St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A++" Grade

Course structure and syllabus of

B.Sc.

FOOD SCIENCE

Under NEP Regulations, 2021

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www.staloysius.edu.in

ESTD : 1880

ST ALOYSIUS COLLEGE (AUTONOMOUS)
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Re-accredited by NAAC with '**A++**' Grade with CGPA 3.67/4 (Cycle 4)
Recognised as Centre for Research Capacity Building under UGC-STRIDE Scheme
Recognised under DBT – BUILDER Scheme, Government of India
College with "STAR STATUS" Conferred by DBT, Government of India
Recognised by UGC as "College with Potential for Excellence"

Date: 21-02-2022

NOTIFICATION

Sub: Syllabus of **B.Sc. FOOD SCIENCE** under NEP Regulations, 2021.
(As per Mangalore University guidelines)

Ref: 1. Decision of the Academic Council meeting held on 18-12-2021 vide Agenda No: 6
2. Decision of the Academic Council meeting held on 09-07-2022 vide Agenda No: 14
3. Decision of the Academic Council meeting held on 02-09-2023 vide Agenda No: 3
4. Office Notification dated 21-02-2022
5. Office Notification dated 17-08-2022
6. Office Notification dated 26-09-2023

Pursuant to the above, the Syllabus of **B.Sc. FOOD SCIENCE** under NEP Regulations, 2021 which was approved by the Academic Council at its meeting held on 18-12-2021, 09-07-2022 & 02-09-2023 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL

ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office.
3. Library

Board of studies meeting was held on Thursday 2nd of December 2021 in the LCRI Director room , Department of Food Science, St Aloysius College, Mangalore.

Board of Studies in Food Science

Sl. No.	Category	Name & Contact details
1	**Chairman/Chairperson**	**Dr. AdarshaGowda**
2	**Members of the Department**	**Dr. S.N. Raghavendra** **Ms. ShilpaLekha M.S.** **Mr. Ashok Kumar C** **Ms. Daniella Anne L. Chyne** **Ms. Sherin Mathew** **Ms. JovitaCarrolSoans** **Ms. Rachitha R** **Mr. Roysten Dias** **Ms. Jenisa** **Ms. Claret**
3	**Members of the Allied Departments**	a) Dr. Richard Gonslaves b) Dr. Asha Abraham, c) Prof Harsha Paul, **d)** Dr. LyneddafnyLasrado
4	**Subject Experts**	**Dr. ArchanaPrabhat** **Dr. Krishna Prasad N**
5	**Vice Chancellor Nominee**	**Dr. Mamtha**
6	**Representative from Industry/ Corporate Sector / Allied Area**	**Mr. Ananthesh V Prabhu** **Mr. Prakash** **Mr. G. Girish** .
7	**Special Invite:**	Dr. Anil Kumar

BOS meeting was held on 17th June 2022

Board of Studies in Food Science

Sl. No.	Category	Name & Contact details
1	**Chairman/Chairperson**	**Dr. Adarsha Gowda**
2	**Members of the Department**	**Dr. S.N. Raghavendra** **Ms. Shilpa Lekha M.S.** **Mr. Ashok Kumar C** **Ms. Daniella Anne L. Chyne** **Ms. Sherin Mathew** **Ms. Jovita Carrol Soans** **Ms. Rachitha R** **Mr. Roysten Dias** **Ms. Jenisa** **Ms. Claret**
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5	**Vice Chancellor Nominee**	**Dr. Mamtha**
6	**Representative from Industry/ Corporate Sector / Allied Area**	**Mr. Ananthesh V Prabhu** **Mr. Prakash** **Mr. G. Girish**
7	**Special Invite:**	Dr. Anil Kumar

Board of studies was held on Thursday 2nd December 2022 in the LCRI Director room, Department of Food Science, St Aloysius College, Mangalore.

Board of Studies in Food Science

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6	Representative from Industry/ Corporate Sector / Allied Area	Mr. Ananthesh V Prabhu Mr. Prakash Mr. G. Girish
7	Special Invite:	Dr. Anil Kumar

B.Sc. (Basic / Hons.) Food Science

Preamble:

In keeping with the Govt. of India's NEP-2020 vision of a holistic and multidisciplinary Under-Graduate education that equips employable graduates with the required skills in domain as well as personality that are required in the 21stcentury, the Govt. of Karnataka constituted Subject-wise Committees to work towards envisaging, designing and drafting a common syllabus with hallmarks being multiple entry and exit points enabling horizontal and vertical mobility. This has now been adapted in Mangalore University with minor changes and shall be effective from the academic year 2021-22.

Salient featuresare as follows:

1. Discipline Core(DSC) or Domain-specificCore Courses inFood Science
2. Discipline Electives (DSE) or ElectiveCourses in theCoreSubject or Discipline.
3. Open Electives (OE) are ElectiveCourses offeredto students fromnon-coreSubjects across disciplines.
4. Skill Enhancement Courses (SEC) that aredomain-specificor generic.
5. 1 hourofLectureor 2hours ofpractical perweekin a semester is assignedone credit.
6. Core discipline theory courses are of 3/4 credits, while practicals are of 2credits

Program Out comes (POs)

At the end ofthe program, Food technology graduates will be able to:

PO 1.**Disciplinary Knowledge**: Bachelor degree in Food Technology helps to apply the knowledge of science, engineering fundamentals, and mathematical concepts to the solution in the field offoodtechnology, scienceand other allied subjects

PO 2.**Communication Skills:** Communicate effectively and write effective reports and design documentation, make effective presentations through seminars, project dissertations

PO 3.**Critical thinking and analytical reasoning:** Recognize the need for, and have the preparation and ability to engage in independent/as an entrepreneur and life-long learning in the broadest context of technological change logical reasoning and capability of recognizing and distinguishing the various aspects of real-life problems.

PO 4.**Problem Solving**: Identify, formulate, review research literature, and analyze complex Food Technology/applications problems and Design solutions for complex problems and design system components or processes that meet the specified needs with appropriate consideration for the food sustainability

PO 5.**Research related skills:** Acquire the practical knowledge and demonstrate the ability to design, conduct/trouble shoot experiments and analyze data in the field of food technology

PO 6.**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate software's to apply for bulk scale/industrial production of technology-based food products

PO 7.**Self-directedlearning**: The student completing this program will develop anability of working independently and to make an in-depth study of various disciplines of food technology.

PO 8.**Moral and ethical awareness/reasoning:** Under stand the impact to f the professional food technology solutions in societal and environmental contexts, and apply ethical principles and commit to professional ethics and responsibilities

PO 9.**Lifelong learning:** This programme provides self-directed learning and lifelong learning skills to think independently anddevelopproblemsolving skillswith respect to foodindustry

PO 10. Ability to peruse advanced studies and research in Allied fields of Foodscience.

Scheme and Syllabusfor B.Sc. (Basic / Hons.)Food Science)

SEMESTER– I								
Group	**CourseCode**	**Titleof theCourse**	**Instruction Hours/week**	**Duration of Exam (Hours)**	**Mark**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.1	FundamentalsofFood Science & Nutrition	3	3	40	60	100	3
	G 514 DC2.1P	FundamentalsofFood Science & Nutrition-Practical– 1	3	3	25	25	50	2
Open Elective Courses								
	G 514 OE1.1	FoodandNutrition	3	3	40	60	100	3
	Total		**9**		**250**			**8**

SEMESTER– II								
Group	**CourseCode**	**Titleof theCourse**	**Instruction Hours/week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.2	Food Processing And Preservation	3	3	40	60	100	3
	G 514 DC2.2P	Food Processing And Preservation	3	3	25	25	50	2
Open Elective	G 514 OE1.2	Foodsafety	3	3	40	60	100	3
	Total		9				**250**	**8**

SEMESTER– III								
Group	**CourseCode**	**Titleof theCourse**	**Instruction Hours/week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.3	Basics of Food Safety and Quality Control	3	3	40	60	100	3
	G 514 DC 2.3P	Basics of Food Safety and Quality Control – Practical 3	3	3	25	25	50	2
Open Elective Courses								
	G 514 OE1.3		3	3	40	60	100	3
	Total		**9**				**250**	**8**

SEMESTER– IV								
Group	**CourseCode**	**Titleof theCourse**	**Instruction Hours/week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.4	Fundamentals offoodchemistryand microbiology	3	3	40	60	100	3
	G 514 DC2.4P	Fundamentals offoodchemistryand microbiology – Practical 4	3	3	25	25	50	2
Open Elective Courses			3	3	40	60	100	3
	Total		9				**250**	**8**

SEMESTER– V								
Group	**Course Code**	**Title of the Course**	**InstructionHours/week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.5	Introductions To Dairy & Fermentation Technology	3	3	40	60	100	3
	G 514 DC2.5P	Introductions To Dairy & Fermentation Technology – Practical 4	3	3	25	25	50	2
Discipline Core Courses	G 514 OE1.5	Spices And Plantation Crop Technology	3	3	40	60	100	3
		Spices And Plantation Crop Technology - Practical 5						
Open Elective Courses								
	Total		9				**250**	**8**

SEMESTER– VI								
Group	**Course Code**	**Title of the Course**	**Instruction Hours/week**	**Duration of Exam (Hours)**	**Marks**			**Credits**
					IA	**Exam**	**Total**	
Discipline Core Courses	G 514 DC1.6	Introduction To Meat, Fish And Poultry Processing	3	3	40	60	100	3
	G 514 DC2.6P	Introduction To Meat, Fish And Poultry Processing – Practical 4	3	3	25	25	50	2
Discipline Core Courses	G 514 OE1.6	Waste Management In Food Industry	3	3	40	60	100	3
		Waste Management In Food Industry - Practical 5						
Open Elective Courses								
	Total		9				**250**	**8**

Pedagogy

For student engagement is predominantly lectures. However, other pedagogies that enhance better student engagement may be adopted for each course. The list includes active/ experiential learning/course projects/problem or project-based learning (PBL)/case studies/ self-study like seminar, term paper or MOOC/field visits/ industrial visits/group activity/ simulations / hackathons etc.

Assessment: Every course needs to include assessment for higher order thinking skills (applying/analyzing/evaluating/creating).These shall necessarily be reflected also in the Question Papers, such that questions of all levels of difficulty are framed. Alternate assessment methods that help formative assessment (i.e. assessment for learning) may also be adopted.

SUBJECT TITLE: FOOD SCIENCE

COMBINATION: Food Science, Chemistry and Biochemistry (FS &CB)

SCOPE OF FOOD SCIENCE:

Food science can be defined as the application of the basic sciences and engineering to the study of fundamental physical, chemical and biochemical nature of foods and the principles of food processing. As such food science is a broad branch which contains within it many specializations such as food microbiology, food chemistry, nutrition, preservation, processing food safety and quality control, and subjects like marketing are also mated with food science it makes more comprehensive.

As the knowledge in food science is a very fundamental to all concerned in food-based business and supply, it becomes imperative that the knowledge in the food science is imparted as branch of science at college and university levels. The food industry, government and academic institutions need to employ the trained personnel, the need to include the subject at bachelor level assumes relevance and significance. Therefore, food science is recognized as an essential and much required subject to be included in college curricula.

PROGRAM SPECIFIC OUTCOMES

Food Science Graduates will be able to:

1. Know the chemistry underlying the properties and reactions of various food components, have sufficient knowledge of food chemistry to control reactions in foods, know the major chemical reactions that limit shelf life of foods, use the laboratory techniques common to basic and applied food chemistry and know the principles behind analytical techniques associated with food.
2. Identify the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, inactivated, killed or made harmless in foods and know the principles involving food preservation via fermentation processes.
3. Incorporate the principles of food science and nutrition in practical, real- world situations and problems.
4. Apply the principles of food science to control and assure the quality of food products and also identify government regulations required for the manufacture and sale of food products.
5. List major properties, functions, and important food sources of the nutrients, describe human nutrient and energy needs throughout the life span and in physical training and translate human nutrient and energy needs into daily food selection utilizing appropriate standards and guidelines.
6. Explain the significance of food practices to nutrition and disease prevention and effectively evaluate meal plans for nutritional adequacy, nutrient density, balance, variety, and calorie control.

CURRICULUMSTRUCTUREFORUNDERGRADUATEDEGREE

B.Sc. FOOD SCIENCE

SEMESTER I

Total Credits for the Program: 180 credits

ProgramArticulationMatrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project internships etc. Elective courses may be listed separately

B.Sc. FOOD SCIENCE

FUNDAMENTALSOFFOOD SCIENCE & NUTRITION 52 hours

(THEORY)

CourseOutcomes:

Aftersuccessful completion ofthis Course, students willbe able to:

To enable students

CO 1. Obtain knowledge of different food groups, their composition and role in diet.

CO 2. To gain knowledge of different plant and animal derived foods and their nutritive values and properties.

CO 3. Different methods of processing and cooking.

CO 4. Critically assess and analyze food science information available in the public domain in an innovative and ethical way.

UNIT –I (13 hours)

Food groups: Basic of food groups. Functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions). Food Pyramid, My Plate. Study of various cooking methods - Boiling, steaming, stewing, frying, baking, roasting, broiling, cooking under pressure. Cereals - composition of rice, wheat, effects of cooking on parboiled, principles of starch cookery, gelatinization.

UNIT –II **(13 hours)**

Introduction to Food: Definition, classification and constituents of food: carbohydrates, lipids, proteins,fat soluble vitamins- (A,D,E and K) water soluble vitamins (thiamin, riboflavin, niacin, pyridoxine, vitamin B12 and vitamin C, minerals, calcium, iron, zinc, iodine and fluorine). Nutritional concept in food design**:** nutritive values of cereals, pulses, oil seeds, fruits, vegetables, fish, meat and eggs. Food Pigments: Anthocyanins , chlorophyll, flavonoids, carotenoids.

UNIT –III **(13 hours)**

Basic terms used in study of food and nutrition Understanding relationship between food, nutrition and health**.** Food Groups, Functions of water in body, water balance &energy balance.Assessment of nutritional status (biochemical, anthropometric, dietary), BMI& BMR of an individual.Balanced diet, malnutrition.

UNIT –IV **(13 hours)**

Functions of food-physiological, psychological and social. Concept of balanced diet. Principles of meal planning. Nutrients, vitamins and minerals. Recommended Dietary Allowance (RDA): Requirement of infants, children, adults, old people, expectant and nursing mothers. Geriatric nutrition, nutrition for athletes.FUNCTIONAL FOOD: Introduction to Functional foods, Prebiotics, Probiotics, Nutraceutical. Organic Foods and GM foods

PRACTICALS

CBCS/Semester System ((2020-21) - I Semester Syllabus

B.Sc. FOOD SCIENCE AND NUTRITION

DSC-1 Paper-1 Lab: FOOD SCIENCE (PRACTICAL)

Hours of instruction 2 per week **Credits**

Internals: **Sem end exam: 50**

1. Food group- Grouping of foods, discussion on nutritive value.
2. Measuring ingredients Methods of measuring different types of foods – grains, flours & quids.
3. Edible portion: Determination of edible portion percentage of different foods.
4. Cooking methods Moist heat methods – (i) boiling, simmering, steaming, & Pressure cooking (ii). Dry heat methods – baking. (iii), Fat as a medium for Coking-shallow and deep fat frying.
5. To study nutritional information in different packed foods available in the market.
6. Qualitative and quantitative determination of carbohydrates in food.\
7. To prepare scrap file showing excess and deficiency of different food components.

Reference Books:

1. N. Shakuntala Manay & M. Shadakshara swamy Food Facts and Principles by, New Age International (P) Ltd. Publishers.
2. Food Science by Srilakshmi , second edition,2002.
3. Food science, Chemistry and Experimental foods by M. Swaminathan.
4. N. Potter & J. Hotchkiss, Food Science CBS Publisher and Distributors.
5. Manoranjan Kalia and SagitaSood, Food Preservation and Processing by Kalyani Publishers.
6. Shubhangini Joshi, Nutrition and Dietetics Tata Mcgraw Hill Co. Ltd.
7. M. Swaminathan, Vol-I Food and Nutrition, Bangalore Printing and PublishingCo.
8. Gopalan C, Rama Sastri BV, Balasubramanian SC .1989. Nutritive Value of

IndianFoods. National Institute of Nutrition, ICMR, Hyderabad.

8. Wardlaw and Insel MG, Insel PM. 2004. Perspectives in Nutrition. Sixth Edition, McGraw Hill.
9. Srilakshmi B 2012. Nutrition Science. 4th Revised Edition, New Age International Publishers.
10. Khanna K, Gupta S, Seth R, Passi SJ, Mahna R, PuriS .Textbook of Nutrition andDietetics. Phoenix Publishing House Pvt. Ltd.
11. ICMR.2010. Recommended Dietary Allowances for Indians. Published by NationalInstitute of Nutrition, Hyderabad
12. Antia, F.P. and Abraham, P. 2011: Clinical Dietetics and Nutrition, Fourth Edition, Oxford University Press.
13. Joshi, V.D. 2005: Handbook of Nutrition and Dietetics, Vora Medical Publications, Mumbai.

B.Sc. FOOD SCIENCE

SEMESTERII

Total Credits for the Program: 180credits

Startingyearof implementation: 2021-2022

Name of the Degree Program: B.Sc Degree/Honours and M.Sc

Discipline/Subject: FoodScience / Technology

ProgramArticulationMatrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project internships etc. Elective courses may be listed separately

B.Sc. FOOD SCIENCE

FOOD PROCESSING AND PRESERVATION 52 hours

Course Objectives:

1. To understand the source and variability of raw food material and their impact on food processing operations.
2. To study the principles and current practices of different processing techniques and its effects on process parameters and product quality.
3. To study the spoilage and deterioration mechanisms in foods and its preventive measures.
4. To have an in-depth understanding of water disposal, shelf life of the food material, packaging materials and food storage.

Course Outcome:

At the end of the Course, students will be able to

CO 1. Describes the principles of food preservation and suggest the application of the preservation process depending on the type of food.

CO 2. Determines the thermal processing conditions (time / temperature) for each type of food and propose a device that matches a particular conservation process.

CO 3. Chooses the appropriate application of certain conservation processes with regard to the preservation of quality and the satisfactory durability of food products.

CO 4. Optimizes process parameters for selected conservation processes taking into account the physico-chemical properties of food products.

Unit-I **(13 hours)**

Food Processing: Primary, secondary and tertiary processing, historical perspective, traditional technologies used in food processing. Effects of processing on components, properties and nutritional value of foods. Food Preservation: History, factors affecting food spoilage (physical, chemical and biological).Dehydration and concentration: methods of drying and concentration, Types and methods of dryers. Food preservation methods

Unit-II **(13 hours)**

FoodPreservation:Thermal and non-thermal processing: sterilization, pasteurization, blanching, canning. refrigeration, freezing, Novel technology (HPP, PEF). Low Temperature:(Thawing, refrigeration, cold storage,de-hydrofreezing):Radiations: (Ultravioletand ionizingirradiations). Preservation by fermentation – Curing and Pickling; Smoking Chemicalpreservatives-(Objectives,principles,typesofpreservatives)

Unit-III **(13 hours)**

Methods in Food Processing - Microwave processing, Extrusion cooking, Ohmic Heating, Reverse Osmosis, Electrodialysis, Ultra-filtration, High Pressure Processing, Supercritical fluid extraction .Cereals, legumes and oilseeds: Structure, composition, primary processing, functionality in food system, processing of wheat, Rice, Peas, Beans, Groundnut, sunflower.

Advances in fortification: synthetic nutrients, techniques of food fortification and stability of nutrients in relation to processing.

Unit-IV **(13 hours)**

Fruits and vegetables: Pre-processing operations (washing, blanching, peeling, sorting

and grading) in Tomato, pineapple, Potato and Cabbage. Meat and fish products: Types, composition, structure and utilization. Milk and milk products: Composition, physical properties of milk, milk fat: composition and structure, chemical reaction of fat (hydrolysis, auto-oxidation).

G 514.3P – Food Processing and Preservation (based on G 514.3)

(Each Practical session is of 3 hours duration)

1. Sun drying and dehydration-cereals, legumes, vegetable based.
2. Study different types of browning reactions: enzymatic and non-enzymatic.
3. To study gelatinization behavior of various starches
4. To study the concept of gluten formation of various flours.
5. To study malting and germination.
6. To study dextrinization in foods.
7. Identification of pigments in fruits and vegetables and influence of pH on them.
8. Preparation of brix solution and checking by hand refractometer.
9. Estimation of salt content in brine.
10. Internal assessment and Practical test

Reference Books:

1. Bawa. A.S, O.P Chauhanetal. Food Science. New India Publishing agency, 2013
2. Roday,S. Food Science, Oxford publication, 2011.
3. B. Srilakshmi, Food science, New Age Publishers,2002
4. Meyer, Food Chemistry, New Age,2004
5. De Sukumar., Outlines of Dairy Technology, Oxford University Press, 2007.
6. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006.
7. Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998
8. Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992
9. Potter NH, Food Science, CBS Publication, New Delhi, 1998
10. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006

SEMESTER III

TotalCredits forthe Program: 180credits

Starting year of implementation: 2021-2022

Name of the Degree Program: B.Sc Degree/Honours and M.Sc

Discipline/Subject: Food Science/Technology

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project internships etc. Elective courses may be listed separately

Course Objectives:

The objectives are to introduce the principles and methods of Food Quality Control and Assurance, principles and selection of panel lists for sensory evaluation and Quality Management System and existing food Standards (ISO).

Course Outcome:

At the end of the Course, students will be able to

CO 1. Analyse and understand the export quality control procedures.

CO 2.Provide frame work on the concepts of Quality Control Activities

CO 3. Learn about the applications of safety management in food industry.

CO 4. Define different food laws and regulations for quality management in food industry.

CO 4. Detect the adulteration in food samples

CO 5. Review of legislative approaches for the management of food safety

BASICS OF FOOD SAFETY AND QUALITY CONTROL

Max. Marks: 80 **Total lectures: 52 hrs.**

UNIT I (13 hours)

Food safety concept - Importance of food safety in the food processing industry Risk classification, National and international food regulatory agencies, General food laws and food safety regulations, Nutritional labelling regulation (mandatory and optional nutrients, nutritional descriptors and approved health claims); Microbial contamination (including cross-contamination/indirect contamination) Chemical contamination, Physical contamination, Allergen contamination.

UNIT II (13 hours)

Food Safety Programs: Definitions and importance, Good Manufacturing Practices (GMPs), Pest Control Program, Facility Maintenance, Personal Hygiene, Supplier Control, Sanitary Design of Equipment and Infrastructure, Procedures for Raw Material Reception, Storage and Finished Product Loading, Sanitation Program. (Sanitation Standard Operating Procedures (SSOPs)., Product Identification, Tracking and Recalling Program, Preventive Equipment Maintenance Program, Education and Training Program

UNIT III (13 hours)

Food Hygiene Programs: Personal hygiene, Training programs, Infrastructure, Personal habits, Hygiene verification, Water in the food industry, Water sources, Water uses, Water quality, Treatments, Cleaning and sanitation, cleaning agents, sanitizing agents, Equipment and systems, Evaluation of sanitation efficacy, Pest Control,

UNIT IV (13 hours)

Hazard Analysis and Risk Assessment: Physical hazards (metals, glass, etc), Chemical hazards (food additive toxicology, natural toxins, pesticides, antibiotics, hormones, heavy metals and packaging components), Biological hazards (epidemiology of biological pathogens: virus, bacteria and fungi). Principal of Hazard Analysis Critical Control Point (HACCP) system. Food safety regulation in India: An overview of Food Regulation in India; Food Laws and Structure, organization and duties of regulatory system. Highlight on Registration and Licensing process. Food safety management systems and certifications.

REFERENCES:

1. Nielsen, S.S, 2004, Introduction to chemical Analysis of foods, CBS Publishers, New Delhi.
2. Ranganna. S., 2001, Handbook of Analysis & Quality control for Fruit & Vegetable Products, Tata McGraw Hill, New Delhi.
3. Pomeranz.Y, Meloan.C.E, 1996, Food Analysis – Theory & Practice, CBS Publiushers, New Delhi.
4. Jacobs.M.B., 1999, Chemical Analysis of Food & Food Products, CBS Publiishers, New Delhi.
5. Jay.J.M, 1996, Modern Food Microbiology, CBS Publishers, New Delhi.
6. Debnath, 2005, Tools & Techniques of Biotechnology, Pointer Publishers, Jaipur.
7. Ingraham, John.L.2004, Introduction to Microbiology, 3 Ed., Thomson brocks/Cole Inc.
8. Tortora G.J et al, 2008, Microbiology: an introduction, Pearson Education
9. Nester, E.W, 2009, Microbiology, McGraw-Hill Higher Education
10. Dubey, R.C., Maheshwari, D.K., 2008, Textbook of Microbiology, S.Chand Publications, ND
11. Adams, M.R., Moss, M.O., 2007, Food Microbiology, New Age International Pvt. Ltd., ND.
12. Pelczar, Reid and Chan, 2008, Microbiology, McGraw hill Ed, ND
13. Ananthanarayan, Panikar, CKJ.,2006, Textbook of Microbiology, Oriental Longman Pvt. Ltd., Hyderabad.
14. Frazier, William, C. 2008, Food Microbiology, Tata McGraw Hill Ed., ND.
15. S.Roday 1998, food Hygiene and sanitation Tata McGraw Hill Ed., ND.
16. Bean Malicse 2012 Principles of food sanitation, safety and hygiene patima University

PRACTICALS

PRACTICAL PAPER III (: Basics of Food Safety and Regulatory Act)

1. Introduction and study of microbiological instruments.
2. Cleaning of glass wares, preparation of media, cotton plugging and Sterilization.
3. Detection of adulteration in foods.
4. Screening tests for the detection of pathogens
5. Isolation of microorganisms from food samples.
6. Study of the microbiological quality of milk by MBR test
7. Determine the Critical Control Points for production line of Milk, Fruits & Vegetables and Meat industry as per HACCP system.
8. To prepare a chart of specifications for different Food products as specified by BIS.
9. Sterility and Swab test.
10. Food Safety audit

SEMESTERIV

Total Credits for the Program: 180credits

Starting year of implementation: 2021-2022

Name of the Degree Program: B.Sc Degree/Honours and M.Sc

Discipline/Subject: Food Science/Technology

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project internships etc. Elective courses may be listed separately

Course Objectives:

1. Develop an advanced understanding of microbiological issues associated with the food continuum.
2. Develop an understanding of the physiological processes by which microorganisms use to survive food processing interventions.
3. To enable understanding of the chemistry of food components, the chemical and biochemical reactions in foods.
4. To impart a systematic knowledge of basic and applied aspects of food chemistry

Course Outcome:

At the end of the Course, students will be able to

CO 1. Students will have a thorough understanding of structure and classification various Components of food..

CO 2. The students will know the process of complete digestion and assimilation of food Component.

CO 3. Students will have a thorough understanding of various factors responsible for food Spoilage.

CO 4. Define and have an overview on food chemistry including composition and the importance of water.

FC--FUNDAMENTALS OFFOODCHEMISTRYAND MICROBIOLOGY

Max. Marks: 80 Total lectures: 52 hrs.

UNIT I (13 hours)

1. Introduction- Importance of food chemistry.Water in foods, structure and its properties.Water activity, free and bound moisture. **Carbohydrate:** functional properties of sugars and polysaccharides in foods, chemical reactions of carbohydrates. **Proteins:** Classification of proteins and their functional properties of proteins, Denaturation, renaturation, Gelation, and Hydrolysis of proteins. Browning Reactions in Food: Browning, Maillard reaction, Caramelization reaction.

UNIT II (13 hours)

2.Lipids & Minerals: Classification of lipids, Physical and Chemical properties of lipids. Effect of frying on fats, Changes in fats and oils on storage and its prevention, Technology of edible fats and oils - Refining, Hydrogenation and Interesterification, Minerals: Major and minor minerals, Toxic metals Natural Food Pigments: Introduction. and classification, Water soluble and insoluble food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments) . Introduction to enzymes.

UNIT III (13 hours)

3. Concepts of Microbiology: Introduction,historicaldevelopmentsofgeneralandfood microbiology; Scope of microbiology, prokaryotes and eukaryotes; classification of microorganisms-a brief account; sources of microorganisms in foods; microbial growth, growth curve; factors affecting growth-intrinsic and extrinsicfactors,uses of microorganisms, Food borne illness, typesof Food borne illness, Basics of Microscopy.

UNIT IV (13 hours)

4. Microbial Toxins and Control of Micro-organisms: Microbial Toxins (Endotoxin and Exotoxin), Introduction and types. Control of Micro organisms**:** Control of micro organisms by physical, chemical and other chemotherapeutic agents, Hurdle technology, Aflatoxin

REFERENCES

1. Food Chemistry by L H Meyor (CBS Publisher, Delhi)
2. Food Facts and PrincipalbyN. Shakuntala Manay & M. Shadakshara swamy(New Age International(P)Ltd. Publishers, New Delhi)

1. Food Chemistry by O.R. Fennema, 2nd edn. (Marcel Dekkar Inc.)
2. Food Chemistry by HD Belitzand W. Groech(Springer Publ.)
3. Food Additives by S.N. Mahindru
4. Food Processing and Preservation by B. Siavsankar (Prentice Hall India)
5. Pelezar, M.Iand Reid, R.D.(1993)Microbiology McGraw Hill Book Company, New York, 5th Edition.
6. Frazier, W.C.(1988)FoodMicrobiology, McGraw HillInc. 4th Edition.
7. Doyle, P. Bonehat, L.R. and Mantville, T.J-(1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.
8. Text book of Microbiology(6th edition) by Ananth narayan & CKJ Paniker
9. Basic Food MicrobiologybyGeorge J. Banwart
10. FoodMicrobiologyby M R Adams and M OMos
11. Industrial microbiology L.E.Casida
12. A text book of Biotechnology by R.C.Dubey
13. Neelima Garg. Laboratory Manual of Food Microbiology. 2010. I.K. International

PRACTICAL PAPER II BV-(134.1)

FUNDAMENTALS OF FOOD CHEMISTRY AND MICROBIOLOGY

1. Introduction and study of microbiological instruments.
2. Basic activities in the food microbiology laboratory (Cleaning of glass wares, Preparation of media, cotton plugging and Sterilization).
3. Techniques to isolate, culture and sub-culture microbes
4. Viable cell count by serial dilution technique
5. Staining techniques
6. 6 Determination of moisture in a given food sample
7. Determination of ash in a given food sample.
8. Determination of crude fiber t in a given food sample
9. Estimation of acidity of given food sample/beverage
10. Acid value of Fat /oil.
11. Determination of crude protein in a given food sample using Kjeldahl's apparatus

PRACTICAL III

– Project Work- 1

SEMESTER-V

INTRODUCTIONS TO DAIRY & FERMENTATION TECHNOLOGY (THEORY)

Max. Marks: **Total lectures: 52 hrs.**

Course Objectives:

1) To understand need and importance of fermentation.
2) To study the various types of micro-organisms used in fermentation process
3) To provide knowledge about metabolites.
4) To learn the manufacturing process of various dairy products
5) To impart knowledge about processing of milk and its products and legislation for the quality control of milk and milk products.

Course Outcome:

- After successful completion of this course students will be able to understand production of various dairy products.
  Organization and operations involved in milk processing unit.
- To understand legislation for the quality control of milk and milk products.
- After successful completion of this course students will be able to understand screening process, fermenters, metabolites, production and purification of enzymes Plant cell culture process and production of fermented foods.

Unit-I **(13 hours)**

1. **Processing of Milk:** Status of Dairy Industry in India. Cooperative Dairying. Chemical composition of milk Principle and methods of milk processing (Filtration, Clarification, Pasteurization, Homogenization, Sterilization). Types of processed milk: pasteurized, toned, double-toned, and skim milk, flavored & fermented milk, infant milk, milk powder . Homogenization: Effect of homogenization on physicochemical properties of milk. UHT Processing, aseptic packaging. Membrane processing of milk: types of membranes, principle of operation, applications of reverse osmosis, ultrafiltration and microfiltration. Dairy plant sanitation- hygiene in dairy industry.

Unit-II **(13 hours)**

2. **Milk Products**: composition, process of manufacture, defects (their causes and prevention). Technology of indigenous milk products: *dahi* ,butter, ghee, cheese spread, whey protein concentrates. Utilization of milk industry by-products: Importance/Need and food applications of dairy products. Probiotics and their applications. Preparation methods and principles of Paneer, cheddar Cheese, Curd, Yoghurt.

Unit-III **(13 hours)**

3. Introduction to Fermentation Technology: Types of fermentations, fermentation kinetics (Microbial Growth Curve, fermenter design, Types of fermenter, fermentation systems. Process description and control for preparing fermented products. Traditional Indian products like *idli, dosa, dhokla*. Soya based products like soya sauce, natto.

Unit-IV **(13 hours)**

4.**Downstream processing in fermentation**: objectives and problems with downstream processing; various equipment for product recovery. Membrane Technology. Outline of Brewing, Malts, Brewing liquors, Milling and Mashing, Processing of Beer, types of beer, malting. Wine Processing. Importance of Yeast in Fermentation Process.

REFERENCES:

1. Sukumar, De (1994).Outlines of Dairy Technology. Oxford University Press.
2. SmithG. (2003).Dairy processing improving quality. Wood head Publishers.
3. Andrews, A.T.(1994).Biochemistry of Milk Products. Woodhead Publishers.
4. Technology of Dairy Products by Early, R.
5. Aneja P, Mathur BN, Chandan RC & Banerjee AK.2002. Technology of Indian Milk Products. Dairy India Pub.
6. Maurice Shachman. 2000. The soft drinks companion-A technical handbook for the beverage industry published by CRC Press.
7. Shakuntala Manay. N and M. Shadakshara Swamy. 2000. FOODS: Facts and Principles Published by New Age International(p) ltd. Publishers
8. Hui et al., Hand book of food and beverage fermentation
9. Boulton , Brewing yeast and fermentation.

INTRODUCTIONS TO DAIRY & FERMENTATION TECHNOLOGY (based on G 514.3)

(Each Practical session is of 3 hours duration)

1. To check the heat stability of milk by COB and Alcohol tests.
2. Quantitative estimation of acidity of milk by Titration method.
3. Determination of specific gravity, SNF % and TS% of milk.
4. To determine the Casein content of the milk.
5. To check the sterility of milk by Turbidity test.
6. Preparation of Ghee by different methods
7. Preparation of dahi, cream and buttermilk
8. Estimiation of free fatty acids in ghee sample
9. Estimation of milk PH
10. Phosphate test for pasteurization milk.
11. Adulteration test milk.
12. Milk based beverages
13. Preparation of natural sauerkraut fermentation
14. Preparation of yoghurt and analysis
15. Wine production+ Beer production
16. Fermented traditional foods.

REFERENCES:

1. Vogel, H. C. and Todaro, C.L.(2005).Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment, 2nd Edition, Standard Publishers.
2. El-Mansi, E.M.T.(2007). Fermentation Microbiology an Biotechnology2nd Edition, CRC/Taylor & Francis.
3. Joshi, V.K. and Ashok Pandey, (1999), Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology, Vol. I & vol. II Educational Publisher.
4. Peppler, H.J. and D.Perlman, (2004), Microbial Technology: Fermentation Technology, 2nd Edition, Vol. II Academic Press/Elsevier.
5. Stanbury, P.F.,A. Whitaker and S.J.Hall, (1997), Principles of Fermentation

Technology, 2nd Edition Aditya Books(P) Ltd.

6. Philip R Ashurst. 1998. Chemistry & Technology of soft drinks & fruit juices published by Blackwell Publishers.
7. Mitchel AJ. 1997. Formulation and production of carbonated soft drinks published by Blackwell Publishers
8. Maurice Shachman. 2000. The soft drinks companion-A technical handbook for the beverage industry published by CRC Press.
9. Shakuntala Manay. N and M. Shadakshara Swamy. 2000. FOODS: Facts and Principles Published by New Age International(p) ltd. publishers
10. Hui et al., Hand book of food and beverage fermentation
11. Boulton , Brewing yeast and fermentation.
12. Outlines of Dairy Technology by Sukumar De, Oxford University Press.
13. Principles of Dairy Processing by James N. Warner, Wiley Eastern Ltd.
14. Milk and Milk Products by Eckles, Combs; and Macy, Tata McGraw Hill.
15. Technology of Indian Milk Products by Aneja et al. A Dairy India Publication.

SEMESTER VI

FS 1.2 SPICES AND PLANTATION CROP TECHNOLOGY (THEORY)

Max. Marks: **Total lectures: 52 hrs**

Course Objectives: To develop the skills on the postharvest changes in plant based foods, their losses and to preserve food by suitable packaging.

Course Outcome:

- Students will have a thorough understanding the unit operations followed for raw form to an edible form of Spices, Herbs, cereals and legumes.
- The students will know the importance of various methods to identify any disorder in fresh commodities.
- Students will have a thorough understanding on various methods of preparation of food packaging materials, their defects and standards.
- The students will know the importance of packaging in food preservation, shelf-life determination and deterioration of nutritional components with the use of various types of packaging materials.

Unit-I **(13 hours)**

1.Importance of spices: Status and scope of spice and flavour processing industries in India; Spices, Herbs and seasonings**,** Spices–production and importance–pepper, cardamom, chilli, turmeric, ginger, clove, nutmeg and other minor spices. Stage of harvesting and harvesting methods -Role and Status of Post & Pre Harvest Technology, spices as living products: Chemical composition; pre and post harvest changes, maturity standards for storage, desirable characteristics of Spice processing, Cleaning, grading, packaging and storage of spices. Methods –merits and demerits.

Unit-II **(13 hours)**

2. Processing of spices: Processing of major and minor spices– pepper, cardamom, chilli, turmeric, ginger, clove, nutmeg, vanilla–quality analysis of spices-processes

involved in the manufacture of oleoresins and essential oils. Different methods of drying and storage, microbial contamination of stored product, influence of temperature and time combination on active principles of plantation crops- traditional and mechanical drying- construction and operation of different mills. quality control; fumigation and irradiation of spices. Cryogenic grinding.

Unit-III **(13 hours)**

3.Processing of coconut, oil palm, Arecanut and cashew: Processing of plantation crops– production and importance–processing of Cocoa, coconut, oilpalm ,arecanut, cashew–harvesting and stages of harvest – drying, cleaning and grading – production of value added products – packaging and storage of produces.

Unit-IV **(13 hours)**

4. Processing of coffee, tea, cocoa and vanilla: Processing of coffee, tea, cocoa and vanilla–methods, process and equipment– value added products– packaging and storage. **Spice Essential Oils:** Defintion, methods of extraction, isolation, separation equipments.

REFERENCE:

1. Pruthi, J.S. 2001. Minor Spices and Condiments: Crop management and post harvest technology, ICAR Publications, New Delhi, India pp. 1-781.
2. Pruthi ,J.S. 1998. Major Spices and Condiments: Crop management and postharvest technology, Reprint: ICAR Publications, New Delhi, India pp. 1-514. K. V.Peter, 2004, Handbook of herbs and spices, Woodhead Publishing Ltd ,Cambridge England.
3. The complete Book on Coconut & Coconut Produts (Cultivation &Processing).By NIIR Board, Asia Pacific Business Press Inc., New Delhi– 110 007.
4. Hand Book on Spices. By NIIR Board, Asia Pacific Business Press Inc., New Delhi–110007.
5. Banerjee B. 2002. *Tea Production and Processing*. Oxford Univ. Press.

6. Minifie BW. 1999. *Chocolate, Cocoa and Confectionery Technology*. 3rd Ed. Aspen Publ.
7. NIIR. 2004. *Handbook on Spices*. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.

G 514.3P –SPICES AND PLANTATION CROP TECHNOLOGY (based on G 514.3) (Each Practical session is of 3 hours duration)

1. Extraction of essential oil in spices.(Clove oil)
2. Detection of adulteration in spices.
3. Analysis of cocoa beans
4. Analysis of chocolate
5. Extraction of virgin coconut oil.
6. Estimation of caffeine in coffee.

SEMESTER - VII

INTRODUCTION TO MEAT, FISH AND POULTRY PROCESSING

(THEORY)

Max. Marks: **Total lectures: 52 hrs.**

Course Objectives:

- To understand need and importance of livestock, egg and poultry industry.
- To study structure, composition and nutritional quality of animal products.
- To study processing and preservation of animal foods.
- To understand technology behind preparation of various animal food products and byproduct utilization.

Course Outcome:

- Students will get knowledge about structure of meat, pre and post mortem examination of meat and poultry.
- Students will acquaint with different techniques of meat and fish processing and preservation along with slaughter house by product utilization.
- Slaughtering, post mortem physico-chemicals changes knowledge will also be gained by students.

Unit-I **(13 hours)**

1. **Status and scope of meat industry in India**: Development of meat and poultry industry in India and its need in nation's economy. Structure and physico-chemical properties of muscle meat: meat pigments, composition and nutritive value, conversion of muscle into meat. Global commercial fisheries resources, production trends.

Unit-II **(13 hours)**

2. **Meat-nutritional quality:** Meat and poultry, structure of muscles-factor affecting quality of fresh meat and their quality Meat Quality-color, flavor, texture, Water-Holding Capacity(WHC),. Postmortem changes – rigor mortis. postmortem glycolysis, rigor mortis and contraction of muscles. Meat products –

RTE meat products, meat curing. Sausages-processing. Poultry: Pre-slaughter care and consideration; Operations in preparation of dressed poultry, its storage and marketing; Quality and safety considerations; utilization of by-products. Poultry cuts. canning of meat,

Unit-III **(13 hours)**

3. **Fish preservation** - low temperature, chilling and freezing, Thermal processing, dehydration- curing and smoking, preservation using antibiotics, preservation by irradiation. Types of fish. post mortem changes in fish, handling, storage and transportation of fish. Marine products segment includes sundried, artificially dehydrated, radiation preserved, processed, preserved and canned fish. By products of fish processing industry.

Unit-IV **(13 hours)**

4. **Egg processing:** Structure, composition, nutritional and functional characteristics of eggs. Grading, spoilage, storage and transportation of whole eggs. Processing of eggs for liquid products (white, yolk and whole egg) and solid products (albumen, whole egg powder) for preservation through freezing & drying. Types of egg products. storage and transportation.

REFERENCES:

1. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
2. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
3. Outlines of Dairy Chemistry, De S; Oxford.
4. Richardson and Mead. 1999. Poultry meat science.
5. Pearson and Tauber. 1989. Muscle and meat biochemistry.
6. Pearson and Dutson. 1994. Quality attributes and their measurement in meat poultry
7. Egg Science and Technology by Stadelman WJ, and Cotterill OJ, 2002, CBS Publishers, New Delhi.
8. The Meat We Eat by Romans. JR and Costllo WJ, Carlson WC, Greaser ML and Jones KW, 2004, Interstate Publishers, USA

PRACTICAL CONTENTS

INTRODUCTION TO MEAT, FISH AND POULTRY PROCESSING (based on G 514.3)

(Each Practical session is of 3 hours duration)

1) Estimation of moisture content of meat
2) Cutout analysis of canned meats/retort pouches
3) Estimation of protein content of meat
4) Analysis of frozen meat/meat emulsion products
5) To study shelf-life of eggs by different methods of preservation
6) Evaluation of eggs for quality parameters(market eggs, branded eggs)
7) To perform freezing of yolk/albumen
8) Meat/Egg product formulation

Books Recommended:

1) Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3) Pearson & Gillet Processed Meats,3 Ed, CBS Publication, New Delhi, 1997
4) ShaiBarbut, Poultry Products Processing, CRC Press 2005
5) Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002.
6) Poultry Meat and Egg Production by Parkhurst & Mountney.
7) Principles of Meat Science by JC Forest, ED Aberle, HB Hedrick

SEMESTER VIII

WASTE MANAGEMENT IN FOOD INDUSTRY

(THEORY)

Max. Marks: **Total lectures: 52 hrs.**

Course Objectives:

- To acquaint with importance of food wastes for resource generation.
- To familiar with various technologies for recycling of waste.
- To understand Waste Management and Effluent treatment**.**

Course Outcome:

- Students will have a thorough understanding the biotechnological tools and techniques.
- The students will know the importance of various fermentation methods to design various fermented foods and food products.
- Students will have a thorough understanding on utilization of food wastes to produce value-added products or ingredients.
- The students will know the importance of research on new product development and its scope**.**

Unit-I **(13 hours)**

1. Introduction to Waste Managements: Introduction, status in India, definition, origin and type of waste and by products, their identification, classification, composition and characterization, need for treatment and utilization, impact on environment, food waste as source of biogenic raw material and energetic utilization. Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by different methods. .

Unit-II **(13 hours)**

2. Introduction to Food Waste Treatment, Basic unit operations, techniques & equipment for treatment, primary treatments like screening, sedimentation, skimming, floatation coagulation &flocculation, flow equalization, filtration, adsorption, chemical oxidation, membrane separation, ion exchange. Anaerobic & aerobic digestion of organic wastes, activated sludge process, biomass generation & its utilization. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermicomposting pit.

Unit-III **(13 hours)**

3.Food Wastes and By-products Related to Specific Processing Industries; Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry**,** sugar industry,grains andmillingindustry,fermentation (alcohol and beer),livestock and poultry, fish, meat.

Unit-IV **(13 hours)**

4. **Food Methods in Food Waste Management:** handling and treatment, Farm wastes. Incineration of solid food waste and its disposal. Waste Management and Effluent treatment of Food industry Introduction to Waste Management, Waste disposal – Types of Waste, Method of Waste disposal – Land filling, anaerobic, recycling digestion Measurement of BOD & COD..**FutureTrends**, introduction to legal and statutory requirements for food waste handling, treatment and disposal.

Reference
s

1. Waste Management for the Food Industries, by IoannisS. Arvanitoyannis, First edition 2008, Elsevier Inc, USA.
2. Food and Agricultural Wastewater Utilization and Treatment, Sean X.Liu, First edition 2007, Blackwell Publishing,Iowa50014, USA.
3. ManagingFoodIndustryWaste, ROBERT R. ZALL, First edition, 2004, Blackwell Publishing Professional, Iowa, USA.
4. The Treatment and Handling of Waste by Bradshaw AD Chapman & Hali.
5. Alternative Strategies for the Treatment of Food Processing Waste by Rockey J.
6. Food ProcessingWasteManagement byGreen J.H. AVIPublications.
7. Post harvest Technology of Fruits and Vegetables by L.R. Verma. Indus Pub.
8. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
9. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
10. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.

WASTE MANAGEMENT IN FOOD INDUSTRY (based on G 514.3)

(Each Practical session is of 3 hours duration)

1. Utilization of by products from different food waste.
2. Lycopene extraction from tomato peel.
3. Isolation of starch in potato peel
4. Extraction of pectin from citrus peel
5. Utilization of waste for preparation of different products like vinegar, starch, pectin.
6. Biogas production.
7. Solid waste management, liquid waste management. Eg- vermiculture
8. Waste management in diary industries
9. Mango bar preparation
10. Urva market visit