

# **Regulations and Curriculum**

## **M. Sc. in Food Science and Technology**

*(Effective from Academic Session 2024-25 onwards)*

*Offered by*

**Department of Food Science and Technology**

**FACULTY OF AGRICULTURE**



**MAHARAJA SUHEL DEV STATE UNIVERSITY  
AZAMGARH (U.P.)**

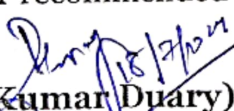
## Resolution

The meeting of the Board of Studies (BoS) of Food Science and Technology was held on July 18, 2024 at Maharaja Suhel Dev State University, Azamgarh to consider and approve the *regulations* and *curriculum* for **M. Sc. in Food Science and Technology** developed in accordance to the CBCS of National Education Policy, 2020.

The following were present in the aforementioned meeting:

S. No.	Name	Designation /Address	Capacity
1.	Dr. Santosh Kumar Singh	Professor S. D. J. P. G College Chandeshwar, Azamgarh	Dean, Faculty of Agriculture
2.	Dr. Vishnu Deo	Asstt. Professor Dept. of Animal Husbandry & Dairying S. D. J. P. G College Chandeshwar, Azamgarh	Convenor ( <i>ad-hoc</i> )
3.	Dr. Anil Kumar Chauhan	Professor & Head Dept. of Dairy Science and Technology, B. H. U., Varanasi	External Member
4.	Dr. Raj Kumar Duary	Professor Dept. of Dairy Science and Technology, B. H. U., Varanasi	External Member
5.	Dr. Neelam Yadav	Professor Centre of Food Technology Allahabad University, Allahabad	External Member
6.	Dr. Sarvesh Kumar	Asstt. Professor Dept. of Agricultural Economics S. D. J. P. G College Chandeshwar, Azamgarh	Member (special invitee)


After a detailed discussion, the BoS of Food Science and Technology unanimously approved the proposed *regulations* and *curriculum* for **M. Sc. in Food Science and Technology**. It is further recommended that it may be implemented from 2024-25 onwards.

  
(Raj Kumar Duary)  
External Member

*on-line*  
(Anil Kumar Chauhan)  
External Member

*on-line*  
(Neelam Yadav)  
External Member

  
(Vishnu Deo)  
Convenor

  
(Sarvesh Kumar) 7.24  
Member (Special Invitee)

  
(Santosh Kumar Singh)  
(Dean)

# MAHARAJA SUHEL DEV STATE UNIVERSITY

## POSTGRADUATE DEGREE PROGRAMME

### **M. Sc. in Food Science and Technology**

#### **Choice Based Credit System (CBCS)**

(Regulations)

#### **1. SYSTEM OF EDUCATION**

- 1.1 The rules and regulations provided herein shall govern Master degree programme in **M. Sc. Food Science and Technology** offered by the Department of M. Sc. Food Science and Technology, Faculty of Agriculture at **Maharaja Suhel Dev State University, Azamgarh** as per NEP (UGC), 2020.
- 1.2 The duration of Master's programme is two academic years (4 semesters). The first academic year of study shall be the first and second semesters after admission. The second academic year of study shall be the third and fourth semesters.

#### **2. COMMENCEMENT**

These regulations shall come into force from the academic year **2024-25 onwards**.

#### **3. DEFINITIONS & ACADEMIC TERMS**

**Chairperson** means a teacher of the major discipline proposed by the Head of Department through the Dean of the College and duly approved by the Director of Education/ Dean Post Graduate Studies (or as per the procedure laid down in the concerned University regulations) to act as the Chairperson of the Advisory Committee and also to guide the student on academic issues.

**Course** means a unit of instruction in a discipline carrying a specific number and credits to be covered in a semester as laid down in detail in the

syllabus of a degree programme.

**Credit** means the unit of work load per week for a particular course in theory and/ or practical. One credit of theory means one class of one clock hour duration and one credit practical means one class of minimum two clock hours of laboratory work per week.

**Credit load** of a student refers to the total number of credits of all the courses he/ she registers during a particular semester.

**Credit points:** It is the product of grade point and number of credits for a course. Grade Point is a numerical weight allotted to each letter grade on a 10-point scale.

**Semester Grade Point Average (SGPA):** It is a ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken in the respective semester. It is expressed up to two decimal places.

**Cumulative Grade Point Average (CGPA):** The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all semesters. It is expressed up to two decimal places.

**Programme Educational Objective (PEO)** PEOs are broad statements that describe the career and professional accomplishments that graduates of a programme are expected to achieve within a few years of graduation.

**Programme Outcome (PO)** POs are specific statements that describe what students are expected to know and be able to do by the time they complete a programme.

**Programme Specific Outcome (PSO)** PSOs are similar to POs but are more specific to a particular specialization or focus area within a programme.

#### 4. NAME OF PROGRAMME

The Postgraduate programme offered in the Discipline of Agriculture is

### **M. Sc. in Food Science and Technology**

#### 5. RESIDENTIAL REQUIREMENTS

The minimum and maximum duration of residential requirement for Masters' Programme shall be as follows:

P.G. Degree Programme	Duration of Residential Requirement	
	Minimum	Maximum
M. Sc. Food Science and Technology	2 Academic Years (4 Semesters)	5 Academic Years (10 Semesters)

In case a student fails to complete the degree programme within the maximum duration of residential requirement, his/ her admission shall stand cancelled.

#### 6. ADMISSION

6.1 Eligibility for admission: The eligibility of entry is:

B.Sc. Agri./ B.Sc. Horti./ B.Sc. (Hons.) Agriculture/ B.Sc. (Hons.) Horticulture / B.Sc. (Hons.) Food Sci. & Tech./ B. Sc. or B. Tech. in Food Technology/ B.Sc. (Hons.) Food Nutrition and Dietetics/ B. Sc. Home Science/ B. Sc. with Biochemistry/Microbiology/B.Tech. (Agri. Engg.)/ B. E. (Food Technology / Food Engineering / Food Engineering and Technology / Food Process Engineering / Food Technology and Management / Dairy Technology / Agricultural Process Engineering / Agricultural Engineering / Food Processing and Management/B. Tech. (Post harvest Engineering / Technology) or equivalent degree.

6.2 Mode of admission: As per the University rules.

#### 7. EVALUATION AND GRADING SYSTEM

- i. There will be a 10-point grading system of evaluation.
- ii. The candidates are required to obtain minimum 33 per cent (17/25 marks) of marks assigned (50/75 marks) for theory examinations (external) conducted by the University.
- iii. In case of courses with theory and practical, minimum of 33 per cent marks

in theory and practical separately are essential.

- iv. To pass in a course/paper/internship/seminar etc, it is required to obtain 40 per cent (40 marks) of total marks (100 marks) assigned cumulatively (Internal continuous assessment and external examinations) with minimum 33 per cent of marks assigned for external examinations (theory and/or practical) conducted by the University. Hence, Grade Point, GP, of 4.00 to pass in a course and an Overall Grade Point Average, CGPA, of 4.00 to award the M. Sc. Food Science and Technology shall be required mandatorily. A candidate failing to secure minimum CGPA 4.00 will not be considered for the award of degree and shall be declared as 'failed'.
- v. There is no minimum passing marks in internal continuous assessment examinations.
- vi. To attain the final degree a student has to pass all the courses of each semester.
- vii. The minimum Semester Grade Point Average (S. G.P.A.) and Cumulative Grade Point Average (C.G.P.A.) for passing / promotion of a particular semester as well as degree course should not less than 4.00.
- viii. If a student fails in course(s), he/she will get opportunities to pass the course(s) in consecutive academic years of that semester (course of odd semester in consecutive odd semester similarly course of even semester in consecutive even semester).
- ix. Percentage of Marks = CGPA x 9.5
- x. In special case or cases Vice-Chancellor will have to right to allow the separate examination schedule to clear the repeated course/courses for individual or group of individuals.

## 7.a. Internal Continuous Assessment Process

Parameters	Marks
(1) Project/ essay /assignment/ Survey/book review, (2) Seminar/presentation, (3) Role play /screen play/ puzzle /student parliament, (4) Quiz/mid-term/ test, (5) Practical work/lab work/ Mock test/viva voce/ student interaction (6) Exhibition/fair/ educational visit. <i>Note</i> <ul style="list-style-type: none"> <li>• Minimum any (1-6) two activities, and</li> <li>• The weightage of marks for each activity to be assigned by Course Instructor(s) in such way that the marks for any one activity should not exceed 15 marks in any circumstances.</li> </ul>	25
<i>Total</i>	25

### 8. Letter Grades and Grade Points:

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study. The University may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

## 9. Computation of SGPA and CGPA

- i. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$\text{SGPA (Si)} = \frac{\sum(C_i \times G_i)}{\sum C_i}$$

Where  $C_i$  is the number of credits of the  $i$ th course and  $G_i$  is the grade point scored by the student in the  $i$ th course. Example for Computation of SGPA

Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	$3 \times 8 = 24$
1	Course 1	4	B +	7	$4 \times 7 = 28$
1	Course 1	3	B	6	$3 \times 6 = 18$
1	Course 1	3	O	10	$3 \times 10 = 30$
1	Course 1	3	C	5	$3 \times 5 = 15$
1	Course 1	4	B	6	$4 \times 6 = 24$
		20			139
SGPA					$139/20=6.95$

- ii. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$\text{CGPA} = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

Where  $S_i$  is the SGPA of the  $i$ th semester and  $C_i$  is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit 20 SGPA 6.9	Credit 20 SGPA 7.8	Credit 20 SGPA 5.6	Credit 20 SGPA 6.0
CGPA= $(20 \times 6.9 + 20 \times 7.8 + 20 \times 5.6 + 20 \times 6.0)/80 = 6.6$			

iii. Award of Division:

श्रेणी	वर्गीकरण
प्रथम श्रेणी	6.50 अथवा उससे अधिक तथा 10.00 से कम CGPA
द्वितीय श्रेणी	5.00 अथवा उससे अधिक तथा 6.50 से कम CGPA
तृतीय श्रेणी	4.00 अथवा उससे अधिक तथा 5.00 से कम CGPA

## 10. ADVISORY SYSTEM

### 10.1 Advisory Committee

- i. There shall be an Advisory Committee for every student consisting of not fewer than three members in the case of a candidate for Masters' degree with the Advisor as Chairperson. The Advisory Committee should have representatives from the major and minor fields amongst the members of the post-graduate faculty accredited for appropriate P.G. level research. However, in those departments where qualified staff exists but due to unavoidable reasons post-graduate degree programmes are not existing, the staff having post-graduate teaching experience of two years or more may be included in the Advisory Committee as member representing the minor.
- ii. The Advisor should convene a meeting of the Advisory Committee at least once in a Semester. The summary record should be communicated to the Head of Department, Dean/Principal of the College(s) of concerned.

- iii. A proposal for the formation of the advisory committee of the student shall be forwarded by the Heads of the Department to the Dean/Principal for approval within one month from the commencement of the first semester.

10.2 Advisor/ Co-guide/ Member, Advisory Committee from other collaborating University/ Institute/ Organization

- i. In order to promote quality post-graduate research and training in cutting edge areas, the University may enter into Memorandum of Understanding (MOU) with other Universities/ Institutions for conducting research. While constituting an Advisory Committee of a student, if the Chairperson, Advisory Committee feels the requirement of involving of a faculty member/ scientist of such partnering university/ Institute/ Organization, he/ she may send a proposal to this effect to the Dean along with the proposal for consideration of Student's Advisory Committee (SAC).
- ii. The proposed faculty member from the partnering institution can be allowed to act as Chairperson/ Co-guide/ Member, SAC, by mutual consent, primarily on the basis of intellectual input and time devoted for carrying out the research work at the particular institution. The faculty member/ scientist of partnering institutions in the SAC shall become a temporary faculty member of the University by following the procedure approved by the Academic Council.

10.3 Changes in advisory committee

- i. The proposal for changes in the advisory committee is to be sent to the Dean/Principal for approval, if it is keenly felt that such changes are absolutely necessary. The reason for such change should be indicated.
- ii. The changes may be affected immediately, when the existing members are transferred elsewhere or resigned or retired.
- iii. If a guide goes abroad or within India for more than 6 months, to attend any training or on leave for more than six months, the Chairman of the

Advisory Committee has to be changed immediately. The same conditions will apply to members also.

#### **11. RESEARCH PROPOSAL**

- i. With the guidance of the advisory committee the students should identify the tentative area of research and include it in the plan of work. The topic for thesis research for the students of Master's programme should be of such a nature as to indicate a student's potentialities for conducting research and to train him in research.
- ii. The research proposal has to be presented by the student in a meeting organized by the Head of the department to get the opinion/suggestions of the teachers of the department for improving it.
- iii. Three copies of the research proposal in the prescribed format (to be developed by the department) should be sent to the Dean/Principal through the Head of the department for approval.
- iv. The research work may begin at any time between semesters I and IV, but the thesis must be turned in by the conclusion of semester IV or within the date notified by the University.

#### **12. SUBMISSION OF THESIS**

- i. The research credits registered in the last semester of postgraduate programme should be evaluated only at the time of the submission of thesis by the advisory committee. Students can submit the thesis at the end of the final (4<sup>th</sup>) semester.
- ii. If a postgraduate student has completed the thesis before the closure of the final semester, the Chairman can convene the advisory committee meeting and take decision on the submission of the thesis provided the student satisfies 75 per cent attendance requirement.
- iii. Copy of the thesis to be sent for evaluation to the external examiner (one) should be submitted in paper pack.
- iv. After incorporating the suggestions of the examiner, by which thesis is evaluated, and those received at the time of viva-voce, the thesis should

be submitted to the University/College, as case may be, in hard bound copies (four copies) and soft copies (in PDF).

12.A Grace period: Students can avail a grace period upto three months for submission of thesis after the closure of final semester by paying prescribed fine to the University.

- i. If a student is not able to submit the thesis within three months grace period, the student has to re-register the credits in the forthcoming semester.
- ii. The student who re-register the credits after availing the grace period will not be permitted to avail grace period for the second time.
- iii. The Registrar can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission.

### **13. EVALUATION OF THESIS**

- i. The thesis submitted in partial fulfillment of a Master's degree shall be evaluated by an external examiner nominated by the Controller of Examinations. However, the Dean/Principal may send panel of three examiners.
- ii. An oral examination will be conducted by External examiner (one) and the Advisory Committee after the thesis is recommended by the external examiner and carrying out the corrections/suggestions made by the external examiner by the student.
- iii. The Chairman of the advisory committee shall communicate the date of final thesis viva-voce examination to the student and advisory committee members within 15 days and the thesis final viva-voce examination shall be completed within one month from the date of receipt of the report from the external examiner.
- iv. In case, the External examiner does not recommend the thesis for the award of the degree, the advisory committee may send their

recommendation for scrutiny of the thesis by another external examiner, through the Dean to Controller of Examinations within one month from the date of receipt of the thesis. The Controller of Examinations may, on the recommendation of the advisory committee and Dean, refer the thesis for scrutiny and independent judgment to a second external expert chosen by him.

- v. If the second external expert recommends the thesis for acceptance, this recommendation may be accepted.
- vi. If the second examiner also does not recommend the thesis for acceptance, the degree shall not be awarded.

**14. REVISION OF THESIS**

If an examiner recommends for revision of thesis the following norms will be adopted:

- i. For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from the Dean.
- ii. If the revision is recommended for repeating lab experiments, field trial etc., resubmission must be after a minimum period of six months.
- iii. At the time of resubmission, the advisory committee should give a certificate for having carried out the corrections/recommendations. The resubmitted copies of thesis should have incorporated the necessary corrections as indicated by the external examiners.

**15. REMOVAL OF DIFFICULTIES:**

- i. If any difficulty arises in giving effect to the provisions of these regulations, the Vice- Chancellor may issue necessary orders which appear to him to be necessary or expedient for removing the difficulty.
- ii. Every order issued by the Vice-Chancellor under this provision shall be laid before the Academic Council of the University in the next meeting after the issuance.
- iii. Notwithstanding anything contained in the regulations, the Board of Studies or Academic Council reserve the right to make changes whenever necessary.

## **M.Sc. in Food Science and Technology**

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

PEO 1: Ability to identify and develop multi-disciplinary approaches to tackle food processing, quality, safety, environmental and sustainability issues arising nationally and globally.

PEO 2: To inculcate skill in problem solving, critical thinking and reasoning vis-à-vis scientific problems.

PEO 3: To have ability to carry forward new areas of research in both food technology and allied field of science and technology independently.

PEO 4: Amicable and be able to adapt food specific process and technologies for better and safe preservation of foods pertaining to plant and animal foods, cereals, pulses, oilseeds, fruits, vegetables, spices, meat, fish, poultry, sea food, milk and dairy products and their by-product utilization.

PEO 5: To impart advanced skills and knowledge for working in food laboratories/industries/research centres and/or will be competent to address challenges of local to global dimensions aligned with consumer demand, economy, and sustainability goals.

### **PROGRAMME OUTCOMES (POs)**

PO 1: Problem Solving:

A graduate student should be able to demonstrate the capability to:

- solve problems of familiar and non-familiar contexts that are best approached with critical thinking and apply the learning to real-life situations.

PO 2: Analytical Reasoning & Critical Thinking:

The graduates should be able to demonstrate the capability to:

- apply analytical thought to a body of knowledge, including the analysis, evaluation and practices, as well as evidence, arguments, claims, beliefs, and the reliability and relevance of evidence,
- identify relevant assumptions or implications; and formulate coherent arguments,
- identify logical flaws in the arguments,
- analyse and synthesise data from various sources, draw valid conclusions and support them with evidence and examples.

#### PO 3: Creativity

The graduates should be able to demonstrate the ability to:

- create, perform, or think in different and diverse ways about the same objects or scenarios,
- deal with problems and situations that do not have simple solutions,
- innovate and perform tasks in a better manner,
- view a problem or a situation from multiple perspectives,
- think 'out of the box' and generate solutions to complex problems in unfamiliar contexts,
- adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

#### PO 4: Communication Skills

The graduates should be able to demonstrate the skills that enable them to:

- listen carefully, read texts and research papers analytically, and present complex information clearly and concisely to peers and the public at large,

- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media,
- confidently share views and express herself/himself,
- construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice,
- convey ideas, thoughts, and arguments using respectful and sensitive language to gender and other minority groups.

#### PO 5: Research related Skills

The graduates should be able to demonstrate:

- a keen sense of observation, inquiry, and capability for asking relevant/appropriate questions,
- the ability to problematise, synthesize and articulate issues and design research proposals,
- the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships,
- the capacity to develop appropriate methodology and tools of data collection,
- the appropriate use of statistical and other analytical tools and techniques,
- the ability to plan, execute and report the results of an experiment or investigation,
- the ability to understand basic research ethics and skills in practising/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.

#### PO 6: Leadership Development

The graduates should be able to demonstrate the capability for:

- mapping out the tasks of a team or an organization and setting direction.
- formulating an inspiring vision and building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision.
- using management skills to guide people to the right destination.

PO 7: Digital and technological skills

The graduates should be able to demonstrate the capability to:

- use ICT in a variety of learning and work situations,
- access, evaluate, and use a variety of relevant information sources,
- use appropriate software for analysis of data.

PO 8: Community engagement and service

The graduates should be able to demonstrate the capability to:

- participate in community-engaged services/ activities for promoting the well-being of society.

PO 9: Environmental awareness and action

The graduates should be able to demonstrate the acquisition of and ability to apply the knowledge, skills, attitudes, and values required to take appropriate actions for:

- recognize environmental and sustainability issues, and participate in actions to promote sustainable development.
- mitigating the effects of environmental degradation, climate change, and pollution,
- effective waste management, conservation of biological diversity, management of biological resources and biodiversity.

## **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

The learning outcomes that a student should be able to demonstrate on completion of the post graduate degree programme may involve varied competencies as under:

PSO 1: To inculcate the basic theoretical and practical knowledge in the area of food science and technology, and gain ability to disseminate acquired knowledge and spread awareness in the field effectively.

PSO 2: To enhance ability to think critically, identify issues and scientifically resolve problems arising in real world situations in food processing, food quality control, food packaging and storage sectors.

PSO 3: To develop competency in integrating knowledge of basic, advance and cross disciplinary concepts in the field, and train them with necessary skills for development of relevant process technologies and food products design catering to the human health and safety needs.

PSO 4: To demonstrate attributes of professional development consistent with expectations in the field, enhance communication ability, team work, inculcation of professional ethics and fostering commitment towards environmental and societal issues.

**M. Sc. in Food Science and Technology**  
Semester-wise (I to II) detailed course structure

Sem.	Paper Code	Title of paper	Credit Hrs.	Evaluation pattern				
				Internal Assessment	External		Total	
					TH	P		
I	FST 501	Principles of Food Processing	4(4+0)	25	75	-	100	
	FST 502	Food Chemistry	4(3+1)	25	50	25	100	
	FST 503	Instrumentation and Analytical Techniques	4(3+1)	25	50	25	100	
	FST 504	Research Methodology and Statistics	4(4+0)	25	75	-	100	
	FST 591	Communication Skills	2(1+1)	25	50	25	100	
	FST 592	Basics of Computer Application	2(1+1)	25	50	25	100	
			<b>TOTAL</b>	<b>20</b>	25			
II	FST 505	Post Harvest Technology of Horticulture Crops	3(2+1)	25	50	25	100	
	FST 506	Food Microbiology	4(3+1)	25	50	25	100	
	FST 507	Packaging of Food Materials	3(3+0)	25	75	-	100	
	FST 508	Food Engineering	4(3+1)	25	50	25	100	
	FST551	<b>Elective – I (Any two)</b>	Processing of Meat, Fish and Poultry Products	2(2+0)	25	75	-	100
	FST 552		Intellectual Property Rights					
	FST 553		Specialty Foods					
	FST 554		Fundamentals of Nutrition					
	FST 557		Spices and Flavour Technology					
	FST 604	Training/Summer internship*	2	25	--	75	100	
		<b>TOTAL</b>	<b>20</b>					

\*During II and III sem.,; TH: Theory; P: Practical

**M. Sc. in Food Science and Technology**  
Semester-wise (III to IV) detailed course structure

Sem.	Paper Code	Title of paper	Credit Hrs.	Evaluation pattern				
				Internal Assessment	External		Total	
					TH	P		
III	FST 601	Processing of Cereals, Pulses and Oilseeds	4(3+1)	25	50	25	100	
	FST 602	Processing of Milk and Milk Products	4(3+1)	25	50	25	100	
	FFT 603	Quality Control, Food Standards and Food laws	3(3+0)	25	75	-	100	
	FST 651	Elective - II (Any two)	Entrepreneurship in Food Processing	2(2+0)	25	75	-	100
	FST 652		Food Fermentation and Microbial Technology					
	FST 653		Food Rheology					
	FST 654		Food Product Development					
	FST 655		Advanced Food Analysis					
	FST 691	Workplace Skills	2(1+1)	25	50	25	100	
	FST 593	Communication skills and Scientific writing	2(1+1)	25	50	25	100	
FST 641	Master's Seminar	1	25	--	75	100		
<b>TOTAL</b>			<b>20</b>					
IV	FST 646	Master's Research/Thesis	20	Satisfactory				
<b>TOTAL CREDITS</b>			<b>80</b>					

TH: Theory; P: Practical

\*Respective MOOC's; SWAYAM, NPTEL courses related to Food Science and Technology are also included and will be offered in due time.

**COURSE CONTENTS**

## SEMESTER I

### Core Course: FST 501 Principles of Food Processing Credits: (4+0)

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** B.Sc. with Chemistry / Biochemistry as one of the paper/course.

**Objective:**

To acquaint with principles of different techniques used in processing and preservation of foods.

**Course Content**

**UNIT I**

(5 lectures)

Introduction: Definition and scope of Food Science and Technology, historical development of food processing and preservation, general principles of food preservation.

**UNIT II**

(15 lectures)

Preservation by heating: Principles of the method, Types of microorganisms, bacterial load, sterilization and commercial sterility, thermal resistance of the microorganisms and enzymes..

Canning and bottling: General aspects of canning and bottling, processing operations exhausting and sealing, retorting, ultra-high temperature processes, determination of thermal process time, processing equipments, canning/ bottling of various food products.

Chemical preservation: Preservation of foods by use of sugar, salt, chemicals and antibiotics and by smoking. Effect of various food processing operations on the nutrients of foods.

**UNIT III**

(15 lectures)

Refrigeration and freezing preservation: Refrigeration and storage of fresh foods, major requirements of a refrigeration plant, controlled atmospheric storage, refrigerated storage of various foods, freezing point of selected foods, influence of freezing and freezing rate of the quality of food products, methods of freezing, storage and thawing of frozen foods.

**UNIT IV**

(13 lectures)

Drying and dehydrations: Sun drying of various foods, water activity and its effect on the keeping quality, sorption isotherms and their use. Characteristics of food substances related to their dehydration behavior, drying phenomenon, factors affecting rate of drying, methods of drying of various food products, type of driers and their suitability for different foods; intermediate moisture foods.

Concentration (Evaporation): Application in food industry, processes and equipment for manufacture of various concentrated foods and their keeping quality, Properties of liquid, single and multiple effect evaporation,

**UNIT V**

(12 lectures)

Radiations: Sources of radiations, effect on microorganisms and different nutrients; Radiation units and doses for foods, dose requirements for radiation preservation of foods, safe limits, irradiation mechanism and survival curve, irradiation of packaging materials. Microwave Heating: Principles and application in food processing.

**Learning Outcomes:** The students will have knowledge about different processing and preservation methods and principles involved.

**Reference Books**

- Food Processing Technology by P.J. Fellows, Woodhead publishing ltd.
- Food Science by N.N. Potter, CBS publishing.
- Physical principles of Food Preservation. Vol. II by M. Karel, O.R. Fenema and D.B. Lurd, Maroel, Dekker Inc. New York.

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### Core Course: FST 502 Food Chemistry Credits: (3+1)

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** B.Sc. with Chemistry as one paper / course.

**Objective:** To acquaint with properties and role of various constituents in foods, interaction and changes during processing.

### Course Content

#### UNIT I

Water: properties, bonding and chemistry.

(4 lectures)

#### UNIT II

Carbohydrates: Classification, structure and properties of carbohydrates. Role of carbohydrates in food industry. Sugar, starch, cellulose, glucans, hemicelluloses, gums, pectic substances, polysaccharides. Browning reaction in foods: Enzymatic and non-enzymatic browning in foods of vegetable and animal origin during storage and processing of foods.

(8 lectures)

#### UNIT III

Proteins: Classification, structure, properties, purification and denaturation of proteins. Protein interaction and degradation, protein-protein interaction, protein-lipid complexes and protein-carbohydrate complex. Major protein systems and factors affecting them, the nature of interaction in proteins derived from milk. Egg proteins, meat proteins, fish muscle proteins, oil seed proteins and cereal proteins.

(12 lectures)

Enzymes: Nature, classification and properties of food enzyme, enzyme activity in different food systems, commercial availability. Food enzyme technology. Immobilization of enzymes, removal of toxicants through enzymes, flavor production by enzymes.

#### UNIT IV

Lipids: Classification and physico-chemical properties of food lipids. Refining of crude oils, hydrogenation and winterization. Vegetable and animal fat, margarine, lard, butter. Frying and shortening. Flavor changes in fats and oils, lipid oxidation, factors affecting lipid oxidation, auto-oxidation, biological significance of auto-oxidation of lipids.

(10 lectures)

#### UNIT V

Vitamins: Role of vitamins in food industry, effect of various processing treatments and fortification of foods. Minerals: Role of minerals in food industry, effects of various processing treatments.

(11 lectures)

Biological changes in foods: Plant pigments and their roles in food industry. Bitter substance and tannins. Flavour Composition of Foods and beverages. Emulsion: Definition, Theory, Emulsifiers: Properties, role & action in stabilizing an emulsion.

### Practical

- Preparation of standard solutions for the chemical analysis i.e. HCl, H<sub>2</sub>SO<sub>4</sub>, KmnO<sub>4</sub>, Sodium Thiosulphate and Iodine.
- Determination of pH and acidity of foods
- Determination of proximate composition of Foods: Moisture, Protein, Fat, Total ash, Crude fibre, Carbohydrate, Calorific Value
- Determination of minerals in food products: Calcium by Titration, Phosphorus by Spectrophotometer, Iron by Spectrophotometer
- Estimation of reducing, non-reducing, total sugars in cereals and fruits & vegetable products.
- Determination of starch content in food products.
- Estimation of fats & Oils: Free fatty acid, Peroxide value, Saponification value, RM Number, TBA test, Iodine value, Fat adulteration test
- Determination of NaCl content in food products.
- Determination of trypsin inhibitors.

**Learning Outcome:** The students will gain information about various food constituents, and changes that occur in them during food processing.

### Reference Books

- Belitz HD.1999. Food Chemistry. Springer Verlag.
- DeMan JM. 1976. Principles of Food Chemistry. AVI.
- Fennema OR.1996. Food Chemistry. Marcel Dekker.
- Meyer LH. 1987. Food Chemistry. CBS

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**Core Course: FST 503 Instrumentation and Analytical Techniques**  
**Credits: (3+1)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Graduation in any stream of science.

**Objective:** To develop an understanding and methodologies of instrumental techniques in food analysis used for objective methods of food quality parameters.

**Course Content**

**UNIT I**

(3 lectures)

Preparation of chemical solutions: Concept of molar, molal, and normal solutions. pH and Buffers: Importance and measurement of pH.

**UNIT II**

(8 lectures)

Chromatographic techniques: General principles. Partition and adsorption chromatography. Paper, thin layer, gas liquid, ion exchange and affinity chromatography. Gel filtration. Introduction to High Pressure Liquid Chromatography.

**UNIT III**

(5 lectures)

Electrophoretic Techniques: General principles. Paper and gel electrophoresis. Polyacrylamide gel electrophoresis.

**UNIT IV**

(8 lectures)

Spectroscopy: Beers and Lambert's Law. Extinction coefficient. General principles of colorimeters and spectrophotometers, Atomic spectroscopy, Emission spectroscopy, IR spectroscopy.

**UNIT V**

(6 lectures)

Fluorimetry: Spectrofluorometers. Flame photometry and atomic absorption spectrophotometry.

Use of radioisotopes. Microbiological assays. Microscopy

**Practical**

- Qualitative analysis of compounds by chromatography techniques: Thin layer Chromatography, Paper Chromatography: Descending, Ascending and Circular Paper chromatography.
- Qualitative analysis of compounds By using High Performance Liquid Chromatography.
- Column chromatography: Separation of beta carotene
- Use of electrophoresis in the determination of proteins.
- Determination of Rheological properties by using texture analyzer.

**Learning Outcome:** Students will get acquainted with analytical methods used for quality control analysis of raw material and processed food commodities.

**Reference Books**

- Hand Book of Food Analysis by Nollet & Toldra, CRC publishing ltd.
- Hand Book of Analysis & Quality Control for Fruit & Vegetable Products by Rangana, Tata Mcgraw hill publishing.
- Introduction to the chemical analysis of foods by Nielson, CBS publishing.

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**Core Course FST 504 : Research Methodology and Statistics**  
**Credits: (4+0)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** Basic knowledge of mathematics

**Objective:**

The students will be exposed to various statistical tools required to analyze the experimental data in Food Technology.

**Course Content**

**UNIT I**

11 lectures

Introduction to Research; Types of Research: (Basic & Applied) and their applications. Formulating a Research Problem; Research Design: Definition, Characteristics & Components. Research Questions, Objectives & Assumptions. Generation of Hypothesis. Data Collection: Tools, Primary & Secondary methods of Data collection.

UNIT II 12 lectures  
Sampling methods: Rationale & Characteristics. Types of Sampling: Probability & Non-probability sampling. General consideration in and Scaling Techniques. Consideration and Calculation of Sample Size. Data management & Analytics: Editing & Coding of Data, Tabulation & Graphical Representation of Research Data using MS Excel & Statistical software.

UNIT III 10 lectures  
Design of Experiments (DOE): Applications of Randomized Block Design (RBD) and its types, Factorial Design, Fractional Factorial Design, Latin Square Design (LSD). Critical Difference (CD), Split Plot Design.

UNIT IV 15 lectures  
Descriptive Statistics: Measures of Central Tendency – (Mean, Mode, and Mode for Grouped and Ungrouped Data). Measures of Variability – Range, Variance, Standard Deviation and Standard Error. Measures of Relative Positions - Sigma Scores, Standard Scores, Percentiles, Percentile Ranks. Measures of Relationships (Correlation and Regression Analysis). Normal Distribution & its applications; Measures of Shape – (Skewness, Kurtosis ). Calculations and Interpretation of Statistical Procedures

UNIT V 12 lectures  
Hypothesis Testing in Research: Confidence Intervals and Levels of Significance. Degrees of Freedom Tests of Significance . Parametric Tests – Z-test, t-Test, and F-test, ANOVA (One way & Two Way) . Non-Parametric Tests – Chi-Square. Calculations and Interpretation of Parametric and Non-Parametric Tests – use of statistical software.

**Learning Outcomes:** The students are expected to have learnt statistical tools for analyzing data.

**Reference Books**

- Jackson SL. 2012. Research Methods and Statistics: A Critical Thinking Approach. Fourth Edition. Wadsworth Cengage Learning.
- Krishnan V. 2011. Statistics for Beginners. Atlantic Publishers and Distributors (P) Ltd.
- Singh YK. 2006. Fundamentals of Research Methodology and Statistics. New Age International Publishers.
- Aggarwal BL. 2003. Basic Statistics. New Age.
- Kothari CR. 1989. Research Methodology. Wiley Eastern.
- Gupta SP. 2004. Statistical Methods. S. Chand & Sons.

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**Foundation Course: FST 591 Communication Skills**  
**Credits: (1+1)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** English as a subject at secondary level.

**Objective:** To equip the students with skills to write, communicate and articulate in English (verbal as well as written).

**Course Content**

<b>Unit I</b>	2 lectures
<b>Introduction to communication</b> – Definition, Purpose, Basic communication model, need for effective communication, process & barriers to communication	
<b>Unit II</b>	4 lectures
<b>Grammar</b> - Noun, Articles, Adjective & Degrees of comparisons, Preposition, Subject-verb agreement, Present, past & future Tense, Modals & Moods, Active & passive voice, Reported speech	
<b>Unit III</b>	4 lectures
<b>Oral Communication</b> –Identification of sounds (Phonetics), Consonant & Vowel sounds, Indianism, Syllable & Syllable Stress, Intonation & modulation, Word stress, Development of Speaking Skills	
<b>Unit IV</b>	3 lectures
<b>Written Communication</b> –Formal & informal letter writing, Introduction to Essay writing,	
<b>Unit V</b>	2 lectures
<b>Vocabulary building</b> - Learning new words, Synonyms, Antonyms, use of suffix/prefix.	

**Practical:**

- Ice breaker session
- creating new words
- exercise on picture description
- story completion
- oral practice of vowel sounds and syllable stress (phonetics)
- Comprehension Practical
- Dictionary Quiz
- Paragraph writing
- Vocabulary building exercises
- Paragraph Reading

**Learning Outcomes:** The students are expected to be able to communicate effectively in English after completing the course.

**Reference books:**

- English Grammar Composition & Usage. J C Nesfield
- Essential Grammar in Use, Raymond Murphy, Cambridge
- Oxford English Grammar , Sidney Greenbaum, Oxford University Press

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**Foundation Course FST 592: Basics of Computer Application**

**Credits: (1+1)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Graduation in any stream.

**Objective:** To educate students about the basic use. applications and web applications so as to facilitate learning.

**Course Content**

UNIT I	(2 lectures)
Introduction to Computer (Hardware / Software)	(2 lectures)
UNIT II	
Microsoft Word and its applications (Documentation and Formatting)	(4 lectures)
UNIT III	
MS Excel and its applications (Making Tabular data, charts & formatting, Use of general functions & formulae)	(4 lectures)
UNIT IV	
MS PowerPoint and its applications (Creating own design, design & formatting of a presentation, Use of Image, audio, video in the presentation)	(3 lectures)
UNIT V	
Use of Internet & Web Applications and Email Services, Industry customer approach.	

**Practical**

- Basics of Computers, usage of short cut keys, taking out print outs, page set ups.
- Making of Power point Presentation
- E- Mail ( Subject line, salutation, subscription, how to mark cc, drafting, sending of mails, reverts, forwarding of mails, attaching pictures and documents, attaching ppts
- Differentiation between hardware and software and practical usage of both.
- Diagrammatic representation of pic-charts, tabular presentation of data/info, Etc
- Basic use of MS Excel/Spread Sheets

**Learning Outcomes:** Learning of basic computer applications and use of web services will be completed after studying the course.

**Reference Books**

- Fundamentals of Computers by E. Balagurusamy (Author) Publisher: McGraw Hill Education (India) Private Limited
- Ms Office 2007 in a Nutshell by S. Saxena (Author) Publisher: S.Chand (G/L) & Company Ltd

## SEMESTER II

### Core Course: FST 505 Post Harvest Technology of Horticultural Crops

Credits: (2+1)

Level: Post Graduate

Semester: Spring

Pre-requisite: FST 501

**Objective:** To acquaint with the proper handling technologies of fruits and vegetables to reduce post harvest losses and acquaint with principles and methods of preservation of fruits and vegetables into various products.

#### Course Content

##### UNIT I

(4 lectures)

Fruits and vegetables as living products: Chemical composition; pre and post harvest changes, maturity standards for storage, desirable characteristics of fruits and vegetables of processing.

Post harvest handling of fresh fruits and vegetables: Role of plants growth regulators in relation to storage; physical and chemical treatment to increase the shelf-life, conditions for transportation and storage, disease and injuries during marketing.

##### UNIT II

(8 lectures)

Storage of fresh fruits and vegetables. Containers: Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling: quality of raw materials, preparation of materials, preparation of syrups and brines, canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control.

Fruit and vegetable juices: Preparation of juice, syrups, squashes, cordials, and nectars; concentrations and drying of juice, packaging and storage and concentrations and powders; fortified and soft drinks.

Preparation of preserve and candied fruits

##### UNIT III

(4 lectures)

Preservation by freezing, general methods for freezing of fruits and vegetables; problem relating to storage of frozen products; standards for frozen food products.

Dehydration of fruits and vegetables: Methods; packaging, storage, quality control during and after dehydration.

##### UNIT IV

(8 lectures)

Pickles and chutneys: Preparation of various types of pickles- theory and practice; preparation of sauces and chutneys; problems relating to the shelf life of pickles and chutneys; quality control.

Tomato products: preparation of various tomato products, food standards and quality control.

Pectin: Raw materials; processes and uses of pectin; products based on pectin manufacture and quality control.

##### UNIT V

(6 lectures)

Food additives: Use in fruit and vegetable preservation.

Vinegar: General methods of preparation, food standards and quality control. Uses

Utilization of waste from fruit and vegetables processing plant.

#### Practical

- Analysis of canned food products for chemical and microbiological spoilage.
- Tin coating test
  - Tin coating weight measurement (Clarke's Test)
  - Determination of the continuity of tin coating
  - Sulphide stain test and corrosion resistance test
- Determination of Ascorbic acid content in food products.
- Determination of lycopene content
- Determination of tannins in food products.
- Dehydration of fruits and vegetables
- Preparation of tomato products like ketchup, puree & past

- Preparation of Jam, Jelly, marmalade, preserve and fruit candy
- Pectin determination in fruits and vegetable products.
- Determination of chemical preservatives in fruits and vegetables products.
- Preparation and analysis of fruits beverages i.e. Squash and cordial.
- Use of flame photometry in the estimation of trace metals like Sodium and Potassium

**Learning Outcomes:** Students would have learnt different post harvest handling methods of fruits and vegetables.

#### Reference Books

- Lal G, Siddapa GS & Tandon GL.1986. Preservation of Fruits and Vegetables. ICAR.
- Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.
- Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci.

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### Core Course FST 506 : Food Microbiology

Credits: (3+1)

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** Science (Biology) as a subject in Class X.

**Objective:** To acquaint with different groups of micro-organisms associated with food, their activities, destruction and detection in food.

#### Course Content

##### UNIT I

(10 lectures)

General characteristics of microorganisms: Classification and identification of yeasts, molds and groups of bacteria important in food industry. Source of contamination: Air, water, soil, sewage, post processing contamination. Intrinsic and extrinsic factors influencing growth of microorganisms in foods.

##### UNIT II

(8 lectures)

Classification of foods and general principles involved in their preservation. Effects on microbes of: Low temperature preservation, lethal effects of chilling, freezing and thawing; high temperature preservation. Heat resistance of microorganism, heat penetration and thermal processing. Pasteurization, sterilization, canning and dehydration; chemical preservation and its toxic effects; irradiations.

##### UNIT III

(9 lectures)

Food fermentations: Bacterial, yeast and mold cultures; single and mixed cultures, propagation, maintenance and evaluation of cultures; factors affecting activity of cultures, bacteriophages, residual antibiotics and chemicals.

##### UNIT IV

(8 lectures)

Microbiology of fermentation: Fermented milks. Cereal foods, vinegar, oriental foods, alcoholic beverages. Therapeutic value of fermented foods. Food Biotechnology: Use of biotechnologically improved enzymes in food processing industry

##### UNIT V

(10 lectures)

Food spoilage: Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins.

Pathogens in foods: Microbial infections and intoxications. Growth and survival of pathogens in food.

Food borne diseases. Investigation and control

#### FFT 605 Food Microbiology Practical

- Determination of microbial counts: Total viable, thermophilic, proteolytic, lipolytic and aerobic spore formers, coliform counts, yeast and mold count.
- Determination of activity of starter cultures used and dairy industry.
- Dye reduction test.
- Determination of thermal resistance of enzymes and microorganisms

**Learning Outcomes:** After completing the course, the students will have knowledge about different groups of micro-organisms and their beneficial as well as harmful effects related to food.

#### Reference Books

- Food microbiology by V. Ramesh, MJP publishing.
- Food microbiology by W.C. Frazier, 1st Edition by Mcgraw Hill Pub. Co. New York.
- Modern Food Microbiology, J.M. Jay, CBS publisher.

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### Core Course: FST 507 Packaging of Food materials

**Credits: (3+0)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** FST 501

**Objective:** To acquaint the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.

#### Course Content

**UNIT I** (11 lectures)  
 Definitions and functions of packaging and packaging materials. Packaging requirements and selection of packaging materials; Types of packaging materials: paper: pulping, fibrillation and beating, types of paper and their testing methods; Glass: composition, properties, methods of making bottles and jars; Metals: Tin plate containers, tinning process, components of tin plate, tin free steel (TFS), types of cans, aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, coextrusion, edible films and biodegradable plastics.

**UNIT II** (11 lectures)  
 Properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength, their methods of testing and evaluation; Barrier properties of packaging materials: Theory of permeability, factors affecting permeability, permeability coefficient, gas transmission rate (GTR) and its measurement, water vapour transmission rate (WVTR) and its measurement, prediction of shelf life of foods. Different packaging systems for dehydrated foods, frozen foods, dairy foods, fresh fruits and vegetables, meat, poultry and sea foods.

**UNIT III** (8 lectures)  
 Process of Packaging: Material handling, filling, air removal, sealing, retorting, Modified atmosphere packaging, vacuum and gas packaging. Package sterilization techniques, cushioning, unitizing, palletizing, stacking and containerization.

**UNIT IV** (8 lectures)  
 Quality Control: Evaluation of Packaging materials, toxicity, corrosion prevention, shelf life testing, minimization of transport losses, Hazards in handling and storage and packaging and their minimization.

**UNIT V** (7 lectures)  
 Packaging Laws and Regulations, Standards of Weights and Measures Act, Advancement in packaging Technology: Smart packaging, Active packaging, Anti-microbial packaging etc.

**Learning Outcomes:** Students will have learnt about packaging materials, methods and their applications in food industry.

#### Reference Books

- Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
- Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group, 2012
- Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and Professional, 1992

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### Core Course FST 508: Food Engineering

**Credits: (3+1)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** B.Sc. with Chemistry as one paper.

**Objective:** To acquaint with basic principle of Food Engineering and its Processes, with importance of various foods process and their evaluation.

**Course Content**

UNIT I (9 lectures)  
Mass, Energy balance and Heat transfer: Steam injection, steam infusion, plate heat exchangers, tubular heat exchangers and scraped surface heat exchangers, Pasteurization: Theory and application, pasteurization of packaged and unpacked foods, pasteurization calculations, equipments. Thermal processing: Death kinetics, thermal death curve, decimal reduction time. Z-factor, heat penetration curve, process time calculations, mathematical curve, process time calculations. Mathematical and graphical solutions

UNIT II (10 lectures)  
Size reduction process: Principles, theories and laws, energy considerations, equipments. Mixing and forming, theory and applications, mixing indices, equipments for solid and liquid. Separation processes: Filtration and centrifugation, theories and mathematical descriptions, constant rate and constant pressure filtration, equipment. Membrane Technology- Reverse osmosis and Ultra filtration, Micro filtration

UNIT III (4 lectures)  
Fluid flow, laminar, turbulent and transitional ranges, velocity distribution profiles, basic equations, thermal velocity calculations.

UNIT IV (10 lectures)  
Evaporation: heat and mass balance, steam economy, heat recovery, efficiency, process calculations, Food dehydration: constant and falling rate periods, drying rate calculations. Chilling, refrigeration and freezing: theories, characteristics curve, cooling rate calculations.

UNIT V (12 lectures)  
Advanced Technologies: Extrusion: Theory and applications, extrusion cookers and cold extrusion, single and twin screw extruders, design considerations., Supercritical gas extraction, Advances in fortification: Synthetic nutrients. Techniques of food fortification. Stability of nutrients in relation to processing. Encapsulations: design and structure of microcapsules, release rate and mechanism. Techniques of micro encapsulation, advantages and application of encapsulation. Non thermal Processing: High pressure processing, Pulsed electric processing, Ohmic heating.

**Learning Outcomes:** After completing the course the students shall be well acquainted about different food engineering processes and various principles working behind them.

**Reference Books**

- S. K. Sharma, S.J.Mulvaney, and S.S.H.Rizvi, Food Process Engineering: Theory and Laboratory Experiments, Wiley and Sons, 2000
- H. Pandey, H.K. Sharma, R.C.Chouhan, B.C. Sarkar and M.C. Bera, Experiments in Food Process Engineering, CBS Publishers and Distributors, 2004
- M.A. Rao, S.S. H.Rizvi and A.K.Dutta, Engineering properties of Foods, 3rd ed., Marcel Dekker, 2005

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**Elective Course FST 551 : Technology of Meat and meat Products**  
**Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** Graduate in Science and must have completed a course Food Science / Food Chemistry.

**Objective:** To provide an understanding of the technology for handling, processing, preservation and bi-product utilization of meat, poultry and fish products processing.

**Course Content**

UNIT I (8 lectures)  
Scope of meat & meat products industry in India. Structure of meat tissue. Chemical composition and nutritive value of meat Mechanism of muscle contraction and relaxation.

Postmortem changes-factor affecting post-mortem changes, thaw rigor and cold shortening Properties of fresh meat. Meat carcass grading and cuts. Restructured meat products, Pre rigor processing of meat. Meat tenderization -and its techniques.

UNIT II (6 lectures)

Preservation of meat & poultry- chilling, freezing, curing, smoking, canning, dehydration, irradiation, freeze drying, antibiotics, microwave, chemicals

(2 lectures)

#### UNIT III

Utilization of meat industry by-products.

(10 lectures)

#### UNIT IV

Eggs - structure, composition, nutritive value and functional properties of eggs. Internal quality of eggs- evaluation, quality troubleshooters in eggs, egg grading. Preservation and maintenance of internal quality of eggs, Egg products- Egg powders, frozen eggs, egg foams, factors influencing foaming.

Poultry -types, factors affecting quality, chemical composition and nutritive value of poultry meat

Poultry dressing - ante and postmortem examination, methods of stunning, slaughter, scalding & dressing.

Tenderness of poultry, problem factors in poultry meat. Utilization of poultry industry by-products.

#### UNIT V

(4 lectures)

Fish structure and composition. Cold storage, freezing preservation and canning of fish. Picking of fish, fish protein concentrates, fish meal and by products of fish processing industry

**Learning Outcome:** Students will have learnt about chemistry of meat and various processing methods used for meat, fish, poultry and eggs.

#### Reference Books

- Govindan TK. 1985. Fish Processing Technology. Oxford & IBH.
- Hui YH. 2001. Meat Science and Applications. Marcel Dekker. 32
- Kerry J. et al. 2002. Meat Processing. Woodhead Publ. CRC Press.
- Pearson AM & Gillett TA. 1996. Processed Meat. 3rd Ed. Chapman & Hall.

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### Elective Course FST 552 : Intellectual Property Rights

Credits: (2+0)

Level: Post Graduate

Semester: Spring

**Pre-requisite:** Graduation in any stream.

#### Objective:

To sensitize the students regarding the essentials of Intellectual Property Rights, its fundamentals, legislations and significance to it in the development of agriculture, food and nutritional security.

#### Course Content

##### UNIT I

(6 lectures)

Need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPs Agreement.

##### UNIT II

(7 lectures)

Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties.

##### UNIT III

(5 lectures)

Fundamentals of patents, copyrights, geographical indications, designs and layout, trademarks.

##### UNIT IV

(6 lectures)

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection;

##### UNIT V

(6 lectures)

International Treaty on Plant Genetic; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement

**Learning Outcome:** The course is expected to acquaint the students with different IPR and its their importance in protecting individual rights.

#### Reference Books

- Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI,

- Wallingford.
- Ganguli, Prabudha. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill, New Delhi.

**Elective Course FST 553 : Specialty Foods**  
**Credits: (2+0)**

**Level:** Post Graduate  
**Semester:** Spring

**Pre-requisite:** Basic knowledge of Food Science and Nutrition at undergraduate level.

**Objective:**

To make students understand the need, importance and process of developing healthy and nutritious foods for special category of population groups.

**Course Contents**

**UNIT I** (6 lectures)  
Need and scope of specialty foods: Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods.

**UNIT II** (6 lectures)  
Specialty foods based on sources; Cereals and millets, Legumes and pulses, Fruits and vegetables, Animal food sources, By product based, Non conventional foods.

**UNIT III** (6 lectures)  
Specialty foods based on process; Innovative process technology, Food additives basis, Bioactive components, Novel nutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods.

**UNIT IV** (5 lectures)  
Specialty food based on genetics; Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods. Supplementary foods.

**UNIT V** (7 lectures)  
Therapeutic foods; Modification of diets in disorders, feeding purposes, Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney, metabolic disorders, allergy, endocrine disorders.

Specific consumer oriented foods; Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance. Specialty foods based on growing condition -organic, inorganic farming.

**Learning Outcome:** After completion of course the students would have an understanding of various specialty foods and their development based on variation of sources, process and genetics.

**Reference Books**

- Gibson GR & William CM. 2000. *Functional Foods - Concept to Product*.
- Roberts EC. 2006. *Handbook of Nutraceuticals and Functional Foods*. 2<sup>nd</sup> Ed. Wildman.
- Manson P. 2001. *Dietary Supplements*. 2nd Ed. Pharmaceutical Press.
- Bamji MS, Rao NP & Reddy V. 2003. *Textbook of Human Nutrition*. Oxford & IBH.

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**Elective Course FST 554 : Fundamentals of Nutrition**

**Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** FST 502

**Objective:** To acquaint the students about importance of nutrition, balanced diets, therapeutic diets for health and role of food and nutraceuticals in health.

**Course Content**

**UNIT I** (7 lectures)  
Introduction to human nutrition. Macronutrients and micronutrients - Classification and functions. Digestion,

absorption and assimilation of nutrients. Energy metabolism- Components of energy expenditure, Basal Metabolic Requirements and Activity, Recommended Dietary Allowances, Food Groups, Concept of a balanced diet, Methods of evaluation of nutritive value of foods.

UNIT II

(5 lectures)

Carbohydrates- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT III

(5 lectures)

Proteins- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT IV

(5 lectures)

Fat- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

UNIT V

(8 lectures)

Vitamin- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Minerals- Types, functions, sources, requirement, storage, Effect of deficiency and excess.

Water and electrolytes- Concept and importance. Nutritional assessment and nutritional policies- Salient features, concept of community nutrition

**Learning Outcomes:** The student. would be well informed about human nutrition concepts and various food groups after completing the course.

**Reference books**

- Nutrition Science by B. Srilakshmi
- Fundamentals of Foods & Nutrition by Sumati R. Mudambi
- Textbook of Nutrition : A Life cycle approach by Ravinder Chadha

## **Elective Course: FST 557 Spices and Flavour Technology**

**Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** FST 502.

**Objective:** To impart basic knowledge about the importance and production technology of spices and to know chemistry and physiology of taste, flavouring compounds in foods

### **Course Content**

Unit I

(5 lectures)

Spice processing Introduction, classification, composition and functions. Standards specification of spices and flavours, Spice processing, spice reconditioning, spice grinding, post- processing treatments.

Unit II

(7 lectures)

Processing of Major Spices: Pepper, cardamom, ginger, onion, garlic, vanilla, cinnamon, chilli and turmeric – method of manufacture; chemistry of the volatiles; enzymatic synthesis of flavour identical.

Unit III

(5 lectures)

Processing of Minor Spices, herbs and leafy vegetables: processing and utilization, All spice, Annie seed, sweet Basil, Caraway seed, Cassia, Cinnamon, Clove, Coriander, cumin, Dill seed Fern seed nutmeg mint marjoram, Rose merry, saffron, sage.

Unit IV

(5 lectures)

Spice extractives, Value added spice products: Spice volatile oils, spice oleoresins, Use of spice extractives, replacement of spices with oils and oleoresins, alternative products, Ground spices, processed spices, organic spices, curry powders. Packaging of spices and spice products

Unit V

(8 lectures)

Chemistry and physiology of taste, flavouring compounds in foods, Separation, purification and identification of natural flavouring materials& Synthetic flavouring agents and their stability: Processing quality control of Savory, Thyme, Ajowan, Curry leaves, Asafoetida, Tea, Coffee, Cocoa, Vanilla and annatto. Flavours of soft drinks, Baking and confectionery industry.

**Learning Outcomes:** The students are expected to have learnt importance and production technology of spices and flavours.

**Reference Books:**

- Spices – vol. II Parry J. W.

- Spice and condiments Pruthi J. S.
- Herbs and spices by Rosemary Hemphill
- The book of spices by Rosen garten, F. and Livingston Jr.
- Spices and herbs for the Food Inudstry by Lewies, Y.S.
- Spices Vol. I and II by Tropical Agril. Series. Purseglove, J. W. Brown E. G.,
- Green C. L. And Robbins SRJ. Food Flavourings P. R. Ashust.
- Food Flavouring composition,manufacture and uses. by J. Merrory

**FST 604 : Training/Summer internship (2 CREDITS)**

## SEMESTER III

### Core Course FST 601 : Processing of Cereals, Pulses and Oilseeds

Credits: (3+1)

Level: Post Graduate

Semester: Autumn

**Pre-requisite:** FST 501 and FST 502

**Objective:** To acquaint with production and consumption trends, structure, composition, quality evaluation, and processing technologies for product development and value addition of various cereals, pulses and oilseeds.

#### Course Contents:

##### UNIT I

(8 lectures)

Wheat Technology: Composition of grain and environmental effects on its processing quality, enzymes of wheat and their role in the manufacture of wheat products; principles of wheat milling and its effect on composition of flour, aging of flour, byproducts, chemical improvers- bleaching and maturing agents, property of dough and its rheology, manufacture of wheat products bread, biscuits etc.; formulation of premixes for bakery products; pasta goods and processed cereal foods for infants.

##### UNIT II

(10 lectures)

Rice Technology: Composition, type of proteins, starch content, amylose and amylopectin fractions; presence and effect of lipases; distribution of vitamins; minerals, and proteins in rice grain and its relation to milling; rice milling operations and its effect on nutritive value; cooking quality; byproducts of rice milling and their utilization; processed and prepared mixes based on rice.

##### UNIT III

(8 lectures)

Legumes: Composition, anti-nutritional factors, processing methods, methods of cooking.

##### UNIT IV

(10 lectures)

Corn Technology: Composition, processing of corn for manufacture of corn grits, meal and flour; manufacture of corn flakes, corn syrup, cornstarch, corn steep liquor, corn oil and canned corn. Composition and Processing of millets like barley, sorghum, oats etc.

##### UNIT V

(9 lectures)

Oilseeds: Composition, processing of oilseeds as protein concentrations, properties and uses of oilseeds meals, technology vegetable protein isolates; Barrier compounds in the utilization of oil seed proteins. Low cost protein foods from oilseeds.

#### Practical

- Physico-chemical and rheological examination of wheat and its products test weight, kernel hardness, gluten content, milling tests.
- Evaluation of rice amylose and amylopectin determination, gelatinization temperature, water absorption tests.
- Experimental parboiling and assessment of degree of polishing.
- Experimental baking of selected cereals products bread, biscuits.
- Preparation of protein concentrates and isolates and their evaluation for protein content and solubility.
- Determination of Yeast activity used in fermented cereal products.
- Quality test for wheat flour used in the baked products.
  - Maltose Number
  - Water Absorption
  - Sedimentation value
  - Alcohol Acidity
- Texture profile analysis of baked cereal food products by texture analyzer.

**Learning Outcome:** The students will have learnt about composition and processing of various cereals, pulses and oilseeds.

#### Reference Books

- Chakrabarty MM. 2003. Chemistry and Technology of Oils and Fats. Prentice Hall.
- Dendy DAV & Dobraszczyk BJ. 2001. Cereal and Cereal Products. Aspen.
- Hamilton RJ & Bhati A. 1980. Fats and Oils - Chemistry and Technology. App. Sci. Publ.
- Hosenev RS. 1994. Principles of Cereal Science and Technology. 2nd Ed. AACC.

## Core Course FST 602 : Processing of Milk and Milk Products

Credits: (3+1)

Level: Post Graduate

Semester: Autumn

Pre-requisite: FST 501

**Objective:** To acquaint with techniques and technologies of testing and processing of milk into various products and by products.

### Course Contents:

#### UNIT I

(12 lectures)

Introduction: Physicochemical properties of milk. Platform tests, Chemical composition and nutritive value of milk, Factors affecting composition of milk. Importance of milk industry in India: Collection, chilling, transportation, cream separation, standardization, pasteurization, sterilization, homogenization, packaging, storage and distribution of fluid milk, Ultrahigh temperature processed milk.

Preparation of various types of milks: Toned, homogenized, fortified, reconstituted and flavored milk.

#### UNIT II

(12 lectures)

Technology of fermented milk products: Principles and practices of manufacture, packaging, storage and marketing of Dahi, cultured butter milk, acidophilus milk etc. Preparation of soft curd milk, vitaminized milk, standardized milk, filled milk and imitation milk.

Cheese: Manufacture of hard, semi hard, soft and processed cheeses. Storage, grading and marketing of cheese, cheese defects and their control. Butter: Manufacture, packaging, storage and marketing of butter; butter defects and their control, margarine.

#### UNIT III

(8 lectures)

Technology of frozen milk products: Classification, manufacture, packaging, storage and marketing of ice cream, ices, sherbets etc. defects of frozen products and their control. Technology of evaporated and dried milk: Manufacture of evaporated milks and milk powders. Packaging storage defects and their control.

Technology of condensed milk: Manufacture of condensed milks, Packaging storage defects and their control.

#### UNIT IV

(8 lectures)

Technology of dairy by products: Utilization of skim milk, buttermilk and whey for the manufacture of casein, lactose etc. Technology of indigenous milk products: Principles and practices of manufacture, packaging, storage and marketing of ghee, Khoa, Chhena, shrikhand, paneer, rasogulla, gulabjamun and Milk based foods.

#### UNIT V

(5 lectures)

Sanitary aspects: of dairy plant building, equipment and their maintenance. Disposal of dairy plant waste. Application of membrane technology in dairy industry.

### Practical

- Plat form test for raw milk
- Determination of moisture content in milk
- Determination of fat content in Milk powders and ice-cream products.
- Determination of Milk adulterants: Starch, Urea, Formaldehyde and Sugar,
- Hydrogen peroxide, salt and detergent
- Operation, cleaning and sterilization of dairy plant machinery involved in fluid milk processing
- Preparation of toned, homogenized, fortified, reconstituted and flavored milks
- Manufacture of fermented milks.
- To study the kinetics of enzymes and manufacture of cheeses.
- Manufacture of butter
- Manufacture of ice- cream, ices, sherbets.
- Manufacture of casein, ghee, khoa, chhena.
- Sensory analysis of food products: Paired comparison test, Duo-trio test, Hedonic test, Triangle test, Ranking test, Single sample test, Composite scoring test,
- Analysis of water used in food industries i.e. Alkalinity, Acidity, Hardness, pH, TPC and Coliform count

**Learning Outcomes:** After completion of course students are expected to have an understanding of processing methods of milk in a dairy industry and manufacturing of dairy products.

### Reference Books

- Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. Technology of Indian Milk Products. Dairy India Publ.
- De S. 1980. Outlines of Dairy Technology. Oxford Univ. Press.
- Rathore NS et al. 2008. Fundamentals of Dairy Technology - Theory & Practices. Himanshu Publ.

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**Core Course: FST 603 Quality control Food Standards and Food Laws**  
**Credits: (3+0)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** FST 601

**Objective:** To acquaint with food quality parameters and control systems, food standards, regulations, specifications.

**Course contents:**

UNIT I

(5 lectures)

Quality Assurance: Introduction, Importance and Difference. Food Quality and Food Safety: Scope and difference.

UNIT II

(12 lectures)

Raw materials & Finished product quality: Quality parameters and evaluation procedures: Appearance, color, texture, viscosity, consistency, flavor.

Sensory evaluation: Selection of panel of judges, sensory characteristics of foods, types of tests.

UNIT III

(12 lectures)

Food standards and laws: International – Concept of Codex alimentarius, HACCP, GMP, GHP, USFDA, ISO 9000, ISO 22000, ISO 14000. National – Introduction of BIS/IS, Food Safety and standards – 2006, Food Safety and standard regulation 2010, FPO, MPO, MMPO, Agmark. Prevention of food adulteration Act: Food Adulteration: definition, common adulterants in different foods, contamination, methods of detection. Food additives and legislation; coloring matter, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides and pesticides. PFA specification for food products, Nutritional labeling

UNIT IV

(6 lectures)

Quality Certification & Accrediation: Introduction and procedure.

UNIT V

(10 lectures)

Water Quality: Water standards and Analysis physical, chemical and microbiological characteristics of water analysis. Waste treatment: Fundamentals of Physical, Biological & Chemical waste treatments

**Learning Outcome:** The students must have an understanding about food laws and standards, quality parameters and sensory evaluation of food.

**Reference Books**

- Early R. 1995. Guide to Quality Management Systems for Food Industries. Blackie Academic.
- Krammer A & Twigg BA. 1973. Quality Control in Food Industry. Vol. I, II. AVI Publ

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**Elective Course FST 651 : Entrepreneurship in Food Processing**  
**Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Completed basic course on Food Processing.

**Objective:** To enable the student to plan and prepare a project report for food processing unit and to provide capability to execute and evaluate the same and to introduce students to the methodology of project formulations and the implementation procedures and strategic planning of new projects.

**Course contents:**

UNIT I

(6 lectures)

Aggregate Planning-: General design considerations, Financial Analysis, plant location and plant layout, Flowcharts and their design, equipment selection

UNIT II

(4 lectures)

Design of service facilities

UNIT III (4 lectures)

Human resource planning: Planning and design of marketing system, worker's safety and plant hygiene

UNIT IV (6 lectures)

Introduction to Marketing and economics: Demand, Supply, Sample survey techniques, marketing information, consumer trends, consumer behavior.

UNIT V (10 lectures)

Introduction to Operations Research: Definition, applications. Inventory control, Linear Programming. Queuing Theory, Transportation and Assignment. Forecasting

**Learning Outcome:** The students would have been acquainted with designing and planning of food plant layout and operations research.

#### Reference Books

- Chandra P. 2005. Project Management. Tata McGraw Hill.
- Gopal Krishan P & Nagarajan K. 2005. Project Management. New Age.
- Hisrich RD & Peters MP. 2002. Entrepreneurship. Tata McGraw Hill.
- Kaplan JM. 2003. Patterns of Entrepreneurship. John Wiley & Sons.
- Nandan H. 2007. Fundamentals of Entrepreneurship Management. Prentice Hall.

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### Elective Course: FST 652 Food Fermentation and Microbial Technology

Credits: (2+0)

Level: Post Graduate

Semester: Autumn

**Pre-requisite:** Must have completed one course / paper on Microbiology / Food Microbiology.

**Objective:** To familiarize about the various microbial processes/systems/activities which have been used for the development of industrially important products/processes.

#### Course Content

Unit I (6 lectures)

Fermentation: History, definition and types. Study of a Bio fermentor – its design and operation, Down Stream Processing and Product recovery. Its measurement and control in fermentation, Aeration and agitation in fermentation: Oxygen requirement, sterilization of air and media; scale up in fermentation.

Unit II (6 lectures)

Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two-phase separation, solvent extraction, chromatography and electrophoresis.

Unit III (8 lectures)

Production of alcoholic beverages, organic acids, enzymes and immobilization of enzymes. Biological waste treatment.

Unit IV (4 lectures)

Dairy Fermentations-starter cultures and their types, concept of probiotics.

Unit V (6 lectures)

Microbial enzymes, role in various industrial processes, Bio-transformations, Immobilized enzymes based bioreactors; production of antibiotics, vaccines, and biocides; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Bioinsecticides; Biofertilizers.

**Learning Outcome:** The course will make the students learn about fermentation techniques and industrial microbiology.

#### Reference Books

- Huffnagle GB & Wernick S. 2007. The Probiotics Revolution: The Definitive Guide to Safe, Natural Health. Bantam Books.
- Nout RMJ, de Vos WM and Zwietering MH. 2005. Food fermentation. Wageningen Academic Publishers, Netherlands.

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**Elective Course: FST 653 Food Rheology**

**Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** FST 508

**Objective:** To explain the basics of food rheology and to familiarize the students with rheological instruments and their use in relation to food products.

**UNIT I** (6 lectures)

Food rheology and structure: stress and strain tensors, viscometric properties, shear stress-shear rate relationships, units in rheological measurements, types of fluid flow behaviour, apparent viscosity, intrinsic viscosity, stress- strain behaviour of solid foods, linear viscoelasticity, phase transitions in foods.

**UNIT II** (6 lectures)

Flow and functional models for rheological properties of fluid foods: Time independent flow behaviour, Apparent viscosity- shear rate relationships of shear- thinning foods, models for time dependent flow behaviour, role of solids fraction in rheology of dispersions, affect of temperature on viscosity, treatment of rheological data using models.

**UNIT III** (6 lectures)

Tube viscometry, Rotational viscometry: introduction

**UNIT IV** (6 lectures)

Viscoelasticity: introduction, transient tests for viscoelasticity, oscillatory testing. Rheology of food gum and starch dispersions: effect of heating, effect of sugar and protein, rheological behaviour of starch, rheology of starch- gum dispersions.

**UNIT V** (6 lectures)

Rheological behaviour of processed fluid, semisolid foods and food gels: rheological tests to evaluate properties of gel systems, gel point and sol-gel transition by rheological measurements.

Application of rheology to fluid food handling and processing

**Learning Outcome:** It is expected that the students would have learnt concepts of rheology and structure of food systems.

**Reference Books**

- Bourne MC. 2002. Food Texture and Viscosity: Concept and Measurement. Academic Press
- Deman JM. et al. 1976. Rheology and Texture in Food Quality. AVI Publ.
- Mohsanin NN.1989. Physical Properties of Plant and Animal Material. Vol. I, II. Gordon and Breach Science Publ.
- Steffe JF. 1992. Rheology and Texture in Food Quality. AVI Publ.

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**Elective course: FST 654**

**Food Product Development Credits: (2+0)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Basic knowledge of Food Science.

**Objective:**

To acquaint the students about the need, types, basic technique and details of food product development to plan nutritious products.

**Course Content**

**UNIT I(6 lectures)**

Concept of product development - product success and failure, factors for success, process of product development, managing for product's success. Innovation strategy - possibilities for innovation, building up strategy, product development programme.

UNIT II(5 lectures)

The product development process - product strategy, product design and process development, product commercialization, product launch and evaluation.

UNIT III(6 lectures)

The knowledge base for product development technology - knowledge and the food system, knowledge management, knowledge for conversion of product concept to new product, technological knowledge (product qualities, raw material properties, processing, packaging requirement, distribution and marketing.

UNIT IV(5 lectures)

Role of consumers in product development - consumer behaviour, food preferences, avoiding acceptance, integration of consumer needs in product development and sensory needs.

UNIT V

(8 lectures)

Managing the product development process, - principles of product development management, people in product development management, designing the product development process, key decision points, establishing outcomes, budgets and constraints, managing and organizing product development process, innovative matrices, striving for continuous improvement, Improving success potential of new products, market exploration and acquisition, Legal aspects of new product launch.

**Learning Outcome:** The course must have acquainted the students with principles of food product design and development.

**Reference Books:**

- Clarke & Wright W. 1999. Managing New Product and Process Development. Free Press.
- Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.
- Fuller 2004. New Food Product Development - from Concept to Market Place. CRC.

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**Elective Course: FST 655 Advanced Food Analysis**

**Credits: (1+1)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Must have completed one course / paper on Basic Food Analysis.

**Objective:** To develop an understanding of instrumental techniques in food analysis used for determination of food quality parameters.

**Course Content**

Unit I(2 lectures)

Concepts of food analysis. Rules and regulations of food analysis. Sample preparation for food analysis. Measurement of colour and water activity of raw and processed foods.

Unit II(3 lectures)

Determination of browning reaction in foods, food additives, residues and deleterious factors in raw and processed foods. Measurement of enzymatic changes in foods. Sugar profiling of foods through Bioscan.

Unit III(3 lectures)

Measurement of viscosity/texture in food products. Rheological techniques and instrumentation in food. Microscopic, Fluorimetric and polarimetric techniques in food analysis.

Unit IV(4 lectures)

Application and operating parameters of spectrophotometer, AAS (Atomic absorption spectroscopy),

Inductively coupled plasma optical emission spectroscopy (ICP-OES), NMR (nuclear magnetic resonance), FTIR (Fourier transform infrared spectroscopy)

Unit V(3 lectures)

Application and operating parameters of GC (Gas chromatography), HPLC (high performance liquid chromatography), GC-MS (gas chromatography- mass spectroscopy), LC-MS (liquid chromatography-mass spectroscopy).

**Practical**

- Sample preparation of food analysis
- Measurement of enzymatic changes in foods
- Sugar profiling of foods through Bioscan.
- Determination of Rheological properties by using texture analyzer
- Pasting properties of foods through RVA
- Working and operation of UV Visible Spectrophotometer
- Determination of Minerals through AAS
- Determination of heavy metals through ICP-OES
- Working and operation of HPLC, GC
- Qualitative analysis of compounds by chromatography techniques: Thin layer Chromatography, Paper Chromatography

**Learning Outcome:** The students would have been acquainted with application and working of Advance food analysis techniques.

**Reference Books:**

1. Nielson S S(2017). Food Analysis.Fifth edition. Springer, New York.
2. Clifton M and Pomeranz Y (1988)Food Analysis - Laboratory Experiments. AVI Publ.
3. Leenheer AP, Lambert WE and van Boexlaer JF (2000)Modern Chromatographic Analysis of Vitamins. 3rd Ed. Marcel Dekker, New York.
4. Pollet LML (2004) Handbook of Food Analysis. Vol. I. Marcel Dekker, Switzerland.
5. Handbook of Analytical Techniques by Helmut Gunzler and Alex Williams
6. The Chemical Analysis of Foods and Food products By Morris b. Jacobs

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**Foundation Course: FST 691 Workplace Skills**

**Credits: (1+1)**

**Level:** Post Graduate

**Semester:** Autumn

**Pre-requisite:** Understanding of basics of communication skills.

**Objective:** To enable students to have firm grounding in English to be able to use it effectively in professional as well as social contexts and have good job seeking skills to work in the fiercely competitive job market.

**Course Content:**

**Unit I**

3 lectures

**Business communication** - Job Application, Business Letters, Cover letter, Writing Emails, Minutes writing, Project report

**Unit II**

2 lectures

**Effective job seeking skills** - Needed documentation, Application process, Preparing for the interview, Post interview process, Job interview question model,.

**Unit III**

3 lectures

**Professional Practices and Ethical Codes-** Work Ethics, Code of Conduct, Protocol, Motivation,

Leadership, Formal writing

**Unit IV**

**Presentation & public speaking skills** – The art of listening, active listening, Presentation skills, public speaking 2 lectures

**Unit V**

**Behavioral skills** – Teamwork, Time management, Problem-solving Skills, Interpersonal & negotiation skills, building customer relations, Body language, Stress & Anger management 5 lectures

**Practical:**

- Oral presentations
- Using visual aids while presentations
- Critical Reading & Writing
- Mock interview
- Group discussions
- Team building exercises
- Proofreading and editing emails
- Cover letter drafting
- Resume-making
- Drafting reports

**Learning Outcome:** The course must have acquainted the students with communication and public speaking skills specially for interviews and group discussions.

**Reference Books**

- Barun K Mitra, Personality Development and Soft Skills, Oxford Higher Education
- Gopalawamy Ramesh and Mahadevan Ramesh, The Ace of Soft Skills, Pearson Education
- T. Anchukandam and J. Kuttaimathathil (Ed) Grow Free Live Free, Krisitu Jyoti Publications, Bangalore (1995)
- Mani Jacob (Ed) Resource Book for Value Education, Institute for Value Education, New Delhi 2002.
- T.N. & L.A. Olson Technical Writing & Professional Communication for Non-native speakers of English, McGraw-Hill, NY, 1991.

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**Foundation Course: FST 593 Communication Skills &**

**Scientific Writing Credits: (1+1)**

**Level:** Post Graduate

**Semester:** Spring

**Pre-requisite:** Knowledge of basics of communication skills.

**Objective:**

To educate the students about kinds of communication, enhance their vocabulary and teach them types of formal writing used in academic research.

**Course Content**

**Unit I**

**Advance Communication-** Types of communication, Mass Communication, Levels of professional communication, Role of newspapers, radio, Cinema and TV, role of social media and networking 3 lectures

**Unit II**

**Audio Visual Communication** – Nature and scope of visual aids, use of Power Presentations in professional life 2 lectures

**Unit III**

**Grammar usage and Word power** – Phrase and Clauses, Idioms, Proverbs, Homophones, 3 lectures

Homonyms, Reading and Comprehension.

**Unit IV** 2 lectures

**Advance writing skills** – Movie review, Book review

**Unit V** 5 lectures

**Scientific Writing** – Introduction to Technical writing, definition, types, characteristics, Report Writing, CV & Resume making, plagiarism

**Practical:**

- Sentence framing exercises - revision
- Writing descriptive paragraphs
- Dictionary consulting activities-Spell bee,
- Role Plays
- Movie viewing Sessions
- Book Reading sessions
- Impromptu Presentations
- Listening Practice
- Creating audio visual (AVs) using photographs
- Reading Scientific Texts
- Outlining a research

**Learning Outcome:** The course would have equipped the students with advance communication skills and basics of technical writing.

**Reference Books**

- Test your English Vocabulary in use, Michael McCarthy, Felicity O'Dell, Cambridge
- Wren & Martin, High School English Grammar and Composition, S.Chand, Paperback, 2005
- Oxford English Grammar Use, Micheal Swan & Catheirne Walter, Oxford University Press
- Using English in Science & Technology, Singh, R.K., Prakash Book Depot, Bareilly, 2000.

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**FST 641 Master's Seminar (1)**

**SEMESTER IV**

**FST 646 Master's Research/Thesis (20)**