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 viable. To develop entrepreneurial skills to set up small scale food industries.

Work load for M. Sc.

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<th>M.Sc. I (Sem.I and II)</th>
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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:

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td><strong>SEMESTER –I</strong></td>
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<tr>
<td>FST 101: Principles of food processing &amp; preservation (Core Course)</td>
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<tr>
<td>FST 102: Food Microbiology (Core Course)</td>
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<td>FST 103: Food Chemistry (Core Course)</td>
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<td>FST 104: Biochemistry and Nutrition (Optional Course)</td>
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<td>FST 105: Laboratory Course I</td>
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<td><strong>SEMESTER-II</strong></td>
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<td>FST 201: Principles of food engineering (Core Course)</td>
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<td>FST 202: Cereal and legume technology (Core Course)</td>
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<td>FST 203: Fruit and vegetable technology (Core Course)</td>
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<td>FST 204: Fermentation technology (Optional Course)</td>
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<td>FST 205: Laboratory Course III</td>
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<td>FST 206: Laboratory Course IV</td>
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<td><strong>SEMESTER-III</strong></td>
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<td>FST 301: Technology of meat, fish and poultry products (Core Course)</td>
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<td>FST 302: Technology of milk and milk products (Core Course)</td>
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<td>FST 303: Food quality and safety management (Core Course)</td>
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<td>FST 304: Food additives, contaminants and toxicology (Optional Course)</td>
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<td>FST 305: Laboratory Course V</td>
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<td>FST 306: Laboratory Course VI</td>
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<td><strong>SEMESTER-IV</strong></td>
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<td>FST 401: Post-harvest technology of plantation crops (Core Course)</td>
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<td>FST 402: Technology of oilseeds and fats. (Core Course)</td>
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COURSE CONTENT

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

Unit-1
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
Food preservation by low-temp: Refrigeration, freezing and freeze-drying.

Unit-3
Food preservation by heating: drying, osmotic dehydration, blanching, canning, pasteurization, sterilization, extrusion cooking.

Unit-4
Non-thermal preservation: Hydrostatic pressure, dielectric heating, microwave processing, hurdle technology, membrane technology, irradiation.

Suggested Readings
Jelen, P. 1985. Introduction to Food Processing. Prentice Hall, Reston Virginia, USA.

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

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)
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

**FST 104 Biochemistry and Nutrition**

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)

Unit-4 (1 credit, 15 lectures)

Suggested Readings

**FST 105: Laboratory Course I**

(4 credits, 60 hours)

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


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

Unit-1 (1 credit, 15 lectures)

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

**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**

**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)


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)

Unit - 3  (1 credit, 15 lectures)

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**

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

Unit-I  (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)

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

**Suggested Readings**

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

Unit-I  (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
Sanitation and hygiene, GMP, GLP, Statistical quality control. Food laws and standard, PFA, AGMARK.

Unit-3
Sampling and specification of raw materials and finished products, Concept of Codex Alimentarious/USFDA/ISO 9000 series, rules and regulations for waste disposals.

Unit-4
Food adulteration and food safety. HACCP, Sensory evaluation—introduction, panel screening, Sensory and instrumental analysis in quality control, IPR and patents.

Suggested Readings

FST 304 Food additives, contaminants and toxicology

Various additives such as preservatives, antioxidants, emulsifiers, sequesterants, humectants, stabilizers with respect to chemistry, food uses and functions in formulations.

FST 304 Food additives, contaminants and toxicology (4 credits, 60 lectures)
Unit-1

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

Unit-3
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**

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

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**

**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

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)

Unit-3 (1 credit, 15 lectures)

Unit-4 (1 credit, 15 lectures)
Imitation 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.

**Suggested Readings**


**FST 403 Food Packaging**

(4 credits, 60 lectures)

Unit-1

(1 credit, 15 lectures)

Unit-2

(1 credit, 15 lectures)

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)

**Suggested Readings**


**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 biomolecules.

Suggested Readings

FST 405 Laboratory Course VII
(4 credits, 60 hours)
Method of plant cell culture, 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.

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)
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.
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

3rd 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


Branch:

Title of the Paper:

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Format of the question paper

Shivaji University, Kolhapur.
Department of Food Science & Technology


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 :