research design; Different research designs; Basic principles of experimental designs, Developing a research plan.

Unit-III

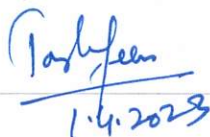
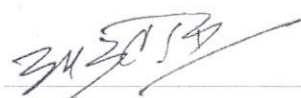
Sampling Design :Census and sample survey; Implications of sample design; Steps in sampling design; Criteria for selecting a sampling procedure; Characteristics of a good sample design; Different types of sample designs Measurement and Scaling Techniques Measurement in research, Measurement scales, Sources of error in measurement, Developing measurement tools; Scaling Meaning, Classification and Techniques.

Unit-IV

Data Collection Collection of primary data Observation method, Interview method, Collection of data through instruments (questionnaires and schedules) and experimentation; Collection of secondary data; Selecting appropriate methods for data collection Sampling Need, Definition, Sampling theory; Concept of Standard Error, Estimation Population mean and population proportion, Sample size and its determination Data Processing and Analysis Processing operations; Types of analysis; Statistics in research :Measures of central tendency, Dispersion, Skewness (Asymmetry), Correlation and Regression analysis; Statistical packages of data analysis. Hypothesis Testing Basic concepts of hypothesis and hypothesis testing, Chi square test, Analysis of variance and Co variance, Non parametric or Distribution free tests, Multivariate analysis techniques.

Unit V

Report Writing Interpretation A pre-requisite for report writing, Meaning of interpretation, Techniques of interpretation, Precautions in interpretation. Research Report Significance of report, Types of report Technical report and thesis, Popular report; Structure and components of a scientific report; Steps in report writing; Layout of a typical report Structure, language, illustrations, tables, bibliographic entries, referencing and footnotes; Writing research papers; Making presentations oral and poster. Research Ethics and Standards Commercialization and research; Research ethics Definition and importance; Research ethics in practice Intellectual Property Rights, Professional values and qualities of a researcher and sponsoring organization; Detecting unethical research Plagiarism, paraphrasing and copyright violation; Tools for detecting unethical research; Consequences of plagiarism, Reproducibility and accountability; Valuing research Citation counting and impact factor, Scientific citation index (SCI), SCI expanded (SCI E), H index.



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OUTCOME

No. of Lecture: 45

The knowledge of research and research methodology could be applied by the learners for doing research and presentation of research output in an ethical manner

SUGGESTED READINGS

1. Anthony, M., Graziano, A.M. and Raulin, M.L. 2009. *Research Methods: A Process of Inquiry*, Allyn and Bacon, New York.
2. Banerjee, S. and Ramendu, Roy. 2017. *Fundamentals of Research Methodology*, (3rd Edition), Kitab Mahal, New Delhi.
3. Cooper, D. R. and Schindler, P. S. 2006. *Business Research Methods*, Tata McRraw Hill Publishing P. Ltd., New Delhi.
4. Fisher R. A. 2004, *Statistical Methods for Research Workers*, Cosmo Publications, New Delhi. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K. 2002. *An Introduction to Research Methodology*, RBSA Publishers., New Delhi.
5. Hart, C. 2015. *Doing Your Masters Dissertation*, Sage Publication India P. Ltd. New Delhi, 481 p. Kothari, C.R. 1990. *Research Methodology: Methods and Techniques*. New Age International, New Delhi, 418p.
6. Kumar, R. 2014. *Research Methodology: A-Step- by Step Guide for Beginners*, Sage Publications India P. Ltd., New Delhi.
7. Montgomery D.C. 2001. *Design and Analysis of Experiments*, John Wiley and Sons, New York. Sinha, S.C. and Dhiman, A.K. 2002. *Research Methodology*, 2 Volumes, Ess Ess Publications, New Delhi.
8. Snedecor, G.W. and Cochran, G.W. 1989. *Statistical Methods*, 8th Edition; Iowa State University Press, Ames, Iowa.
9. Trochim, W.M.K. 2005. *Research Methods: The Concise Knowledge Base*, Atomic Dog Publishing, New Delhi, 270p.
10. Wadehra, B.L. 2000. *Law Relating to Patents, Trade-marks, Copyright, Designs and Geographical indications*. Universal Law Publishing, New Delhi.



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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)**

Semester I

FS-401 Food Process Technology (3+0+0)

OBJECTIVES: To understand the area of Food engineering. To elaborate the basic concepts of material and energy balance, fluid dynamics, thermal process calculations etc.

Unit –I

Fundamental of unit operations in food engineering: Material handling, cleaning, sorting and grading. Material handling–theory, classification of various material handling equipments, conveyors and elevators Cleaning: Types of contaminants found on raw foods, aims of cleaning, methods of cleaning dry, wet and combination methods; dry cleaning methods- screening, aspiration, magnetic cleaning, and abrasive cleaning; wet cleaning methods- soaking, spray washing, flotation washing and ultrasonic washing. Sorting and grading – advantages of sorting and grading, grading factors, methods of sorting and grading. Mass and energy balance: basic principles, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration, heat balance calculation.

Unit –II

Fluid flow principles: Fluid statics, fluid dynamics, mass and energy balances in fluid flow: Newtonian and Non-Newtonian fluids, stream line and turbulent flow, fluid flow applications-measurement of pressure and velocity. Liquid transport system-pipelines and pumps for food processing plants- positive displacement pumps- air-lift pumps, propeller pumps, centrifugal pumps and jet pumps.

Unit –III

Heat transfer in food processing: Modes of heat transfer, conduction, convection, and radiation, heat exchangers: plate, tubular, scraped surface and steam infusion heat exchanger. Thermal process calculations: commercially sterile concept, concept of D, F and Z values, effect of temperature on thermal inactivation of micro-organism, thermal process calculation for canned food: calculation of processing time in continuous flow system. Thermal processing: evaporation and concentration, dehydration, drying, blanching, pasteurization, sterilization, distillation and crystallization.

Unit –IV

Refrigeration: Refrigeration cycles, refrigeration compressors, refrigeration system balance and multiple evaporation systems. Flash cooling, design of condensers, evaporators, cooling towers, thermo-electric cooling, cryogenics, and different refrigeration systems for ultra- low refrigeration.

Unit –V

Conversion unit operation: Size reduction, mixing, filtration. Size reduction- benefits of size reduction, nature of forces used in size reduction, criteria of size reduction, equipment selection, mode of operation of size reduction equipment – open circuit and closed circuit grinding, free crushing, choke feeding and wet milling; size reduction of solid foods, fibrous foods and liquid foods; effects of size reduction on solid and liquid foods. Mixing- mixing terminology, mixing equipments – mixers for liquids of low or moderate viscosity, mixers for high viscosity pastes, mixers for dry solids; effects of mixing on foods. Filtration- filtration terminology , filtration methods/equipments – pressure filtration, vacuum filtration, & centrifugal filtration.

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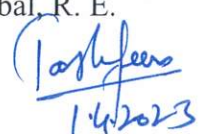
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After the completion of the course, the students will be able to:

1. Understand various basic aspects of food engineering.
2. Grasp the knowledge about fluid flow of foods.

Recommended Books:

1. Food Process Engineering - Heldman, D. R. and Singh, R. P.
2. Fundamental of Food Process Engineering - Romeo T. Toledo
3. Unit Operation of Chemical Engineering - Mc Cabe, Smith & Harriot
4. Mass Transfer Operation - Treybal, R. E.



**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)**

Semester I

FS-403 Food Microbiology (3+0+0)

OBJECTIVE: To understand the role of microorganisms in food spoilage, fermentation and food borne illness.

Unit- I

Introduction, history and scope of food microbiology. Classification of microbes, Types of microorganisms associated with food; bacteria, yeast, mold. Microbial growth, Factors affecting growth of microorganisms: Intrinsic and extrinsic factors.

Unit- II

Source of microorganism in foods, Biochemical changes caused by microorganism, Microbial spoilage of : milk, fruits and vegetables, cereals and cereal products, meat, fish , poultry and eggs; and canned foods. Fermented food products. Importance of microorganism in food industry.

Unit- III

Heat Resistance of microorganisms and spores. Decimal reduction time (D values), 12D concept, Thermal Death Time curves. Control of Microorganisms & Food Preservation methods. Hurdle Technology and its applications.

Unit- IV

Foods microbiology and public health - Types of food poisonings, important features and control; Overview of bacterial, fungal and viral food borne illnesses. Toxins from microbes: *Staphylococcus aureus*, *Clostridium botulinum* and *Aspergillus* genera. Indicators microorganisms.

OUTCOMES:

No. of Lecture: 45

After the completion of the course, the students will be able to explain the microbiology of various food products.

Reference Books

1. James M. J. (2000) Modern Food Microbiology, 5th Edition, CBS Publishers.
2. Barnart G. J. (1997) Basic Food Microbiology, CBS Publishers.
3. Adam M. R. & Moss M. O. (1995) Food Microbiology, New Age International Pvt. Ltd. Publishers.
4. Bibek Ray (1996) Fundamental Food Microbiology, CRC Press.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester I

FS-405 Food Chemistry and Nutrition (3+0+0)

OBJECTIVE: The course aims to develop the knowledge of students in the basic area of Food Chemistry. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

Unit-I

Food Chemistry: Definition, scope and importance. Chemistry of carbohydrates: classification, functions, chemical and physical properties. Types of fibers and its constituents, soluble fibers, insoluble fibers and their important functions. Starch processing enzymes: alpha amylase, beta amylase, starches: modified starches, resistant starches, gelatinization and retrogradation.

Unit-II

Proteins and amino acids: types, chemical, physical and functional properties, denaturation of protein, gel formation. Proteins from milk, egg and meat. Allergens, toxic constituents and anti-nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing oligosaccharids, phytolectins).

Unit-III

Fats and oils: classification, functions, physico-chemical properties, oxidation of oils and fats, rancidity. Chemistry of emulsifiers, antioxidants, stabilizers and additives used in food industry. Vitamins: Water and fat-soluble vitamins, use of vitamins in foods and their properties. Effect of processing on vitamins. Minerals of Foods: Calcium, phosphorus, iron, copper, lead, zinc and arsenic. Chemistry of pigments and flavour compounds.

Unit-IV

Enzymatic and non-enzymatic browning in Foods, reactions of aldehydes and ketones with amino compounds, caramelization, oxidative changes of polyphenols) and their applications in food products. Important chemical changes during storage.

Unit-V

Foods and nutrients: basic definitions, functions of food and nutrients, levels of nutritional status. Major world health problems- food supply and security, malnutrition, heart diseases, cancer, diabetes etc. Recommended dietary allowances (R.D.A.), ICMR standards, food guide, exchange lists, health promotion guidelines. Guidelines for nutritional labeling in India.

OUTCOMES:

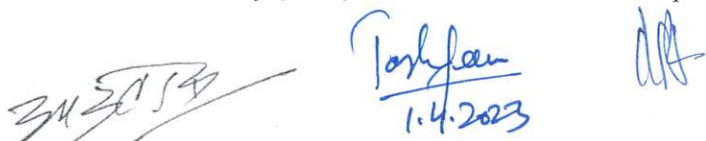
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On completion of the course the students will be able to:

1. Understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
2. Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition.

Recommended Books:

1. Chopra, H. K. & Panesar, P. S. (2010). Food chemistry: Alpha Science Intl Ltd, Oxford, U.K.
2. Coulter, T. P. (2009). Food: The Chemistry of Its Components (5th.).
3. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). Fennema's Food Chemistry: CRC.
4. Wang, D. (2012). Food Chemistry: Nova Science Publisher
5. Shakuntala Manay (2008). N. Foods Facts and Principles, New Age International Publishers

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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester I

FS-407 Technology of Food Processing & Preservation (3+0+0)

OBJECTIVE: To expose the students to the principles and different methods of food processing and preservation.

Unit I

Aim and Objective: Scope and importance of food processing, Aim and objectives of preservation and processing of foods, degree of perishability of natural foods, Quality deterioration and spoilage of perishable foods, Water Activity and its significance in food preservation, intermediate moisture foods, types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality

Unit II

Low temperatures Preservation: Storage of foods at chilling temperature, applications and procedures, controlled and modified atmosphere storage of foods, post storage handling of foods, Freezing process, slow and fast freezing of foods and its consequences etc. Technological aspects of pre-freezing, Actual freezing, frozen storage and thawing of foods, IQF.

Unit III

High temperature Preservation: Basic concepts in thermal destruction of microorganisms- D, Z, F, values Heat resistance and thermophilic in microorganisms. Cooking, blanching, pasteurization and sterilization of foods, Extrusion Cooking.

Unit IV

Chemicals Preservation : Definitions and classifications, use of chemical Preservatives in food, tolerance of chemical preservative, use of antibiotics, sugars and salts. Preservation by fermentation and irradiation; technological aspects and applications of sugar and salt, antimicrobial agents.

Unit-V

Radiation Preservation: Irradiation of foods type of radiations, Changes induced by radiations, interaction of radiation with living organisms. Radiated food, safety, Canning of Food, Advance technology: Membrane Processing, Hurdle Technology, HPP, Nanotechnology, Ultrasonic in food Processing, Supercritical fluid Extraction, PEF.

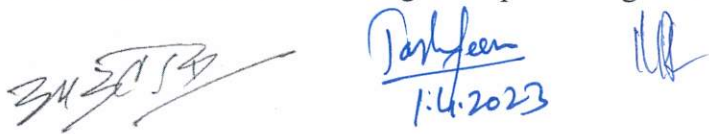
OUTCOMES

No. of Lecture: 45

- To understand the principles of food processing and preservation.
- To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods to understand the materials and types of packaging for foods

Recommended Books:

1. Principles of Food Science-Part-II": Physical Method of Food Preservation by M.Karel, O.R.Fennema and D.B.Lund, Marcel Dekkar Inc.
2. Principles of Food Preservation' by V.Kyzlink, Elsevier Press.
3. Preservation of fruits and Vegetable processing- Girdhari Lal

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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester I

FS-409 Food Safety and Quality (3-0-0)

OBJECTIVES:

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world

Unit -I

Concept of quality: Quality attributes and their measurement and evaluation; Sensory vis-à-vis instrumental methods for testing quality. Sensory evaluation techniques and factors influencing sensory verdicts. Quality control and quality assurance functions.

Unit -II

Total Quality Management: GMP/GHP; GLP, GAP; Sanitary and hygienic practices; HACCP: Application of HACCP to products, Hazard Identification and characterization (HACCP CASES), Quality manuals, documentation and audits; Indian & International quality systems and standards; ISO and Food Codex; Export import policy, export documentation.

Unit -III

Food standards and regulations: Food Safety and Standards Act, 2006; Domestic regulations; Global Food safety Initiative; Various organizations dealing with inspection, traceability and authentication, certification and quality assurance, Labeling issues; International scenario, International food standards.

Unit -IV

Food safety management system: Introduction, prerequisite program of food safety management system, understanding and implementation of food safety management system in food industries, understanding and implementation of ISO 9000, ISO 17025, ISO14000 and ISO 22000.

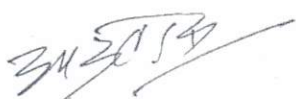
OUTCOMES:


No. of Lecture: 45

- 1) Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments.
- 2) Awareness on regulatory and statutory bodies in India and the world.

Recommended Books :

1. Quality control in the food industry -S. M. Herschfoerfer.
2. Quality control for the food industry -A. Kramer and B.A.Twigg.
3. Principles of sensory evaluation of Foods -M. A. Amerine.




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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester II**

FS-404 Cereals, Legumes and Oil crop Technology (3+0+0)

OBJECTIVE: The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods.

Unit-I

Current status and future scenario of world wheat production and uses. Wheat Chemistry and Technology: Structure and chemical composition of wheat grain. Criteria of wheat quality – physical and chemical. Wheat milling- general principle, cleaning, conditioning and milling systems. Flour grades and their suitability for baking purposes, Assessment of flour quality and characteristics.

Unit-II

Rice Chemistry and Technology: Structure, composition and milling of rice. Modern rice milling unit operation-dehusking, paddy separation, polishing and grading. Rice parboiling Technology. Method of parboiling. Properties of parboiled rice, changes during parboiling. Advantages and disadvantages of parboiling, Quality characteristics, Curing and aging of rice, Processed rice products.

Unit-III

Ingredients, Technology and quality parameters for baked products: Bread, Biscuits and cakes; Breakfast cereals. Processing of Oilseeds: Composition, processing of oilseeds as protein concentrations, properties and uses of oil seed meals, technology vegetable protein isolates.

Unit-IV

Chemical, technological and nutritional aspects of sorghum, oats and millets. Malting of barley, Pearling of Millets. Corn Technology: Dry and wet milling of corn, products of wet and dry milling of corn, HFCS and their uses, Milling of legume-pulses by traditional and improved processes. Anti-nutrients in pulses and modes of elimination.

OUTCOMES

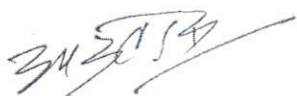
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On completion of the course the students are expected to

- 1) Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- 2) Understand the application of scientific principles in the processing technologies specific to the materials.

Recommended Books:

1. Samuel, A.M. (2014). The Chemistry and Technology of Cereals as Food and Feed:
2. Khan, K. & Shewry, P. R. (2009). Wheat: Chemistry and Technology: St. Paul, U.S.A.
3. Champagne, E.T. (2004). Rice: Chemistry and Technology(3rd ed.): AACC, USA.
4. Dendy, D. A. V. & Dobraszczyk, B. J. (2001). Cereals and Cereal Products: Chemistry and Technology: Aspen, Maryland.
5. Pomeranz, Y. (1998). Wheat: Chemistry and Technology (3rd ed.): AACC, USA.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester II

FS-406 Fruits and Vegetables Technology (3+0+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of fruits and vegetables

Unit-I

Structural, Compositional and Nutritional aspects of fruits and vegetables. Post harvest changes, storage, handling and preservation of fresh fruits and vegetables, controlled and modified atmosphere storage. Present scenario of fruits and vegetable industry in india.

Unit-II

Techniques of processing and preservation of fruits and vegetables by refrigeration and freezing, canning and bottling, drying and dehydration. Canning: Machinery and equipments, canning of different fruits and vegetables.

Unit-III

Technology of fruits and vegetable products: Juices and pulps, Concentrates and powders, Squashes, cordials nectars, fruit drinks and carbonated beverages and its quality control.

Unit-IV

Other fruits and vegetables products: Jam, Jellies and Marmalades. Preserves, candies and crystallized fruits. Tomato products: Puree, Paste, Ketchup, Sauce and soup. Chutneys, pickles and other products.

Unit-V

Condiments, spice oils, oleoresins, Processing of cashew nuts. Specialty fruit and vegetable products.

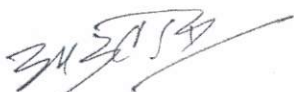
OUTCOME

No. of Lecture: 45

- To develop skills related to Preservation and analytical techniques in fruit and vegetable products.
- Use of various techniques and additives for fruit and vegetable processing and quality analysis.

Recommended Books :

1. Food science by B.Srilakshami;New Age International.
2. Fundamentals of Foods and Nutrition by R. Madambi and M.V. Rajgopal.
3. Foods :Facts and Principles by N Shakuntala manay;New Age International (P) Ltd.
4. Preservation of Fruits and Vegetable by Girdhari lal and Sidappa; CBS Publications



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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester II**

FS-408 Technology of Meat, Fish and Poultry Products (3+0+0)

OBJECTIVES: The course aims to develop the knowledge of students in the area of animal product processing and technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

Unit-I

Scope of meat industry: Status and Introduction to meat, fish and poultry industry, Meat production, processing and consumption.

Unit-II

Structure, composition and nutritive value of meat tissues, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing, Animal slaughtering methods, Post slaughter care and post mortem inspection – classification and quality of meat. Storage and preservation of meat, Restructured meat products, meat analogs (texture vegetable proteins, tofu and tempeh). Recent trends in meat processing. Cooking methods for meat.

Unit-III

Poultry: Chemical composition and nutritive value of poultry meat, Pre-slaughter handling, slaughtering methods, preservation, grading and packaging of poultry meat.

Egg: Structure, composition, nutritional and functional properties of egg. Grading, Storage and transportation of whole eggs. Microbial spoilage of eggs, Preservation and maintenance of eggs, Quality evaluation methods of eggs, Processing of eggs and egg products.

Unit-IV

Fish: Types of fish, Composition and Nutritive Value, Post-mortem changes in fish. Unit operations in fish processing. Canning, Smoking, Salting, Curing, Freezing and Drying/Dehydration of fishes. Fish spoilage, Manufacturing of fish products.

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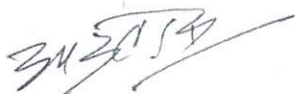
No. of Lecture: 45

On completion of the course the students are expected to:

- 1) Be able to understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.
- 2) Grasp the changes in the composition of foods with respect to the type of processing technology used.

Recommended Books:

1. Meat and Meat Products Technology (Including Poultry Products Technology) by B.D Sharma
2. Meat Science by R.A. Lawrie, Pergamon Press.
3. Poultry Products Technology by G.J. Mountney.
4. Meat, Poultry and Sea Food Technology by R.L. Henricksons.
5. Poultry Meat and Egg Production by Parkhurst and Mountney



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester II

FS-410 Technology of Functional Foods & Nutraceuticals (3+0+0)

OBJECTIVES: To understand the basic concepts of Nutraceuticals and functional food, and their chemical nature. To understand the role of Nutraceuticals and functional food in health and disease.

Unit-I

Introduction to nutraceuticals and functional foods: Definition, classification. Health benefits of nutraceuticals, natural pigments (chlorophyll, carotenoids) anthocyanins, glucosinolates, isoflavonoids, phytoestrogens, omega-3 and omega-6 fatty acids, antioxidants, phytosterols.

Unit-II

Dietary fibers as functional food ingredients. Herbs as functional, Functional cereals, beverages as functional foods/drinks. Dairy based functional foods. Nutritional deficiencies and its correction through fortification and supplementation of foods.

Unit-III

Nutritional deficiencies and its correction through fortification and supplementation of foods. Nutraceuticals bridging the gap between food and drug, Nutraceuticals in prevention of cancer, heart disease, stress, hypertension etc. Dosage levels; adverse effects and toxicity of nutraceuticals.

Unit-IV

Introduction to Probiotics and Prebiotics: Health effects of probiotic microorganisms, Probiotics in various foods, Quality Assurance of probiotics and safety. Marketing and regulatory issues for functional foods and nutraceuticals. Modern trends in nutraceutical and functional foods.

OUTCOMES:

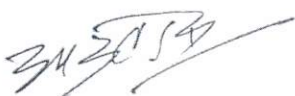
No. of Lecture: 45

After studying this course, the student shall be able to describe:

1. The functional foods and nutraceuticals, classify the functional foods,
2. The potential health benefits of functional foods.
3. The industrial applications of nutraceuticals.

Books Recommended:

1. Gibson, G. R. and Williams, M. C. (2001). Functional Foods Concept to Product. CRC Press.
2. Gupta, R. C. (2016). Nutraceuticals: Efficacy, Safety and Toxicity. Academic Press.
3. Vatter, D.A. and Maitin V.(2016). Functional Foods, Nutraceuticals and Natural Products, Concepts and Applications. DEStech Publications, Inc.
4. Webb, P P. (2006). Dietary Supplements and Functional Foods. Blackwell.
5. Wildman, R. (2006). Handbook of Nutraceuticals and Functional Foods. CRC.
6. Wildman, R. E. (2016). Handbook of Nutraceuticals and Functional Foods. CRC Press.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester II

FS-424 Post Harvest Technology (3+0+0)

OBJECTIVES: To develop knowledge regarding biochemistry and physiology of fruits and vegetables and their role in pre- and post-harvest changes in product quality.

Unit-I

Current status of fruits and vegetables 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: Physical and chemical indices of fruit maturity, crop maturity and ripening. Biochemical changes during maturation, ripening, processing and storage.

Unit-II

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; 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.

Unit-III

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 handling and precooling methods, post-harvest treatments, edible coatings, cold chain, and commercial cooling systems.

Unit-IV

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

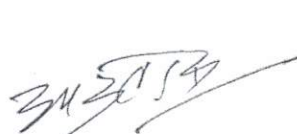
OUTCOMES:

No. of Lecture: 45

1. The student shall understand biological, chemical and physical properties of fruits and vegetables.
2. The technologies involved in the processing, preservation and value-addition of fruit and vegetable products.

Recommended Books :

1. Salunkhe, D.K. and Kadam, S.S. (2005). Handbook of Fruit Science and technology, Production, Composition, Storage, and Processing: Marcel Dekker, USA.
2. Thompson, A.K. 1995. Post-Harvest Technology of Fruits and Vegetables: Blackwell.
3. Wills-Ron B.H. and Golding, J.B. (2015). Advances in Postharvest Fruit and Vegetable Technology: Taylor and Francis, CRC Press.
4. Siddiqui, M. W., (2015). Post-Harvest Biology and Technology of Horticultural Crops: Principles and Practices for Quality Maintenance: Apple Academic Press Inc.



Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-II

FS-412 Food Additives (3+0+0)

OBJECTIVES:

1. To get an insight into additives that are relevant to processed food industry for shelf life extension, processing aids and sensory appeal.
2. To explain about role of food additives in food quality control.
3. To explain the techniques of best use of food additives.
4. To describe the role of food additives in health maintenance and cure of diseases.

Unit-I

Definition of food additives, General principles for the use of food additives. GRAS and regulatory aspects (FAO, WHO, WTO) of food additives, functions, types, modes of action, consequences of use, risks and benefits of food additives

Unit-II

Food preservatives (antioxidants agents and antimicrobial agents), Emulsifying and stabilizing agents, Anti-caking agents, thickeners, Firming agents. Flour bleaching agents and Bread improvers.

Unit-III

Definitions, uses and functions: Acid, Base, Buffer systems, Salts and chelating/sequestering agents, Masticatory substances. Nutritional and non nutritive sweeteners, Polyols.

Unit-IV

Colorants, Flavoring agents and related substances, Clarifying agents. Gases and Propellants. Tracers and other additives.

OUTCOMES:

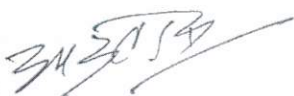
No. of Lecture: 45

After the completion of the course, the students will be able to:

1. Understand about the use of food additives in food formulations.
2. Apprehend the suitable application of food ingredients in health foods and convenience food preparation.
3. Grasp the techniques of food additives stability and use level.
4. Understand the role of food additives in health maintenance and cure of diseases

Recommended Books :

1. O.R.Fennema Food Chemistry
2. N.S.Manay Food Acts and Principles
3. PFA Rules 1955 PFA Act 1954



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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-II**

FS – 414 Technology of Plantation Crops and Spices (3+0+0)

OBJECTIVES:

1. To acquaint students with the types of plantation crops and their processing techniques.
2. To familiarize students with the processing of spices and condiments.

Unit-I

Plantation crops: Introduction, Definition, Classification and Importance of plantation crops.

Coffee: Chemical Constituents, Harvesting, Bean Processing, Types and Varieties, Manufacture, Quality and Grading, Chicory Chemistry and Use.

Tea: Chemical Constituents, Harvesting, Leaf Processing, Types and Varieties, Manufacture, Quality and Grading.

Unit-II

Cocoa: Production, Composition, Grading, Processing, Cocoa Products (cocoa mass, cocoa powder, cocoa butter, cocoa-based beverages, malted beverages, cocoa liquor)

Unit-III

Spice Processing: History of Spices and Condiments, Classification and Composition of Spices and Condiments. Post-Harvest Technology – spice oils, spice powders, oleoresins, flavour.

Unit-IV

Major and Minor Spices: Chemistry, Constituents, Nutritive Value, and Functional Benefits of black pepper, green pepper, white pepper, Cardamom, ginger, chillies, turmeric, Ajwain, coriander, cumin, cinnamon, fenugreek, garlic, mustard, mace and nutmeg, saffron, tamarind, cloves, mint, vanilla, asafetida.

OUTCOMES:

No. of Lecture : 45

1. The student will gain an understanding of processing techniques used for plantation crops.
2. The student will comprehend the processing and use of herbs and spices .

Books recommended

1. Bernard, W.M. (1999). Chocolate, Cocoa and Confectionery Technology, III Ed, Aspen Publication.
2. Pandey, P. H. (2002). Post Harvest Engineering of Horticultural Crops through Objectives. Saroj Prakasam, Allahabad.
3. Panda, P. H. (2010). Handbook on Spices, Asia Pacific Business Press Inc., New Delhi.
4. Pruthi, J.S. (1980). Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-II

FS-416 Snack Food Technology (3+0+0)

OBJECTIVE

To impart knowledge related to various snack foods and their manufacturing techniques.

Unit-I

Extrusion: Introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses. Single screw extruder: principle of working, factors affecting extrusion process, co-kneaders. Twin screw extruder: Feeding, screw design, screw speed, screw configurations. Pre-conditioning of raw materials used in extrusion process: operations and benefits and devolatilization. Chemical and nutritional changes in food during extrusion. Addition and subtraction of materials, shaping and forming at the die. Post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.

Unit-II

Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Breakfast cereal-manufacturing processes (traditional and modern methods), High shear cooking process and steam cookers. Texturized vegetable protein: definition, processing techniques. Direct expanded (DX) and third generation (3G) snacks: types. Concept of junk & fried foods and their impact on human health.

Unit-III

Technology for grain-based snacks: Whole grains- roasted, toasted, puffed, popped, flaked. Coated grains- salted, spiced and sweetened. Formulation, processing and quality assessment of chips and wafers, papads, instant premixes of traditional Indian snack foods.

Unit-IV

Technology for fruit and vegetable-based snacks- chips, wafers; Technology for coated nuts- salted, spiced and sweetened chikkies. Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping.

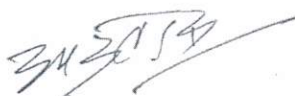
OUTCOMES:

No. of Lecture: 45

Students shall be able to understand various technological aspects of traditional and modern snack foods.

Recommended Books:

1. Booth, R. G. (1997). Snack Food: CBS, New Delhi.
2. Raymond, W. L. & Rooney, L. W. (2001). Snack Foods Processing: CRC. London.
3. Lusas, E. W. & Rooney, L. W. (2015). Snack Foods Processing: CRC. London.
4. Guy, R. (2001). Extrusion Cooking: Technologies and Applications: Woodhead, USA.
5. Riaz, M. N. (2000). Extruders in Food Applications: Technomic, Lanchester.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-II

FS-418 Technology of Oilseeds and Fats (3+0+0)

OBJECTIVE:

- The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

Unit- I

Introduction: Importance and functions of fats and oils in foods and health, composition of fats/oils from different animal sources and oilseeds.

Oil extraction: Different methods of oil extraction, oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oils, Calculations based on the extraction processes.

Unit- II

Oil/fat purification: Refining techniques, bleaching, refining losses and deodorization, Batch and continuous refining losses. Hydrogenation: Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.

Unit- III

Chemistry of fats and oils: Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, effects of ionizing radiation in fats, inter-esterification, reversion.

Technology of individual fat products: Butter, Margarine, Shortening, Lard, Salad, cooking and frying oil.

Unit- IV

Different quality parameters: Peroxide value, Saponification value, Iodine value, acid value, TBA, RM value, P-value, Kries value, Adulteration in oils and fats. Soap processing: Chemistry, physical properties of soap, processing and finishing, different types of soaps, soaps in cosmetics and toiletries.

OUTCOMES

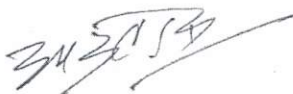
No. of Lecture: 45

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.

Recommended Books :

1. Chrysam, Erickson and others Bailey's Industrial Oil and Fat Products Volume-3
2. Fennema Food Chemistry
3. Meyer Food Chemistry
4. Lawson Food oils and fats
5. Maran Fats in food products



Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-II

FS-420 Innovative Techniques in Food Processing (3+0+0)

OBJECTIVES:

- The course aims to develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.
- This course will enable students to understand the advantages and disadvantages over existing technologies.

Unit – I

Membrane technology: Introduction to pressure activated membrane processes: microfiltration, ultra-filtration, Nano filtration, reverse osmosis and their industrial application. Supercritical fluid extraction: Concept, property of near critical fluids NCF, extraction methods.

Unit – II

Microwave and radio frequency processing: Definition, Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Types of preservation techniques and their principles, concept of hurdle technology and its application.

Unit – III

High Pressure processing: Concept, equipments for HPP treatment, mechanism of microbial inactivation and its application in food processing. Ultrasonic processing: Properties of ultrasonic, application of ultrasonic as processing techniques.

Unit – IV

Novel techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation. Nanotechnology: Principles and applications in foods.

OUTCOMES:

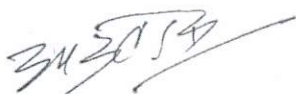
Number of Lectures: 45

On completion of the course the students are expected to

- Be able to understand and identify the different processing technologies and their application.
- Understand the application of scientific principles in the processing technologies specific to the materials.

Recommended Books:

1. New Methods of Food Preservation by G. W. Gould
2. Introduction to Food Engineering by R.P.Singh
3. Novel Food Processing Technologies Barbosa-Canovas



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)

Semester-II

FS- 422 Food Supply Chain Management (3+0+0)

OBJECTIVE: To provide an introduction to the concepts and tools of supply chain management in the food and beverage industry

Unit- I

Introduction and overview of Food supply chain management, present status of Food Supply Chains in India and challenges thereof, Inbound and outbound logistics, Supply chain as a source of competitive advantage.

Unit- II

Inbound logistics, Buyer-Vendor co-ordination, Procurement, Vendor development and evaluation, reduced sourcing and supplier partnership - benefits, risks and critical success factors, multi-level supply control. inventory control systems of stock replenishment, cost elements, EOQ and its derivative models, use of computers for materials function.

Unit- III

Outbound logistics, System view of logistics-Coordination and management of transportation, inter model transportation and third party transportation services, characteristics of different transportation services, carrier selection, contracting and evaluation methods, inventory order processing, purchasing ware housing materials handling, packaging and customer service standards, physical distribution planning, channel considerations, inventory strategies and management, transportation infrastructure and management, facility location, materials handling.

Unit- IV

Strategic considerations for supply chain, Porter's industry analysis and value-chain models, the concept of total cost of ownership, supply stream strategies, classification and development guidelines, measuring effectiveness of supply management, logistics engineering.

Unit- V

Operations Research Models for operational and strategic issues in supply chain management. The Bullwhip Effect and supply-chain management game.

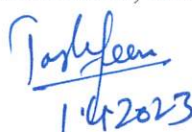
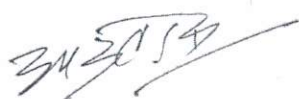
OUTCOMES:

No of Lecture 45

1. To demonstrate an awareness of the role of supply chain management in competitive strategy in the food and drinks industry.
2. To get a critical understanding of the buyer-supplier relationship debate.
3. To be aware of the challenges involved in identifying, acquiring and managing the various resources required in food supply chains.

Recommended Books :

1. Chopra, S, and P. Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson Education.
2. Raghuram, G. and N. Rangaraj, Logistics and Supply Chain Management: Cases and Concepts; Macmillan, New Delhi.
3. Simchi-Levi, D., P. Kaminski and E. Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies; Irwin, McGraw-Hill



Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)

Semester-III

FS-501 Advances in Food Process Technology (3+0+0)

OBJECTIVES:

The course aims to develop the knowledge of students in the area of emerging or alternative technologies applied to food processing.

This course will enable students to understand the advantages and disadvantages over existing technologies.

Unit – I

Microbial Food Spoilages: Growth curves generation time, measurement of growth, Microbial growth dynamics models, partial differentiation equation models, Control of micro-organisms by physical, chemical and biological agents, thermal death time, Z, F and D values. Membrane Technology: Introduction to pressure activated membrane processes, performance of RO/UF and NF and industrial application.

Unit – II

Supercritical Fluid Extraction: Property of near critical fluids (NCF), solubility and efficiency of NCF extraction, equipment and experimental techniques used in NCF extraction and industrial application. Use of Microwave Energy in Foods: Theory of microwave heating, dielectric properties of food materials, working principle of magnetron, microwave blanching, sterilization and finish drying.

Unit – III

Hurdle Technology: Types of preservation techniques and their principles, concept of hurdle technology and its application. High Pressure Processing of Foods: Concept of high-pressure processing, quality changes, effects of pressure on microorganisms and its application in food processing.

Unit – IV

Ultrasonic in Food Processing: Properties and generation of ultrasonic, ultrasonic imaging, application of ultrasonics as an analytical tool and processing techniques. Newer Techniques in Food Processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, micronization in food processing and preservation.

Nanotechnology: Principles, mechanism and applications in foods.

OUTCOMES:

Number of Lectures: 45

On completion of the course the students are expected to

1. Be able to understand and identify the different processing technologies and their application.
2. Understand the application of scientific principles in the processing technologies specific to the materials.

Recommended Books :

1. G. W. Gould. New Methods of Food Preservation (Non-Thermal Processing of Foods)
2. R. P. Singh. Introduction to Food Engineering
3. Food processing technology. Fellows, P. J.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-III

FS-503 Food Packaging Technology (3+0+0)

OBJECTIVE: The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used. This course will enable students to appreciate the application of scientific principles in the packaging of foods.

Unit -I

Introduction to food packaging. Functions of food packaging, Packaging environment. Characteristics of food stuff that influences packaging selection. Packaging material and their properties: Glass, Paper and paper board, Corrugated fibre board (CFB), Metal containers: Tin Plate and Aluminum, Composite containers, Collapsible tubes, Plastic Films, Laminations, Metalized films, Co-extruded films, Testing of packaging material, Packaging Systems and methods: eco friendly Edible packaging, Shrink and stretch packaging, Active packaging techniques, intelligent & smart packaging techniques. Environmental Issues in Packaging: Food marketing and role of packaging- bar coding, Migration in food packaging. FSSAI regulations for packaging and food labeling.

Unit -II

Current use of novel packaging techniques, Consumers and novel packaging. Oxygen scavenging technology, Selection of right type of oxygen scavenger, Ethylene scavenging technology, Carbon dioxide and other scavengers. Antimicrobial agents, constructing an antimicrobial packaging system, Factors affecting the effectiveness of antimicrobial packaging. Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, Applications of polymers with immobilized bioactive compounds.

Unit -III

Definition and classification of TTIs, Requirements for TTIs, Development of TTIs, Maximization for effectiveness of TTIs, Using TTIs to monitor shelf life during distribution. Compounds indicating the quality of packaged food products, Freshness indicators, Pathogen indicators, other methods for spoilage detection. Factors affecting flavour absorption, Role of the food matrix, Role of different packaging materials, Flavour modification and sensory quality. Silica gel, Clay, Molecular sieve, Humectant salts, Irreversible adsorption.

Unit-IV

Novel MAP gases, testing novel MAP applications, High O₂ MAP, Recyclability of packaging plastics, improving the recyclability of plastic packaging, Testing the safety and quality of recycled material, Using recycled plastics in packaging. Problem of plastic packaging waste, Range of biopolymers, developed novel biodegradable materials. The supply chain for perishable foods, Role of packaging in the supply chain, Creating integrated packaging, storage and distribution: alarm systems and TTIs. New packaging techniques and the consumer, Methods for testing consumer responses, Consumer attitudes towards active and intelligent packaging.

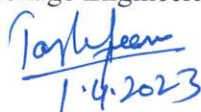
OUTCOMES

No. of Lecture: 45

- 1) The different types of materials and media used for packaging foods.
- 2) Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, labelling of foods

Books Recommended:

1. Ahvenainen, Novel Food Packaging Techniques
2. Robertson, Food Packaging
3. Hanlon, Kelsey & Forcinio, Handbook of Package Engineering



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-III

FS-505 Techniques in Food Analysis (3+0+0)

OBJECTIVE To enable the students to understand the principles and methods of advanced techniques in the analysis of foods

Unit – I

Principles of techniques used in food analysis: Classical methods: Titrimetric analysis, Gravimetric procedures, Solvent extraction methods, Refractometry, Polarimetry, Textural profile analysis of foods, Quantification of sensory attributes- Artificial Tongue and Artificial Nose.

Unit - II

Chromatographic techniques: Basis of chromatography, Paper, TLC, Size exclusion, Ion exchange, Affinity chromatography, High Performance Liquid Chromatography and Gas Chromatography: Concepts and principles, methodology, instrumentation and applications.

Unit - III

Spectroscopic techniques: UV-Visible spectroscopy, Atomic absorption spectroscopy, Fluorescence spectroscopy, Emission spectroscopy, Mass-spectrometry and Fourier-transform infrared spectroscopy.

Unit – IV

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

Unit – V

Electrophoresis: Principle, types, procedure and applications, western blotting, gel documentation; DNA analysis: DNA purification, PCR-based analysis and DNA fingerprinting.

OUTCOME

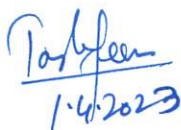
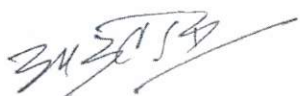
Number of Lectures: 45

The students will learn the following skills:

1. To apply different methods of extracting food components
2. To use different types of spectrophotometers
3. To use instruments that analyze the physical properties of foods

Books Recommended:

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.
3. Winton, A. L. (2001). Techniques of Food Analysis: Agrobios, Jodhpur.
4. Sharma, B. K. (1994). Instrumental Methods of Chemical Analysis: Krishna, Meerut.
5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). Principles of Instrumental Analysis (5 ed.): Harcourt, Singapore.
4. Spectral method in food analysis by Magdi Mossoba, 1999.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)

Semester-III

FS-507 Technology of Milk and Milk Products (3+0+0)

OBJECTIVE: To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry

Unit-1

Dairy industry in India: Scope, strengths and opportunities for dairy industry. Definition, composition and nutritive value of milk, factors affecting composition of milk. Physicochemical properties of milk and milk components. Milk enzymes, enzymatic and acidic coagulation of milk.

Unit-II

Fluid milk processing: Pasteurisation, Homogenization, Sterilization, UHT treatment. Membrane processing of milk: types of membranes, principle of operation, applications of reverse osmosis, ultrafiltration and microfiltration. Technology of condensed and evaporated milk: composition, nutritive value, process of manufacture. Technology of milk powders (WMP, SMP): composition, nutritive value, process of manufacture, defects - their causes and prevention.

Unit-III

Technology of milk products: Cheese- classification, composition, nutritive value, process of manufacture of cheddar, mozzarella, cottage and processed cheese, defects - their causes and prevention. Indigenous milk products - dahi, butter, ghee, channa, paneer etc. Utilization of milk industry by-products.

Unit-IV

Milk and milk products standards and legislations in India, Grading of milk and criterion of grading. Dairy plant sanitation- hygiene in dairy industry. Newer concepts in dairy products- cream powder, butter spread, cheese spread, WPC, lactose powder.

OUTCOME:

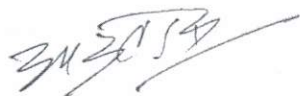
No. of Lecture: 45

After the completion of the course, the students will be able to:

- 1) Understand the manufacturing processes of various dairy products.
- 2) Use technology for value addition and dairy plant sanitation.
- 3) Prescribe processing conditions and new technologies related to dairy sector.

Recommended Books:

- 1) Sukumar De (1977) Outlines of Dairy Technology, Oxford University Press.
- 2) Smit G. (2003) Dairy processing - improving quality, Woodhead Publishing.
- 3) Hohnson M. and Alford (1987) Fundamentals of dairy chemistry. 2nd edition, CBS Publishers.
- 4) Rajagopal, Roy, S.K. (2014) Milk & milk products technology, BS Publishers.
- 5) Early R. (2010) Technology of dairy product, Springer Publishers.
- 6) Ahmed, Tufail (1997) Dairy Plant Engineering and Management, Kitab Mahal, Allahabad.



Tufail
1.6.2023



Course Structure for M.Sc. Food Science

(Effective from Session 2023 Onwards)

Semester-III

FS-509 Technology of Fermented Foods (3+0+0)

OBJECTIVES:

- To understand the Enzyme kinetics, Inhibition kinetics, Immobilization
- To understand the concept of basic fermentation processes and its control systems etc.

Unit-I

Importance and scope of fermentation in food industry, Introduction to fermentation: Rate of microbial growth and death. Fermentation kinetics, Types of fermentation submerged/solid state, Batch /continuous fermentation.

Unit-II

Introduction to Fermenters, Fermenter design, operation, measurement and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, sterilization of air and media; scale up in fermentation.

Unit-III

Traditional fermented foods like idli and dosa. Principles of downstream processing and Product recovery. Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles). Production of Baker's Yeast, Microbial Proteins and fats.

Unit-IV

Food enzymes and Food additives. Oriental fermented foods. Production of alcohols, organic acids, enzymes and immobilization of enzymes. Use of genetically modified microorganisms in food processing. Biological waste treatment.

OUTCOMES

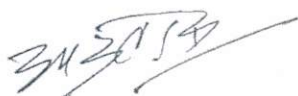
No. of Lecture: 45

The student will be able to

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization.
- Understand the concept of basic fermentation processes and its application during scale up operations.

Recommended Books:

1. Industrial Microbiology - Prescott & Dunn
2. Industrial Microbiology - L.E. Casida
3. Principle of Fermentation Technology - Whittaker and Stanbury
4. Handbook of Indigenous Fermented Foods - K.H. Steinkrus



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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-III**

FS-511/CH 505 IPR and Patent Laws in Food Sector/ Patent Law and IPR Issues (3+0+0)

OBJECTIVES:

- Follow research ethics
- Understand relevance and significance of IPR

Unit-I

Introduction - GATT - A historical perspective, objectives, fundamental principles, GATT rounds. WTO Historical background- Objectives, scope, function and structure, membership and withdrawal, dispute settlement.

Unit-II

Conventions and treaties (WTO, GATT, Paris convention, Madrid protocol, Berne convention, Budapest treaty, etc). Trade related aspects of Intellectual property rights (TRIPs) agreement - An overview, WIPO and its role.

Unit-III

Patents - Indian Patent law, meaning, scope, objectives, patentability criteria, patentable and non-patentable inventions. Kinds of patent applications, procedure for obtaining patent. Patent specification (provisional, complete specification), drafting, patent claims. Patent opposition, enforcement and revocation, fee structure. Patent Cooperation Treaty, Sources of patent information, patent databases.

Unit-IV

Protection of biological material and biotechnology. IPR and Biodiversity. IPR and Plant Breeders Rights (UPOV and PPVandFR Acts). US and European patent system - comparison with Indian patent system. Copyrights - Introduction, how to obtain, scope, term, treaties, infringement. Trademarks- Introduction, how to obtain, scope, term, different types of marks (collective, certification, service).

Unit-V

Industrial designs - Definition, how to obtain, features, international design registration. Geographical indications, Trade secrets, Layout design of Integrated circuits. IP-licensing and technology transfer- licensing agreements, issues in licensing, valuation of technology, data exclusivity. IP infringement issues and enforcement.

OUTCOMES:

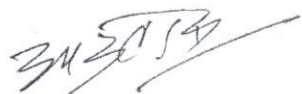
Number of Lectures : 45

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information

Books Recommended:

1. Bhandari Surendra, World Trade Organization and Developing Countries, Deep and Deep Publications, New Delhi.
2. Kumar Ratnesh, World Trade Organization, Deep and Deep Publications, New Delhi.
3. Mittal D.P., Indian Patent Law [As Patent (Amendment) Act, 2005], Taxman's Allied Service (P) Ltd., New Delhi.
4. Wadehra B.L., Law Relating to Patent Trademark Copyright Designs and Geographical Indications, Universal Law



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)

Semester-III

FS-513 Food Plant Design and Sanitation (3+0+0)

OBJECTIVE: To enable the students understand the various concepts of process development, design consideration and cost estimation in food industry

Unit-1

Sanitary considerations of (a) Exterior aspects (b) Interior Aspects. Exterior aspects - Site selection and plant location, Grounds, Exterior, Design, Layout, roof of a food industry. Interior Aspects - Walls and priming, door & doorways, ceiling, floor, lighting, noise, elevators, stairwell and stairs, ventilation, paint/white washing of a food industry.

Unit-II

Personal Hygiene: Sanitary considerations of personal Hygiene in terms of (a) Physical examinations (b) Hand washing (c) Use of caps and gloves (d) Rest room facilities (e) Clothing (f) Jewellery (g) Eating and personal habits.

Unit-III

Food Transport sanitation: Regulatory aspects, of transport sanitation, importance of inspection in receiving, loading, unloading, sanitary design considerations of transport vehicle, pest & rodent control by fumigation, spray.

Unit-IV

Cleaning and sanitization: Differentiation between cleaning and sanitization, types of soil, cleaning agents. Soaps detergent, mechanism of cleaning criterion for selection of a cleaning agent, water for cleaning, cleaning system like CIP, sanitising agents for food industry, selection of a sanitising agent for a food industry, dry cleaning & vacuum cleaning.

Unit-V

Water Sanitation: Water & Steam for food industry sanitation, source & quality of water treatment like chlorination, deionisation, and coagulation/filtration.

OUTCOME:

Number of Lectures : 45

- The students will be able to apply their knowledge to design projects for setting up a Food Processing Industry

Books Recommended:

1. Sanitary design principles for food processing plants - Stinson W.S.
2. Food plant Sanitation - J.H. Litfield, ME Parber,



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**Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)**

Semester-III

FS-525 Technology of Beverages (3+0+0)

OBJECTIVE: To provide an understanding of the science and technology for processing of different types of beverages.

Unit-I

Introduction: Beverages classification, importance of beverages in our diet prospect and scope of beverage industry in India. Packaged drinking water- definition, types, manufacturing processes, quality evaluation, BIS quality standards of bottled water; mineral water, natural spring water, flavoured water, carbonated water.

Unit-II

Fruit juice beverage: juices, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices, production, preservation & packaging. Equipments and machineries for juice pressing, methods of bottling, clarification and debittering of juices. Technology of soft drinks, Manufacturing of carbonated and non-carbonated beverages, technology of carbonation, and application of CO₂ in juice preservation.

Unit-III

Coffee: Production practices, structure of coffee/cherry, coffee processing including roasting, grinding, brewing extraction, instant coffee, de-cafeinated coffee. Tea: Production, processing and chemistry of tea manufacturing, tea products such as black, green, red, yellow, oolong, instant tea, soluble tea, flavoured tea, decaffeinated tea, iced tea, scented tea. Cocoa processing and cocoa beverages. Specialty beverages- whey beverages and utilization of whey in development of fortified drinks

Unit-IV

Alcoholic beverages- types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipments used for brewing and distillation, wine and related beverages, distilled spirits.

Unit-V

Water for beverage: and raw and processed water, methods of water treatment, quality parameters & treatment for beverage industry. Additives for beverages: Natural and synthetic sweeteners and colours, acids, flavours, flavour enhancers. Quality control and Quality standards for beverages, chemical, microbial and sensory evaluation, product shelf life.

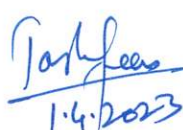
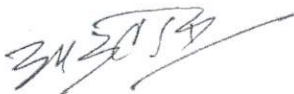
OUTCOME:

Number of Lectures: 45

Students shall have thorough knowledge of processing of fruit juice beverages, carbonated beverages, citrus beverages, tea and coffee.

Recommended Books:

1. Rao, L. J. M. & Ramalakshmi, K. (2011). Recent trends in soft beverages: AFST, India.
2. Priest, F. G. & Campbell, I. (1996). Brewing Microbiology (2nd): Chapman and Hall, .
3. Hui, Y.H. (2004). Handbook of Food and Beverage Fermentation Technology: Marcel
4. Varnam & Sutherland (2009). Beverages Technology, Chemistry and Microbiology.
5. Ashurst PR. (2005). Chemistry and Technology of Soft drink and fruit juices.



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Course Structure for M.Sc. Food Science
(Effective from Session 2023 Onwards)
Semester-IV

FS-556- Project

(20 Credits)

34/5/23

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