REGULATION, CURRICULUM AND SYLLABI

(With effect from the academic year 2009- 2010 onwards)

M.Sc. Food Science and Technology

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY

PONDICHERRY UNIVERSITY

R. Venaktaraman Nagar,

Kalapet, Puducherry – 605 014.

PONDICHERRY UNIVERSITY

M.Sc. Food Science and Technology

REGULATIONS, CURRICULUM AND SYLLABI

Of late, with increasing demand for processed food and increased export of food and food products, food technology has gained so much importance that economists and policy makers look for a tremendous boost in the GDP of our country. The changing urban life style coupled with compulsions has enabled the food industry to become lucrative and prosperous. Food technology provides an effective and timely platform for researchers in Universities and industries as well to develop and innovate cutting edge processing technologies for the development of our nation. Development of curriculum in consultation with the constellation of food industries would open up new vistas for employment to the graduates. Therefore, it is timely and challenging to offer this course in Pondicherry University.

Programme of study:

M.Sc Food Technology programme is interdisciplinary in nature comprising of microbiology, biotechnology, biochemistry, Food Science and Technology and nutrition, engineering etc. The main thrust would be hands on experience in different areas of food processing, nutrition, packaging, preservation and marketing. The students admitted in the programme shall be required to take up dissertation work on any emerging areas of food technology which demand attention. Field visits, industrial visits, etc by the students would immensely help them to understand and analyze in depth the problems, challenges, remedial measures and management of industries.

Entrance Examination:

The entrance examination shall be conducted on the specified dates and locations as given in University brochure.

Infrastructural facilities:

The department of Food science and Technology offers an M.Sc degree programme in Food Science and Nutrition besides M.Sc Food Technology programme. The department has well qualified teaching faculty specialized in various disciplines of food technology. The department has spacious and well lit class rooms and laboratories. All the sophisticated facilities including equipments are available in multiples where necessary. The University has a central instrumentation facility where SEM, X-ray diffraction unit; NMR, FTIR, etc are available. Since the food technology programme is interdisciplinary in nature the faculties are drawn from other departments such as biotechnology, biochemistry and molecular biology, statistics etc, and this adds credence to the quality of education, imparted to the students.

Eligibility:

The minimum qualification for applying to the course is B.Sc/B.Tech Degree in Agriculture / Vetinary sciences, Home Science, Food Science and Nutrition, Food Science and Quality Control, Clinical Nutrition, Biochemistry, Biotechnology, Microbiology and other life science related subjects. **Maths at +2 / P.U.C level is compulsory.**

Duration of course: Two years

M.Sc FOOD SCIENCE AND TECHNOLOGY –COURSE OUTLINE

Semester	Course Code	Title	Credit/ Hours	Nature of the course
I	FST401	Food chemistry	3	HC
	FST451	Food chemistry lab	1	HC
	FST402	Food microbiology	3	HC
	FST452	Food microbiology lab	1	HC
	FST403	Food process engineering	3	HC
	FST404	Biostatistics	3	SC
	FST405	Food processing and preservation	3	HC
	FST453	Food processing and preservation Lab	1	HC
	FST454	Techniques in food analysis lab	2	HC
II	FST406	Food plant equipment	3	HC
	FST407	Nutrition and biochemistry	3	SC
	FST457	Nutrition and biochemistry lab	1	SC
	FST408	Food product development and quality evaluation	3	HC
	FST458	Food product development and quality evaluation lab	1	HC
	FST409	Enzymes in food processing	3	HC
	FST459	Enzymes in food processing lab	1	HC
	FST410	Fermentation technology	3	HC
	FST411	Nutraceuticals and functional foods	3	HC
	FST491	Seminar	1	HC
III	FST501	Food biotechnology	3	HC
	FST502	Food packaging	3	HC
	FST503	Elective paper (any two from 503-555 with lab) Technology of animal products	3	HC
	FST 551	Technology of animal products lab	1	HC
	FST 504	Technology of fruits and vegetables	3	HC
	FST 552	Technology of fruits and vegetables lab	1	HC
	FST 505	Technology of cereals , legumes and oil seeds	3	HC
	FST 553	Technology of cereals, legumes and oil seeds lab	1	HC
	FST 506	Technology of milk and milk products	3	HC
	FST 554	Technology of milk and milk products lab	1	HC
	FST 507	Technology of plantation products	3	HC
	FST 555	Technology of plantation products lab	1	HC
	FST 508	Food safety and quality control	3	SC
	FST 556	Food safety and quality control lab	1	SC
	FST595	Dissertation	3	HC
IV	FST509	Environmental issues in food industry	3	HC
	FST510	Elective paper (any one from 510-511) Food plant organization and management	3	SC
	FST511	Food laws and regulatory issues	3	SC
	FST596	Dissertation	4	HC

PONDICHERRY UNIVERSITY
Department of Food Science and Technology

M.Sc. Food Science andTechnology

Semester –I

Course Code	Title	Credits	Nature of the course
FST401	Food chemistry	3	HC
FST451	Food chemistry lab	1	HC
FST402	Food microbiology	3	HC
FST452	Food microbiology lab	1	HC
FST403	Food process engineering	3	HC
FST404	Biostatistics	3	SC
FST405	Food processing and preservation	3	HC
FST 453	Food processing and preservation Lab	1	HC
FST454	Techniques in food analysis lab	2	HC

FST401 FOOD CHEMISTRY CREDIT 3

UNIT -I **8 hours**

Introduction to chemistry of foods: composition and factors affecting the composition of foods, moisture in foods and methods of moisture determination. Flavonoids and tannins. Carbohydrates: occurrence and classification. Principles of structure determination, diagrammatic representation of optical isomers, absolute configurations properties of sugars, sugar derivatives. Caramelisation. Chemistry of fibre fractions and their constituents. Starch enzymes. Properties of starch, Pectic substances, their occurrence, structure, properties and use in foods. Plant acids and their functions.

UNIT -II **8 hours**

Chemistry of amino acids and proteins. Classification of proteins, chemical and physical properties of proteins, structure of proteins and techniques used in elucidation of protein structure. Protein conformation, functional properties of proteins in foods, enzymatic and non enzymatic browning, hydrolysis of proteins, major food proteins and their sources. Changes in proteins during processing.

UNIT -III **8 hours**

Oils and fats their chemistry, occurrence, classification, composition. Physical and chemical properties of fats, rancidity and flavour reversion, oil sources, extraction, refining, hydrogenation and interesterification .

UNIT -IV **6 hours**

Vitamins classification, properties and chemistry,changes during processing. Emulsions: Definition, classification and functional properties. Essential oils, chemistry occurrence and extraction. Terpeneless oils and their use in foods.

UNIT -V **6 hours**

Principles of Colorimetry, spectrophotometry, fluorimetry, atomic absorption spectroscopy and chromatographic methods

References

1. Belitz HD.2005. *Food Chemistry*. Springer Verlag.

2. Owen R. Fennema ,2006,Food Chemistry , Academic Press.
3. Meyer LH. 1987. *Food Chemistry*. CBS.
4. Potter, N. and Hotchikiss, J.H. (1996), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema OR.1996. *Food Chemistry*. Marcel Dekker.

FST451 FOOD CHEMISTRY LAB CREDIT 1

1. Determination of boiling point and freezing point of water
2. Estimation of sugars
3. Stages of sugar cookery
4. Estimation of gluten content
5. Estimation of polyphenols
6. Determination of acidity
7. Determination of gelatinization
8. Determination of natural pigments in foods
9. Fat acidity in foods-flour
10. Determination of refractive index of fats

FST402 FOOD MICROBIOLOGY CREDIT 3

UNIT -I **6 hours**

Micro-organisms of importance in food - Factors affecting the growth of micro organisms in food - Intrinsic and Extrinsic parameters that affect microbial growth. Role of microbes in fermented foods and genetically modified foods**.**

UNIT -II **8 hours**

Spoilage of different groups of foods: Cereal and cereal products, vegetables and fruits, meat and meat products, eggs and poultry, fish and other sea foods, milk and milk products, canned food.

UNIT -III **8 hours**

Methods of Isolation and detection of micro organisms or their products in food
Conventional methods - Rapid methods (Newer techniques) - Immunological methods: Fluorescent, antibody, Radio immunoassay, principles of ELISA. - Chemical methods, Thermostable nuclear, ATP measurement and PCR (Polymerised chain reactions).

UNIT -IV **6 hours**

Indicators of water and food safety and quality: Microbiological criteria of foods and their Significance. The HACCP system and food safety used in controlling microbiological hazards.

UNIT -V **8 hours**

Food borne diseases: -*Bacterial food borne diseases* (Staphylococcal intoxification, Botulism, Salmonellosis, Shigellosis, Enteropathogenic Escherichia Coli Diarrhoea, Clostridium Perfringens gastroenteritis, Bacillus cereus Gastroenteritics) *Food Borne Viral Pathogens* (Norwalk virus, Norovirus, Reovirus, Rotavirus, Astrovirus, Adenovirus, Parvovirus, Hepatitis A Virus) *Food Borne Animal Parasites* Protozoa – Giardiasis, Amebiasis, Toxoplasmosis, Sarcocystosis, Crypotosporiodiosis. Cysticercosis/Taeniasis. Roundworm – Trichinosis, Anisakiasis. *Mycotoxins:* Aflatoxicosis, Deoxyni valenol Mycotoxicosis, Ergotism

References

1. Pelezar, M.I and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5th Edition.
2. Jay, James, M(2000) Modern Food Microbilogy, 2nd Edition. CBS Publisher
3. Adams, M.R. and M.G. Moss (1995): Food Microbiology, 1st Edition, New Age International (P) Ltd.
4. Frazier, W.C. (1988) Food Microbiology, Mc Graw Hill Inc. 4th Edition.
5. Doyle, P. Bonehat, L.R. and Mantville, T.J-(1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC,

FST452 FOOD MICROBIOLOGY LAB CREDIT 1

1. Preparation of common laboratory media and special media
2. Staining of Bacteria: Gram's staining, acid-fast, spore, capsule and flagellar staining, Motility of bacteria, Staining of yeast and molds.
3. Identification of important molds and yeast
4. Microbiology of air
5. Microbiology of water
6. Microbiology of soil
7. Microbiological analysis of processed food
8. Microbiological analysis of unprocessed food
9. Isolation of specific culture

FST403 FOOD PROCESS ENGINERRING CREDIT 3

UNIT -I **8 hours**

Transport Phenomena Nature and properties of fluids. Transport phenomena with respect to foods. Laminar and turbulent flow. Laws governing fluid flow. Newtonian and non Newtonian fluids. Visco-elastic behaviour of dough.

UNIT -II **8 hours**

Mechanism of heat transfer. Study of heat exchangers, condensers, jacketed kettles and coils. Evaporation. Multiple effect evaporators in sugar and fruit juice industry.
Thermal processing as applicable in canning, sterilization, microbial death rates. Batch and continuous processing. Operation of plate heat exchangers, shell and tube and other designs for aseptic processing, HTST, UHT.

UNIT -III **8 hours**

Drying curves, equilibrium moisture, adsorption isotherms and relation to storage, water activity, absolute humidity and relative humidity. Drying of milk, fruit juices and liquid foods as well as convective drying for solid foods.

UNIT -IV **6 hours**

Principles of mass and energy balance. Factors affecting heat and mass transfer. Phase change operations e.g. Freezing and thawing. Mechanical refrigeration and refrigerants.

UNIT -V **6 hours**

Principles of other food processing such as membrane filtration (ultra, osmosis and reverse osmosis, dialysis), pulsed electric, irradiation and other non-thermal technologies.

Reference

1. Gopala Rao, Chandra, "Essential of Food Process Engineering", BS Publications, 2006.
2. Majumdar, Arun S. "Dehydration of Products of Biological Origin", Oxford & IBH Publication, 2004.
3. Das, H. "Food Processing Operations Analysis", Asian Books, 2005.
4. Smith, P.G. "Introduction to Food Process Engineering" Springer, 2005.
5. Rao, M.A., S.S.H. Rizvi and A.K. Datta "Engineering Properties of Rood", 3rd Edition, Taylor & Francis, 2005.
6. Fellows, P.J. "food Processing Technology : Principles and Practice", Wood head Publishing, 1997.
7. Aguilera, J.M. "Microstructural Principles of Food Processing and Engineering", 2nd Edition, Aspen, 1999.

FST404 BIOSTATISTICS CREDIT 3

UNIT -I **7 hours**

Fundamentals of Biostatistics; sampling, Data collection and recording, central tendency-concept; arithmetic mean, mode, median for ungrouped and grouped data. Probability Rules and Theoretical Distributions: Basic probability rules, expectation, conditional probability; Probability distributions – Bionomial, Poisson, Normal and Log-normal distributions; Fitting of probability distributions to environmental data

UNIT -II **7 hours**

Sample survey: Need and Purpose of sampling, Sampling with and without replacement, Population and sample, Population parameters; Environmental sampling design – Methods for selecting sampling locations and times; Different techniques of sampling – simple random sampling, stratified random sampling, systematic sampling, two stage sampling, compositing and three-stage sampling; Relative advantages and disadvantages of different techniques.

UNIT -III **9 hours**

Sampling distribution and TEst of Significance: Parameter and statistics; Sampling distribution, Standard error and its uses; Concept of t-distribution, F-distributions, Chi Square distribution without derivation and their applications; Null hypothesis and uses of t-test, F-test, X^2-tests; Test of significance of large samples. Correlation and Regression: Bi-variate data and scatter diagram; Simple (linear) correlation and regression; Coefficient of correlation and regression and their properties; Fitting of regression line; Multiple and partial correlations and regressions.

UNIT -IV **7 hours**

Analysis of Variance: Different types of models used in AOV; Baisc assumptions and its violation; One and two way classified data; Application of AOV to environmental data. Distribution-Normal, t and chi square test; Difference among means; f-test: 1 way ANOVA. Computer applications in environmental modeling. Computer based modeling for population and population studies.

UNIT -V **5 hours**

Multivariate analysis, hypothesis testing Model fitting; Biometry – principles and concepts; Matrices, simultaneous linear equations; tests of hypothesis and significance, time series analysis-moving averages (3 and 5 unit cycles); current development in the subject.

References

1. Zar, Jerrold H. (1998). Biostatistical Analysis. Prentice Hall, N.J.
2. Walpole, R. and R. Myres (1993). Statistics for Engineers and scientists, 5th edn. Mac Millan, N.Y.
3. Wayne, R. Ott (1995). Environmental Statistics and Data analysis. CRC Press.
4. Manly (2001) statistics for environmental science and management, chapman and Hall/CRC

FST405 FOOD PROCESSING AND PRESERVATION CREDIT 3

UNIT -I **9 hours**

Principles of Fresh Food Storage: Nature of harvested crop, plant and animal; Product storage; Effect of cold storage and quality- storage of grains; Principles of refrigerated gas storage of food- Gas packed refrigerated foods; Sub atmospheric storage; gas atmospheric storage of foods. Principles of freezing of food product, processes and equipment for freezing of fresh and processed foods. IQF of marine products. Frozen and cold storage. Changes during freezing and storage. Microbial aspects of frozen foods.

UNIT -II **9 hours**

Principles of thermal processing of food. Pasteurization, sterilization and canning. Spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food; improvement in canning technology. Calculation of process time temperature-schedules. Retort processing of Ready to eat (RTE) products.Drying – Water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products etc. Types of dryers. Osmotic dehydration.
Newer methods of thermal processing- batch and continuous; application of infra-red microwaves; ohmic heating.Intermediate moisture foods.

UNIT -III **6 hours**

Preservation by Concentration of liquid foods :Control of water activity; preservation by concentration; reverse osmosis and membrane filtration with reference to fruit juice and milk. Freeze drying and freeze concentration.

UNIT -IV **6 hours**

Other non-thermal methods, **c**hemical preservatives, irradiation, high hydrostatic pressure, smoking. Application of Hurdle technology and minimal processing. GRAS and permissible limits for chemical preservatives and legal aspects for gamma irradiation.

UNIT -V **6 hours**

Use of enzymes and microorganisms in processing and preservation of foods. Lactic acid fermentation, alcoholic fermentation, pickling, smoking.

References

1. Arsdel WB, Copley MJ & Morgan AI. 1973. *Food Dehydration*. 2nd Ed. Vols. I, II. AVI Publ.
2. Desrosier NW & James N.1977. *Technology of Food Preservation*. 4th Ed. AVI. Publ.
3. Fellows PJ. 2005. *Food Processing Technology: Principle and Practice*. 2nd Ed. CRC.
4. Jelen P. 1985. *Introduction to Food Processing*. Prentice Hall.

FST453 FOOD PROCESSING AND CREDIT 1

PRESERVATION LAB

1. Blanching and browning control
2. Preparation of fruit preserves (jam, jelly).
3. Preparation of vegetable preserves (pickle)
4. Dehydrated products – vegetables dices tray drying, osmotic dehydration of seasonal fruit.
5. Tomato processing
6. Fruit pulping / juice / beverage preparation
7. Preparation and standardization of traditional Indian fermented food (idli udid and rice, dhokla – horse gram, dahi – milk) --- lactic acid fermentations. – solid state – rise in batter, softness on cooking, weight gain / loss – bulk density)
8. Bread making - texture.
9. Confectionery
10. Visit to food processing and preservation unit.

FST454 TECHNIQUES IN FOOD ANALYSIS LAB CREDIT 2

1. Estimation of calorific value of food
2. Estimation of moisture content
3. Estimation of ash content
4. Estimation of protein
5. Estimation of fat
6. Estimation of crude fibre
7. Estimation of Dietary fiber
8. Estimation of Calcium
9. Estimation of Phosphorus
10. Estimation of iron
11. Estimation of Vitamin C
12. Estimation of Thiamine
13. Estimation of Riboflavin
14. Estimation of Vitamin A and β carotene
15. Estimation of cholesterol
16. Estimation of antioxidants
17. Estimation of sugars
18. Estimation of iodine number
19. Estimation of saponification number

M.Sc. Food Science and Technology

Semester –II

Course Code	Title	Credits	Nature of the course
FST406	Food plant equipment	3	HC
FST407	Nutrition and biochemistry	3	SC
FST457	Nutrition and biochemistry lab	1	SC
FST408	Food product development and quality evaluation	3	HC
FST458	Food product development and quality evaluation lab	1	HC
FST409	Enzymes in food processing	3	HC
FST459	Enzymes in food processing lab	1	HC
FST410	Fermentation technology	3	HC
FST411	Nutraceuticals and functional foods	3	HC
FST491	Seminar	1	HC

FST406 FOOD PLANT EQUIPMENT CREDIT 3

UNIT -I **6 hours**

Milling Equipments : Types of equipment used for milling rice and wheat, pearling and flaking equipment; dhal mills.

UNIT -II **7 hours**

Washing, Filtration & Centrifugation equipment. Different Fruits and Vegetable washing systems; Conveyor belts - types, material of construction, product specific conveyors. Screw, bucket, belt, oscillating and vibratory conveyors. Filtration of liquid foods (dairy, fruit & vegetables); centrifugation systems: Solid bowl and disc bowl centrifuges; cyclone separator and self cleaning centrifuge.

UNIT -III **9 hours**

Heat Processing & Cooling Equipments: Heat exchangers – Plate, shell and tube etc. Autoclaves - types, operation; Different Dryers and freezers – Tray, tunnel, Fluidized. Spray dryer, Blast and IQF, Freezers, short tube and pan evaporators;
Roasting & confectionery equipments.

UNIT -IV **8 hours**

Mixing, Blending. extrusion & Filling Equipments: Agitation and mixing of liquid foods, powders and pastes; Mixers - ribbon blenders, augur, nauta, cone.
Cold and hot extruders, single screw, twin screw, extrusion cooking.
Liquid and powder filling machines - like aseptic system, form and fill (volumetric and gravimetric), bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines.

UNIT -V **6 hours**

GMP and Hygienic Design Aspects: Basic principles: as applied to various equipment-sanitary pipes and fittings, pumps, machines, tanks. Clean-in-Place (CIP) system; corrosion process and their control.

Reference

1. Lopez – Gomez, A. and Barbosa – Canovas, G.V. “Food Plant Design”, Taylor & Francis, 2005.
2. Smith, P.G. “Introduction to Food Process Engineering”, Springer, 2005.
3. Rao, M.A. S.S.H. Rizvi and A.K. Datta, “Engineering Properties of Food”, 3rd Edition, Taylor & Francis, 2005.

FST407 NUTRITION AND BIOCHEMISTRY CREDIT 3

UNIT -I **10 hours**

Metabolic pathways: Carbohydrates – Aerobic and anaerobic degradation, glycogenesis, glycogenolysis, gluconeogenesis, HMP shunt pathway.Hormonal regulations of blood glucose.Bioenergetics – Principles of bioenergetics, free energy – endergonic and exergonic

process, role of high energy compounds in energy storage, formation of ATP- Biological oxidation and electron transport chain - Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain.

UNIT -II **8 hours**

Protein and amino acids: Protein degradation, fate of nitrotgen (urea cycle), metabolism of aromatic, sulfur containing, BCAA and other amino acid pool. Glutamine and alanine cycle, protein biosynthesis. Nucleic acids- metabolism of nucleic acid components, biosynthesis of nucleotides.

UNIT -III **6 hours**

Lipids- Metabolism of triaclyglycerol, β oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies.Oxidative stress and antioxidants – Free radicals – definition, formation in biological systems, defense against free radicals. Role of free radicals and antioxidants in health and disease Determination of free radicals, lipid peroxides and antioxidants

UNIT-IV **6hours**

Regulation of metabolism – Interrelationship of carbohydrate, protein and lipid metabolism, Role of Vitamins and Minerals in Metabolism,metabolic adaptation during starvation, exercise, stress and diabetes mellitus

UNIT -V **6 hours**

Significances of enzymes in food metabolism Classification, Chemical nature - Enzyme inhibition, enzyme pattern in disease pattern.Hormones: Classification – synthesis - regulatory functions and mechanism of hormone action - Prostaglandin – structure, biosynthesis, metabolism and biological action and their role in pathology.

References

1. Murray, R.K., Graner, D.K., Mayes, P.A. and Rodwell, V.W. (2000): 25th Ed. Harpers Biochemistry Macmillan Worth Publishers.
2. Nelson, D.L., and Cox, M.M. (2000): 3rd Ed. Lehninger's Principles of Biochemistry, Macmillan Worth Publishers.
3. Conn, E.E., Stumpf, P.K., Bruening, G. and Doi, R.H. (2001): 5th Ed. Outlines of Biochemistry, Heinemann Medical Books Ltd.
4. Raghuramulu, N.; Madhavan Nair and K. Kalyanasundaram, S. (1983). A Manual of Laboratory Techniques, NIN, ICMR.
5. King, E.J. and Wootton, I.D.P. (1956), 3rd ed. Micro-Analysis in Medical Biochemistry. J. and Chuchill Ltd.

FST 457 NUTRITION AND BIOCHEMISTRY LAB CREDIT 1

1. Estimation of blood and urine glucose

2. Haematological analysis

3. Estimation of serum albumin and globulin
4. Estimation of serum retinol
5. Estimation of serum ferritin
6. Estimation of lipid profile
7. Estimation of urea.
8. Estimation of creatinine.
9. Estimation of immunoglobulin

FST408 FOOD PRODUCT DEVELOPMENT AND QUALITY EVALUATION CREDIT 3

UNIT -I **8 hours**

Method of Food Product Development, product design, food innovation case studies, Recipe development; advance technological applications for traditional recipe recent development in food ingredients/additives, flavorings, colourings, emulsifiers, stabilizer and sweeteners. Selection of materials / ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients and novel processing technologies.

UNIT -II **8 hours**

Stability of products; evaluation of shelf life; changes in quality attributes- sensory nutritional technological, microbial , statistical and packaging. Food regulation Act .

UNIT -III **8 hours**

Food sampling method: Sampling and sample preparation: samplers, storage materials, preservatives, product analysis.

UNIT -IV **6hours**

Introduction to sensory evaluation - Types of sensory tests: Detection, threshold and dilution tests – different tests for sensory evaluation – discrimination, descriptive, affective; flavour profile and tests – ranking tests – methods of sensory evaluation of different food products. Sensory and instrumental methods.

UNIT -V **6 hours**

Selection of sensory panelists –general testing conditions - factors influencing sensory measurements – sensory quality parameters – size and shape, texture, aroma, taste, colour and gloss; designing of questionnaire and/or evaluation scorecard; consumer acceptability using sensory evaluation.

References

1. Lyon, D.H.; Francombe, M.A.; Hasdell, T.A.; Lawson, K. (eds) (1992): Guidelines for Sensory Analysis in Food Products Development and Quality Control. Chepman and Hall, London.
2. Lawless, H.T. and Klein, B.P. (1991): Sensory Science Theory and Applications in Foods. Marcel Dekker Inc. New York.
3. Piggott, J.R. (ed) (1988): Sensory Analysis of Foods. Elservier Applied Science, London.
4. Ranganna

FST458 FOOD PRODUCT DEVELOPMENT AND QUALITY EVALUATION LAB CREDIT 1

Product development:

1. Permutation combination method
2. Response surface methodogy

Evaluation of product

3. Analysis of physical properties
4. Analysis of chemical properties

Sensory evaluation

5. Selection of panel
6. Threshold test

Collection and analysis of sensory data

7. Statistical analysis
8. Interpretation
9. Reporting

FST409 ENZYMES IN FOOD PROCESSING CREDIT 3

UNIT -I **6 hours**

Enzymes– classification, properties, characterization, kinetics and immobilization; fermentative production of enzymes (amylases, proteases, cellulases, pectinases, xylanases, lipases) used in food industry and their downstream processing.

UNIT -II **6 hours**

Enzymes for production of protein hydrolysates and bioactive peptides, maltodextrins and corn syrup solids (liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup), fructose and fructo-oligosaccharides.

UNIT -III **8 hours**

Enzymes as processing aids: Role of enzymes in cheese making and whey processing; fruit juices (cell wall degrading enzymes for liquefaction, clarification, peeling, debittering, decolourization of very dark coloured juices such as anthocyanases);

UNIT -IV **8 hours**

Baking (fungal α-amylase for bread making; maltogenic α-amylases for anti-staling; xylanses and pentosanases as dough conditioners; lipases or dough conditioning; oxidases as replacers of chemical oxidants; synergistic effect of enzymes); meat and meat
processing (meat tenderization); egg processing.

UNIT -V **8 hours**

Enzyme processing for flavours (enzyme-aided extraction of plant materials for production of flavours, production of flavour enhancers such as nucleotides; flavours from hydrolyzed vegetable/animal protein); enzymatic approach to tailor- made fats.

Reference

1. Mehta, Rajesh and J. George "Food Safety Regulations, Concerns and Trade : The Developing Country Perspective", Macmillan, 2005.
2. "The Prevention of Food Adulteration Act, 1954", Commercial Law Publishers (India) Pvt. Ltd.
3. Rees, Naomi and David Watson "International Standards for Food Safety", Aspen Publication, 2000.
4. Newslow, D.L. "The ISO 9000 Quality System: Applications in Food and Technology", John Wiley & Sons, 2001.
5. Hubbard, Merton R. "Statistical Quality Control for the Food Industry", 3rd Edition, Springer, 2003.

FST459 ENZYMES IN FOOD PROCESSING LAB CREDIT 1

1. Assay of enzymes for activity
2. Effect of pH on enzymes

3. Effect of temperature on enzymes
4. Extraction of juice with enzymes
5. Clarification of juice with enzymes
6. Enzymes in baking
7. Immobilization of enzyme by entrapment and comparison with free enzyme
8. Enzyme deactivation by heat and / or relation with blanching
9. Enzymes in meat tenderization
10. Brewery industry visit

FST410 FERMENTATION TECHNOLOGY CREDIT 3

UNIT -I **7 hours**

Fermentation Pathways for Industrial Products: Biochemical pathways of metabolic reactions for utilization of carbon sources and formation of different metabolites by micro organisms; possibility of control of the reactions for the increased formation of useful metabolites. Strain

Development - Various techniques of modifying the strains for increased production of industrial products. Use of chemicals, UV rays, genetic engineering to produce newer strains.

UNIT -II **8 hours**

Media for Fermentation: Importance of media components for production of industrial products by fermentation; use of different sources of carbon, nitrogen, minerals and activators for commercial fermentation; importance of pH, temperature and aeration in fermentation; optimization of fermentation media.

UNIT -III **6 hours**

Different Types of Fermenters: Laboratory and plant fermenters; shake flasks and advantages; laboratory fermentation systems with various controls and sampling and data collection provisions; aeration and agitation; production fermenters; sterilization of media; cooling systems; inoculation, temperature and pH control systems; scale-up of fermentation process.

UNIT -IV **6 hours**

Downstream Processing: Various equipment for product recovery; micro-filters and Ultra-filtration systems for separation of cells and fermentation medium and for concentration of medium containing product; chromatographic systems of separation; extraction of product with solvent; evaporation and crystallization; centrifugation, different types of centrifuges; drying techniques; instrumentation and controls.

UNIT -V **9 hours**

Fermentative Production: a) Foods: Processes for preparing fermented products including Yogurt (curd) and other Traditional Indian Products like idli, dosa, dhokla, shrikhand, etc., Soya based products like soya sauce, natto, etc., Cocoa, Cheese etc.; control of quality in such products. Alcoholic Beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc,), sugar cane (rum) etc. Process description, quality of raw materials, fermentation process controls etc.

b) Industrial chemicals:Fermentative Production of Organic acids like (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Antibiotics (Erythromycin, Penicillin), Polysaccharides (Dextran, Xanthan) etc.; steroids transformation and industrial enzyme production by micro-organisms; process descriptions and key controls for optimal production.

References

1. Vogel, H.C. and C.L. Todaro, 2005 “Fermentation and Biochemical Engineering Handbook : Principles, Process Design and Equipment”, 2nd Edition, Standard Publishers.
2. El-Mansi, E.M.T, 2007, “Fermentation Microbiology and Biotechnology” 2nd 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.

FST 411 **NUTRACEUTICALS AND FUNCTIONAL FOODS** **CREDIT 3**

UNIT -I **4 hours**

Nutraceuticals and phytochemicals: definition. Traditional health sciences including Sidha, Ayurveda,Unani and Chinese. Nutraceuticals in controlling diseases.

UNIT -II **8 hours**

Natural occurrence of certain photochemicals .Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Dosage for effective control of disease or health benefit with adequate safety; studies with animals and humans ; acute and chronic studies. Regulatory issues.

UNIT -III **8 hours**

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.

UNIT -IV **8 hours**

Isolation of photochemical from plant materials: Care in handling and storage of raw materials with minimal damage to sensitive bioactive compounds; Extractive methods for maximum recovery and minimal recovery and minimal destruction of active material; stability studies.

UNIT -V **8 hours**

Definition, development of functional foods, use of bioactive compound in appropriate form with protective substances and activators; Effect of environmental condition in food matrix ; Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods; delivery of immunomodulators /vaccines in functional foods.

Reference

1. Brigelius-Flohé, J & Joost *HG. 2006. Nutritional* Genomics: Impact on Health and Disease. Wiley VCH.
2. Cupp J & Tracy TS. 2003. *Dietary Supplements: Toxicology and Clinical Pharmacology*. Humana Press.
3. Gibson GR & William CM. 2000. *Functional Foods - Concept to Product*.
4. Goldberg I. 1994. *Functional Foods: Designer Foods, Pharma Foods*.
5. Losso JN. 2007. *Angi-angiogenic Functional and Medicinal Foods*. CRC Press.

FST 491 SEMINAR CREDIT 1

Seminar on any Topic related to Food technology.

Note:

Internal evaluation only - 50 Marks

Duration of Seminar - 20 minutes

PONDICHERRY UNIVERSITY

Department of Food Science and Technology

M.Sc. Food Science and Technology

Semester –III

Course Code	Title	Credits	Nature of the course
FST501	Food biotechnology	3	HC
FST502	Food packaging	3	HC
FST503	Elective paper (any two from 503-555 with lab) Technology of animal products	3	HC
FST 551	Technology of animal products lab	1	HC
FST 504	Technology of fruits and vegetables	3	HC
FST 552	Technology of fruits and vegetables lab	1	HC
FST 505	Technology of cereals , legumes and oil seeds	3	HC
FST 553	Technology of cereals, legumes and oil seeds lab	1	HC
FST 506	Technology of milk and milk products	3	HC
FST 554	Technology of milk and milk products lab	1	HC
FST 507	Technology of plantation products	3	HC
FST 555	Technology of plantation products lab	1	HC
FST 508	Food safety and quality control	3	SC
FST 556	Food safety and quality control lab	1	SC
FST595	Dissertation	3	HC

FST 501 FOOD BIOTECHNOLOGY CREDIT 3

UNIT -I **8 hours**

Traditional applications of food biotechnology - Fermented foods: eg dairy products, oriental fermentations, alcoholic beverages, and food ingredients. The role of biotechnology in

fermented food products (dairy, meat, vegetable). Starter culture development, process development. · Enzymes in the dairy industry: cheese making and whey processing, impact of enzyme technology. · Enzymic processing of fruit juices. Role of enzymes in baking, meat and meat processing.

UNIT -II **6 hours**

Prospectus of biotechnology- Definition, scope and applications. Application of biotechnology in food. Introduction to Genetics, Mendelian genetics, Population & Evolutionary genetics, Gene Mapping. Microbial gene transfer mechanisms, Mutation, Types of mutations, Molecular mechanism of mutations, practical applications, DNA repair Mechanisms, Recombinant DNA Technology.

UNIT -III **6 hours**

Cell and tissue culture, Micro-propagation. Nutrogenomics and nutraceuticals. Pre and probiotics.

UNIT -IV **8 hours**

Genetic engineering in microbial cell. Concept of molecular cloning. Plant and animal culture, transgenic plants, application of genetic enginerring.Biological role of DNA in cell metabolism, molecular genetics – fundaments of molecular biology with special reference to chemistry and biology and DNA(primary , secondary and tertiary) structure. Application to produce genetically modified foods.

UNIT -V **8 Hours**

Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labeling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act –2004.

References:

1. Bains W.1993.Biotechnology from A to Z. Oxford Unuiv.Press.
2. Joshi VK and Pandey A. 1999.Biotechnology: Food Fermentaion. Vols.I,II.Education Publ.
3. Knorr D.1982.Food Biotechnology.Marcel Dekker.
4. Lee BH.1996. Fundamentals of Food Biotechnology.VCH.
5. Perlman D.1977-1979. Annual Reports of Fermentation Processes.
6. Percott SC and Dunn CG.1959.Industrial Microbiology.McGraw Hill.
7. Ward. OP.1989.Fermentaion Biotechnology.Prentice Hall.

FST502 FOOD PACKAGING CREDIT-3

UNIT -I **8 hours**

Introduction to packaging. Packaging Media & Materials : Primary packaging media , Properties and application manufacturing and applications of textiles and wood, paper and paperboard, metal, glass, plastics; combined package systems; Identification methods used for plastic food packaging materials; Shaping and manufacturing processes used for the production of moulded plastic food containers; Edible films and coatings used in the food packaging industry; Labels, caps and closures and adhesives, inks and lacquers, cushioning materials, reinforcements.

UNIT -II **8 hours**

Packaging systems and methods : Vacuum packaging, gas flush packaging, Tamper-evident packaging; aseptic packaging; modified atmosphere packaging (MAP), Controlled atmosphere packaging (CAP) & aseptic & retort pouch technology, box in box; microwave packaging; active packaging; bio-degradable packages, edible packages; Use of smart packaging by the food industry; Use of sensor technology within the food packaging industry; Industrial packaging: unitizing, palletizing, containerizing, stacking and materials handling; distribution systems for packaged foods including prevention of shock damage to articles during transportation; Rigid and semi-rigid containers; flexible containers; form-fill-seal systems; Testing & evaluation of packaging media – retail packs & transport packages.

UNIT -III **8 hours**

Packaging Fresh and Processed Food : Packaging requirements for different foods and processing methods- General classification and packaging types, varieties and trends; Protective packaging of foods; packaging of food products sensitive to oxygen, light, moisture; special problems in canned foods; packaging of convenience foods; Packaging of Food products-; fruits and vegetables; packaging requirements of fresh fruits and vegetables; packaging of fruit juices; fats and oils; packaging of spices; packaging of meat and poultry; packaging and transportation of fish and other sea-foods; criteria for selection of proper packaging based on the shelf life desired; diary products; beverage products; cakes and snack foods; different packaging requirements for thermal- processed, dehydrated, frozen, irradiated and other specially processed foods.

UNIT -IV **6 Hours**

Status of current packaging; critical review of the existing knowledge in packaging of products. Special needs: Packaging for gamma irradiation, packaging for HHP processing. Active packaging. Edible packaging. Recent developments in packaging.

UNIT -V **6 hours**

Packaging Design & Environmental Issues in Packaging : Food marketing and role of packaging- Packaging aesthetic and graphic design; Coding and marking including bar coding; Consumer attitudes to food packaging materials; Packaging – Laws and regulations, safety aspects of packaging materials; sources of toxic materials and migration of toxins into food materials; Packaging material residues in food products; Environmental & Economic issues, recycling and waste disposal.

References

1. Robertson, G.L. Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis 2006
2. Parry R. T. and Blakistone B. A. Principles & Applications of MAP –Springer, New York, 1999
3. Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003
4. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, 2003
5. Han, J.H. (Ed.) Innovations in Food Packaging, Elsevier Academic Press, 2005
6. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press, 2003

FST503 TECHNOLOGY OF ANIMAL PRODUCTS CREDIT-3

UNIT -I **6hours**

Meat composition from different sources; muscle structure and compositions; post-mortem muscle chemistry; meat colour and flavours; Factors influencing the quality of meat. Meat microbiology and safety.

UNIT -II **8 hours**

Modern abattoirs, typical layout and features, Ante-mortem handling and design of handling facilities; Hoisting rail and traveling pulley system; stunning methods; steps in slaughtering and dressing; offal handling and inspection; inedible by-products; operational factors affecting meat quality; effects of processing on meat tenderization; abattoir equipment and utilities

UNIT -III **7 hours**

Chilling and freezing of carcass and meat; canning, cooking, drying, pickling, curing and smoking; prepared meat products like salami, kebabs, sausages, sliced, minced, corned; intermediate moisture and dried meat products; meat plant hygiene – GMP and HACCP; Packaging of meat products.

UNIT -IV **7 hours**

Poultry industry in India, measuring the yields and quality characteristics of poultry products, microbiology of poultry meat, spoilage factors; Lay-out and design of poultry processing plants, Plant sanitation; Poultry meat processing operations, equipment used – Defeathering, bleeding, scalding etc.; Packaging of poultry products, refrigerated storage of poultry meat, by products – eggs, egg products, Whole egg powder, Egg yolk products, their manufacture, packaging and storage.

UNIT -V **8 hours**

Commercially important marine products from India; product export and its sustenance; basic biochemistry and microbiology; preservation of postharvest fish freshness; transportation in refrigerated vehicles; deodorization of transport systems; design of refrigerated and insulated trucks; grading and preservation of shell fish; pickling and preparation of fish protein concentrate, fish oil and other by products.

Reference

1. Forrest JC. 1975. *Principles of Meat Science*. Freeman.
2. Govindan TK. 1985. *Fish Processing Technology*. Oxford & IBH.
3. Hui YH. 2001. *Meat Science and Applications*. Marcel Dekker.
4. Kerry J. *et al.* 2002. *Meat Processing*. Woodhead Publ. CRC Press.
5. Levie A. 1984. *Meat Hand Book*. 4th Ed. AVI Publ.
6. Mead M. 2004. *Poultry Meat Processing and Quality*. Woodhead Publ.
7. Mead GC. 1989. *Processing of Poultry*. Elsevier.
8. Pearson AM & Gillett TA. 1996. *Processed Meat*. 3rd Ed. Chapman & Hall.

9. Stadelman WJ & Cotterill OJ. 2002. *Egg Science and Technology*. 4th Ed.CBS.

FST551 TECHNOLOGY OF ANIMAL PRODUCTS LAB **CREDIT-1**

1. Slaughtering and dressing of meat animals; study of post-mortem changes; meat cutting and handling;
2. Evaluation of meat quality; estimation of meat: bone ratios.
3. Preservation by dehydration, freezing, canning, curing, smoking and pickling of fish
4. Meat; shelf-life studies on processed meat products
5. Evaluation of quality of eggs
6. Preservation of shell eggs
7. Preparation of meat products- barbecued sausages, loaves, burger,

8 Evaluation of fish and other marine products preparation of fish fingers and others .

9. Storage and packaging of marine products.
10. Visit to meat processing plants.

FST504 TECHNOLOGY OF FRUIT AND VEGETABLE CREDIT-3

UNIT -I **6 hours**

Indian and global scenario on production and processing of fruits and Vegetable.Pre-processing: Fresh fruits and vegetables – Handling, grading, cleaning, pretreatments, transportation, pre cooling, chilling, modified atmosphere packaging, Controlled atmosphere storage, packaging, transportation, quality assurance.

UNIT -II **5 hours**

Freezing of Fruits and Vegetables:Different freezing methods and equipments, problems associated with specific fruits and vegetables;

UNIT -III **8 hours**

Dehydration of Fruits and Vegetables:dehydration – different methods of drying including sun, tray, cabinet, drum, spray, vacuum, tunnel, spray, low temperature drying process, process calculations ,osmotic dehydration and other modern methods, choice of suitable methods, preserving the colour, flavour and nutrient content of the products

UNIT - IV **9 hours**

Canning, Juices & Concentrates:Different unit operations involved in fruit and vegetable Pulp/juice extraction, concentration, Bulk aseptic packaging of fruit and vegetable pulps, juices and concentrates; aseptic packaging of fruit drinks, juices and other products
Bottling, canning - essential principles, different types of cans, unit operations in canning blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic; Vegetable Purees/pastes - processing of Tomato and tomato products

UNIT -V **8 hours**

Fruit and Vegetable Products & Standards: Ready to eat vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres - specific processing, different packing including aseptic, Product specifications and standards; food regulations with respect to fruit and vegetable products

Reference

1. Potter, Norman N. and J.H. Hotchkiss “Food science”, 5th Edition, CBS, 1996.
2. Vaclavik, V.A. and E.W. Christian “Essentials of Food Science”, 2nd Edition, Springer, 2005.
3. Salunkhe, D.K. and Kadam, S.S. “Handbook of Fruit Science and Technology :

Production, Composition, Storage, and Processing", Marcel Dekker, 2005.
4. "Agro – Food Processing : Technology Vision 2020 Fruits & Vegetables Current Status and Vision", TIFAC, 1996.
5. Alzamora, S.M., Tapia, M.S. and Lopez – Malo, A. "Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications", Springer, 2005.

FST552 TECHNOLOGY OF FRUIT AND VEGETABLE LAB CREDIT-1

1. Evaluation of pectin content
2. Canning of fruits and vegetables
3. Quality evaluation of fruits
4. Fruit preserve and candy
5. RTs products
6. Dehydrated products of fruits
7. Dehydrated products of vegetables
8. Preparation of pickles
9. Waffers from vegetables and fruits

FST505 TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS — CREDIT-3

UNIT -I **5 hours**

General introduction and production and utilization trends; Structure and composition of common cereals, pulses and oilseeds.

UNIT -II **7 hours**

Wheat: Types and physicochemical characteristics; wheat milling -products and byproducts; factors affecting quality parameters; physical,chemical and rheological tests on wheat flour; additives used in bakery products; flour improvers and bleaching agents; manufacture of bakery products, pasta products and various processed cereal-based foods; manufacture of whole wheat atta, blended flour and fortified flour.

UNIT -III **8 hours**

Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Parboiling of rice- technology and effect on quality characteristics; aging of rice - quality changes; processed products based on rice.

UNIT -IV **8 hours**

Corn: Types and nutritive value; dry and wet milling, manufacture of value-added products; processing of barley, oats, sorghum and millets.

UNIT -V **8 hours**

Legumes and oilseeds: composition, anti-nutritional factors, processing and storage; processing for production of edible oil, meal, flour, protein concentrates and isolates; extrusion cooking technology; snack foods ; development of low cost protein foods

Reference

1. Chakrabarty MM. 2003. Chemistry and Technology of Oils and Fats.Prentice Hall.
2. Dendy DAV & Dobraszczyk BJ. 2001. Cereal and Cereal Products.Aspen.
3. Hamilton RJ & Bhati A. 1980. Fats and Oils - Chemistry and Technology.App. Sci. Publ.
4. Hoseney RS. 1994. Principles of Cereal Science and Technology. 2nd Ed.AACC.
5. Kay DE. 1979. Food Legumes. Tropical Products Institute.
6. Kent NL. 1983. Technology of Cereals. 4th Ed. Pergamon Press.

FST553 TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS LAB **CREDIT-1**

1. Physical-tests on wheat and rice
2. Physicochemical and rheological properties;
3. Determination of gluten content in wheat flour;
4. Conditioning of wheat; Milling of wheat and rice by laboratory mill;
5. Parboiling of rice;
6. Quality tests of rice: Amylose content determination in rice;
7. Malting, puffing and popping of grains;
8. Preparation of protein concentrates and isolates and their evaluation for protein content and solubility;
9. Extraction of oil using expeller and solvent extraction methods
10. Visit to related processing industries.

FST506 TECHNOLOGY OF MILK AND MILK PRODUCTS CREDIT-3

UNIT -I **5 hours**

Present status of milk & milk products in India and Abroad; market milk-Composition of milk of various species, quality evaluation and testing of milk, procurement, transportation and processing of market milk, cleaning & sanitization of dairy equipments. Special milks such as flavoured, sterilized, recombined & reconstituted toned & double toned.

UNIT -II **7 hours**

Condensed milk- Definition, methods of manufacture, evaluation of condensed & evaporated milk; dried milk- Definition, methods of manufacture of skim & whole milk powder, instantiation, physiochemical properties, evaluation, defects in dried milk powder.

UNIT -III **8 hours**

Cream- Definition, classification, composition, cream separation, sampling, neutralization, sterilization, pasteurization & cooling of cream, evaluation, defects in cream; Butter- Definition, composition, classification, methods of manufacture, theories of churning, evaluation, defects in butter.

UNIT -IV **8 hours**

Ice cream- Definition, composition and standards, nutritive value, classification, methods of manufacture, evaluation, defects in ice cream, and technology aspects of softy manufacture.

UNIT -V **8 hours**

Cheese: Definition, composition, classification, methods of manufacture, cheddar, Gouda, cottage and processed cheese, evaluation, defects in cheese.Indigenous milk products - Present status, method of manufacture of *yoghurt, dahi, khoa, burfi, kalakand, gulabjamun, rosogolla, srikhand, chhana, paneer, ghee, lassi* etc; probiotic milk products.

Reference

1. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ.
2. De S.1980. *Outlines of Dairy Technology*. Oxford Univ. Press.
3. Henderson JL. 1971. *Fluid Milk Industry*. AVI Publ.
4. Rathore NS *et al.* 2008. *Fundamentals of Dairy Technology - Theory &Practices*. Himanshu Publ
5. Spreer E. 1993. *Milk and Dairy Products*. Marcel Dekker.
6. Walstra P. 1999. *Dairy Technology*. Marcel Dekker.
7. Walstra P. (Ed.). 2006. *Dairy Science and Technology*. 2nd Ed. Taylor & Francis.

8. Web BH, Johnson AH & Lford JA. 1987. *Fundamental of Dairy Chemistry*. 3rd Ed. AVI Publ.

FST554 TECHNOLOGY OF MILK AND MILK PRODUCTS LAB CREDIT-1

1. Platform tests in milk.
2. Estimation and fat and SNF in milk; Operation of LTLT & HTST Pasteurization;
3. Preparation of special milks.
4. Cream separation & standardization of milk.
5. Preparation and evaluation of table butter.
6. Preparation and evaluation of icecream.
7. Preparation and evaluation of cheese
8. Preparation and evaluation of indigenous milk product such as *khoa, chhana, paneer, ghee, rosogolla, gulab jamun, shrikhand, lassi, burfi.*
9. Visit to dairy plants.

FST507 TECHNOLOGY OF PLANTATION PRODUCTS CREDIT-3

UNIT -I **6 hours**

Coffee: Occurrence, chemical constituents; harvesting, fermentation of coffee beans; changes taking place during fermentation; drying; roasting; process flow sheet for the manufacture of coffee powder; instant coffee technology; chicory chemistry; quality grading of coffee.

UNIT -II **8 hours**

Tea: Occurrence, chemistry of constituents; harvesting; types of tea – green, oolong and CTC; chemistry and technology of CTC tea; manufacturing process for green tea and black tea manufacture; instant tea manufacture; quality evaluation and grading of tea.

UNIT -III **7 hours**

Cocoa: Occurrence, chemistry of the cocoa bean; changes taking place during fermentation of cocoa bean; processing of cocoa bean; cocoa powder; cocoa liquor manufacture; chocolates– types, chemistry and technology of chocolate manufacture; quality control of chocolates.

UNIT -IV **7 hours**

Major spices: Pepper, cardamom, ginger, chili and turmeric–Oleoresins and essential oils; method of manufacture; chemistry of the volatiles; enzymatic synthesis of flavour identicals; quality control; fumigation and irradiation of spices.

UNIT -V **8 hours**

Other spices: Cumin, coriander, cinnamon, fenugreek, garlic, mace, clove, mint and vanilla; present trends in synthesis of volatiles; microbial and chemical contaminants, plant suspension cultures.

Reference

1. Banerjee B. 2002. *Tea Production and Processing*. Oxford Univ. Press.
2. Minifie BW. 1999. *Chocolate, Cocoa and Confectionery Technology*. 3rd Ed. Aspen Publ.
3. NIIR. 2004. *Handbook on Spices*. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
4. Sivetz M & Foote HE. 1963. *Coffee Processing Technology*. AVI Publ.

FST555 TECHNOLOGY OF PLANTATION PRODUCTS LAB **CREDIT-1**

1. Estimation of extractives, caffeine in tea and coffee; the aflavin and thearubigens of tea and total solids;
2. Estimation of Moisture and volatile oil content of spices;
3. Estimation of Aromatic compounds in spices;
4. Estimation of capsaicin content , Scoville Heat Units in chilies,
5. Curcumin content of turmeric;
6. Storage and packaging of spices;
7. Detection of microbial quality and adulteration in spices;
8. Visit to Coffee and tea processing centers
9. Visit to other spice processing Units.

FST508 FOOD SAFETY AND QUALITY CONTROL CREDIT 3

UNIT -I **4 hours**

Hazards – microbiological, nutritional, environmental, natural toxicants, pesticide residues and food additives.

UNIT -II **6 hours**

Sanitary and hygienic practices; HACCP; Quality manuals, documentation and audits; Indian and international quality systems and standards like ISO and Food Codcex; export, import policy, export documentation, laboratory quality procedures and assessment of laboratory performance; applications in different food industries; food adulteration and food safety. IPR and patent.

UNIT -III **8 hours**

Introduction to quality control and quality assurance. Food safety measures. Current concepts of quality control.

UNIT -IV **10 hours**

Quality assurance programme: Quality plan, documentation of records, product standards product and purchase specifications, process control, hygiene and housekeeping, corrective action.

UNIT -V **8 hours**

Concepts of quality management: objectives, importance and functions of quality control; quality management systems in India; sampling procedures and plans; Food safety and Standards Act 2006; domestic regulations; global food safety initiative; various organization dealing with inspections, traceability and authentication, certification and quality assurance (PFA,FPO,MMPO,MPO,AGMARK,BIS), labeling issues, international scenario , international food standards.

References

1. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (1998).. Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. pomeraz, Y. and MeLoari, C.E. (1996): Food Analyasis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (1992): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organisation, Geneva.

5. Kirk, R.S and Sawyer, R. (1991): Pearson's Composition and Analysis of Foods, Longman Scientific and Technical. 9th Edition, England.
6. Food and Agricultural Organisation (1980): Manuals of Food Quality Control. 2-Additives Contaminants Techniques, Rome.

FST 556 FOOD SAFETY AND QUALITY CONTROL LAB — CREDIT-1

Market sample evaluation and statistical application of:

1. Qualitative tests for detection of adulterants
2. Test for assessment of purity of water
3. Test for assessment of quality of milk and milk products
4. Test for assessment of quality of cereals/millets
5. Test for assessment of quality of pulses
6. Test for assessment of quality of fats and oils
7. Test for assessment of quality of meat/fish products
8. Test for assessment of quality of canned/bottle fruits and vegetables
9. Test for assessment of quality of baked foods

FST 595 DISSERTATION CREDIT 3

The Dissertation work starts in Semester III. The Review of Literature and plan of work must be completed in this semester. This would be evaluated internally.

PONDICHERRY UNIVERSITY

Department of Food Science and Technology

Course Code	Title	Credits	Nature of the course
FST509	Environmental issues in food industry	3	HC
FST510	Elective paper (any one from 510-511) Food plant organization and management	3	SC
FST511	Food laws and regulatory issues	3	SC
FST596	Dissertation	4	HC

M.Sc. Food Science and Technology

Semester –IV

FST509 ENVIRONMENTAL ISSUES IN FOOD INDUSTRY CREDIT 3

UNIT -I **7 hours**

Environment and Pollution: Components of environment; Environmental pollutions, its measurements and management; Air pollution and its control; Water pollution and its control; Xenobiotic compounds; Pesticides and pest management; processes; Solid wastes and management; Microorganisms as components of the environment; microorganisms as indicators of environmental pollution; bioorganic pollution; microbial toxicants and pollutants, and their bio-degradation; biodegradation of plastics, biofouling and biofilms; bioremediation.

UNIT -II **6 hours**

Control of Air Quality: Air duct design and room air distribution; air conditioning systems; clean-room air conditioning; important pollutants of air; properties of particulate matter and air pollution control methods; air quality in the processing plants, legal requirements.

UNIT -III **7 hours**

Waste Water Treatment: Waste water sources characteristics - standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; Physical unit operations in waste water treatment - screening; racks, mixing, flocculation, sedimentation, floatation, elutriation, vacuum filtration, incineration; chemical unit operations in waste water treatment - reaction kinetics; chemical precipitation, aeration and gas transfer process, rate of gas transfer, adsorption, disinfection; biological unit operations - aerobic and anaerobic

UNIT -IV **6 hours**

Storage & Disposal of Waste: Types of waste generated; Non- degradable & biodegradable wastes, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; Biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal; environmental laws; pests & their control.

UNIT -V **10 hours**

Utilization of Waste: Methods of utilizing wastes to make value added products-
CASE STUDIES : Pectin, food colourants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, vegetable seed oils, biomolecules and enzymes from meat processing. Generation of biogas, SCP, microalgae, animal feeds, zero emission plants; recovery & recycling of materials.

Reference

1. Potter, Norman N. and J.H. Hotchkiss “Food Science”, 5th Edition, CBS, 1996.
2. Moorthy, C.K. “Principles and Practices of Contamination Control and Clean rooms”, Pharma Book Syndicate, 2003.
3. Roday, S. “Hygiene and Sanitation in Food Industry”, Tata McGraw – Hill

Publishing, 1999.
4. Wilson, C.L. "Microbial Food Contamination", 2nd Edition, CRC, 2008.

FST510 FOOD PLANT ORGANIZATION AND MANAGEMENT CREDIT-3

UNIT -I **6 hours**

Operation Research , definition and scope, techniques in operation research. Food plant management . Factors bearing on location and layout of food plants. Regulatory requirements of food industries.

UNIT -II **9 hours**

Structure and operation of food plants. Executive design making in a food plant. Decision protocols. Evolution and role of management planning , organising and controlling. Decision processed for raising efficiency, productivity and quality in food plant operation. System analysis, its need and methodology.

UNIT -III **7 hours**

Model building- deterministic and probabilistic models. Management decision making , problems of productions, production intending, marketing-sales forecasting, inventory , finance-Break down maintenance, inventory, finance replacement and maintenance , inventory, finance replacement and maintenance .

UNIT -IV **6 hours**

Network models.. Computer applications, database operating systems, networking project management, spread sheeting and Statistical Quality Control (SQC).

UNIT -V **8 hours**

Industrial cost accounting, purchase procedure, stores procedure, material accounting, overhead costing, budget and budgetary control, process costing,. Cost factor in fixation of prices, job costing and product costing.

FST511 FOOD LAWS AND REGULATORY ISSUES CREDIT-3

UNIT -I **6 hours**

Historical Perspectives including necessity of Food Laws.Establishment of US Pure Food Law in early 1900s and of Food & Drug Administration to enforce safety of food products; Urbanisation of population and necessity of processed and preserved foods and the necessity of ensuring quality of food to prevent adulteration

UNIT -II **10 hours**

Food Quality, Safety & Testing:Quality of Foods and Quality Standards like BIS; Agmark and other optional standards; the difference between mandatory and optional standards; enforcement of optional standards; Food Safety Systems: Quality systems standards including ISO; Auditing; Good Manufacturing Practice and HACCP.Various ways of testing the safety of foods; Detection of harmful chemicals and microbes in foods; Testing of ingredients and additives; using animals for evaluating safety; Clinical studies. Responsibility of agriculture, food industry & food supply sector;Standards of Weights & Measures, British Regulatory Consortium(BRC),American Institute of Bakers(AIB) and some provisions under these regarding food products such as requirements of labelling and giving information therein, size of packages etc. Important Issues of GM Foods, Fortification, Nutrition Information on Label, Organic Foods, Safety of Additives, Processes etc. affecting consumers and industry.

UNIT -III **9 hours**

Food Laws & Implementing Agencies-National:Prevention of Food Adulteration Act 1954 & Rules 1955 established in India to enforce safety and purity of food products; Various aspects of defining adulteration, taking samples of food for analysis by public analyst, prosecution for adulteration and punishment; Standards of various food products; FPO; Infant Milk Substitute Act; Laws relating to vegetable oils; Use of permitted additives like colours, preservatives, emulsifiers, stabilisers, antioxidants.Food Safety & Standards Act 2006 and the provisions therein; Integrated Food Law - Multi departmental - multilevel to single window control system, consumer protection Act

UNIT -IV **7 hours**

International Scenario in Food Regulation USFDA, EFSA, UK, Canada, A & NZ, Japan, Malaysia, Singapore; Consumer Movements; Intellectual Property Rights and Trade Marks: Protection of investment and efforts in research and development by patenting; Criteria of patentability; National and international patent; Terms of patents; Copyright.

UNIT -V **4 hours**

International Agencies in Food Regulation:Food Codex Alimentarius: The necessity of harmonised Food Standards for international trade; various aspects and relation with domestic laws; Codex Nodal agency, FAO, WHO, WTO, TUV ,Consumer protection forums.

References

1. Mehta, Rajesh and J. George “Food Safety Regulations, Concerns and Trade : The Developing Country Perspective”, Macmillan, 2005.
2. “The Prevention of Food Adulteration Act, 1954”, Commercial Law Publishers (India) Pvt. Ltd.
3. Rees, Naomi and David Watson “International Standards for Food Safety”, Aspen Publication, 2000.
4. Newslow, D.L. “The ISO 9000 Quality System: Applications in Food and Technology”, John Wiley & Sons, 2001.
5. Hubbard, Merton R. “Statistical Quality Control for the Food Industry”, 3rd Edition, Springer, 2003.

FST596 DISSERTATION CREDIT 4

The Dissertation work continues in IV Semester. Preparation of Thesis report and Thesis Viva-voce are to be done in IV Semester.