Estd. 1962
"A++" Accredited by NAAC(2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४,महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१–२६०९०९३/९४

SU/BOS/Science/ 14 Date: 01/10/22

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of M.Sc. & B.Sc. (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy 2020

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **M.Sc., & B. Sc.** under the Faculty of Science and Technology **as per National Education Policy 2020**

Sr. No.	Faculty of Science and Technology	Programme/ Course
1	**Food Science & Technology**	M. Sc. Part- I/II Food Science and Technology, M. Sc. Part- I Food Science and Nurition, B. Sc. Part- I Food Science & Technology

This syllabi and nature of question paper shall be implemented from the Academic Year 2022-2023 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

SHIVAJI UNIVERSITY, KOLHAPUR

Accredited by NAAC with 'A^{++} Grade

Choice Based Credit System

Syllabus for

M. Sc. Part I and Part II

Food Science and Technology

(Syllabus to be implemented from June 2022)

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. (Food Science and Technology) Programme Structure
M.Sc. Part – I (Level-8)

Type	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
SEMESTER-I (Duration- Six Month)											
CGPA	1	CC-101	4	4	4	80	32	3	20	8	1
	2	CC-102	4	4	4	80	32	3	20	8	1
	3	CC-103	4	4	4	80	32	3	20	8	1
	4	CC-104	4	4	4	80	32	3	20	8	1
	5	CCPR-105	16	16	8	200	80	--	--	--	*
Total (A)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	AEC-106	2	2	2	--	--	--	50	20	2
SEMESTER-II (Duration- Six Month)											
CGPA	1	CC-201	4	4	4	80	32	3	20	8	1
	2	CC-202	4	4	4	80	32	3	20	8	1
	3	CC-203	4	4	4	80	32	3	20	8	1
	4	CC-204	4	4	4	80	32	3	20	8	1
	5	CCPR-205	16	16	8	200	80	--	200	80	*
Total (B)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	SEC-206	2	2	2	--	--	--	50	20	2
Total (A+B)					**48**	**1040**	--	--	**160**	--	--

• Student contact hours per week : **32** Hours (Min.)	• Total Marks for M.Sc.-I : **1200**
• Theory and Practical Lectures : **60** Minutes Each	• Total Credits for M.Sc.-I (Semester I & II) : **48**
• CC-Core Course • CCPR-Core Course Practical • AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course • SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course	• Practical Examination is annual. • Examination for CCPR-105 shall be based on Semester I Practicals. • Examination for CCPR-205 shall be based on Semester II Practicals. • *Duration of Practical Examination as per respective BOS guidelines • *Separate passing is mandatory for Theory, Internal and Practical Examination*
• **Requirement for Entry at Level 8:** Completed all requirements of the relevant Bachelor's degree (Level 7) with principal / major subjects.....	
• **Exit Option at Level 8:** Students can exit after Level 8 with Post Graduate Diploma in ..... if he/she completes the courses equivalent to minimum of 48 credits.	

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. (Food Science and Technology) Programme Structure
M.Sc. Part – II (Level-9)

Type	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
SEMESTER-III (Duration- Six Month)											
CGPA	1	CC-301	4	4	4	80	32	3	20	8	1
	2	CCS -302	4	4	4	80	32	3	20	8	1
	3	CCS-303	4	4	4	80	32	3	20	8	1
	4	DSE -304	4	4	4	80	32	3	20	8	1
	5	CCPR-305	16	16	8	200	80	--	--	--	*
Total (C)			--	--	**24**	**520**	--	--	**80**	--	
Non-CGPA	1	AEC-306	2	2	2	--	--	--	50	20	2
	2	EC (SWM MOOC)-307	Number of lectures and credit shall be as specified on SWAYAM MOOC								
SEMESTER-IV (Duration- Six Month)											
CGPA	1	CC-401	4	4	4	80	32	3	20	8	1
	2	CCS -402	4	4	4	80	32	3	20	8	1
	3	CCS-403	4	4	4	80	32	3	20	8	1
	4	DSE -404	4	4	4	80	32	3	20	8	1
	5	CCPR-405	16	16	8	200	80	--	--	--	*
Total (D)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	SEC-406	2	2	2	--	--	--	50	20	2
	2	GE-407	2	2	2	--	--	--	50	20	2
Total (C+D)					**48**	**1040**	--	--	**160**	--	--

	M.Sc.-I	M.Sc.-II	Total
Marks	**1200**	**1200**	**2400**
Credits	**48**	**48**	**96**

Student contact hours per week : **32** Hours (Min.)	• Total Marks for M.Sc.-II : **1200**
• Theory and Practical Lectures : **60** Minutes Each	• Total Credits for M.Sc.-II (Semester III & IV) : **48**
• CC-Core Course • CCS- Core Course Specialization • CCPR-Core Course Practical and Project • DSE-Discipline Specific Elective • AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course • SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course • EC (SWM MOOC) - Non-CGPA Elective Course • GE- Multidisciplinary Generic Elective	• Practical Examination is annual. • Examination for CCPR-305 shall be based on Semester III Practicals. • Examination for CCPR-405 shall be based on Semester IV Practicals. • *Duration of Practical Examination as per respective BOS guidelines • ***Separate passing is mandatory for Theory, Internal and Practical Examination***
• **Requirement for Entry at Level 9:** Completed all requirements of the relevant Post Graduate Diploma (Level 8) in	
• **Exit at Level 9:** Students will exit after Level 9 with Master's Degree in ..... if he/she completes the courses equivalent to minimum of 96 credits.	

I. CGPA course:

1. There shall be 14 Core Courses (CC)per programme.
2. There shall be 04 Core Course Specialization (CCS)of 16 credits per programme.
3. There shall be 02 Discipline Specific Elective (DSE) courses of 08 credits per programme
4. Total credits for CGPA courses shall be of 96 credits per programme

II. Mandatory Non-CGPA Courses:

1. There shall be 02 Mandatory Non-CGPA compulsory Ability Enhancement Courses (AEC) of 02 credits each per programme.
2. There shall be 01 Mandatory Non-CGPA compulsory Skill Enhancement Course (SEC) of 02 credits per programme.
3. There shall be one Elective Course (EC) (SWAYAM MOOC). The credits of this course shall be as specified on SWAYAM MOOC.
4. There shall be one Generic Elective (GE) course of 02 credits per programme. Each student has to take generic elective from the department other than parent department.
5. The total credits for Non-CGPA course shall be of 08 credits + 2-4 credits of EC as per availability.
6. The credits assigned to the course and the programme are to be earned by the students and shall not have any relevance with the work load of the teacher.

Department of Food Science and Technology

M. Sc. Food Science and Technology

Pos, PSOs and COs

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

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

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

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

Course Name		Course Outcomes (CO's)
CC-301: Technology of Meat, Fish and Poultry Products	CO1	Able to understand about processing of meat, poultry and fish, preparation of different types of products from meat, poultry and fish.
	CO2	Students will get to know about the nutritional profile of meat, poultry, fish and egg
	CO3	Gain knowledge on the methods of grading meat
	CO4	Different techniques available to slaughter animal
	CO5	Processing and preservation of egg and fish
	CO6	Quality control and standardization of meat, fish and poultry
CCS-302: Technology of Milk and Milk Products	CO1	Train students to scientifically undertake all operations of dairy technology and to create employment potential and man power for dairy development
	CO2	To create entrepreneur in milk and milk products
	CO3	To develop organizational capabilities among our youth in milk and milk product industry
	CO4	To develop skill, instill confidence by enhancing life skills
	CO5	To increase nutritional status and income of community through dairy farming
CCS-303: Food Additives, Contaminants and Toxicology	CO1	Better understanding of the functions of different food additives in improving shelf life, texture and other physical and sensory characteristics of foods
	CO2	Exposure about food additives related to bakery and confectionary
	CO3	Exposure about types and chemical properties of pigments, flavouring compounds and their processing effect.
	CO4	Provide students with a basic understanding of the principles of food toxicology
	CO5	Identification of appropriate techniques for analysis of additives
	CO6	Recognize the common analytical techniques for detection of food adulterant
DSE-304: Food Quality and Safety Management	CO1	Develop a HACCP plans for different food industries
	CO2	Understanding knowledge of HACCP certification
	CO3	Understand laws and regulations governing food safety principles (FSMS and HACCP)
	CO4	Understand industry food safety requirements and certifications :organic, halal, kosher, GFSI, SQF (SQF implementation certification)
	CO5	Understand auditing and different auditing schemes, and be able to complete internal (first party) audits
	CO6	Presents ideas in written, graphic and oral form using computer software where appropriate

CC-401:Technology of Oilseeds and Fats	CO1	Better understanding of the concepts of physiological characteristics of oil bearing materials (Plant and Animal Origin) and lipids thereof
	CO2	Able to gain knowledge in different processing of oilseeds and oil extraction, and also its by-products.
	CO3	Understand the work space, tool and equipment for post harvest technology of oilseeds, oil extraction and refining of oil
	CO4	Able to acquire a confidence to get placement in any kind of oilseeds processing industry with minimum post harvest losses
	CO5	Understanding by-product process technique
	CO6	Thorough knowledge and understandings of the specific processing technologies, and analytical methods for quality evaluation
CCS-402: Food Biotechnology	CO1	Understanding knowledge regarding use of biotechnology in various fields (Plant and Animal)
	CO2	Understanding knowledge regarding use of biotechnology in food sector which helps in producing different products
	CO3	Understanding biotechnology helps in understanding the microbiology
	CO4	Fermented food technology helps to prepare various healthy products
	CO5	Upstream and downstream Processing Improvement Techniques can be helpful in production of various nutrients and medicines
	CO6	Understanding of microbial contents
CCS-403: Post Harvest Technology of Plantation Crops	CO1	Better understanding of the concepts of physiological characteristics of plantation crops and spices
	CO2	Able to gain knowledge in different processing of plantation crops, spices, tea and coffee and also its value added products
	CO3	Understand the work space, tool and equipment for post harvest technology plantation crops, spices, tea and coffee
	CO4	Get placed in any kind of plantation crops, spices, tea, & coffee, industry with minimum post harvest losses and maximum benefit to the industry.
	CO5	Thorough knowledge and understandings of the specific processing technologies used for different foods products derived from these materials
	CO6	Quality control and standardization of Post Harvest Technology of Plantation Crops
DSE-404: Food Packaging	CO1	Better Understandings of the various properties of food packaging materials
	CO2	Ability to Select suitable packaging material for different food substances
	CO3	Describe the role and function of packaging materials used for a range of consumer food needs and wants
	CO4	Relate the properties of food packages to conversion technologies, processing and packaging technologies and user requirements including safety, convenience and environmental issues.
	CO5	Describe the technology involved in the production, shaping and printing of various packaging materials and package
	CO6	Understanding why different materials are used for different purposes.

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

M. sc. Part – I

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

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

M. sc. Part – II

SEMESTER – III (Duration – Six Month)												
	SR. NO	COURSE CODE	TITLE OF THE PAPER	TEACHING SCHEME			EXAMINATION SCHEME					
				Theory and Practical			University assessment (UA)			Internal Assessment (IA)		
				LECTURES (per week)	HOURS (per week)	CREDITS	MAX. MARKS	MINI. MARKS	EXAM. HOURS	MAX. MARKS	MINI. MARKS	EXAM. HOURS
CGPA	1	CC-301	Technology of Meat, Fish and Poultry Products	4	4	4	80	32	3	20	8	1
	2	CCS-302	Technology of Milk and Milk Products	4	4	4	80	32	3	20	8	1
	3	CCS-303	Food Additives, Contaminants and Toxicology	4	4	4	80	32	3	20	8	1
	4	DSE-304	Food Quality and Safety Management	4	4	4	80	32	3	20	8	1
	5	CCPR-305	Laboratory Course III	16	16	8	200	80	---	---	---	*
Total (C)				---	---	24	520	---	---	80	---	---
Non-CGPA	1	AEC-306	Communicative English - II	2	2	2	---	---	---	50	20	2
	2	EC	SWAYAM/MOOCs/Online	Number of lectures and credits will be as specified on SWAYAM / MOOC Course / Online Courses								
SEMESTER – IV (Duration – Six Month)												
	1	CC-401	Technology of Oilseeds and Fats	4	4	4	80	32	3	20	8	1
	2	CCS-402	Food Biotechnology	4	4	4	80	32	3	20	8	1
	3	CCS-403	Post-Harvest Technology of Plantation Crops	4	4	4	80	32	3	20	8	1
	4	DSE-404	Food Packaging	4	4	4	80	32	3	20	8	1
	5	CCPR-405	Laboratory Course IV	16	16	8	200	80	---	---	---	*
Total (D)				---	---	24	520	---	---	80	---	---
Non-CGPA	1	SEC-406	Fundamentals of Information Technology - II	2	2	2	---	---	---	50	20	2
	2	GE-407	Food Analysis and Quality Control	2	2	2				50	20	2
Total (C + D)						48	1040	---	---	160	---	---

COURSE CONTENT

CC-301: Technology of Meat, Fish and Poultry Products **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

Introduction to animal product technology.
Plant Layout, Design and Construction of an Abattoir
Muscle Structure and composition of meat.
Conversion of Muscle to Meat. Pre-slaughtering practices and slaughtering methods.
Ante- and Post-mortem examination. Carcass grading and Cuts. Factors affecting meat quality.

Unit-2 (1credit, 15 lectures)

Classification of fish – Fresh Water and Marine Water, Fin Fish and Shell Fish.
Commercially important fish. Structure and composition fish muscle.
Handling, Storage and Transportation of Fresh Fish.
Fish freshness and quality evaluation. Post-mortem changes in fish.

Unit-3 (1credit, 15 lectures)

Types and classes of Poultry - chickens, turkeys, ducks, geese, guineas, and pigeons.
Classification of chicken. Poultry parts. Premortem handling, Transportation and Slaughtering.
Poultry carcass evaluation.
Structure of Egg. Grading and quality evaluation of shell eggs.

Unit-4 (1credit, 15lectures)

Tenderization of meat, Freezing and Thawing of meat, Curing of meat, Smoking of meat
Fish processing- Freezing, Chilling, Curing, Drying and Dehydration, Canning, Smoking
Egg processing- Liquid egg, Egg powder and desugarization of egg products.

Suggested Readings

Fidel Toldra. 2010. Handbook of meat processing. Wiley-Blackwell Publication, Iowa, USA
Ranken M. D. 2000. Handbook of meat product technology. Blackwell Science Publication
Warriss P. D. 2000. Meat Science. CABI Publishing, UK
Isabel Guerrero-Legarreta. 2010. Handbook of Poultry Science and Technology. John Wiley & Sons, Inc., Pub., New Jersey
Meat processing and meat products hand book. EIRI Board of Consultants and Engineers. New Delhi.
Preservation of meat and poultry products. NIIR Board of Consultants and Engineers. APBP Inc., Delhi
NPCS Board of Consultants and Engineers. The complete technology book on meat, poultry and fish processing. NPCS. Delhi

CC- 302: Technology of Milk and Milk Products **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

Introduction to Indian Dairy Industry. National Dairy Development Board (NDDB).
Market milk. Constituents of milk and milk quality assessment.
Physical, Chemical and Microbiological quality of milk.
Factors affecting composition of milk.

Unit-2 (1 credit, 15 lectures)

Handeling, Collection, Transportation of milk.
Full Cream Milk, Toned Milk, Skimmed Milk, Pasteurized milk
Sterilized Milk, UHT Milk, Reconstituted Milk, Standardized Milk

Unit-3 (1 credit, 15 lectures)

Dried Milk – Whole Milk Powder (WMP) and Skimmed Milk Powder (SMP)
Evaporated and Condensed Milk. Types of Khoa and manufacturing process.
Coagulated milk products - Curd, Channa, Paneer, Cheese

Unit-4 (1 credit, 15 lectures)

Manufacturing of cream, butter, and butter oil
Ice cream- Classification, composition, manufacturing process
Indigenous milk and milk product – Rubri, Pedha, Burfi, Kulfi, Shrikhand, Lassi
Cleaning and sanitation of dairy plant and equipment

Suggested Readings

De S. 2008. Outlines of Dairy Technology. Oxford University Press, New Delhi.
Walstra P., Geurts T. J., Noomen A., Jellema A and Boekel. 2005. Dairy Technology. Principles of milk properties and processes. Marcel Dekker, Inc., New York.
R. C. Chandan, A. Kilara and N. P. Shah. 2008. Dairy processing and quality assurance. Wiley-Blackwell Publication, Iowa, USA.
Handbook of milk processing, dairy products and packaging technology. EIRI Board of Consultants and Engineers, Delhi.

CC-303: Food Additives, Contaminants and Toxicology **(4 credits, 60 lectures)**

Unit-1 (1 credit, 15 lectures)

Introduction to food additives. Types of additives.
Functions of food additives.
Food additives intake assessment.
Food Preservatives – Classification (Class I, Class II and Grass)

Unit-2 (1 credit, 15 lectures)

Natural food additive (Vitamins, Minerals, Pigments, Amino Acids, Essential Fatty Acids).
Food fortification and supplementation.
Fat substitute and replacers.
Sweeteners.

Unit-3 (1 credit, 15 lectures)

Sequestering and chelating agents.
Emulsifying, Stabilizing and Thickening agents.
Antioxidants. Antifoaming and Anticaking agents.
Desiccants and Humectants.

Unit-4 (1 credit, 15 lectures)

Contamination of food. Types of food contaminants and sources. Food Allergens.
Food Toxicology. Toxicity – Acute, Subacute, Subchronic, Chronic.
Toxicology study – In-vitro and In-vivo.
Dose and Responses -NOEL, LD50

Suggested Readings

S. N. Mahindru. 2012. Food Additives. APH Publishing Corporation, New Delhi.
T. Pussa. 2008. Principles of food toxicology. CRC press. Taylor & Francis Group. New York.
A. L. Branen, P. M. Davidson, S. Salminen and J. H. Thorngate. 2001. Food Additives. Marcel Dekker, Inc. New York
T. Shibamoto and L. F. Bjeldanes. 1993. Introduction to Food Toxicology. Academic Press, Inc. California

DSE-304: Food Quality and Safety Management **(4 credits, 60 hours)**

Unit-1 (1credit, 15 lectures)

Definition of Food Quality. External and internal quality factors.
Assessment of food quality. Sample and Sampling methods.
Food testing laboratory and food analyst. NABL accreditation.
Methods of food quality evaluation - Physical, Chemical, Microbiological, Sensorial.
Instrumental analysis of food – Texture, Viscosity, Consistency, Colour, Flavour

Unit-2 (1credit, 15 lectures)

Food safety and security.
Food laws and standards – National and International.
Indian food laws and regulations – Prevention of Food Adulteration Act, Essential Commodity Act, Food Safety and Standard Act, Voluntary Standards: BIS and AGMARK
Structure and salient features of FSSA, 2006. Food Licensing and Registration.

Unit-3 (1 credit, 15 lectures)

Food Quality Management System – International Organization for Standardization (ISO)
Food Safety Management System – HACCP, ISO 22000, FSSC, BRC, PRPs (GAP,GMP,GHPetc.)
Codex Alimentarius Commission, WHO, FAO, WTO, USFDA
Export (Quality Control and Inspection) Act, Custom Act, Import Control regulation

Unit-4 (1 credit, 15 lectures)

Introduction to auditing. Definition and Types of audits.
Auditing principles, Auditor attributes, Roles and responsibility of auditors.
Internal audit planning and preparation.
Conducting an audit, Reporting audit results, Corrective action and audit follow-up activities.
Waste disposal methods. Environmental Protection Act and ISO 14000.

Suggested Readings

The Food Safety and Standards Act, 2006. Professional Book Publishers, Delhi.
The Prevention of Food Adulteration Act, 1954 & The Food Safety and Standard Act, 2006. Professional Book Publishers, Delhi.
Ranganna S. 2012. Handbook of analysis and quality control for fruits and vegetable products. Tata McGraw Hill Education Pvt. Ltd., New Delhi
Pomeranz Y and Meloan C. 2000. Food Analysis: Theory and Practice. Aspen Publication, Maryland
H. R. Moskowitz, J. H. Beckley and A. V. A. Resurreccion. 2006. Sensory and consumer research in food product design and development. IFT Press, Blackwell publishing. Iowa, USA.
R. Lawley, L. Curtis and J. Davis. 2008. The Food Safety Hazard Guidebook. Royal Society of Chemistry Publication, UK
R. H. Schmidt and G. E. Rodrick. 2003. Food Safety Handbook. Wiley-Interscience. John Wiley & Sons Publication, New Jersey

CCPR-305 Laboratory Course III **(4 credits, 60 hours)**

Group – A

Slaughtering and dressing of Poultry Bird

Study of poultry meat cuts

Physical quality evaluation of meat

Determination of Water Holding Capacity and drip loss

Determination of pH

Determination of Extract Release Volume (ERV)

Determination of Meat Swelling Capacity (MSC)

External quality evaluation of egg

Breakout test for internal quality evaluation of egg

Evaluation of freshness of fish

Group - B

Quality Evaluation of Milk (Plat Form Test)

Determination of fat content of milk by Gerber's method

Standardization of milk Fat and SNF

Preparation of flavoured milk and its analysis

Preparation and Analysis of Khoa, Pedha, Gulab jamun

Preparation and Analysis of Channa, Rasogolla, Paneer

Preparation and Analysis of Curd and Lassi

Preparation and Analysis of Chakka (Hung Curd) and Shrikhand

Group - C

Estimation of Chlorophyll content

Estimation of Carotenoid Content

Separation of plant pigments by TLC

Determination of Sodium Benzoate Content

Determination of Salt Content

Study of relative sweetness of sweeteners

Estimation of tyrosine value

Estimation of Thiobarbituric acid value

Group - D

Sensory evaluation methods

Determination of overrun in ice-cream

Colour analysis by using Lovibond Tintometer

Colour analysis by using Hunter Colour Lab

Determination of Viscosity by Brookfield Viscometer

Determination of Food Texture by Texture Analyzer

Detection of Adulteration in Common Food Products

Study of HPLC/GCMS/AAS

Visit to Food Processing Plant-

Abattoir/Slaughter House/Poultry Farm/Fish Processing/Milk and Milk Products etc.

AEC-306 Communicative English - II **(2 credits, 30 hours)**

EC SWAYAM/MOOCs/Online

Number of lectures and credits will be as specified on SWAYAM / MOOC Course / Online Courses

CC-401 Technology of Oilseeds and Fats **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)
Commercial edible oil sources.
Composition and characteristics of oilseeds, oils and animal fats.
Handling and storage of oil bearing material.
Pre-treatments for oilseeds.

Unit-2 (1credit, 15 lectures)
Methods of recovering oil and fats.
Mechanical Oil Extraction – Traditional and Modern method. Oil Expeller
Solvent Extraction – Principle and Types of extractors. Solvent characteristics for oil extraction.
Rendering of Animal Fat – Lard and Tallow

Unit-3 (1credit, 15 lectures)
Refining of crude oil –
Degumming, Neutralization, Washing, Drying, Bleaching, Winterization, Deodorization.
Modification of oil – Fractionation, Winterization, Hydrogenation, Esterification.
Production of Hydrogenated Vegetable Fat and Margarine.

Unit-4 (1credit, 15 lectures)
Quality assessment of oils and fats. Factors affecting quality of oils and fats.
Physical and chemical properties of oils and fats.
Frying of food and reactions during frying of food.
By-product utilization from oil industry – Production of Lecithin and Biodiesel.

Suggested Readings

Shukla B. D., Srivastava P. K. and Gupta R. K. 1992. Oilseeds processing technology. CIAE, Bhopal
Chakraverty A. 2010. Post harvest technology of cereals, pulses and oilseeds. 3rd edition. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi
NIIR Board of Consultants and Engineers. Moder technology of oil, fats and its derivatives. APBP Inc., Delhi.
EIRI Board of Consultants and Engineers. Hand Book of Oils, Fats And Derivatives with Refining and Packaging Technology. EIRI, New Delhi.

CCS-402 Food Biotechnology **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

Basic principles of molecular biology and biotechnology.
Introduction to Genetics. Gene transfer mechanisms, Mutation, Types of mutations.
Recombinant DNA Technology – Tools and Techniques.

Unit-2 (1credit, 15 lectures)

Introduction to tissue culture techniques.
Plant cell, tissue and organ culture.
Animal cell and organ culture.
Applications of tissue culture.

Unit-3 (1credit, 15 lectures)

Industrial Biotechnology – GMOs, Bioengineered food, Bioremediation
Genetically Modified Food (GMF) - Concept, Types and Applications.
Regulations concerning GMF in India and at the International level.

Unit-4 (1credit, 15 lectures)

Bioinformatics- Introduction, Tools and Biological Database.
Computational structural biology.
Nano-biotechnology- Production and application of nano-particles.
Biosensors and novel tools and their application in food science.

Suggested Readings

Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto and Robert E. Levin. 2006. Food Biotechnology. 2nd Edition. CRC Press, Taylor and Francis Group, Boca Raton, FL.
John E. Smith. 2009. Biotechnology. 5th edition. Cambridge University Press, New York
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.

CCS-403 Post-Harvest Technology of Plantation Crops **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

Plantation crops - Introduction and Importance.
Value addition through processing.
Processing of onion, garlic, ginger, turmeric, coconut

Unit-2 (1credit, 15 lectures)

Spices and condiments processing.
Pepper, Chilli, Mace and Nutmeg, Asafoetida, Clove, Cardamom, Cinnamon, Saffron, Vanilla Masala, Spice Blend, Spice Mix

Unit-3 (1credit, 15 lectures)

Natural food flavours.
Extraction of essential oils and oleoresins.
Methods- Steam/Water Distillation, Solvent/CO_2/Cold Press/Microwave Extraction

Unit-4 (1credit, 15 lectures)

Sugar cane processing – Jaggery, Raw and Refined Sugar.
Composition and processing of tea, coffee, cocoa.
Cocoa butter, Cocoa Powder and Liquor and Chocolate manufacturing

Suggested Readings

D. K. Salunkhe, and S. S. Kadam. 1998. Handbook of Vegetable Science and Technology. Marcel Dekker, New York, USA.
A. J. Taylor, R. S. T. Linforth. 2010. Food Flavour Technology. Wiley-Blackwell Publication. Iowa, USA.
K. V. Peter. 2006. Handbook of herbs and spices. Woodhead Publishing Limited. England
B. W. Minifie. 1999. Chocolate, Cocoa, and Confectionery: Science and Technology. Aspen Publishers

DSE-404 Food Packaging **(4 credits, 60 lectures)**

Unit-1 (1credit, 15 lectures)

Introduction to packaging technology. Package Evaluation
Functions of packaging. Properties of packaging material.
Types of packaging- Primary/Secondary/Tertiary
Labelling guidelines for packaged foods. Label printing and bar-coding.

Unit-2 (1credit, 15 lectures)

Paper and Paper Board: Manufacturing method and Types.
Glass Containers: Composition and Manufacturing Method.
Plastics and Polymers: Composition and Types. Non-migratory bioactive polymers.

Unit-3 (1credit, 15 lectures)

Rigid Packaging Material (Non Plastic) - CFB, Composites, Metal, Wood etc.
Fibre board Containers, Drums, Tin, Aluminium Cans / Containers, Aluminium Foils, Steel Drums, Wooden Containers / Crates.
Laminates, Multilayer packaging, Flexible packaging.

Unit-4 (1credit, 15 lectures)

Packaging Techniques- Vacuum Packaging, Shrink packaging, Aseptic Packaging
Modified Atmosphere Packaging and Controlled Atmosphere Packaging.
Active and Intelligent Packaging, Antimicrobial packaging, Edible packaging.

Suggested Readings

G. L. Robertson. 2006. Food Packaging: Principles And Practice. CRC Press, Taylor and Francis Group, Boca Raton, FL
R. Ahvenainen. 2003. Novel food packaging techniques. Woodhead Publishing Limited, England
Jung Han. 2005. Innovations in Food Packaging. Elsevier Science & Technology Books
M.L. Rooney. 1995. Active Food Packaging. Blackie Acad. & Profl. Chapman & Hall, Glasgow

CCPR-405 Laboratory Course IV **(4 credits, 60 hours)**

Group - A

Determination of melting point of fats

Microscopic examination of fat crystals

Estimation of Acid value of oil

Estimation of Iodine value of oil

Estimation of Saponification value of oil

Extraction of essential oil by steam distillation

Preparation of peanut butter

Preparation of chocolate

Qualitative test for phytochemicals

Estimation of caffeine

Group - B

Preparation of packaging material album

Determination of GSM of packaging material

Determination of WVTR

Cut out examination of canned food products

Study of filling and sealing methods

Study of Tearing Strength Tester

Study of Bursting Strength Tester

Study of Breaking Strength Tester

Study of PCR

Study of Gel Electrophoresis

Group – C Research Project Work

Visit to Food Processing Plants –

Oil Industry/Packaging Industry/Spices Processing/Tissue Culture Lab

SEC-406 Fundamentals of Information Technology – II **(2 credits, 30 hours)**

GE-407 Food Analysis and Quality Control **(2 credits, 30 hours)**

Unit-1 (10 Lectures)

Introduction to Food Analysis and Quality Control. Scope and Importance

Composition of Food. Types of Food Products.

Sampling techniques and preparation of Sample.

Physical analysis of Food. pH, weight, volume, density, specific gravity, size, thickness.

Advanced instrumentation for physical analysis. Texture Analysis, Viscosity Analysis, Color Analysis

Unit-2 (10 Lectures)

Chemical analysis of Food.

Preparation of standard solutions.

Moisture, Crude Protein, Crude Fat, Total Minerals, Total Carbohydrates.

Spectrophotometry/Chromatography/Flame Photometery for chemical analysis of food

Unit-3 (10 Lectures)

Introduction to Food Microbiology.

Media Preparation, Sterilization and Inoculation Techniques.

Methods for microbial examinations of foods. TPC, Yeast and Mold Count, MPN, Dye Reduction Test

Sensory Analysis of Food. Introduction to sensory organs and senses.

Olfaction and Gustation. Methods of sensory analysis.

SHIVAJI UNIVERSITY, KOLHAPUR

Accredited by NAAC with 'A^{++}' Grade

Choice Based Credit System

Syllabus for

M. Sc. Part - II

Semester III and IV

Food Science and Technology

(Syllabus to be implemented from June 2022)

Department of Food Science and Technology

M. Sc. Food Science and Technology

Pos, PSOs and COs

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

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

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

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

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

M. Sc. Part – I

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

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

M. Sc. Part – II

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

COURSE CONTENT

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

Unit-1 (1credit, 15 lectures)

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

Unit-2 (1credit, 15 lectures)

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

Unit-3 (1credit, 15 lectures)

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

Unit-4 (1credit, 15lectures)

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

Suggested Readings

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

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

Unit-1 (1credit, 15 lectures)

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

Unit-2 (1 credit, 15 lectures)

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

Unit-3 (1 credit, 15 lectures)

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

Unit-4 (1 credit, 15 lectures)

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

Suggested Readings

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

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

Unit-1 (1 credit, 15 lectures)

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

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

Unit-2 (1 credit, 15 lectures)

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

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

Unit-3 (1 credit, 15 lectures)

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

Unit-4 (1 credit, 15 lectures)

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

Suggested Readings

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

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

Unit-1 (1credit, 15 lectures)
Concept and scope of Nutrition and Health.
Metabolic Rate, Nutritional Requirement and RDA.
Human Physiology: Respiratory System, Gastrointentestinal System and Excretory System.
Blood and blood composition.
Nutritional assessment of human: nutritional anthropometry and biochemical tests

Unit-2 (1credit, 15 lectures)
Nutritional Biochemistry.
Carbohydrate Metabolism: Digestion and absorption of carbohydrates.
Glycolysis, TCA cycle & energy generation, gluconeogenesis,glycogenesis, glycogenolysis.
Blood sugar regulation. Disorders of carbohydrate metabolism.
Lipid Metabolism: triacylglycerol, adipose tissue, ketone bodies, cholesterol
Oxidation and biosynthesis of fatty acids. Lipid storage disorders and metabolic syndromes.

Unit-3 (1 credit, 15 lectures)
Protein Metabolism: Digestion and absorption of Protein. Urea cycle.
Biosynthesis of nonessential amino acids.
Biochemical role of Vitamins and Minerals. Deficiency disorders.

Unit-4 (1 credit, 15 lectures)
Nutrition of dietary fibres.
Energy value of foods. Protein quality: PER, NPU and BV.
Formulation of diets and food products for specific needs.
Nutraceuticals and functional foods.

Suggested Readings

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

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

Group - A

Study of laboratory instruments/equipments

Determination of moisture content of given food sample

Determination of fat content by soxhlet method

Determination of protein by kjeldahl`s method

Determination of ash content from given food sample

Determination of crude fibre by weende's method

Isolation and characterization of starch

Isolation and characterization of casein

Group - B

Preparation and sterilization of nutrient media and utensils

Determination of Total Plate Count

Determination of Yeast and Mold Count

Determination of Most Probable Number

Isolation of pure culture by Streak plate technique

Isolation of pure culture by Spread plate technique

Isolation of pure culture by Pour plate technique

Isolation of Halophilic Bacteria

Isolation of Antibiotic producers

Study of Gram staining techniques

Study of Monochrome staining techniques

Study of Negative staining techniques

Study of IMViC test

Group - C

Determination of Iron

Determination of Calcium

Estimation of starch by using anthrones method

Estimation of reducing sugar by fehlings method

Estimation of non-reducing sugar by fehling solution method

Estimation of fructose by using resorcinol method

Estimation of protein by using lowry,s method

Estimation of protein by biuret method

Estimation of Ascorbic Acid by using 2, 6 dichlorophenol indophenols

Group - D

Anthropometric Assessment of Body

Determination of energy value of food

Determination of BMR

Determination of Haemoglobin

Determination of Daily energy requirement of body

Study of Heamatology Analyzer

Study of Blood Biochemestry Analyzer

Study of Balanced Diet Plan

Visit to Analytical Lab/Pathological Lab/Processing Industry

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

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

Unit-1 (1credit, 15 lectures)

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

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

Heat exchangers and their designs.

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

Unit-2 (1credit, 15 lectures)

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

Theories and unit operations of mass transfer.

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

Freezing operations and Planck's Equation. Freezing curve.

Unit-3 (1credit, 15 lectures)

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

Size reduction and classification-mixing, kneading, blending.

Unit-4 (1credit, 15 lectures)

Applied mathematics, numerical analysis, computational mathematics.

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

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

Statistical approach for new product development: Response Surface Methodology.

Suggested Readings

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

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

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

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

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

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

Unit-1 (1credits, 15 lectures)

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

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

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

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

Suggested Readings

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

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

Unit-1 (1credit, 15 lectures)

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

Unit-2 (1 credit, 15 lectures)

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

Unit-3 (1 credits, 15 lectures)

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

Unit – 4 (1 credits, 15 lectures)

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

Suggested Readings

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

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

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

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

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

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

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

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

Unit-1 (1credits, 15 lectures)
Origin and history of food fermentation.
Range of fermentation process: biomass, enzymes, metabolites, colours and flavours
Microbial growth kinetics: Batch Culture, Continuous Culture and Fedbatch Culture
Types of fermentation sub-merged/solid state, Batch /continuous fermentation.

Unit-2 (1credits, 15 lectures)
Fermenter design.
Body construction, Ports, Sensor Probe, Valves
Aeration and agitation system. Impellers, Baffels and Spargers.
Sterilization of Fermenter, Air, Media and Exhaust gas.

Unit - 3 (1credits, 15 lectures)
Operational measurement and quality control.
Principles of downstream processes and product recovery.
Effluent treatment.

Unit -4 (1credits, 15 lectures)
Commercial production process for beer, wine and vinegar. Traditional fermented foods.
Production of alcohols, organic acids, enzymes, colours and flavours.
Fermentation economics.

Suggested Readings

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

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

Group - A

Determination of Bulk Density

Determination of Angle of Repose

Determination of Water Absorption Capacity

Determination of Alcoholic Acidity of Flour

Determination of Gluten content

Determination of Dough Raising Capacity

Determination of Particle size of flour

Study of germination/sprouting process

Study of heat exchangers and dryers

Group - B

Preparation and analysis of Bread

Preparation and analysis of Biscuits

Preparation and analysis of Cookies

Preparation and analysis of Cake

Preparation and analysis of Soymilk

Preparation and analysis of Tofu

Preparation and analysis of Idli

Preparation and analysis of Dhokala

Preparation and analysis of Popped Cereals

Group - C

Preparation and analysis of Fruit Juice and RTS

Preparation and analysis of Squash

Preparation and analysis of Jam

Preparation and analysis of Jelly

Preparation and analysis of Marmalade

Preparation and analysis of Tomato Sauce /Tomato Ketchup

Preparation and analysis of Tutti fruity / Amla Candy

Preparation and analysis of Hard Boiled Candy

Preparation and analysis of Fruit syrup /Synthetic syrup

Group - D

Determination of Browning intensity

Blanching of Fruits and Vegetables

Dehydration of Fruits and Vegetables

Determination of Drying Rate Curve

Preparation and analysis of Pickle

Preparation and analysis of Wine

Preparation and analysis of Sauerkraut

Measurement of B.O.D.

Measurement of C.O.D.

Visit to food processing plants:

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

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