Curriculum of M. Sc. Food Science & Technology
Shivaji University, Kolhapur-416 004.

A two years M. Sc. Program is formulated for developing competent Food technologist for whom significant job opportunities exist in this country. The course is based on basic sciences involved viz. Food Chemistry, Biochemistry, Food Microbiology, Food preservation, Food processing and genetically modified foods. The program obliges students to read original publications and envisages significant inputs in laboratory work, communication skill, creativity, planning, execution and critical evaluation of the studies undertaken. This program gives common basic knowledge (Biochemistry, Molecular Biology and genetic engineering for development of genetically modified foods, Research Methodology in Food science) during this course.

With liberalization of Indian economy, all-round industrial growth has been witnessed in all sectors with improvement in social and economic conditions of our people. This has created demand for more and better quality foods. With advancement in production technology, high yield levels will lead to large amount of marketable surplus of food grains and crop residues, demanding appropriate handling, processing, preservation, storage, marketing and utilization. The development of processing industries to preserve the perishable agricultural produce will not only improve economic and nutritional status of our population but it may help in employment generation in rural as well as urban areas of the country. This can be achieved by linking production, and post harvest technology in synergistic way.

At present the export from agro-sector represents about 16% of total Indian exports. The primary export commodities are cereals, fruits, vegetables and their processed products, and marine products but fast growing specialty products have also penetrated in foreign markets. Considering the contribution of these products in Indian export, it is necessary to have appropriate technology for handling and processing of agricultural produce. The importance of Food Science and Technology lies in the fact that it has capability to provide food to our population through scientific conservations, eliminating avoidable losses and making available more balanced and nutritious food. High value products from low grade material can be produced by innovative and appropriate processing and packaging technologies and also from byproducts and residue waste using integrated approach. Thus modernization of post harvest operations and agro-processing industries through innovative and appropriate technology has a vital role to play in national economy in general and rural economy in particular. Considering the above aspects, the role of agricultural scientists does not stop at farm level but it continues till the harvested crops and animal products are processed, preserved and further modified into useful and nutritious products, until these are utilized by the consumer. Hence, the post harvest handling and processing need to be attended on priority basis at national level.

The postgraduate education should meet the occupational demand and absorptive capacity of the economy. Specializations offered at postgraduate level are by and large needed for jobs in research and education sector. Moreover, with development of processing industries, it is quite likely that the demand for food scientists and technologists will increase in the next few decades. Hence, specializations offered at postgraduate level need to be strengthened considering occupational needs as well as demands of the food industries. Food Science is basically interdisciplinary program involving chemistry, microbiology and engineering. Hence, basic knowledge of these three disciplines becomes mandatory if student wishes to pursue career in this discipline. In order to develop strong and need based program, core courses in above disciplines need to be added for developing Food Science and Technology discipline for effective preservation, processing and utilization of perishable produces.

Objectives:

To enable the students to gain an insight into basic aspect of fruit and vegetable processing, to understand the importance of advance techniques in food analysis, acquire knowledge of availability of fruits and vegetables in lean season, regarding processing of animal proteins, recent advances in dairy technology and to develop high quality protein concentrates and weaning foods, novel foodstuff, awareness of importance of cereal legume and oil seed technology. The students will also gain knowledge about various packaging materials and importance of packaging, to be familiar with testing and evaluation of packing media, packaging laws and regulations, to select appropriate packaging material for a variety of foodstuffs vis-à-vis the need for preventing environmental degradation. To develop new food products which are marketable, nutritionally and economically vialable. To develop entrepreneurial skills to set up small scale food industries.

Work load for M. Sc.

M.Sc. I (Sem.I and II)	Theory	Practicals
	16 hr	16 hr
Seminars	2 hr	
Oral Exam	2 hr	
	20 hr	

M.Sc.II (Sem.III and IV)	Theory	Practicals
	16 hr	16 hr
Seminars	2 hr	
Oral Exam	2 hr	
	20 hr	

It is also suggested that every student undertake two hours library work under the supervision of faculty members. It is envisaged that the research projects (dissertation) and specializations will inculcate aptitude for research and practical applications. The students will also have basic inputs on communications skills and computers knowledge (information technology) and learn the basics of scientific writing and presentation.

Admission:

Intake capacity:

1. 24 students every year on the basis of entrance examination which includes 10% students from other university.

Eligibility for Admission:

A) Candidate possessing B.Sc. Degree from Shivaji University with minimum 50% marks.

   Bachelor degree from Shivaji University in Food Science and technology, Food Science and Quality control, Food Technology and Management, Agriculture, Horticulture and Home Science with minimum 50% marks.

   Students from other universities with B.Sc. degree in general, Agriculture and Horticulture with minimum 50% marks.

B) All the candidates eligible as mentioned with above eligibility criterion have to pass entrance examination conducted by the Department of Food Science & Technology, Shivaji University.

Course Structure:

		Credits	Marks
SEMESTER –I			
FST 101: Principles of food processing & preservation (Core Course)		4	100
FST 102: Food Microbiology	(Core Course)	4	100
FST 103: Food Chemistry	(Core Course)	4	100
FST 104: Biochemistry and Nutrition	(Optional Course)	4	100
FST 105: Laboratory Course I		4	100
FST 106: Laboratory Course II		4	100
		24	600
SEMESTER-II			
FST 201: Principles of food engineering	(Core Course)	4	100
FST 202: Cereal and legume technology	(Core Course)	4	100
FST 203: Fruit and vegetable technology	(Core Course)	4	100
FST 204: Fermentation technology	(Optional Course)	4	100
FST 205: Laboratory Course III		4	100
FST 206: Laboratory Course IV		4	100
		24	600
SEMESTER-III			
FST 301: Technology of meat, fish and poultry products (Core Course)		4	100
FST 302: Technology of milk and milk products	(Core Course)	4	100
FST 303: Food quality and safety management	(Core Course)	4	100
FST 304: Food additives, contaminants and toxicology (Optional Course)		4	100
FST 305: Laboratory Course V		4	100
FST 306: Laboratory Course VI		4	100
		24	600
SEMESTER-IV			
FST 401: Post-harvest technology of plantation crops (Core Course)		4	100
FST 402: Technology of oilseeds and fats.	(Core Course)	4	100

FST 403: Food Packaging	(Core Course)	4	100
FST 404: Food Biotechnology	(Optional Course)	4	100
FST 405: Laboratory Course VII		4	100
FST 406: Project and Seminar		4	100
		24	600

COURSE CONTENT

FST 101: Principles of food processing and preservation (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Scope and importance of food processing: national and international perspectives, Principles of Preservation methods, fermentation methods for preservation, and chemical preservations of foods.

Unit-2 (1 credit, 15 lectures)
Food preservation by low-temp: Refrigeration, freezing and freeze-drying.

Unit-3 (1 credit, 15 lectures)
Food preservation by heating: drying, osmotic dehydration, blanching, canning, pasteurization, sterilization, extrusion cooking.

Unit-4 (1 credit, 15lectures)
Non-thermal preservation: Hydrostatic pressure, dielectric heating, microwave processing, hurdle technology, membrane technology, irradiation.

Suggested Readings

Arsdel W.B., Copley, M.J. and Morgen, A.I. 1973. Food Dehydration, 2nd Edn. (2 vol. Set). AVI, Westport.
Bender, A.E. 1978. Food Processing and Nutrition. Academic Press, London.
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.
Lewis, M.J. 1990. Physical Properties of Food and Food Processing Systems. Woodhead, UK.
Wildey, R.C. Ed. 1994. Minimally Processed Refrigerated Fruits and Vegetables. Chapman and Hall, London.

FST 102 Food microbiology (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
History of microbiology of food.. Types of micro-organism normally associated with food- mold, yeast, and bacteria, Microbial growth pattern, physical and chemical factors influencing destruction 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

Unit-3 (1 credit, 15 lectures)
Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.

Unit-4 (1 credit, 15 lectures)
Food poisoning and microbial toxins, standards for different foods. Food borne intoxicants and mycotoxins.

Suggested Readings

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.

FST 103 Food chemistry (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Food chemistry-definition and importance, Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods. Applications and preparations of sugars and polysaccharides.

Unit-2 (1 credit, 15 lectures)
Protein and amino acids: structure, classifications, sources, denaturation and functional properties of proteins. Maillard browning.
Lipids: classification, and use of lipids in foods, physical and chemical properties, effects of processing on functional properties.

Unit-3 (1 credit, 15 lectures)
Vitamins and Minerals, Effect of processing on vitamins and minerals. Enzymatic browning in foods and industrial applications of enzymes.
Water in food, water activity and shelf life of food.

Unit-4 (1 credit, 15 lectures)
Natural food flavours, extraction methods and characterization. Pigments in food and their industrial applications.

Suggested Readings

Aurand, L.W. and Woods, A.E. 1973. Food Chemistry. AVI, Westport.
Birch, G.G., Cameron, A.G. and Spencer, M. 1986. Food Science, 3rd Ed. Pergamon Press, New York.
Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
Meyer, L.H. 1973. Food Chemistry. East-West Press Pvt. Ltd., New Delhi.
Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.

FST 104 Biochemistry and Nutrition (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)

Protein structure, commercial sources of proteins, principles for separation methods. Protein concentrates and isolates - various methods of manufacturing, factors affecting quality of isolates and concentrates. Protein hydrolysates - protein hydrolysates, factors affecting quality of hydrolysates.

Unit-2 (1 credit, 15 lectures)

Enzymes as biocatalysts – chemistry, classification, mode of action, specificity, assay techniques, isolation and purification, stabilization, enzyme kinetics. Applications of enzymes.

Unit-3 (1 credit, 15 lectures)

Pathways of metabolism of carbohydrates, proteins, lipids. Enzyme biosynthesis and regulation. Metabolic regulation, hormones, Release of energy and its trapping.

Unit-4 (1 credit, 15 lectures)

Metabolic rate and caloric needs. Requirements and role of nutrients in human health, RDAs. Nutrition of dietary fibres. Biological value of proteins. Energy value of foods. Techniques of diet and health surveys. Formulation of diets and food products for specific needs.

Suggested Readings

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.
Salunkhe, O.K. and Kadam, S.S. Eds. 1999. Handbook of World Legumes: Nutritional Chemistry, Processing Technology and.Utilization. Volume I to III. CRC Press, Florida.
Salunkhe, D.K. Chavan, J.K., Adsule, R.N. Kadam, S.S. 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York.

FST 105: Laboratory Course I (4 credits, 60 hours)

Importance of sampling and techniques of sampling. Estimation of moisture, proteins, fats, minerals and vitamins, starches, sugars, amino acids, crude fibrer in foods. Determination of minerals-calcium, phosphorus, iron, Estimation of vitamins-ascorbic acid, carotene, thiamine. Analysis of lipids-saponification value, acid value and iodine value. Determination of starch and pectic substances using different methods. Isolation of starch, casein. Estimation of lactose in milk. Testing storage stability of fats and oils.

FST 106: Laboratory Course II (4 credits, 60 hours)

Microscopy and micrometry. Preparation of nutrient media, sterilization and inoculation techniques, Isolation of pure culture, microbial examination of natural food products, identification of food pathogen in water, milk, cereals, pulses, oilseeds, meat and poultry. Microbial production of alcohol (cereal based), acetic acid and lactic acid.
Electrophoresis of proteins for their identification. Determination of free fatty acids of GLC. Estimation of antinutritional factors including gossypol, trypsin inhibitor, phytic and etc.Chromatographic separation techniques for sugars and proteins.
Determination of physical, chemical and functional properties of various proteins. Preparation of protein concentrates and isolates from different sources. Preparation of protein hydrolysate.

FST 201 Principles of food engineering (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Unit operation in food engineering, Mass and energy balance, Fluid flow, fluid statics, fluid dynamics, fluid flow applications, Heat transfer-modes of heat transfer, conduction, convection, and radiation, heat exchangers and their designs.

Unit-2 (1 credit, 15 lectures)
Thermal processing-evaporation and concentration, dehydration, drying, blanching, pasteurization, sterilization, distillation and crystallization.

Unit-3 (1 credit, 15 lectures)
Mechanical separation-filtration, membrane concentration, sieving, centrifugation, sedimentation, Mechanical handling-conveying and elevation. Size reduction and classification-mixing, kneading, blending.

Unit-4 (1 credit, 15 lectures)
Applied mathematics, numerical analysis, computational mathematics; statistics, mean, mode, variance, standard deviation and statistical tools for data analysis.

Suggested Readings

Batty, J.C. and Folkman, S.L. 1983. Food Engineering Fundamentals. John wiley and Sons, New York.
Fennema O.R. Ed. 1985, Principles of Food Science: Part-II Physical Principles of food Preservation. Marcel Dekker, New York.

Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.
Heldman, D.R. and Lund, D.B. Ed. 1992. Handbood of Food Engineering marcel Dekker, New York.

FST 202 Cereal and legume technology (4 credits, 60 lectures)

Unit-1 (1 credits, 15 lectures)
General introduction to cereals, production trends of cereals, Structure and nutrient distribution in cereals, wheat types, milling of wheat, quality of flour and flour treatment,

Unit-2 (1credit, 15 lectures)
Technology of bread, biscuits, cakes, durum wheat, extruded products (pasta and noodles).
Corn-wet milling and dry milling, corn flakes, corn starch and its hydrolyzed syrups.

Unit-3 (1credit, 15 lectures)
Rice milling, milling machines, effect of different factors on milling yield and rice quality, parboiling of rice, and rice products.
Production and utilization of minor cereals.

Unit-4 (1credit, 15 lectures)
Structure and composition of legumes, their importance in Indian diet. Dhal milling and processing of pulses, antinutritional factors in legumes and methods of removal. Technology of baby foods.

Suggested Readings

Blanshard J.M.V., Frazier, P.J. and Galliard, T. Ed. 1986. Chemistry and Physics of Baking. Royal Society of Chemistry, London.
Chakraverty, A. 1988. Postharvest Technology of Cereals, Pulses and oilseeds. Oxford and IBH, New Delhi.
Durbey, S.C. 1979. Basic Baking: Science and Craft. Gujarat Agricultural University, Anand (Gujrat).
Kent, N.L. 1983. Technology of Cereals. 3rd Edn. Pergamon Press, Oxford, UK.
Mathews, R.H. Ed. 1989. Legumes: Chemistry, Technology and Human Nutrition. Marcel Dekker, New York.
Pomeranz, Y. Ed. 1978. Wheat: Chemistry and Technology. Am. Assoc. of Cereal Chemist. St. Paul, minnesota.
Pomeranz, Y. 1987. Modern Cereal Science and Technology. VCH Pub., New York.
Salunkhe, D.K., Kadam, S.S. and Austin A. Ed. 1986. Quality of Wheat and Wheat Products. Metropolitan Book Co., New Delhi.
Salunkhe, D.K., Kadam, S.S. Ed. 1989. Handbook of World Food Legumes: Chemistry, Processing and Utilization, (3 vol. set). CRC Press, Florida.

FST 203 Fruit and vegetable technology (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Principles and methods of fruit and vegetable preservation. Principles of storage of fruits and vegetables. Types of storage: natural, ventilated low temperature storage. Freezing and freeze-drying of fruits and vegetables.

Unit-2 (1 credit, 15 lectures)
Drying and dehydration of fruits and vegetables, problems related to storage of dehydrated products., Canning of fruits and vegetables, tin cans, glass containers, aseptic canning technology.

Unit-3 (1 credits, 15 lectures)
Fruit and vegetable juices, preparation of syrups, cordials and nectars, juice concentrates, pectin and related compounds, jams, jellies, marmalades, preserves. pickles, chutneys, tomato products.

Unit – 4 (1 credits, 15 lectures)
Fruit product order and quality control, Carbonated beverages.
Processing of mineral water and water standards for food processing plants.

Suggested Readings

Bose, T.K. Ed. 1985. Fruits of India: Tropical and Sub-tropical. Naya Prokash, Calcutta.
Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.
Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.
Jagtiani J., Chan, H.T. and Sakal, W.S. Ed. 1988. Tropical Fruit Processing Academic Press, London.
Kadar, A. A. 1992. Postharvest Technology of Horticultural Crops. 2nd Ed. University of California.
Lai, G., Siddappa, G. and Tondon G.L. 1986. Preservation of Fruits and Vegetables, indian Council of Agril. Research, New Delhi.
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.
Seymour, G.B., Taylor, J.E. and Tucker, G.A. Ed. 1993. Biochemistry of Fruit Ripening. Chapman and Hall, London.
Srivastava, R.P. and Kumar, S. 1998. Fruit and Vegetable Preservation: Principles and Practices. 2nd Ed. International Book Distributing Co. Lucknow.
Ting, S.V. and Rousett, R.L. 1986. Citrus Fruits and Their Products. Marcel Dekker, New York.
Thurme S. Ed. 1991. Food Irradiation. Elsevier Applied Science, London.

Wills, R.B.H., McGlasson, W.B., Graham, W.B., Lee, T.H. and Hall, E.G. 1981. Postharvest: An Introduction tothe Physiology and Handling of Fruits and Vegetables. Granada, U.K.

FST 204 Fermentation technology (4 credits, 60 lectures)

Unit-1 (1 credits, 15 lectures)
Introduction to fermentation: Rate of microbial growth and death. Fermentation kinetics, Types of fermentation sub-merged/solid state, Batch /continuous fermentation.

Unit-2 (1 credits, 15 lectures)
Fermenter design, operation, measurement and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, sterilization of air and media; scale up in fermentation.

Unit - 3 (1 credits, 15 lectures)
Production of beer, wine and vinegar, Traditional fermented foods like idli and dosa. Principles of down stream processing and Product recovery.

Unit -4 (1 credits, 15 lectures)
Production of alcohols, organic acids, enzymes and immobilization of enzymes. Biological waste treatment

Suggested Readings

Stanburry P.P. and Whitaker, A. 1984. Principles of Fermentation Technology. Pergamon Press, Oxford UK.
Steinkraus, K.H. 1983. Handbook of Indigenous Fermented Foods. Marcel Dekker, New York.

FST 205: Laboratory Course III (4 credits, 60 hours)

Determination of thermal process time, osmotic dehydration of food. Preparation of intermediate moisture food, clarified juice, candy and microwaved (cooked) foods. Extrusion cooking, modified atmosphere packaging. Application of psychrometric charts in food engineering, Generation of steam and its applications, Measurement of pressure, and flow of fluids. Study of heat exchangers, dryers, elevating and conveying equipments, size reduction equipments, and sieve analysis. Food plant design, Study of mechanical separators, Kinetics of fruit and vegetable dehydration, Visit to food processing plants.
Follow up of bacterial growth in batch culture, Different methods of microbial cultivation, Mass transfer across membrane, permeability coefficient, Measurement of B.O.D., Measurement of C.O.D., Fermenter operation and measurement, Production of

starter, bakers yeast culture, production of citric acid, alcohol, alcoholic beverages, enzymes, amino acids, Visit to effluent treatment plant.

FST 206: Laboratory Course IV (4 credits, 60 hours)

Experimental milling, physico-chemical tests for flour quality of wheat, rheological properties of dough, test baking, physico0chemical test of rice and evaluation of cooking quality, milling and parboiling of paddy, dhal milling, visit to dhal mills. Preparation of protein concentrates and isolates, antinutritional factors in pulses, and extruded products. Malting flaking, puffing, corn syrup, germination, soaking and sprouting food grade cake, production of protein rich food. Preparation of peanut butter.
Equipment for fruits and vegetable processing, Canning of fruits and vegetables, precooling unit and cold storage. Preparation of fruit juices, squashes, syrups, nectar and ready-to-serve beverages. Preparation of jams, jellies, marmalade, preserves, and candies. Preparation of pickles, chutneys, and tomato products, Drying of fruits and vegetables, quality control of processed products. Visit to fruit and vegetables processing factories, freezing and freeze drying of foods, processing of mushroom. Manufacture of texturized vegetable proteins. Preparation of protein gels and expanded products. Development of simulated milk products from soy proteins. Use of vegetable proteins as meal extenders.

FST 301 Technology of meat, fish and poultry products (4 credits, 60 lectures)

Unit-1 (1 credits, 15 lectures)
Sources of meat and meat products in India, its importance in national economy. Chemical composition and microscopic structure of meat. Effect of feed, breed and management on meat production and quality. Slaughtering of animals and poultry, inspection and grading of meat.

Unit-2 (1 credits, 15 lectures)
Factors affecting post-mortem changes, properties and shelf-life of meat. Meat quality evaluation. Mechanical deboning, meat tenderization. Aging, pickling and smoking of meat. Meat plant sanitation and safety, Byproduct utilization. Poultry: classification, composition, preservation methods and processing.

Unit - 3 (1 credit, 15 lectures)
Structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Processing of egg products. Factor affecting egg quality and measures of egg quality.

Unit-4 (1 credit, 15 lectures)

Types of fish, composition, structure, post-mortem changes in fish. Handling of fresh water fish. Canning, smoking, freezing and dehydration of fish. Preparation of fish products, fish sausage and home makings.

Suggested Readings

Lawrie, R.A. 1975. Meat Science, 2nd Edn. Pergamon Press, Oxford UK.
Lavie A. 1980. Meat Handbook. 4th Edn. AVI, Westport.
Portsmouth, J.I. 1979, Commercial Rabit Meat Production. 2nd Edn. Saiga Survey, England.
Stadelmen, W.J. and Cotterill, O.J., 1977. Egg. Science and Technology. 2nd Edn. AVI, Westport.

FST302 Technology of milk and milk products (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Sources, and composition of milk, processing of market milk, standardization, toning of milk, homogenization, pasteurization, sterilization, storage, transportation and distribution of milk.

Unit-2 (1 credit, 15 lectures)
Milk product processing-cream, butter, , condensed milk, evaporated milk, whole and skimmed milk powder.

Unit-3 (1 credit, 15 lectures)
Instantization of milk and milk products, ice cream, khoa, channa, paneer, milk sweets. Judging and grading of milk and its products.

Unit-4 (1 credit, 15 lectures)
Fermented milk products. cheese, cheese spread, Youghurt, dahi shrikhand and similar products. Dairy equipments and sanitization.

Suggested Readings

Considine, D.M. Ed. 1982. Foods and Food Production Encyclopaedia, VNR, NewYork.
Dey, S. 1994. Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
MaCrae, R., Robinson, R.K. and Sadler, M.J. Ed. 1993. Encyelopaedia of Food Science, Food Technology and Nutrition Academic Press, London.
Robinson, R.K. (2 vol. set). 1986. Modern Dairy Technology Elsevier Applied Science, UK.
Rosenthal, I. 1991. Milk and Milk Products. VCH, New York.
Warner, J.M. 1976. Principles of Dairy Processing. Wiley Eastern Ltd. New Delhi.
Yarpar, WJ. and Hall, C.W. 1975. Dairy Technology and Engineering AVI, Westport.

FST 303 Food quality and safety management (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)

Objectives, importance and functions of quality control. Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products.

Unit-2 (1 credit, 15 lectures)
Sanitationand hygiene, GMP, GLP, Statistical quality control. Food laws and standard, PFA, AGMARK.

Unit-3 (1 credit, 15 lectures)
Sampling and specification of raw materials and finished products, Concept of Codex Almentarious/ /USFDA/ISO 9000 series , rules and regulations for waste disposals.

Unit-4 (1 credit, 15 lectures)
Food adulteration and food safety. HACCP, Sensory evaluation-introduction, panel screening, Sensory and instrumental analysis in quality control, IPR and patents.

Suggested Readings

Amerine, M.A. Pangborn, R.M., and Rosseler, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, New York.
Birk, G.G., Herman, J.G. and Parker, K.J. Ed. -1977. Sensory Properties of Foods. Applied Science, London.
Charalambous, G. and Inglett, G. 1981. The Quality of Foods and Beverages. (2 vol.set). Academic Press, New York.
Furia, T.E. Ed. 1980. Regulatory Status of Direct Food Additives. CRC Press, Florida.
Krammer, A. and Twigg, B.A. 1970. Quality Control for the Food Industry. 3rd Edn. AVI, Westport.
Pattee, H.E. Ed. 1985. Evaluation of Quality of Fruits and Vegetables. AVI, Westport.
Ranganna, S. 1986. Handbook of Analysis and Quality Control for Fruits and Vegetable Products. Tata McGraw Hill, New Delhi.
Tannenbaum, S.R. Ed. 1979. Nutritional and Safety Aspects of Food Processing, marcel Dekker, New York.

FST 304 Food additives, contaminants and toxicology (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Additives in food processing and preservation. Their functions and safety. Safety and quality evaluation of additives. Acute and chronic studies. LD_{50}. Analytical methods: chemical and instrumental.

Unit-2 (1 credit, 15 lectures)
Various additives such as preservatives, antioxidants, emulsifiers, sequesterants, humectants, stabilizers with respect to chemistry, food uses and functions in formulations.

Unit-3 (1 credit, 15 lectures)

Colours, flavours, sweeteners, acidulants with respect to chemistry, food uses and functions in formulations, indirect food additives

Unit-4 (1 credit, 15 lectures)
Food contaminants, physical, chemical, microbial and other contaminants; food toxicants.

Suggested Readings

Fennema, O.R. Ed. 1976. Principles of Food Science: Part-I Food Chemistry. Marcel Dekker, New York.
Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport.
Branen A.L. and Davidson, P.M. 1983. Antimicrobials in Foods. Marcel Dekker, New York.
Furia, T.E. 1980, Handbook of food additives, Vol I and Vol II.

FST 305 Laboratory Course V (4 credits, 60 hours)

Determination of food additives in foods. Detection of adulteration in foods. Estimaotion of toxins and pesticide in foods. Chemical residues and aflatoxins, estimation of preservative and antioxidants. Rheological properties of foods. Detection of adulteration of fats and oil.
Estimation of sugars using HPLC. Electrophoresis of proteins for their identification. Determination of free fatty acids by GLC. Mass spectroscopy, Nuclear magnetic resonance (NMR).Chromatography-different types, their principles and applications,GC-MS. Spectroscopy- UV-Visible, DSC, SEM.

Suggested Readings

Joslyn, M.A. Ed. 1970. Methods in Food Analysis. Academic Press, New York.
King, R.D. Ed. 1978. Developments in Food Analysis Techniques-1. Applied Science Publishers Ltd., London.
Morris, C.J. and Morris, P. 1976. Separation Methods in Biochemistry 2nd Ed. Pitman Pub., London.
Plummer, D.T. 1971. An Introduction to Practical Biochemistry. Mc-Graw Hill Pub. Co., New York.
Raghuramulu, N., Madhavan Nair, K., and Kalyanasundaram, S. Ed. 1983. A Manual of Laboratory Techniques. National Institute of Nutrition, ICMR, Hyderabad.

FST 306 Laboratory Course VI (4 credits, 60 hours)

Processing of meat and fish, freezing, canning, curing, smoking, drying and pickling. Evaluation of quality and grading of eggs, preparation of egg-products.
Analysis of milk , milk pasteurization and sterilization. Analysis of milk products. Preparation of cream, butter, cheese, paneer, milk sweets and ice cream. Visit to dairy plants.
Sensory analysis and hedonic rating of food. Identification and ranking of food product attributes, sensory and instrumental methods for measuring food attributes.

FST 401 Postharvest technology of plantation Crops (4 credits, 60 lectures)

Unit-1 (1 credits, 15 lectures)
Importance of plantation crops, chemical composition and processing of tea, coffee, cocoa and their quality assessment. Instant coffee and tea.

Unit-2 (1 credits, 15 lectures)
Cocoa processing and chocolate. Processing of raw and refined sugar.
Unit-3 (1 credits, 15 lectures)
Spices - black pepper, green pepper, white peper, oleoresin and volatile. Cardamom, ginger, chillies, turmeric; powder, oleoresin and volatiles.

Unit-4 (1 credits, 15 lectures)
Minor spices - Ajwan, coriander, cumin, cinnamon, fenugreek, garlic, mustard, mace and nutmeg, onion, saffron, tamarind, cloves, mint, vanilla, asafetida and spice production, processing of spices.

Suggested Readings
Haard, N.F. and Salunkhe, D.K. 1975. Postharvest Biology and Handling of Fruits and Vegetables. AVI, Westport.
Kader, A. A. 1992. Postharvest Technology of Horticultural Crops, 2nd Ed. University of California, Division of Agriculture and National Resources, California.
Salunkhe, D.K. and Kadam, S.S. Ed. 1998. Handbook of Vegetable Science andTechnology. Marcel Dekker, New York, USA.
Wills, R.B.H., McGlasson, W.B., graham, D., Lee, T.H. and Hall, E.G. 1989. Postharvest: An Introduction to the Physiology and Handling of Fruits and Vegetables. BSP Professional Books, Oxford.

FST 402 Technology of oilseeds and fats (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)
Importance of oil seeds processing in India, Commercial edible oil sources. Processing of crude oils - oil extraction/expression and solvent extraction.

Unit-2 (1 credit, 15 lectures)
Refining of crude oil- degumming, bleaching, deodourization. Preparation of protein concentrates and isolates and their use in high protein foods.

Unit-3 (1 credit, 15 lectures)
Hydrogenation and interesterification, Shortening-introduction, manufacturing and uses of shortening, types of shortening. Margarine-manufacturing and uses of Margarine. Confectionery coatings.

Unit-4 (1 credit, 15 lectures)

Immitation dairy products - peanut butter and vegetable ghee. Chemical adjuncts-lecithins, GMS. Packing and storage of fats and oils, Cocoa butter, fat substitutes and low-calorie foods.

Sugested Readings

Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.
Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and Utilization. VNR, New York.
Wolf, I.A. Ed. 1983. Handbook of Processing and Utilization in Agriculture. (2 vol. set). CRC Press, Florida.

FST 403 Food Packaging (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)

Introduction to packaging. Packaging operation, package-functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods for prevention, shelf life of packaged foodstuff, methods to extend shelf-life.

Unit-2 (1 credit, 15 lectures)

Food containers-rigid containers, corrosion of containers (tin plate). Flexible packaging materials and their properties. Food packaging materials and their properties. Food packages-bags, pouches, wrappers, carton and other traditional package. Containers-wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks.

Unit-3 (1 credit, 15 lectures)

Special problems in packaging of food stuff, consideration in the packaging of perishables and processed foods. Evaluation of packaging, and package performance, packaging equipment, package standards and regulation, Bar coding material.

Unit-4 (1 credit, 15 lectures)

Shrink packaging., aseptic and retortable pauches. Flexible and laminated pouches, aluminium as packaging material. Biodegradable packaging. Active packaging. modified atmosphere packaging.

Suggested Readings

Painy, F.A. and Painy, H.Y. 1983. A Handbook of Food Packaging. Leonard Hill, Glasgow, UK.
Scicharow, S. and Griffin, R.C. 1970. Food Packaging. AVI, Westport.

FST 404 Food biotechnology (4 credits, 60 lectures)

Unit-1 (1 credit, 15 lectures)

History and development of biotechnology, Application of genetics to food production. Methods of molecular cloning, immobilization of microbial and cultured plant cells.

Unit-2 (1 credits, 15 lectures)
Plant tissue culture, Regulatory and social aspects of biotechnology of foods. Genetically modified foods (GMF).

Unit-3 (1 credits, 15 lectures)
Production of food flavour, colour. polysaccharides, amino acids, vitamins, baker's yeast, brewer's yeast and single cell protein.

Unit-4 (1 credit, 15 lectures)
Bioinformatics: introduction, databases-protein and nucleic acid, sequence analysis, structural databases,genomics and proteomics, molecular structure and modeling of biomoleculesss.

Suggested Readings

Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford.
Crueger, W. and Crueger A. 1984. Biotechnology: A Textbook of Industrial Microbiology. Science Tech. Madison, USA.
Joshi, V.K. and Pandey, A. Ed. 1999. Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.
Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.

FST 405 Laboratory Course VII (4 credits, 60 hours)

Method of plant cell cutlture, Preparation of starter culture, Preparation of beer, wine, tempeh, yoghurt, vinegar. Production of amylase, pectinase, proteases, flavour, colour by fermentation. Immobilization of enzymes. Practicals on bioinformatics.
Analysis of tea and coffee. Volatile oil content of spices. Aromatic compounds in spices. Capsicin content in chillies, curcumin content of turmeric, storage and packaging of spices.
Strength properties of packaging materials. Water vapor and gas transmission rate of flexible packaging materials. Identification and chemical resistance of plastic films. Pre-packaging of vegetables. Estimation of shelf-life of packaged food stuff. Familiarization of types of packaging material.

FST 406 Project and Seminar (4 credits: 1+3)

Student has to submit a typed and bound copy of seminar and project dissertation.

Suggested Journals :

Food Technology.
Journal of science of food and agriculture.
Journal of agricultural food chemistry.
International journal of food science and nutrition.
International journal of food science and technology.
Journal of food science and technology (India)

Indian food industry.
Beverage and food world.
Indian food packer.
Journal of human nutrition and plant foods.

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Department of Food Science & Technology
Shivaji University, Kolhapur.

2008-2009
M.Sc. Sem. I Practical Examination Schedule

1) Continuous evaluation throughout semester.
2) Attendance to each practical is must
3) No reexamination of absent students.
4) Schedule/outline/nature of the examination :

A. Midterm Examination :

Date of examination : 4th week of August

Duration of examination : One day (10:30 a.m. to 5:30 p.m.)

Nature of examination : Principle writing (10 Marks)
Two Experiments (20 marks each)
Viva-voce (10 marks)

B. Final Examination :

Date of examination : 1st week of October

Duration of examination : One day (10:30 a.m. to 5:30 p.m.)

Nature of examination : Principle writing (10 marks)
Two Experiments (20 marks each)
Viva-voce (10 marks)
Duly completed Journal (10 marks)
Attendance and practical record
Notebook submission duly signed by in
Charge teacher (60 marks)

C. Seminar : after final practical examination (10 marks)

Nature of Question Paper

Practical paper I :

Principle writing (20 marks)

Experiments (80 marks)

Practical paper II :

Viva-voce (20 marks)

Journal (10 marks)

Notebook submission (60 marks)

Seminar (10 marks)

General Guidelines for seminar :

1. For every seminar 10 minutes will be given.
2. For discussion 5 minutes will be given.
3. No change in the topic.
4. Each seminar will have 10 marks.
5. 7 marks for presentation is must.
6. Printout/ hard copy of the seminar has to be submitted one week before seminar.
7. Power point presentation is must.
8. Time and date will be displayed on notice board.
9. Seminars will be conducted immediately after final practical examination in the month of October.

Department of Food Science & Technology

Credit can be given for the following departments -

Name of Departments:
Biochemistry
Microbiology
Environmental Biotechnology
Biotechnology

Course Name:

1. Biochemistry and Nutrition	FST 104	Semester I
2. Food Microbiology	FST 102	Semester I
3. Fermentation Technology	FST 204	Semester II
4. Food Biotechnology	FST 304	Semester IV
5. Food additive, contamination & Toxicology	FST 404	Semester III

Date : 29/5/2008

To,

Board of Studies,
Shivaji University,
Kolhapur.

Sub :- Syllabus of M.Sc. Food Science & Technology as per credit system.

Sir,

Please find enclosed the corrected syllabus of M.Sc. Food Science & Technology as per the credit system.

Yours sincerely,

Dr.(Mrs.) P.B.Dandge
Coordinator,
Food Science & Technology,
Shivaji University, Kolhapur.

Department of Food Science & Technology
Shivaji University, Kolhapur.

2008-2009
M.Sc. Sem. I, Theory Examination

The university authorities have decided that from June 2008 science departments will have credit system. As a part of this program, the theory paper will have 80:20 pattern. The department will conduct the theory examination of each paper of 20 marks in the department and submit the mark list to the university office. In order to execute the examination in smooth manner, the department of food science & Tech. with to implement the system in the following manner :

1. *For this program one of the teacher will work as coordinator.*
2. *Senior teacher who is teaching that paper will be in charge of examination.*
3. *It will be surprise test.*
4. *The examination will be conducted in the department only.*
5. *Objective question of multiple answer type will be asked.*
6. *Examination will be conducted twice in the semester having 10 marks for each test.*
7. *Answer sheets and mark list should be submitted to the coordinator immediately after assessment.*
8. *There is no reexamination.*
9. *The schedule of the examination is given below.*
10. *Appointment of examiners for internal theory and practical examinations will be done by university authorities or head of the department.*
11. *Examiners will be paid remuneration as per university rules.*
12. *The format for the question paper and mark list will as follows.*

Tentative Schedule of Examination

4th week of July – Paper-I

1st week of August – Paper-II

2nd week of August – Paper-III

3red week of August – Paper-IV

4th week of August – Mid term practical examination

1st week of September – Paper-I

2nd week of September- Paper-II

3rd week of September – Paper-III

4th week of September – Paper-IV

1st week of October – Final practical examination

2nd week of October – Seminar

Format of the mark list

Shivaji University, Kolhapur.
Department of Food Science & Technology

M.Sc. Sem. I Food Science & Technology Examination, 2008

Branch :

Title of the Paper :

Roll No.	***Exam No.***	***Name of the student***	***Test No. I (10)***	***Test No. II (10)***	***Total Marks (20)***

Name & Signature of the Examiner:

Format of the question paper

Shivaji University, Kolhapur.
Department of Food Science & Technology

M.Sc. Sem. I Food Science & Technology Examination, 2008.

Name of the student : Roll No. :

Branch : Date of the Examination :

Title of the Paper : Time : 15 minutes.

Total Marks : 10 Test No. : I / II

Instructions : 1. All questions carry equal marks.
2. Tick mark the correct answer.

Q.1

a) b)
b) d)

Total Marks : / 10

Name & Signature of the Examiner :