SHIVAJI UNIVERSITY, KOLHAPUR

Accredited by NAAC with 'A' Grade

Choice Based Credit System

Syllabus for

M. Sc. Part - I

Food Science and Technology

Semester I and II

(Syllabus to be implemented from June 2019)

Department of Food Science and Technology

M. Sc. Food Science and Technology

Pos, PSOs and COs

Program Outcomes (POs)	
PO1	Post Graduates will have an ability to apply knowledge of Food Science, Food Processing, Food Engineering and Technology
PO2	Post Graduates will have an ability to analysis the problems in food science, food processing and food technology, and will be competent to control them during foods manufacturing and storage
PO3	Post Graduates will have an ability to identify problems and design to resolve the problems in the actual situations during food processing, food quality controlling, food packaging and storage
PO4	Post Graduates will have an ability to express practical proficiency in the field of food analysis, food processing and food preservation
PO5	Post Graduates will have advanced knowledge of food microbiology, food science, food engineering, food quality and food processing technology
PO6	Post Graduates will have an ability of designing and development of food products as per the need of society keeping the value of food safety and health benefits
PO7	Post Graduates will have an ability to understand the impact of the professional scientific and technical solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	Post Graduates will have an ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	Post Graduates will have an ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Post Graduates will have an ability to communicate effectively for self development
PO11	Post Graduates will have knowledge of industrial economics and management of food industries
PO12	Post Graduates will have an ability to recognize the need, and have preparations and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs)	
PSO1	Post Graduates will apply the knowledge of food chemistry, food preservation, food processing and food packaging for the effective utilization of agricultural commodities to develop healthy and nutritious foods
PSO2	Post Graduates will design economically feasible equipments for the modernization of traditional food processing methods
PSO3	Post Graduates will apply the knowledge of food engineering and technology principles from the various aspects of food technology and related disciplines to solve practical and real-world problems

Course Name	Course Outcomes (CO's)	
CC-101:Principles of Food Processing and Preservation	CO1	Understanding of the need for food preservation and processing.
	CO2	Understanding of the different preservation technique
	CO3	Knowledge of the principles of food spoilage and the ways to prevent
	CO4	Understanding of identification & selection of appropriate processing equipments and preservation methods for the specific foods
	CO5	Knowledge indirect approaches to food preservation: packaging, hygienic design, sanitation, GMP
	CO6	Understanding of SOPs and SSOPs during laboratory exercise.
CC-102: Food Microbiology	CO1	Be able to understand and identify the various microbes associated with foods and food groups.
	CO2	Enable students to understand and use various microbiological techniques for the study of foods.
	CO3	Be able to understand and identify the role of this microbe in food spoilage, food preservation.
	CO4	be able to acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.
	CO5	Understand the methods used to detect pathogens in foods.
	CO6	Enable students to understand the methods of isolating and characterizing various microbes associated with foods and food groups.
CC-103: Food Chemistry	CO1	The chemistry of food to control a chemical and biochemical reaction that influence food quality
	CO2	The principles behind analytical techniques associated with food components and related problems
	CO3	The role of food nutrients and its use for preservation of food (concepts emphasized in a laboratory experiment)
	CO4	To study the basic nutrients and their requirements for human nutrition
	CO5	Evaluate new product development.
	CO6	Demonstrate practical proficiency in a food analysis laboratory.
CC-104: Biochemistry and Nutrition	CO1	Better understanding in physiological and metabolic functions of nutrients
	CO2	Familiarize nutritional assessment, RDA and Dietary Recommendations & guidelines
	CO3	Understanding and determining BMR and body surface area
	CO4	Understanding of food composition and energy balance in dietary planning
	CO5	Effective understanding of diet plan formulation for health and for nutrition-related disorders.
	CO6	Identifying appropriate techniques for Biochemical analysis of blood, urine

CC-201: Principles of Food Engineering	CO1	Understanding the basic principles of various food unit operations and its applications in food processing
	CO2	Knowledge of the food processing equipments used for the different unit operations.
	CO3	Understanding and practical experience of equipments, & how various unit operations work individually and together.
	CO4	Understanding of the calculations of mass balance and energy balance of food processes
	CO5	The students understood the importance of Food Process Engineering as one of the major pillars of Food Sci. and Tech. discipline.
	CO6	Obtain knowledge in application of scientific principles in the processing technologies specific to the materials.
	CO7	Develop an ability to identify, formulate, and solve engineering problems
CC-202: Cereal and Legume Technology	CO1	Understand the structure of the grains (Cereals and Legumes) and the components of commercial products
	CO2	Better understanding of the concepts of physiological characteristics of cereals and legumes
	CO3	Able to gain knowledge in different processing of Cereals and legumes and also its value added products.
	CO4	Identify the common faults and causes in cereal products
	CO5	Understand quality attributes the laboratory techniques to assess grain and flour quality
	CO6	Thorough Knowledge and understandings of the specific processing technologies used for different cereals and legumes and products
CC-203: Fruit and Vegetable Technology	CO1	Preserving the fruits and vegetables and their products results into availability of them in off season.
	CO2	Bi-products can be prepared from fruits and vegetables.
	CO3	Storage of food material in perfect consumable condition for a longer time without undergoing any spoilage can be possible.
	CO4	By the use of various methods shelf -life of fruits and vegetables can be extended and used as material for processing units.
	CO5	Processing gives value addition to fruit and vegetables due to which cash crop farmers get more income from the field.
	CO6	Identify the common faults and causes in fruits and vegetable product processing
CC-204: Fermentation Technology	CO1	Application of biological and engineering principles to problems involving microbial and biological/biochemical systems.
	CO2	Understand the work space, tool and equipment for fermented products
	CO3	Understanding the basic principles of fermentation process and its applications in food processing
	CO4	Recognize the fundamentals of fermentation technology and Assess modeling of bioprocesses
	CO5	Distinguish bioreactor operations and scale-up of bioreactors
	CO6	Analyze the bioprocess paradigm: Scale-down, simulation and economics, sterilization, and bio-burden in biological manufacturing
	CO7	Justify and analyze the problem associated to quality of fermented products

M. Sc. FOOD SCIENCE AND TECHNOLOGY STRUCTURE (CBCS PATTERN) (2019-20)

M. Sc. Part – I

SEMESTER – I (Duration – Six Month)												
TYPE	**SR. NO.**	**COURSE CODE**	**TITLE OF THE PAPER**	**TEACHING SCHEME**			**EXAMINATION SCHEME**					
				Theory and Practical			**University assessment (UA)**			**Internal Assessment (IA)**		
				LECTURES (per week)	**HOURS (per week)**	**CREDITS**	**MAX. MARKS**	**MINI. MARKS**	**EXAM. HOURS**	**MAX. MARKS**	**MINI. MARKS**	**EXAM. HOURS**
CGPA	1	CC-101	Principles of Food Processing & Preservation	4	4	4	80	32	3	20	8	1
	2	CC-102	Food Microbiology	4	4	4	80	32	3	20	8	1
	3	CC-103	Food Chemistry	4	4	4	80	32	3	20	8	1
	4	CC-104	Biochemistry and Nutrition	4	4	4	80	32	3	20	8	1
	5	CCPR-105	Laboratory Course I	16	16	8	200	80	---	---	---	*
Total (A)				**---**	**---**	**24**	**520**	**---**	**---**	**80**	**---**	**---**
Non-CGPA	1	AEC-106	Communicative English - I	2	2	2	---	---	---	50	20	2
SEMESTER – II (Duration – Six Month)												
	1	CC-201	Principles of Food Engineering	4	4	4	80	32	3	20	8	1
	2	CC-202	Cereal and Legume Technology	4	4	4	80	32	3	20	8	1
	3	CC-203	Fruit and Vegetable Technology	4	4	4	80	32	3	20	8	1
	4	CC-204	Fermentation Technology	4	4	4	80	32	3	20	8	1
	5	CCPR-205	Laboratory Course II	16	16	8	200	80	---	---	---	*
Total (B)				**---**	**---**	**24**	**520**	**---**	**---**	**80**	**---**	**---**
Non-CGPA	1	SEC-106	Fundamentals of Information Technology - I	2	2	2	---	---	---	50	20	2
Total (A + B)						**48**	**1040**	**---**	**---**	**160**	**---**	**---**

M. Sc. FOOD SCIENCE AND TECHNOLOGY STRUCTURE (CBCS PATTERN) (2019-20)

M. Sc. Part – II

SEMESTER – III (Duration – Six Month)													
	SR. NO	COURSE CODE	TITLE OF THE PAPER	TEACHING SCHEME			EXAMINATION SCHEME					
				Theory and Practical			University assessment (UA)			Internal Assessment (IA)		
				LECTURES (per week)	HOURS (per week)	CREDITS	MAX. MARKS	MINI. MARKS	EXAM. HOURS	MAX. MARKS	MINI. MARKS	EXAM. HOURS
CGPA	1	CC-301	Technology of Meat, Fish and Poultry Products	4	4	4	80	32	3	20	8	1
	2	CCS-302	Technology of Milk and Milk Products	4	4	4	80	32	3	20	8	1
	3	CCS-303	Food Additives, Contaminants and Toxicology	4	4	4	80	32	3	20	8	1
	4	DSE-304	Food Quality and Safety Management	4	4	4	80	32	3	20	8	1
	5	CCPR-305	Laboratory Course III	16	16	8	200	80	---	---	---	*
Total (C)				**---**	**---**	**24**	**520**	**---**	**---**	**80**	**---**	**---**
Non-CGPA	1	AEC-306	Communicative English - II	2	2	2	---	---	---	50	20	2
	2	EC	SWAYAM/MOOCs/Online	Number of lectures and credits will be as specified on SWAYAM / MOOC Course / Online Courses								
SEMESTER – IV (Duration – Six Month)												
	1	CC-401	Technology of Oilseeds and Fats	4	4	4	80	32	3	20	8	1
	2	CCS-02	Food Biotechnology	4	4	4	80	32	3	20	8	1
	3	CCS-403	Post-Harvest Technology of Plantation Crops	4	4	4	80	32	3	20	8	1
	4	DSE-404	Food Packaging	4	4	4	80	32	3	20	8	1
	5	CCPR-405	Project & Laboratory Course IV	16	16	8	200	80	---	---	---	*
Total (D)				**---**	**---**	**24**	**520**	**---**	**---**	**80**	**---**	**---**
Non-CGPA	1	SEC-406	Fundamentals of Information Technology - II	2	2	2	---	---	---	50	20	2
	2	GE-407	Food Analysis	2	2	2				50	20	2
Total (C + D)						**48**	**1040**	**---**	**---**	**160**	**---**	**---**

COURSE CONTENT

CC-101: Principles of Food Processing and Preservation (4 credits, 60 lectures)

Unit-1 (1credit, 15 lectures)

Scope and importance of food processing: national and international perspectives.
Food processing techniques and types of processed products
(Minimally Processed, Intermediate Processed and Highly Processed Food Products)
Principles of preservation methods.
Chemical preservations of foods.

Unit-2 (1credit, 15 lectures)

Food preservation by low-temp: Cold Storage, Chilling and super chilling, Refrigeration, Freezing and Freeze-drying. Cryogenic preservation. Advantages and disadvantages of low temperature preservation techniques.

Unit-3 (1credit, 15 lectures)

Food preservation by heating: Drying, Dehydration, Osmotic Dehydration, Blanching, Cooking, Canning, Pasteurization, Sterilization, Baking and Extrusion cooking.

Unit-4 (1credit, 15lectures)

Non-thermal preservation: Hydrostatic pressure, Dielectric heating, Ohmic Heating, Radiofrequency heating, Microwave processing, Irradiation, Membrane technology and Hurdle technology.

Suggested Readings

Hosahalli S. Ramaswamy, Michele Marcotte. 2005. Food Processing: Principles and Applications. CRC Press. Taylor & Francis Group. Boca Raton, Finland.
Fellows, P. and Ellis H. 1990. Food Processing Technology: Principles and Practice, New York.
Jelen, P. 1985. Introduction to Food Processing. Prentice Hall, Reston Virginia, USA.
Norman N. Potter and Joseph H. Hotchkiss. 1998. Aspen Publishers Inc., Maryland.
Arsdel W.B., Copley, M.J. and Morgen, A.I. 1973. Food Dehydration. AVI, Westport.
Bender, A.E. 1978. Food Processing and Nutrition. Academic Press, London.
Lewis, M.J. 1990. Physical Properties of Food and Food Processing Systems. Woodhead, UK.
Wildey, R.C.1994. Minimally Processed Refri. Fruits and Vegetables. Chapman and Hall, London.

CC- 102: Food Microbiology **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

History and scope of food microbiology. Types of micro-organism normally associated with food-bacteria, yeast and mold. Diversity of Habitat. Microbial growth pattern. Intrinsic and extrinsic factors affecting growth of micro-organisms.

Unit-2 (1 credit, 15 lectures)

Micro-organisms in natural food products and their control. Biochemical changes caused by micro-organisms, deterioration and spoilage of various types of food products, microbial food fermentation. Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.

Unit-3 (1 credit, 15 lectures)

Microbial quality control and microbial standards for foods.
Food microbiology and public health. Food born diseases and food born illness.
Food poisoning and microbial toxins. Food borne intoxicants and mycotoxins.

Unit-4 (1 credit, 15 lectures)

Microbiological examination of food. Direct examination, Culture Techniques
Enumeration methods – Plate count and Most probable number count.
Rapid detection techniques for spoilage micro-organisms and toxins.

Suggested Readings

M. R. Adams and M. O. Moss 2008. Food Microbiology. Royal Society of Chemistry, UK
William C. Frazier, Dennis C. Westhoff. 2013. Food Microbiology. Mc Graw Hill India.
Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, New York.
Jay J.M. 1986. Modern Food Microbiology. 3rd Edn. VNR, New York.
Robinson, R.K. Ed. 1983. Dairy Microbiology. Applied Science, London.

CC-103: Food Chemistry **(4 credits, 60 lectures)**

Unit-1 (1 credit, 15 lectures)

Food chemistry-definition and importance. Water in food.
Structure of water and ice. Phase diagram of water.
Sorption isotherm. Water activity and shelf life of food.

Chemistry and classification of Lipids. Nomenclature of fatty acids.
Physical and chemical properties of lipids.
Use of lipids in foods and effects of processing on functional properties.

Unit-2 (1 credit, 15 lectures)

Chemistry and classification of Carbohydrates.
Structure and nomenclature of carbohydrates.
Chemical reactions of carbohydrates.
Functional properties and preparation of sugars, polysaccharides and modified

Chemistry and classification of Protein and amino acids. Structure of protein.
Denaturation and functional properties of proteins. Maillard browning.
Protein concentrates, isolates and hydrolyzates.

Unit-3 (1 credit, 15 lectures)

Structure and solubility of Vitamins and Minerals. Acid/Base chemistry for minerals.
Chemical and functional stability of vitamins and minerals.
Effect of processing on vitamins and minerals.
Antinutritional factors in food and methods of inactivation.

Unit-4 (1 credit, 15 lectures)

Food flavour and colours.
Natural food flavours and taste compounds.
Pigments in animal and plant tissue.
Changes in food flavours and colours due to processing.

Suggested Readings

Srinivasan Damodaran and Kirk L. Parkin. 2017. Fennema's Food Chemistry. CRC Press. Taylor & Francis Group. Finland.
Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.
John M. deMan. 2013. Principles of Food Chemistry. Springer. New York.
Aurand, L.W. and Woods, A.E. 1973. Food Chemistry. AVI, Westport.
Birch, G.G., Cameron, A.G. and Spencer, M. 1986. Food Science. Pergamon Press, New York.

CC-104: Biochemistry and Nutrition **(4 credits, 60 hours)**

Unit-1 (1credit, 15 lectures)

Concept and scope of Nutrition and Health.
Metabolic Rate, Nutritional Requirement and RDA.
Human Physiology: Respiratory System, Gastrointentestinal System and Excretory System.
Blood and blood composition.
Nutritional assessment of human: nutritional anthropometry and biochemical tests

Unit-2 (1credit, 15 lectures)

Nutritional Biochemistry.
Carbohydrate Metabolism: Digestion and absorption of carbohydrates.
Glycolysis, TCA cycle & energy generation, gluconeogenesis,glycogenesis, glycogenolysis.
Blood sugar regulation. Disorders of carbohydrate metabolism.
Lipid Metabolism: triacylglycerol, adipose tissue, ketone bodies, cholesterol
Oxidation and biosynthesis of fatty acids. Lipid storage disorders and metabolic syndromes.

Unit-3 (1 credit, 15 lectures)

Protein Metabolism: Digestion and absorption of Protein. Urea cycle.
Biosynthesis of nonessential amino acids.
Biochemical role of Vitamins and Minerals. Deficiency disorders.

Unit-4 (1 credit, 15 lectures)

Nutrition of dietary fibres.
Energy value of foods. Protein quality: PER, NPU and BV.
Formulation of diets and food products for specific needs.
Nutraceuticals and functional foods.

Suggested Readings

Shubangini A Joshi.1998. Nutrition and Dietetics.Tata McGraw Hill Pub. Co. Ltd., New Delhi
Srilakshmi. B. 2005. Dietetics. 5th Edition.New Age International (P) Ltd, Publishers,Chennai.
National Institute of Nutrition. 2005. Dietary Guidelines for Indians – A Manual, Hyderabad.
Altschul, A.M. and Wilcke, H.L. Ed. 1978. New Protein Foods. Vol. III. Academic Press, New York.
Bodwell, C.E. Ed. 1977. Evaluation of Proteins for Humans. AVI, Westport. Milner, M., Scrimshaw, N.S. and Wang, D.I.C. Ed. 1978. Protein Resources and Technology. AVI, Westport.

CCPR- 105: Laboratory Course - I **(4 credits, 60 hours)**

Group - A

Study of laboratory instruments/equipments

Determination of moisture content of given food sample

Determination of fat content by soxhlet method

Determination of protein by kjeldahl`s method

Determination of ash content from given food sample

Determination of crude fibre by weende's method

Isolation and characterization of starch

Isolation and characterization of casein

Group - B

Preparation and sterilization of nutrient media and utensils

Determination of Total Plate Count

Determination of Yeast and Mold Count

Determination of Most Probable Number

Isolation of pure culture by Streak plate technique

Isolation of pure culture by Spread plate technique

Isolation of pure culture by Pour plate technique

Isolation of Halophilic Bacteria

Isolation of Antibiotic producers

Study of Gram staining techniques

Study of Monochrome staining techniques

Study of Negative staining techniques

Study of IMViC test

Group - C

Determination of Iron

Determination of Calcium

Estimation of starch by using anthrones method

Estimation of reducing sugar by fehlings method

Estimation of non-reducing sugar by fehling solution method

Estimation of fructose by using resorcinol method

Estimation of protein by using lowry,s method

Estimation of protein by biuret method

Estimation of Ascorbic Acid by using 2, 6 dichlorophenol indophenols

Group - D

Anthropometric Assessment of Body

Determination of energy value of food

Determination of BMR

Determination of Haemoglobin

Determination of Daily energy requirement of body

Study of Heamatology Analyzer

Study of Blood Biochemestry Analyzer

Study of Balanced Diet Plan

Visit to Analytical Lab/Pathological Lab/Processing Industry

AEC-106: Communicative English – I **(2 credits, 30 hours)**

CC- 201: Principles of Food Engineering (4 credits, 60 lectures)

Unit-1 (1credit, 15 lectures)

Definitions of Velocity and Speed, Acceleration, Force and Momentum, Weight, Pressure, Work and Energy, Power. Unit operation in food engineering.

Heat transfer-modes of heat transfer, conduction, convection and radiation.

Heat exchangers and their designs.

Heat processing of foods: Evaporation and Concentration, Dehydration and Drying, Boiling and Condensation, Blanching, Pasteurization, Sterilization and crystallization.

Unit-2 (1credit, 15 lectures)

Mass and energy balance. Fick's law of diffusion.

Theories and unit operations of mass transfer.

Fluid flow, fluid statics, fluid dynamics, fluid flow applications. Newton's Law of Rheology.

Freezing operations and Planck's Equation. Freezing curve.

Unit-3 (1credit, 15 lectures)

Mechanical separation-filtration, membrane concentration, sieving, centrifugation, sedimentation, Mechanical handling-conveying and elevation.

Size reduction and classification-mixing, kneading, blending.

Unit-4 (1credit, 15 lectures)

Applied mathematics, numerical analysis, computational mathematics.

Statistics, mean, mode, median, variance and standard deviation

Statistical tools for data analysis: MS Excel, Matlab, Minitab.

Statistical approach for new product development: Response Surface Methodology.

Suggested Readings

Romeo T. Toledo. 1999. Fundamentals of Food Process Engineering. Third Edition. Aspen publisher.

S. S. H. Rizvi and Gauri S. Mittal. 1992. Experimental methods in food engineering. Kluwer Academic Publishers Group.

Heldman, D.R. and Lund, D.B. Ed. 1992. Handbood of Food Engineering marcel Dekker, New York.

Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John wiley and Sons, N.York.

Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.

CC-202: Cereal and Legume Technology **(4 credits, 60 lectures)**

Unit-1 (1credits, 15 lectures)

Introduction to cereals, production trends, structure and nutrient distribution in cereals.
Wheat types, milling of wheat, quality of flour and flour treatment.
Technology of bread, biscuits, cakes, durum wheat, breakfast cereals and extruded products.

Unit-2 (1credit, 15 lectures)
Corn-wet milling and dry milling. Corn starch and its hydrolyzed syrups.
Corn flakes and Popcorn.
Rice milling, milling machines, effect of different factors on milling yield and rice quality, parboiling of rice, and rice products.
Minor cereals processing.

Unit-3 (1credit, 15 lectures)
Introduction to legumes, production trends, structure and nutrient distribution in legumes.
Dhal milling and processing of pulses.
Post harvest processing of legume and pulses. Types of milling. Pre milling treatments.
Milling of individual pulses: Pigeonpea, Chickpea, Urdbean, Mungbean, Lentils etc.

Unit-4 (1credit, 15 lectures)
Technology of cereal and legume based products.
Traditional fermented cereal and legume based food products: Milk Substitute, Meat Analogue, Tofu, Miso, Temphe, Soy sauce, idli and dosa, dhokala.
Instant food and premix.

Suggested Readings

Samuel A. Matz. 1991. Bakery Tech. and Engineering. Van Nostrand Reinhold Publisher, New York.
Salunkhe, D.K., Kadam, S.S. Ed. 1989. Handbook of World Food Legumes: Chemistry, Processing and Utilization, (3 vol. set). CRC Press, Florida.
EIRI Book. 2007. Breakfast, Dietary Food, Pasta & Cereal Products Technology (hand Book). Engineers India Research Ins. Publisher.
Chakraverty, A. 1988. Post-harvest Tech of Cereals, Pulses and oilseeds. Oxford and IBH, New Delhi.
Mathews, R.H.1989. Legumes: Chemistry, Tech. and Human Nutrition. Marcel Dekker, New York.
Pomeranz, Y. 1978. Wheat: Chemistry and Tech. Am. Assoc. of Cereal Chemist. St. Paul, Minnesota.

CC-203: Fruit and Vegetable Technology (4 credits, 60 lectures)

Unit-1 (1credit, 15 lectures)

Introduction to fruits and vegetable processing industry and market statistics.
Structure, cellular components and composition of fruits and vegetables.
Post harvest technology of fruits and vegetables: Harvesting, Handling, Processing.
Principles and methods of fruit and vegetable preservation.
Principles and methods of storage: natural, ventilated, low temperature storage, MAP, CAP.

Unit-2 (1 credit, 15 lectures)

Freezing and freeze-drying of fruits and vegetables.
Drying and dehydration of fruits and vegetables.
Irradiation of fruits and vegetables.
Commercial canning of fruits and vegetables.

Unit-3 (1 credits, 15 lectures)

Fruit and Vegetable Juices, Fruit Syrups, Cordials and Nectars.
Fruit preserve, Candies, Crystallized fruits and vegetables.
Jams, Jellies, Marmalades. Pickles, Chutney, Sauces and Ketchup.
Pectin and related compounds.

Unit – 4 (1 credits, 15 lectures)

Beverage technology: Alcoholic, Non-alcoholic and carbonated beverages.
Utilization of fruits and vegetable waste.
Processing of mineral water and water standards for food processing plants.
Fruit product order and quality control.

Suggested Readings

Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Fruit Science and Technology: Production, Composition and Processing. Marcel Dekker, New York.

Salunkhe, D.K. and Kadam, S.S. Ed. 1995. Handbook of Vegetable Science and Technology. Production, Composition, Storage and processing Marcel Dekker, New York.

Srivastava, R.P. and Kumar, S. 1998. Fruit and Vegetable Preservation: Principles and Practices. 2nd Ed. International Book Distributing Co. Lucknow.

L. R. Verma and Dr. V. K. Joshi. 2000. Postharvest Technology of Fruits and Vegetables: General concepts and principles. Vol I and II. Indus Publishing Company, New Delhi.

W. V. Crusee. 2009. Commercial Fruit and Vegetable Products. Agrobios, India.

S. Rajarathnam and R. S. Ramteke. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. NIPA, New Delhi.

Lal G., Siddappa G. and Tondon G. L. 1986. Preservation of Fruits and Vegetables, Indian Council of Agril. Research, New Delhi.

CC-204: Fermentation Technology **(4 credits, 60 lectures)**

Unit-1 (1credits, 15 lectures)

Origin and history of food fermentation.
Range of fermentation process: biomass, enzymes, metabolites, colours and flavours
Microbial growth kinetics: Batch Culture, Continuous Culture and Fedbatch Culture
Types of fermentation sub-merged/solid state, Batch /continuous fermentation.

Unit-2 (1credits, 15 lectures)

Fermenter design.
Body construction, Ports, Sensor Probe, Valves
Aeration and agitation system. Impellers, Baffels and Spargers.
Sterilization of Fermenter, Air, Media and Exhaust gas.

Unit - 3 (1credits, 15 lectures)

Operational measurement and quality control.
Principles of downstream processes and product recovery.
Effluent treatment.

Unit -4 (1credits, 15 lectures)

Commercial production process for beer, wine and vinegar. Traditional fermented foods.
Production of alcohols, organic acids, enzymes, colours and flavours.
Fermentation economics.

Suggested Readings

Stanburry P. F., Whitaker A. And Hall S. J. 1995. Principles of Fermentation Technology. 2nd Edition. Pergamon Press, Oxford UK.
William C. Frazier, Dennis C. Westhoff. 2013. Food Microbiology. Mc Graw Hill India.
Y. H. Hui, Lisbeth Meunier-Goddik, Jytte Josephsen, Wai-Kit Nip, Peggy S. Stanfield. 2004. Handbook of Food and Beverage Fermentation Technology. CRC Press
Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.
Brian McNeil and Linda Harvey. 2008. Practical Fermentation Technology. John Wiley & Sons Ltd., England

CCPR-205: Laboratory Course - II **(4 credits, 60 hours)**

Group - A

Determination of Bulk Density

Determination of Angle of Repose

Determination of Water Absorption Capacity

Determination of Alcoholic Acidity of Flour

Determination of Gluten content

Determination of Dough Raising Capacity

Determination of Particle size of flour

Study of germination/sprouting process

Study of heat exchangers and dryers

Group - B

Preparation and analysis of Bread

Preparation and analysis of Biscuits

Preparation and analysis of Cookies

Preparation and analysis of Cake

Preparation and analysis of Soymilk

Preparation and analysis of Tofu

Preparation and analysis of Idli

Preparation and analysis of Dhokala

Preparation and analysis of Popped Cereals

Group - C

Preparation and analysis of Fruit Juice and RTS

Preparation and analysis of Squash

Preparation and analysis of Jam

Preparation and analysis of Jelly

Preparation and analysis of Marmalade

Preparation and analysis of Tomato Sauce /Tomato Ketchup

Preparation and analysis of Tutti fruity / Amla Candy

Preparation and analysis of Hard Boiled Candy

Preparation and analysis of Fruit syrup /Synthetic syrup

Group - D

Determination of Browning intensity

Blanching of Fruits and Vegetables

Dehydration of Fruits and Vegetables

Determination of Drying Rate Curve

Preparation and analysis of Pickle

Preparation and analysis of Wine

Preparation and analysis of Sauerkraut

Measurement of B.O.D.

Measurement of C.O.D.

Visit to food processing plants:

Flour Mill/Bakery Unit/Fruit & Vegetable Processing/Brewery/Winery

SEC-106: Fundamentals of Information Technology – I (2 credits, 30 hours)