Learning Outcomes based Curriculum Framework
(LOCF)

For

M.Sc. (Food Science & Technology)
Post Graduate Programme

Department of Food Science & Technology
Chaudhary Devi Lal University
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2021

Table of Contents

1. About the Department

The Department of Food Science & Technology was established in 2004 and the first batch of the students was enrolled in August, 2004. The Department is running M.Sc. and Ph.D. (Food Science & Technology) programme. The Department having well equipped laboratory facilities for research and development is located at first floor of CV Raman Bhawan. The main emphasis of the department is on quality education, research and training activities to meet growing demand of food processing industries. In order to make course curriculum research-oriented, research project is added in the 3rd and 4th semesters. The students are required to undertake compulsory six–weeks training (preferably during semester break) in a reputed food industry/organization after completion of major courses.

2. Learning Outcome based Curriculum Framework

The CBCS evolved into learning outcome-based curriculum framework and provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables the potential employers in assessing the performance of the candidates.

2.1 Objectives of the Programme

- To provide a multidisciplinary quality learning experience to students that will empower them to dream big.
- To provide skill based education to the students and to equip them with innovative industrial and research updates leading towards their self-reliance and development as entrepreneurs.
- To draw funding from various government and non-government agencies for carrying out innovative research projects in the department.
- To enhance multi-institutional collaboration at national and international levels by signing MoUs and by carrying out joint research activities.
- To serve the society by catering the needs at local, national and international level with utmost commitment, integrity and enthusiasm.

2.2 Programme Outcomes (POs)

PO1	**Knowledge:** Knowledge in the basic and advanced fields of the core and applied disciplines, for the fulfilment of professional requirements
PO2	**Critical Thinking:** Capability of critical thinking based on the contextual knowledge of living beings/organisms, non-living components and environmental basis of life, enabling them to critically analyse the day-to-day problems faced by the society.
PO3	**Interdisciplinary approach & Adaptation:** Understanding of the vital connections, within and among-the flora, fauna and the physical environment, enabling them to integrate and synthesize the acquired knowledge within their fields and beyond
PO4	**Application Development:** Understanding for the development of the applications of biological materials in food, health, medicine and environment for sustainable development of the society
PO5	**Ethics and Leadership:** Awareness about sound professional and character ethics as well as the qualities of leadership and team building skills
PO6	**Problem Solving:** Capability for developing innovative and solution cantered approach for handling any kind of problem and the paradigm of scientific temperament
PO7	**Skills and Inferential knowledge:** Knowledge about various core and advanced skills for theoretical and practical understanding of different descriptive and inferential statistical tools and techniques
PO8	**Specialization and Employability:** Specialization in various skills based on practical training, fields visits and project based vocational training as well as specialization for an entrepreneurial thinking and career-oriented approach in research as well as in industries

2.3Programme Specific Outcomes (PSOs)

PSO1	Students will acquire a combination of theoretical, conceptual, analytical, and experimental knowledge and skills in the area of Food Science & Technology & will develop the students in highly skilled professional in the field of food technology, equipped with the required basic, technical and practical knowledge.
PSO2	The students would acquire deep knowledge of Food Science & Technology with an ability to evaluate, analyse and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge to contribute to the scientific and technological developments in food processing sector. Interdisciplinary research undertaken in will develop a strong research aptitude which enables the students to opt for higher levels of

	learning and research in the specialized fields of Food Science & Technology.
PSO3	The students would acquire the ability to recognize the impact of knowledge and understanding of the Food Science & Technology on the responsibilities relevant to the professional ethics and societal role and apply the same to own start up or professional entrepreneurships.
PSO4	The students shall have the ability to apply the principles of planning and management in food production processes from raw material to finished product and will be able to find the solution of complex Scientific & Technological problems in Food Technology. The students will be able to perform scientific experiments, document data and interpret results based on statistics to identify, define and analyse problems and create processes to solve them competently.

2.4 Attainment Level

Table 1: CO-PO-PSO mapping matrix for all the courses offered by Department

Course Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
Semester 1st												
MSc/FST/1/CC1	**1.25**	**1.25**	**1.25**	**2**	**1**	**2**	**1**	**1.25**	**2.5**	**2**	**2**	**2**
MSc/FST/1/CC2	**2.25**	**1.75**	**1.25**	**1.25**	**-**	**2**	**-**	**2**	**2.5**	**1.5**	**1**	**2**
MSc/FST/1/CC3	**2**	**2.25**	**2**	**2**	**1.5**	**2**	**2**	**2.25**	**2.25**	**2.5**	**2.25**	**2**
MSc/FST/1/CC4	**2.5**	**1**	**---**	**2.25**	**1**	**2**	**2**	**2.5**	**2.5**	**2.5**	**2.25**	**2.25**
MSc/FST/1/CC5	**1.5**	**1.5**	**1.5**	**1.5**	**1**	**2.5**	**1.75**	**1.5**	**2.25**	**2**	**1.75**	**1.75**
MSc/FST/1/CC6	**2.5**	**2**	**---**	**1**	**---**	**2**	**2.5**	**2.5**	**2.5**	**2.5**	**2.25**	**1**
MSc/FST/1/SEC1	**2**	**--**	**--**	**--**	**1.75**	**1.5**	**1.75**	**1.5**	**1.25**	**1**	**2**	**1.75**
Semester 2nd												
MSc/FST/2/CC7	**2.25**	**2.0**	**1**	**1.75**	**1**	**2**	**1.5**	**1.50**	**2.5**	**2.25**	**2.5**	**2.5**
MSc/FST/2/CC8	**1.25**	**2.25**	**2**	**2**	**1**	**2**	**1**	**1.25**	**2.5**	**2.5**	**2.25**	**2.25**
MSc/FST/2/CC9	**2.25**	**2**	**1.5**	**1.5**	**-**	**1**	**-**	**2**	**2.5**	**2**	**1**	**2**
MSc/FST/2/CC10	**2.5**	**1**	**2**	**2.5**	**---**	**2.25**	**2**	**2.5**	**2.5**	**2.5**	**2.25**	**2**
MSc/FST/2/CC11	**2.5**	**1.75**	**1**	**2.0**	**1**	**2.0**	**2.25**	**1.25**	**2.5**	**1.75**	**2.0**	**2.25**
MSc/FST/2/CC12	**1**	**1**	**1**	**2**	**1**	**2**	**2.5**	**2.5**	**2.25**	**3**	**2.25**	**2.5**
MSc/FST/2/SEC2	**2.5**	**1.75**	**1**	**1**	**1.75**	**1.5**	**1.5**	**2.5**	**2.25**	**--**	**2.5**	**2.5**
Semester 3rd												
MSc/FST/3/CC13	**2.25**	**2.25**	**1.25**	**1.5**	**1.5**	**1.75**	**1.75**	**1.5**	**1.5**	**1.0**	**1.75**	**1.5**
MSc/FST/3/CC14	**2.5**	**2**	**---**	**1**	**---**	**2**	**2.25**	**2.5**	**2.5**	**2.5**	**2**	**1.5**
MSc/FST/3/CC15	**2**	**2**	**--**	**--**	**2.5**	**1**	**2**	**1.5**	**2**	**2.5**	**2.5**	**2**
MSc/FST/3/DSC1-A	**1.5**	**1.75**	**1.75**	**1.75**	**1**	**2**	**1.5**	**2**	**2.25**	**2.25**	**2**	**2.25**

MSc/FST/3/DSC1-B	**2.5**	**---**	**---**	**---**	**1**	**2**	**---**	**2.5**	**2.5**	**2.25**	**2**	**2**
MSc/FST/3/DSC2-A	**2.25**	**1.5**	**1.5**	**1.5**	**0.25**	**1.25**	**-**	**1.5**	**2.5**	**1.5**	**1.25**	**1.5**
MSc/FST/3/DSC2-B	**2**	**2.25**	**2.25**	**2.5**	**--**	**2.25**	**2**	**2**	**2.25**	**2**	**1.5**	**2.5**
MSc/FST/3/DSC3-A	**2**	**2**	**1.75**	**1.75**	**1**	**1.75**	**2.25**	**1.75**	**2**	**1.75**	**1.75**	**1.5**
MSc/FST/3/DSC3-B	**2.25**	**1.75**	**1**	**1.75**	**2.5**	**2**	**1.25**	**2.25**	**2.5**	**2.25**	**2**	**2**
MSc/FST/3/DSC4-A	**2.25**	**2**	**1.25**	**1.25**	**-**	**2**	**-**	**1.5**	**2.5**	**2**	**1**	**2**
MSc/FST/3/DSC4-B	**2**	**2.25**	**1.5**	**2**	**1**	**2**	**1.5**	**1.75**	**2**	**2**	**2**	**1.66**
Semester 4th												
MSc/FST/4/CC16	**1.25**	**2.0**	**1.5**	**1.5**	**1**	**2.5**	**1.75**	**2.0**	**2.5**	**2.5**	**2.0**	**2.5**
MSc/FST/4/CC17	**2.25**	**1.5**	**1**	**---**	**---**	**---**	**2.25**	**1**	**2.25**	**2**	**2.25**	**1**
MSc/FST/4/DSC5-A	**2.5**	**1.5**	**1.75**	**---**	**--**	**2.5**	**2**	**2.5**	**2.5**	**2**	**2.5**	**1.75**
MSc/FST/4/DSC5-B	**1.5**	**1.25**	**1.75**	**2.25**	**1**	**2.25**	**1**	**1.5**	**2.5**	**2.25**	**2.5**	**2.25**
MSc/FST/4/DSC6-A	**1.5**	**1.75**	**1.5**	**1.25**	**1.5**	**2.0**	**1.5**	**2.0**	**2.0**	**2.0**	**2.25**	**2.0**
MSc/FST/4/DSC6-B	**2.5**	**1.75**	**1.25**	**1**	**-**	**1.75**	**-**	**2**	**2**	**2**	**1**	**2**
MSc/FST/4/DSC7-A	**2.5**	**2**	**--**	**1**	**---**	**2**	**2**	**2.25**	**2**	**2.5**	**2**	**1**
MSc/FST/4/DSC7-B	**1**	**1**	**2**	**2.25**	**1**	**2**	**2.5**	**2.5**	**2.5**	**2.5**	**2**	**2.5**
MSc/FST/4/DSC8-A	**1**	**2**	**2.5**	**2.5**	**1**	**2**	**1**	**2**	**2**	**2**	**2**	**2.5**
MSc/FST/4/DSC8-B	**2**	**2**	**2**	**2.25**	**2.5**	**2**	**1.75**	**2.25**	**2.75**	**2.25**	**2.25**	**2.25**
Open Elective Courses												
MSc/FST/9/OEC1	**1.25**	**1.75**	**1**	**2**	**1**	**1.5**	**1.25**	**1.25**	**1.5**	**1**	**1.25**	**1.25**
MSc/FST/9/OEC2	**2**	**2.25**	**1.75**	**1.75**	**1.75**	**1.5**	**1.25**	**1**	**2**	**1.5**	**2**	**1**
MSc/FST/9/OEC3	**2.5**	**1**	**---**	**---**	**2**	**1.75**	**1.75**	**1.75**	**2.25**	**2**	**2**	**1.25**
Average of above values	**1.99**	**1.66**	**1.20**	**1.46**	**0.93**	**1.86**	**1.48**	**1.89**	**2.26**	**2.01**	**1.95**	**1.90**

2.4.1 Attainment of COs:

Table 2: CO Attainment Levels for a Semester Examination of a course

Attainment Level	Description
1 (Low level of attainment)	50% of students obtained letter grade of A or above (for CBCS programs) or score more than 60% of marks (for non-CBCS programs) of a course.
2 (Medium level of attainment)	60% of students obtained letter grade of A or above (for CBCS programs) or score more than 60% of marks (for non-CBCS programs) of a course.
3	70% of students obtained letter grade of A or above (for CBCS

(High level of attainment)	programs) or score more than 60% of marks (for non-CBCS programs) of a course.

The CO attainment level for all the courses of the program can be obtained in a similar manner.

2.4.2 Calculation of Attainment values of POs and PSOs:

PO attainment value (for example for PO1) for a course can be obtained as follows:

$$\text{AVfor PO1} = \frac{(\text{MFCPO1})\text{X CO attainment value for the course (as per table 2)}}{3}$$

Where

AV = Attainment value

MFCPO1 = Mapping factor for a course with PO1 as obtained from table 1

Likewise, PSO attainment value (for example for PSO1)for a course can be obtained as follows:

$$\text{AVfor PSO1} = \frac{(\text{MFCPSO1})\text{X CO attainment value for the course(as per table 2)}}{3}$$

Where

AV = Attainment value

MFCPSO1 = Mapping factor for a course with PSO1 as obtained from table 1

After finding the attainment values of each PO and PSO for various courses, we may write them in table form as given below:

Table 3: The calculated PO and PSO Attainment Values for all the courses

Course Code	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
Semester 1st												
MSc/FST/1/CC1												
MSc/FST/1/CC2												
MSc/FST/1/CC3												

MSc/FST/1/CC4												
MSc/FST/1/CC5												
MSc/FST/1/CC6												
MSc/FST/1/SEC1												
Semester 2nd												
MSc/FST/2/CC7												
MSc/FST/2/CC8												
MSc/FST/2/CC9												
MSc/FST/2/CC10												
MSc/FST/2/CC11												
MSc/FST/2/CC12												
MSc/FST/2/SEC2												
Semester 3rd												
MSc/FST/3/CC13												
MSc/FST/3/CC14												
MSc/FST/3/CC15												
MSc/FST/3/DSC1-A												
MSc/FST/3/DSC1-B												
MSc/FST/3/DSC2-A												
MSc/FST/3/DSC2-B												
MSc/FST/3/DSC3-A												
MSc/FST/3/DSC3-B												
MSc/FST/3/DSC4-A												
MSc/FST/3/DSC4-B												
Semester 4th												
MSc/FST/4/CC16												
MSc/FST/4/CC17												
MSc/FST/4/DSC5-A												
MSc/FST/4/DSC5-B												
MSc/FST/4/DSC6-A												
MSc/FST/4/DSC6-B												
MSc/FST/4/DSC7-A												

MSc/FST/4/DSC7-B												
MSc/FST/4/DSC8-A												
MSc/FST/4/DSC8-B												
Open Elective Courses												
MSc/FST/9/OEC1												
MSc/FST/9/OEC2												
MSc/FST/9/OEC3												
Average of above values												

The attainment of POs and PSOs is the average of individual PO and PSO attainment values. The PO and PSO attainment values obtained above are compared with set target. The set target for each PO and PSO may be different and can be finalized by the staff councils of the departments/institutes as described in the following table:

Table 4: PO and PSO Attainment Values and Set Target values

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
PO attainment values												
Target Values	2	1.5	2	2	1.5	2	1.5	1.5	2	2	2	2

If PO and PSO attainment value is less than the set target value then an action plan may be prepared for improvement in the subsequent academic session.

3. Programme Structure

M.Sc. Food Science & Technology- a four semesters programme has 108 credits weightage consisting of Core Courses (CC), Discipline Specific Elective Courses (DSC), Skill Enhancement Courses (SEC) and Open Elective Courses (OEC).

Table 5: Courses and Credit Scheme

Semester	**Core Courses (CC)**			**Discipline Specific Courses (DSC)**			**Skill Enhancement Courses (SEC)**			**Open Elective Courses (OEC)**			**Total Credits**
	No. of Papers	**Credits (L+P)**	**Total Credits**	**No. of Papers**	**Credits (L+P)**	**Total Credits**	**No. of Papers**	**Credits (L)**	**Total Credits**	**No. of Papers**	**Credits (L)**	**Total Credits**	
1st	**6**	**24**	**24**	**--**	**--**	**--**	**1**	**2**	**02**				

										A total of 12 credits are to be earned from other Departments or from MOOCs *Students have to opt open elective course in consultation with Chairperson and Director, University Centre for Outreach Programmes and Extension.*		26
2nd	**6**	**24**	**24**	**--**	**--**	**--**	**1**	**2**	**02**			26
3rd	**3**	**06**	**06**	**4**	**16**	**16**	**--**	**--**	**--**			22
4th	**2**	**06**	**06**	**4**	**16**	**16**	**--**	**--**	**--**			22
Total	**Core Credits**		**60**	**Discipline Specific Credits**		**32**	**Skill Enhancement Credits**		**04**	**Open Elective Credits**	**12**	**96+12 =108**
%age	**Core Credits**		**55.55**	**Discipline Specific Credits**		**29.62**	**Skill Enhancement Credits**		**3.70**	**Open Elective Credits**	**11.11**	**100**

Table 6: Detailed break-up of Credit Courses

	Core Courses	Discipline Specific Courses	Skill Enhancement Courses	Open Elective Courses	Total Courses
	CC	DSC	SEC	OEC	
Semester 1st	CC1		SEC1	OECs offered by other departments or MOOCs **(May be enrolled in any of the four semesters)**	7
	CC2				
	CC3				
	CC4				
	CC5				
	CC6				
Semester 2nd	CC7		SEC2		7
	CC8				
	CC9				
	CC10				
	CC11				
	CC12				
Semester 3rd	CC13	DSC1			7
		DSC2			
	CC14	DSC3			

	CC15	DSC4			
Semester 4th	CC16	DSC5			6
		DSC6			
	CC17	DSC7			
		DSC8			

Table 7: Course code and Title along with credits detail

Course Code	Course Title	Credits		
Semester 1st		Theory	Practical	Total
MSc/FST/1/CC1	Principles of Food Preservation	4	0	4
MSc/FST/1/CC2	Food Engineering	4	0	4
MSc/FST/1/CC3	Food Microbiology	4	0	4
MSc/FST/1/CC4	Technology of Milk and milk Products	4	0	4
MSc/FST/1/CC5	Laboratory-I Food Microbiology	0	4	4
MSc/FST/1/CC6	Laboratory -II Technology of Animal Products	0	4	4
MSc/FST/1/SEC1	Computer Fundamentals & Statistics	2	0	2
	Total	**18**	**8**	**26**
Semester 2nd				
MSc/FST/2/CC7	Technology of Cereals & Millets	4	0	4
MSc/FST/2/CC8	Technology of Fruits & Vegetables	4	0	4
MSc/FST/2/CC9	Unit Operations in Food Engineering	4	0	4
MSc/FST/2/CC10	Technology of Meat, Fish &Poultry Products	4	0	4
MSc/FST/2/CC11	Laboratory - III Technology of Cereals& Millets	0	4	4
MSc/FST/2/CC12	Laboratory -IV Technology of Fruits & Vegetables	0	4	4
MSc/FST/2/SEC2	Industrial Organization and Management	2	0	2
	Total	**18**	**8**	**26**
Semester 3rd				
MSc/FST/3/CC 13	In Plant Training **42 Days** (In summer vacation after exams of 2nd Semester)	Non credit		0
MSc/FST/3/CC 14	Laboratory -V Food Analysis	0	4	4
MSc/FST/3/CC 15	Cardinal Principles of Academic Integrity, Research Ethics	2	0	2
MSc/FST/3/DSC1	A Food Chemistry	4	0	4
	B Food Analysis			
	C MOOC			
MSc/FST/3/DSC2	A Food Packaging	4	0	4
	B Nutrition and Health			
MSc/FST/3/DSC3	A Industrial Microbiology	4	0	4

	B Food Biotechnology			
	C MOOC			
MSc/FST/3/DSC4	A Laboratory -VI Food Packaging	0	4	4
	B Laboratory-VII Nutrition and Health			
	Total	**14**	**8**	**22**
Semester 4th				
MSc/FST/4/CC 16	Research Project	0	4	4
MSc/FST/4/CC 17	Credit Seminar	2	0	2
MSc/FST/4/DSC5	A Technology of Beverages	4	0	4
	B Nutraceuticals& Functional Foods			
MSc/FST/4/DSC6	A Technology of Pulses and oilseeds	4	0	4
	B Advances in Food Processing and Preservation			
	C MOOC			
MSc/FST/4/DSC7	A Laboratory – VIII Technology of Beverages	0	4	4
	B Laboratory-IX Nutraceutical & Functional Foods			
MSc/FST/4/DSC8	A Industrial Food Waste Management	4	0	4
	B Food Additives			
	C MOOC			
	Total	**14**	**8**	**22**

Notes:

1. For one credit of theory, one hour of lecture will be delivered while for one credit of practical, two hours of laboratory work will be conducted, per week.
2. Practical will be conducted in groups; one group may have at maximum 20 and at minimum 15 students depending on the total number of students enrolled.
3. Evaluation of Non-credit courses will be entirely internal. Award will be submitted in the form of Satisfactory (S) (in case marks obtained are 60 % or more) or Unsatisfactory (US) (in case marks are less than 60 %) grades.
4. Submission date of Dissertation and Research-Review Project will be 30th April falling in fourth Semester; marks will be added in the result of fourth semester.
5. Besides credits from above courses, students will need to earn additional 12 credits from open elective courses (OECs) offered by other departments of the University or from MOOCs on SWAYAM portal. Students are free to get enrolled for this category courses in any of the semesters. Further, students may get enrolled in any of the various PG MOOCs available at SWAYAM portal for this category for the desired credits.
6. MOOC coordinator will display the list of MOOCs for each Discipline Specific Elective Course (DSC) before the commencement of respective semester.
7. A Discipline Specific Elective Course will be started only when least 10 students opt for a particular course.
8. The Research Project may include Lab work/Field work/Survey/ Review/New Product Development/Analysis as decided by the supervisor.
9. Allotment of Supervisor/Co-supervisor for research project will be made in the beginning of third semester.

Table 8: Core Courses Offered by the Department

Course Code	Course Title	Credits
MSc/FST/1/CC1	Principles of Food Preservation	4
MSc/FST/1/CC2	Food Engineering	4
MSc/FST/1/CC3	Food Microbiology	4
MSc/FST/1/CC4	Technology of Milk and milk Products	4
MSc/FST/1/CC5	Laboratory – I Food Microbiology	4
MSc/FST/1/CC6	Laboratory –II Technology of Animal Products	4
MSc/FST/2/CC7	Technology of Cereals & Millets	4
MSc/FST/2/CC8	Technology of Fruits & Vegetables	4
MSc/FST/2/CC9	Unit Operations in Food Engineering	4
MSc/FST/2/CC10	Technology of Meat, Fish &Poultry Products	4
MSc/FST/2/CC11	Laboratory – III Technology of Cereals& Millets	4
MSc/FST/2/CC12	Laboratory – IV Technology of Fruits and Vegetables	4
MSc/FST/3/CC13	In Plant Training	0
MSc/FST/3/CC14	Laboratory – V Food Analysis	4
MSc/FST/3/CC15	Cardinal Principles of Academic Integrity, Research Ethics	2
MSc/FST/4/CC 16	Research Project	4
MSc/FST/4/CC 17	Credit Seminar	2
	Total	**60**

Table 9: Discipline Specific Courses offered by the Department

Course Code	Course Title	Credits
MSc/FST/3/DSC1	A Food Chemistry	4
	B Food Analysis	
	C MOOC	
MSc/FST/3/DSC2	A Food Packaging	4
	B Nutrition and Health	
MSc/FST/3/DSC3	A Industrial Microbiology	4
	B Food Biotechnology	
	C MOOC	
MSc/FST/3/DSC4	A Laboratory – VI Food Packaging	4
	B Laboratory-VII Nutrition and Health	
MSc/FST/4/DSC5	A Technology of Beverages	4
	B Nutraceutical & Functional Foods	
MSc/FST/4/DSC6	A Technology of Pulses and oilseeds	4
	B Advances in Food Processing and Preservation	
	C MOOC	
MSc/FST/4/DSC7	A Laboratory – VIII Technology of Beverages	4
	B Laboratory-IX Nutraceutical& Functional Foods	
MSc/FST/4/DSC8	A Industrial Food waste management	4
	B Food Additives	
	C MOOC	

Total	**32**

Table 10: Skill Enhancement Course offered by the Department

Course Code	Course Title	Credits
MSc/FST/1/SEC1	Computer Fundamentals & Statistics	2
MSc/FST/2/SEC2	Industrial organization and management	2
	Total	**4**

Table 11: Open Elective Courses offered by the Department

Open Electives Courses (ODD and Even Semesters)		
Course Code	**Course Title**	**Credits**
MSc/FST/9/OEC1	Food Nutrition & Health	4
MSc/FST/9/OEC2	Food Adulteration	4
MSc/FST/9/OEC3	Food Safety, Hygiene & Sanitation	4
	Total	**12**

4. Course Wise Content Details for M.Sc. (Food Science & Technology) Programme

Principles of Food Preservation

Paper code: MSc/FST/1/CC1

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To understand different types of spoilages and decay of raw as well as processed food commodities and their preservation by opting different preservative techniques with minimum damage of nutritional and organoleptic attributes.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Knowledge regarding various types of spoilages would be helpful in determination of causes for different types of spoilages. Knowledge regarding heat processing and preservation of food would be helpful in designing, optimizing heat processing conditions for different types of foods in different conditions without harming the nutritional quality of food products.
CO2	Knowledge regarding drying and dehydration would make the students familiar with the processing of the dried foods and students can opt for their career in dried/dehydrated food products making food industries.
CO3	The students would be able to understand various low temperature preservation conditions and this technical knowledge would make them capable to select proper low temperature storage conditions for specific food

	materials.
CO4	The students would be able to recommend suitable food preservatives for household and other chemical preservative methods for different types of food productions.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Introduction and principles of food preservation.

Food spoilage: Microbial, physical, chemical & miscellaneous.

Heat preservation and processing: Heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods, canning of foods, cans and container types, spoilage of canned foods, heat penetration, different heating processing methods.

Unit II

Dehydration: Drying, dehydration and concentration, Drying curves, Drying methods and type of dryers, Freeze drying in food processing, food concentration, methods of concentration, changes in food during dehydration and concentration.

Water activity: Role of water activity in food preservation, Intermediate moisture foods (IMF), Principles, characteristics, advantages and problems of IM foods.

Unit III

Refrigeration storage: Requirements of refrigeration storage, changes of foods during refrigeration storage.

Freezing and frozen storage: Freezing curves, slow and quick freezing, factors determining freezing rate, freezing methods, changes in food during freezing.

Unit IV

Food frying: general principles, frying process; shallow frying and deep frying, factors affecting oil uptake during frying.

Emulsification in food processing: principles and applications of emulsification in food.

House hold preservation methods: Salt curing, oiling and smoking.

Chemical preservation: types, uses and effects of class I and class II preservatives in foods.

Recommended Books:

1. Norman, N.P. and Joseph, H.H. (1997). Food Science, Fifth edition, CBS Publication, New Delhi
2. Frazier, W.C. and Westhoff, D.C. (1996). Food Microbiology, 4th edition, Tata McGraw Hill Publication, New Delhi.

3. Kalia, M. and Sangita, S. (1996). Food Preservation and Processing, First edition, Kalyani Publishers, New Delhi.
4. Sivasankar, B. (2002). Food Processing and Preservation, Prentice Hall of India Pvt. Ltd., New Delhi.

Course Code: **MSc/FST/1/CC1** Course Title: **Principles of Food Preservation** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	2	1	1	2	2	2	2
	CO2	1	1	1	2	1	3	1	1	3	2	2	2
	CO3	1	1	1	2	1	2	1	1	3	2	2	2
	CO4	1	1	1	2	1	1	1	2	2	2	2	2
Average		**1.25**	**1.25**	**1.25**	**2**	**1**	**2**	**1**	**1.25**	**2.5**	**2**	**2**	**2**

Food Engineering

Paper code: MSc/FST/1/CC2

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Course objective: The course provides an understanding for principles of engineering and mechanics applied to food processing operations.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	An understanding of the fundamental concepts of food engineering and basic principles will make the student familiar with different engineering properties and would enable the students to design and optimizes various food process operations.
CO2	Energy balance calculations will make the students to understand concept of conservation of energy in different thermal processes. An understanding of the liquid transport and fluid flow principles would make the students capable of handling various types of fluid foods and their flow in food industry.
CO3	An understanding of the different modes of heat transfer would help the students to design and optimize heat processing treatments regarding preservation and processing of any food material. Also, understanding of different heat exchangers will help them to assess its suitability for different types of food as well as processes.

CO4	Knowledge of thermal process calculations will help students in designing of thermal processes for inactivation of different microorganisms. Psychometric studies would enable the students to evaluate and optimize the food storage conditions in a food processing plants.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Fundamental concepts and definitions: Dimensions and units, thermodynamic systems (closed, open and isolated), intensive and extensive properties, equilibrium state, density, specific volume, specific weight, specific heat, enthalpy, entropy, pressure, temperature scales.
Material balances: Basic principles, process flow diagrams, total mass balance and component mass balance, material balance problems involved in dilution, concentration and dehydration.

UNIT-II

Energy balances: Basic principles, energy terms, specific heat of solids and liquids, properties of saturated and superheated steam, heat balances.
Fluid flow principles: Fluid statics and dynamics, mass balance and energy balance, Bernoulli's equation, concept of viscosity, Newtonian and non-Newtonian fluids, streamline and turbulent flow, Reynolds's number.

UNIT-III

Heat transfer: Modes of heat transfer, conductive, convective and radiative heat transfer, thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation of overall heat transfer coefficient
Heat exchangers: plate, tubular, scraped surface and steam infusion.

UNIT-IV

Thermal process calculations: Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of micro-organisms, lethality function, thermal process calculation for canned foods. Calculation of processing time in continuous flow systems.Thermal process calculation for canned foods.

Psychrometrics: Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature.Properties of water vapor: specific volume of water vapor, specific heat of water vapour, Gibbs-Dalton law, Dew point temperature, relative humidity, humidity ratio, wet bulb temperature. Study of Psychrometric chart.

Text/Reference Books:

1. Singh, R.P and Heldman, D.R.(1984). *Introduction to Food Engg.,* Academic Press, INC, London
2. Earle, R.L. (1983) *Unit Operations in Food processing,* 2nd Edition Pergamon Press Oxford, U.K.
3. 3. Toledo, R.T.(1997). *Fundamentals of Food Process Engineering*, CBS Publishers, New Delhi.
4. 4. Batty, J.C. and Folkman, S.L. 1983. *Food Engineering Fundamentals.* John Wiley and Sons, New York.

Course Code: **MSc/FST/1/CC2** Course Title: **Food Engineering**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
		Program Outcome (PO)								**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	1	1	-	2	-	2	3	1	1	2
	CO2	2	1	1	1	-	2	-	2	2	2	1	2
	CO3	2	1	1	1	-	2	-	2	2	2	1	2
	CO4	3	2	2	2	-	2	-	2	3	1	1	2
Average		**2.25**	**1.75**	**1.25**	**1.25**	**-**	**2**	**-**	**2**	**2.5**	**1.5**	**1**	**2**

Food Microbiology

Paper code: MSc/FST/1/CC3

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To understand different types of microorganisms, their growth pattern and various techniques for identification which enable the students to preserve food as well as controlling of various food born microbial diseases and food poisoning.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would gain knowledge about different types of microorganisms including their historical development, classification, sources and the factors influencing their growth in food products.
CO2	An understanding of the detection and controlling of microorganisms by various techniques would be beneficial for the students to detect microorganisms in food and their safe limit to ascertain the safety of food products.

CO3	Knowledge regarding fermented foods and their spoilage will help in understanding the food born microbial diseases and food poisoning by microbes would make the students capable to increase awareness regarding public health.
CO4	The students can pursue for the career in various food microbial quality control enterprises

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Introduction to food microbiology: Introduction, historical developments in food microbiology, prokaryotes and eukaryotes. Classification of microorganisms- a brief account.

Microorganisms and foods: Food materials and microorganisms, sources of microorganisms in foods.

UNIT-II

Growth of microorganisms: Microbial growth, growth curve, factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms.

Preservation of food: The microbiology of food preservation, thermal processing, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.

UNIT-III

Fermented foods: Fermented milk and milk products, fermented fruits and vegetables, fermented fish, fermented meats, fermented beverages - beer, vinegar and wine.

Spoilage of food: Food spoilage and microbes of milk, meats, fish and various plant products, spoilage of canned foods.

UNIT-IV

Food microbiology and public health: Food poisoning, types of food poisonings, important features etc.

Bacterial agents of food borne illness: A brief account of various organisms related with food poisoning, food poisoning by clostridium, salmonella, E. coli, bacillus etc.

Non-bacterial agents of food borne illness: Poisonous algae, fungi and food borne viruses- a brief account.

Text/Reference Books:

1. James M. Jay (2000). Modern Food Microbiology, 5th Edition, CBS Publishers.
2. Banwart, G.J. (1997). Basic Food Microbiology, CBS Publishers.
3. Adam M.R. & Moss, M.O. (1995). Food Microbiology, New Age International Pvt. Ltd. Publishers.
4. Bibek Ray (1996). Fundamental Food Microbiology, CRC Press.
5. Stanier, R.Y. (1996). General Microbiology, Vth Edition, MacMillan.

Course Code: **MSc/FST/1/CC3** Course Title: **Food Microbiology** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak		
	Program Outcome (PO)	**Program Specific Outcome (PSO)**

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	**CO1**	3	3	2	2	1	1	1	1	2	2	1	0
	CO2	2	3	3	3	1	2	3	2	3	3	2	2
	CO3	2	3	2	3	3	3	3	3	3	3	3	3
	CO4	1	0	1	0	1	2	1	3	1	2	3	3
Average		**2**	**2.25**	**2**	**2**	**1.5**	**2**	**2**	**2.25**	**2.25**	**2.5**	**2.25**	**2**

Technology of Milk and Milk products

Paper code: MSc/FST/1/CC4

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objectives: Course objectives are to provide the knowledge about properties, processing and various products of milk and prepare the students for job in dairy industries.

Course outcomes (CO): At the end of the course, the students will be able to describe:

CO1	The students would know about composition, properties and processing of milk.
CO2	The students would be able to know about different products of milk.
CO3	The students would be able to optimize and refine the processing of cheese and frozen milk product.
CO4	Students would be able to know about milk adulteration, milk and milk product standards and legislations in India

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Dairy industry in India & its future prospects.

Milk: Definition, composition and nutritive value, factors affecting composition of milk.

Physicochemical properties and nutritive value of milk.

Liquid milk processing: filtration/clarification, standardization, pasteurization (LTLT, HTST, UHT), homogenization.

Microbiology of milk

Unit II

Technology of condensed and evaporated milk: process of manufacture, defects (their causes and prevention).

Technology of milk powders (WMP, SMP): process of manufacture, defects (their causes and prevention), instantization of milk powder.

Technology of indigenous milk products: Dahi, butter, ghee, channa, paneeretc.

Unit III

Technology of cheese: Classification, process of manufacture of cheddar and cottage cheese, defects (their causes and prevention).

Technology of frozen milk products: process of manufacture, defects (their causes and prevention).

Unit IV

Milk and milk product standards and legislations in India: Grading of milk and criterion of grading, reconstituted milk, synthetic milk.

Milk adulteration, synthetic milk and quality control in dairy industry.

By products of dairy industry and their utilization.

Imitation dairy products.

Recommended Books:

1. Sukumar, De (1994). Outlines of Dairy Technology. Oxford University Press.
2. Smith G. (2003). Dairy processing improving quality. Woodhead Publishers.
3. Andrews, A.T. (1994). Biochemistry of Milk Products. Woodhead Publishers.

Course Code: **MSc/FST/1/CC4** Course Title: **Technology of Milk and Milk products** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	---	---	3	2	2	2	2	3	3	2	2
	CO2	2	2	---	2	---	2	2	3	3	2	3	2
	CO3	3	2	--	2	---	2	2	2	2	3	2	3
	CO4	2	---	---	2	2	2	2	3	2	2	2	2
	Average	**2.5**	**1**	**---**	**2.25**	**1**	**2**	**2**	**2.5**	**2.5**	**2.5**	**2.25**	**2.25**

Laboratory-I

Food Microbiology

Paper code- MSc/FST/1/CC5

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6 Hrs**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Student would get familiar with the instrumentation, their principals and working used in the microbiology laboratory.

CO2	Student would be able to prepare basic requirements of microbial laboratory *i.e.* culture and media preparation, sterilization of samples and media etc.
CO3	The students shall acquire the practical skills for the sampling of foods and shall be able to carry out microbial analysis.
CO4	Microbial testing of various food samples enables the students to make their carrier in food testing laboratories as food analyst.

1. Study of the different parts and use of laboratory microscope.
2. Preparation and sterilization of culture media, glasswares.
3. Estimation of bacterial population in a given sample of food by Direct Microscopic Count (DMC) method.
4. Estimation of bacterial load of food sample by SPC (Standard Plate Count) method.
5. Insolation of pure culture of bacteria by Pour Plate and Streak Plate methods.
6. To study simple staining of bacteria.
7. To conduct Gram's staining of bacteria and differentiate between Gram +ve and Gram -ve bacteria.
8. Determination of bacteriological quality of potable water and soft drinks by SPC method.
9. Microbial analysis of Cereals and Cereal products such as wheat flour and biscuits.
10. Microbial analysis of spices (red chillies and coriander).
11. Detection of presence of *E.coli* and other *Coliform* bacteria by rapid high coliform test.
12. Detection of presence of coliforms in water by MPN method.
13. Studies on the bacterial growth curve.
14. Estimation of Total Microbial Count of:
    a. Surrounding air
    b. Workers
    c. Fruit and vegetable products
15. Isolation of bacteria by serial dilution technique.

To study various sub-culturing techniques.Course Code: **MSc/FST/1/CC5** Course Title: **Laboratory-I Food Microbiology**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	1	2	2	2	2	3	2	1	1
	CO2	2	2	1	1	--	3	2	1	2	2	2	1
	CO3	2	2	2	2	--	3	2	1	2	2	2	2
	CO4	--	--	1	2	2	2	1	2	2	2	2	2
Average		**1.5**	**1.5**	**1.5**	**1.5**	**1**	**2.5**	**1.75**	**1.5**	**2.25**	**2**	**1.75**	**1.75**

Laboratory-II

Technology of Animal Products

Paper code: MSc/FST/1/CC6

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 8 Hrs. **Duration of Exam: 6Hrs**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Students would be trained for chemical analysis of various meat and poultry products.
CO2	Development and quality evaluation of meat based products will provide hands on practical training for the students.
CO3	Development and quality evaluation of milk and milk based products will provide hands on practical training for the students.
CO4	The students can pursue for the career in dairy, meat, poultry and egg industry.

1. Determination of external and internal quality of poultry egg.
2. To study the effect of time, temperature on co-agulation properties of egg.
3. Determination of time temperature condition on formation of iron sulphide in egg.
4. Preservation and evaluation of different egg products.
5. Preparation of different poultry meat products:

    I. Chicken nuggets
    II. Chicken wings
    III. Chicken burgers
    IV. Fried chicken
    V. Gravy chicken
    VI. Chicken tikka
6. Determination of tenderness and water holding capacity of different meat type.
7. Visit to meat, fish and poultry processing industries.
8. Determination of specific gravity, total solids (T.S) % and SNF (Solid not fat) % in the given milk sample.
9. Determination of percentage fat in the given sample of milk by Gerber centrifuge method.
10. Determination of titrable acidity (T.A.) and pH of milk.
11. Determination of added Urea in the given sample of milk.
12. Determination of added starch in the given sample of milk.
13. To conduct clot on boiling (COB) and Alcohal – Alizarin test for testing milk quality.
14. Determination of added water in a given sample of milk.
15. Determination of microbiological quality of milk by using MBR test.

Course Code: **MSc/FST/1/CC6** Course Title: **Laboratory -II Technology of Animal Products**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course	**CO1**	3	2	---	1	---	2	3	3	3	3	2	1

Outcome (CO)	**CO2**	3	2	---	1	---	2	3	2	3	2	2	1
	CO3	2	2	---	1	---	2	2	3	2	3	3	1
	CO4	2	2	---	1	---	2	2	2	2	2	2	1
	Average	2.5	2	---	1	---	2	2.5	2.5	2.5	2.5	2.25	1

Computer Fundamentals &Statistics

Paper code: MSc/FST/1/SEC1

Credits: 2 **Lectures: 60** **Max. Marks: 50**



Periods per week: 4 Hrs. **Final Term Exam : 30**

Duration of Exam: 2Hrs **Internal Assessement : 20**

Course Objective: To understand the basic working and application of computer and statistics in data processing, representation and validation in research and non-research work.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would get the knowledge of functioning of computer with its basic principles. It enables students to efficient working with computer.
CO2	Knowledge hardware and software enables students to trouble shoot the problem faced during working with computer.
CO3	Sampling gives basic information to students about the techniques and data collection methods.
CO4	Statistics provide basic information for the data analysis for the research purpose. It also provides data presentation.

Note for the paper setter: *The question paper will consist of five questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, four more questions will be set unit-wise comprising of two questions from each of the units. The candidates are required to attempt four more questions selecting at least one question from*

Unit I

Introduction of computer: Characteristics, classification of computer; block diagram of computer and overview of working.

Number system: Non-positional vs. positional number, binary, octal, decimal, hexa-decimal conversion of number system.

Hardware: Input, output, and secondary storage devices, central processing unit.

Software: Types of software; meaning, functions and types of operating system.

Unit II

Working with software packages: word processor-working with text, tables, checking spelling and grammar, printing a document; spreadsheet software-working with worksheet, formulas and functions, inserting charts; power point presentation-working with different views and designing presentation; window XP-working with files and folders, windows explorer.

Sampling: Methods of data collection, sampling and sampling methods, **Measurements of central tendency and Dispersion**: Mean, Median, Mode, standard deviation, standard error, variance.

Correlation & Regression: Basic of Correlation & regression analysis.

Recommended Books:

1. Introduction to Information Technology, Pearson Education, New Delhi.

2. Norton, peter,Introduction to Computers,Tata McGraw Hill, New Delhi.
3. Douglas,Comer E., Computer Networks and Internet, Pearson Education, New Delhi.
4. Rajaraman, V., Fundamentals of Computers, Prentice Hallof India, New Delhi.
5. Office 2000: No Experience Required, BPB Publications, New Delhi.
6. Ray and Acharya, Information Technolgy: Prinicples and Applications, Prentice Hall of India, New Delhi.
7. Tanenbaum, A.S., Computer Networks, Eastern Economy ed., PHI, New Delhi.

Course Code: **MSc/FST/1/SEC1** Course Title: **Computer Fundamentals and Statistics** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
	Program Outcome (PO)									**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	--	--	--	2	2	1	2	2	--	2	2
	CO2	2	--	--	--	2	1	1	1	2	2	2	2
	CO3	2	--	--	--	2	2	2	1	--	--	2	--
	CO4	2	--	--	--	1	1	3	2	1	2	2	3
Average		**2**	**--**	**--**	**--**	**1.75**	**1.5**	**1.75**	**1.5**	**1.25**	**1**	**2**	**1.75**

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Technology of Cereals & Millets
Paper code: MSc/FST/2/CC7

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Objective: To create knowledge about the processing and quality evaluation of cereal grains.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Wheat milling, flour grading and dough rheology provide functional application of wheat in bakery industry.
CO2	Technology of wheat and its milling would help the students to pursue their career in one of the largest sector of the food processing industry i.e. Bakery Industry.
CO3	Technology of rice milling and rice-based products provide basics to the students that make them capable for rice industry as a rice technologist.
CO4	The students would be familiar with milling of corn and barley malting, which may help in seeking their career in sugar industry and distilleries.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Wheat Chemistry and Technology: Structure and chemical composition of wheat grain. Criteria of wheat quality – physical and chemical factors.Wheat milling – general principles and operation; cleaning, conditioning and roller milling systems.Flour extraction rates and various flour grades.Criteria of flour quality.

Dough rheology and its measurement.Functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making.Technology of pasta products and noodles.

Unit II

Bread making: Bread making processes, importance of critical unit operations, functions of ingredients/additives such as fat, emulsifiers, oxidants, reducing agents and conditioners. Bread faults and staling.Technology of biscuit, cake, cookie and cracker manufacturing. Baking powders as leavening agents in bakery industry.

Unit III

Rice Chemistry and Technology: Structure and chemical composition of rice grain, Milling of rice–types of rice mill; huller mill, Sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking, paddy separation, polishing and grading. Factors affecting rice yield during milling. By-products of rice milling. Rice parboiling technology. CFTRI process of parboiling. Properties of parboiled rice, Changes during parboiling. Advantages and disadvantages of parboiling.Cooking characteristics of rice. Rice convenience foods: precooked rice, canned rice, expanded rice, rice-based infant food formulae.

UNIT IV

Corn Technology: Wet and dry milling of corn, products of wet and dry milling of corn, Corn sweeteners and their uses.

Malt Technology: Malting of barley: steeping, germination and drying. Different types of malts and their food applications.

Technology of coarse cereal grains: Chemical, technological and milling aspects of sorghum, oats and millets

Recommended Books:

1. Samuel, A.M.(1996) " The Chemistry and Technology of Cereals as Food and Feed ", CBS Publisher & Distribution, New Delhi.
2. Pomeranz, Y.(1998) " Wheat : Chemistry and Technology", Vol 1,3" Am. Assoc. Cereal Chemists. St. Paul, MN, USA.
3. Eliasson, A.C. and Larsson, K.(1993) "Cereals in Bread making", Marcel Dekker. Inc. NewYork.
4. Honeney, R.C.(1986) "Principles of Cereal Science and Technology", Am. Assoc. Cereal Chemists, St. Paul, MN, USA.
5. Pomeranz, Y. (1976) "Advances in Cereal Science and Technology", Am. Assoc. Cereal Chemists St.Paul, MN, USA.
6. Juliano, B.O.(1685). "Rice Chemistry and Technology", Am. Assoc. Cereal Chemists, St. Paul, MN, USA.
7. Blanshard J.M.V., Frazier, P.J. and Galliard, T. Ed. 1986. Chemistry and Physics of Baking. Royal Society of Chemistry, London.
8. Chakraverty, A. 1988. Postharvest Technology of Cereals, Pulses and oilseeds. Oxford and IBH, New Delhi.
9. Durbey, S.C. 1979. Basic Baking: Science and Craft. Gujarat Agricultural University, Anand (Gujrat).
10. Kent, N.L. 1983. Technology of Cereals. 3rd Edn. Pergamon Press, Oxford, UK.
11. Mathews, R.H. Ed. 1989. Legumes: Chemistry, Technology and Human Nutrition. Marcel Dekker, New York.
12. Salunkhe, D.K., Kadam, S.S. Ed. 1989. Handbook of World Food Legumes: Chemistry, Processing and Utilization, (3 vol. set). CRC Press, Florida.

Course Code: **MSc/FST/2/CC7** Course Title: **Technology of Cereals & Millets**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	1	2	2	1	2	3	2	2	3
	CO2	3	2	--	2	2	2	2	2	3	2	3	2
	CO3	2	2	--	2	--	2	2	1	2	3	2	3
	CO4	2	2	2	2	--	2	1	--	2	2	3	2
Average		**2.25**	**2.0**	**1**	**1.75**	**1**	**2**	**1.5**	**1.50**	**2.5**	**2.25**	**2.5**	**2.5**

Technology of Fruits & Vegetables

Paper code: MSc/FST/2/CC8

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To estimate nutritional quality and evaluate processing and storage attributes of fruits and vegetables which might be directly related to their pre and post harvesting physiology.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students became capable assessing nutritional attributes and physiological changes happened during the life cycle of different fruits and vegetables.
CO2	Knowledge regarding this helps the students to understand processing and storage requirements for different raw fruit and vegetables commodities and changes happened in them during this.
CO3	Knowledge regarding this helps the students understand technical aspects of processing regarding different beverages and other solid and semisolid food items prepared from fruits and vegetables.
CO4	Students became capable of understanding different attributes of canning of fruits and vegetables and utilization of waste generated from fruits and vegetable processing industry.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Classification and composition of fruits and vegetables and their nutritional significance. Pre-harvest factors influencing post-harvest physiology, post-harvest handling, precooling methods, post-harvest treatments, edible coatings.

Physical and chemical indices of fruit maturity, ripening, bio-chemical changes during ripening, processing and storage.

Unit II

Different storage methods for fruits and vegetables like modified atmospheric storage, cold storage, controlled atmospheric storage etc.

Preprocessing operations: Washing, blanching, peeling, sorting and grading of raw materials. Minimal processing of fruits and vegetables, quality factors for processing, fruit product order (FPO).

Technology of jam, jellies, marmalades, specifications, role of pectin and theories of gel formation.

Unit III

Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, fruit juice powders-preparation and packaging.

Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

Technology of tomato products: Sauce, puree, ketchup and tomato paste

Fruit preserves and candied fruits, dehydrated fruits & vegetables, spoilage of processed products.

Unit IV

Canning of fruits and vegetables, preparation of syrups and brines, method and spoilage of canned fruits and vegetables

By products from fruit and vegetable wastes

Mushroom technology: Types of edible mushrooms, processing of mushrooms.

Recommended Books:

1. R.P. Srivastava and Sanjeev Kumar (2001): Fruit and Vegetable Preservation – Principles and Practices, Third edition, International Book distributing Co. Lucknow (India)
2. A.K. Thompson (2003): Fruit and Vegetables – Harvesting, handling and storage. 2nd edition Blackwell Publishing.
3. Er. B. Pantastico: Post harvest Physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Publishing Company, Inc.
4. W.V. Cruess (1997). Commerical Fruit and Vegetable Products. Allied Scientific Publishers. Bikaner (India)
5. Girdharilal (1996). Preservation of Fruits and Vegetables. ICAR, New Delhi
6. Dauthy, M.E. (1997). Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.
7. Hamson, L.P. (1975). Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.

Course Code: **MSc/FST/2/CC8** Course Title: **Technology of Fruits & Vegetables** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	2	1	1	3	2	2	2
	CO2	1	2	2	2	1	2	1	1	3	3	2	2
	CO3	1	3	2	2	1	2	1	1	3	3	2	2
	CO4	1	2	2	2	1	2	1	2	1	2	3	3
Average		**1.25**	**2.25**	**2**	**2**	**1**	**2**	**1**	**1.25**	**2.5**	**2.5**	**2.25**	**2.25**

Unit Operations in Food Engineering

Paper code: MSc/FST/2/CC9

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To understand different food processing unit operations and functioning of different processing equipments used in food industries with their advantages and limitations.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would get information about scope and importance of material handling and various equipments used in material handling. Also, knowledge regarding different cleaning methods, sorting and grading processes and equipment will helpful in optimizing different conditions during food processing.
CO2	The student will learn about the importance of size reduction, mixing and filteration in the processing of different foods. This would be helpful to work on various food processing lines in food industry involving different unit operations.
CO3	The students would be able to understand different high temperature preservation conditions. Knowledge regarding evaporation and dehydration would make the students familiar with the processing of the dried foods.
CO4	The information regarding low temperature processing conditions and its equipmental knowledge would make students capable to optimize the low temperature operations and storage conditions for different food products.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Preliminary unit operations: Material handling: Conveyors and elevators, types of conveyors and elevators.
Cleaning: Dry-cleaning; screening, aspiration and magnetic cleaning, wet cleaning; soaking, spray washing, ultrasonic washing, sorting and grading: methods, advantages of sorting and grading.

UNIT-II

Conversion unit operations: Size reduction: Benefits, criteria for size reduction, size reduction of solid, fibrous and liquid foods.
Mixing: Mixing terminology, mixers for dry solids (tumbler and vertical screw mixers). Mixers for high viscosity pastes (dough mixer), mixers for low viscosity pastes, effect of mixing on foods.
Filtration: Filtration terminology (feed slurry, filtrate, filter medium, filter cake), filtration equipments.

UNIT-III

Processing/Preservation Unit Operations: High temperature operations: Pasteurization, pasteurizer and its functioning.

Evaporation: Single effect evaporator, multiple effect evaporators and plate evaporators, batch type pan evaporators, natural circulation, forced circulation, rising film, falling film and agitated thin film evaporators.
Dehydration: Terminology, dehydration systems; tray drier, tunnel drier, spray drier, fluidized bed drying, vacuum drying and drum driers.

UNIT-IV

Low temperature operations: Refrigeration, components of refrigeration system, compressors, condensers and expansion valve, selection of refrigerant, cooling load, coefficient of performance, refrigerant flow rate.
Freezing systems: Direct contact and indirect systems, freezing load calculations.
Freeze drying: Conventional drying versus freeze drying, Basic principle, freeze dryer and its components

Recommended Books:

1. Singh, R.P and Heldman, D.R.(1984).Introduction to FoodEngg., Academic Press, INC, London.
2. Earle, R.L.(1983) Unit Operations in Food processing,2nd Edition Pergamon Press Oxford, U.K.
3. Brennan,J.C., Buffers, J.R.,Cowell N.D., Lilly, A.E.V. (1976). Food Engineering Operations, 2nd Edition, Elsevier, New York.
4. Harper, J.C. 1975. Elements of Food Engineering. AVI, Westport.
5. Heldman, D.R. and Lund, D.B. Ed. 1992. Handbood of Food Engineering. Marcel Dekker, New York.

Course Code: **MSc/FST/2/CC9** Course Title: **Unit Operations in Food Engineering**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	2	2	-	1	-	2	3	2	1	2
	CO2	2	2	2	2	-	1	-	2	3	2	1	2
	CO3	2	2	1	1	-	1	-	2	2	2	1	2
	CO4	2	2	1	1	-	1	-	2	2	2	1	2
Average		**2.25**	**2**	**1.5**	**1.5**	**-**	**1**	**-**	**2**	**2.5**	**2**	**1**	**2**

Technology of Meat, Fish &Poultry products

Paper code: MSc/FST/2/CC10

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course Objectives: The purpose of this course is to provide detailed information and knowledge about the different properties of muscles, poultry, fish and meat products. Student would be able to know about nutritional value of egg and its products.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be able to understand physico-chemical properties of muscle and its conversion into meat.
CO2	Knowledge will increase about the various processing methods of meat.
CO3	The students would be able to know about meat analogs and marine products.
CO4	Knowledge regarding processing of poultry products would help the students to make their career in egg and poultry industry.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Status and scope of meat industry in India.

Structure and physico-chemical properties of muscle.

Meat: Composition and nutritive value, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing.

Unit II

Aging of meat, meat tenderization- natural and artificial methods.

Properties of fresh meat-water holding capacity, color, palatability.

Cooking methods for meat.

Storage and preservation of meat: Chilling, Freezing, Curing, Smoking, Dehydration, Canning.

Spoilage of meat.

Unit III

Restructured meat products, meat analogs.

Meat industry by products: Importance and applications.

Fish: Factors affecting quality of fresh fish, fish dressing, chilling, freezing, salting and canning of fish.

Manufacturing of fish oil, fish protein concentrate, fish meal.

By-products of fish industry, their technology of utilization.

Unit IV

Egg: Structure, composition, nutritive and functional properties.

Quality of egg: Internal quality evaluation, egg candling, egg grading, microbial spoilage of eggs, preservation and storage methods for eggs.

Egg powder.

Packaging and transportation of eggs.

Poultry: Types, chemical and nutritive value of poultry meat, poultry dressing and slaughtering methods, preservation, grading and packaging of poultry meat.

Recommended Books:

1. Principles of Meat Science by Forest et al.
2. William J. & Owen J., (1977). Egg Science & Technology, AVI Publishing Company, INC. Westport, Connecticut.
3. Egg Science and Technology by Staddelman.
4. Lawrie, R.A. (1998). Lawrie's Meat Science. Woodhead Publishers.
5. Mead, G. (2004). Poultry Meat Processing and Quality. Woodhead Publishers.
6. Panda, P.C. (1992). Text Book on Egg and Poultry Technology, Vikas Publishers.

Course Code: **MSc/FST/2/CC10** Course Title: **Technology of Meat, Fish & Poultry products** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)									**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	---	2	3	---	3	2	3	3	2	2	2
	CO2	2	---	2	2	---	3	2	3	3	3	2	2
	CO3	3	2	2	3	---	2	2	2	2	3	3	2
	CO4	2	2	2	2	---	1	2	2	2	2	2	2
	Average	2.5	1	2	2.5	---	2.25	2	2.5	2.5	2.5	2.25	2

Laboratory-III

Technology of Cereals& Millets

(Paper code - MSc/FST/2/CC11)

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6 Hrs**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Students would be able to understand the process of milling of cereals and products of milling of rice and wheat.
CO2	Students would be acquainted with the processing and quality analysis of cereals and millets.
CO3	It will provide hand on training of development of cereal based products like bakery products.
CO4	Development of value added novel food products based upon cereals and their waste material through laboratory experimentation would be helpful in recommending and guiding food industry for the novel value added food products development.

1.
2. Experimental milling of rice and assessment of presence of head, broken and immature kernels and degree of polish.
3. Experimental parboiling of rice by different methods and evaluation of parboiled rice.
4. Determination of proximate analysis of wheat flour for moisture, ash, protein and fat contents.
5. Determination of wet gluten and dry gluten content of given sample of wheat Flour.
6. Determination of alpha-amylase activity in wheat flour by falling number apparatus.
7. Determination of amylose content of cereal and legume starches by iodine binding method.
8. Isolation of rice starch and its quantification.
9. Determination of different cooking parameters of various rice cultivars.
10. Determination of the alcoholic acidity of a given sample of wheat flour.
11. Study of pasting properties of corn starch by Rapid Visco Analyzer.
12. Study of thermal properties of different Cereal starches by Differential Scanning Calorimeter.
13. To compare different types of wheat flours by Polenshke test.
14. Determination of turbidity and percentage light transmittance of cereal starches
15. Determination of textural properties of cooked rice using Instron testing machine/Texture Analyzer.
16. Experimental baking of different baked products like biscuits, breads and cakes and their evaluation for different parameters.
17. Visit to milling and bakery industry.

Course Code: **MSc/FST/2/CC11** Course Title: **Laboratory-III Technology of Cereals & Millets** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak		
	Program Outcome (PO)	**Program Specific Outcome (PSO)**

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	**CO1**	2	2	--	2	--	1	2	--	2	1	2	2
	CO2	2	--	--	2	2	2	2	1	3	2	2	2
	CO3	3	2	2	2	1		2	2	3	2	2	2
	CO4	3	3	2	2	1	3	3	2	2	2	2	3
Average		**2.5**	**1.75**	**1**	**2.0**	**1**	**2.0**	**2.25**	**1.25**	**2.5**	**1.75**	**2.0**	**2.25**

Laboratory-IV Technology of Fruits &Vegetables
Paper code: MSc/FST/2/CC12

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6 Hrs.**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Knowledge regarding this helps students to understand technical aspects of juice extraction from different fruits and evaluation of their quality.
CO2	Students became capable of preparing and evaluation of quality for products made from fruits and vegetables.
CO3	The students became capable to evaluate technical aspects related to drying and dehydration of fruits and vegetables.
CO4	Knowledge regarding this helps them to find jobs in different fruit and vegetable processing industries.

Practical's:

1. Extraction of Juices of different fruit (citrus, pomegranate, apple) and
    a. Evaluation of Vitamin C content
    b. Determination of pH
    c. Evaluation of Browning Time
    d. Determination of Acidity
    e. Cost evaluation of Juice
    f. Sensory evaluation of the products
    g. Shelf -life study
2. Preparation of Jams (using different fruits) and
    i) Determination of Pectin content
    ii) Evaluation of Total Soluble Solids
    iii) Evaluation of Sugars using lane eynon method
    iv) Determination of pH
    v) Evaluation of Acidity
    vi) Sensory evaluation of the products
    vii) Cost evaluation product prepared sensory evaluation & organoleptic test
3. Preparation of Jelly and
    i) Estimation of Pectin content
    ii) Determination of TSS
    iii) Jelmeter test
    iv) Checking for pH
    v) Checking of Acidity
    vi) Cost evaluation of product
    vii) Microbiological analysis
    viii) Sensory evaluation of the products

4. Preparation of Marmalade (using different fruits)
    i) Jam Marmalade
    ii) Jelly Marmalade
5. Preparation of Preserves and candies
    i) Evaluation of TSS
    ii) Determination of End point
    iii) Microbiological Analysis
    iv) Evaluation of product cost
    v) Sensory evaluation of the products
6. Preparation of Potato chips and
    i) Calculation of product dimension
    ii) Determination of time-temp combination for product
    iii) Study of the effect of anti-browning agents
7. Preparation of Tomato products (Sauce, Ketchup, Soup, puree) for
    i) Evaluation of TSS
    ii) Evaluation of pH
    iii) Evaluation of acidity
    iv) Cost evaluation
    v) Microbiological analysis
8. Pickling & Fermented products
9. Preparation and shelf-life study of ready-to-serve beverages
10. Experimental studies on drying and dehydration of fruits and vegetables

Course Code: **MSc/FST/2/CC12** Course Title: **Laboratory-IV Technology of Fruits &Vegetables**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	1	1	1	1	1	2	2	2	2	3	2	2
	CO2	1	1	1	3	1	2	3	3	3	3	2	3
	CO3	1	1	1	3	1	2	3	3	3	3	2	3
	CO4	1	1	1	1	1	2	2	2	1	3	3	2
Average		**1**	**1**	**1**	**2**	**1**	**2**	**2.5**	**2.5**	**2.25**	**3**	**2.25**	**2.5**

Industrial Organization and Management

Paper code: MSc/FST/2/SEC2

Credits: 2 **Lectures: 60** **Max. Marks: 50**

Periods per week: 4 Hrs. **Final Term Exam : 30**

Duration of Exam: 2 Hrs. **Internal Assessement : 20**

Objective: To impart knowledge about organization management, marketing and entrepreneurship.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	This course gives basics knowledge to students about principle of management. It enables students to develop effective planning to utilize resources.
CO2	Give basic idea of an organizational structure and develop leadership and communication skills.
CO3	This course provides understanding of organizational setup and management process. It develops ability in students to make decision for financial and marketing strategies for business.
CO4	Provide students hands on skill to develop their entrepreneurships.

Note for the paper setter: *The question paper will consist of five questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, four more questions will be set unit-wise comprising of two questions from each of the units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Management: Meaning, nature, scope, significance, functions and principles; levels of management, process of management, co-ordination as an essence of management.

Planning: Meaning and importance of planning; planning Process; limitations, considerations in planning; methods of planning; types of plans.

Organising: Meaning and importance, process of organizing, principles of effective organisation; key elements in organizing process; formal v/s informal organization departmentation, decentralisation, delegation of authority Relationship – Line, Staff and Functional.

Staffing: Concept and significance.

Unit II

Motivation, leadership and communication: Concept and significance of motivation; determinants of behaviour; Maslow's theory of motivation.

Leadership: Meaning and importance of leadership; leadership styles; qualities of leadership.

Communication: Meaning, Significance, and principles of Effective Communication.

Control: Concept and significance, control process; control techniques.

Decision making: Concept and techniques, steps in decision making process.

Production management: Plant location and layout, production planning and control.

Recommended Books:

1. B.P. Singh and A.K. Singh : Modern Management, Excel Book, New Delhi

2. B.P. Singh : Management Concepts & Practices, Dhanpat Rai & sons, Nai Sarak, Delhi.

3.Fred Luthans : Introduction to Management, McGraw Hill, New Delhi.

4.R.S. Dwivedi :Management – An Integrated Approach, National Publishing Co., Delhi.

Course Code: **MSc/FST/2/SEC2** Course Title: **Industrial Organization and Management** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)									**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	--	2	3	2	1	3	2	--	3	3
	CO2	3	2	--	2	--	--	2	3	3	--	2	3
	CO3	2	2	2	--	2	2	2	2	2	--	2	2
	CO4	2	1	2	--	2	2	1	2	2	--	3	2
Average		**2.5**	**1.75**	**1**	**1**	**1.75**	**1.5**	**1.5**	**2.5**	**2.25**	**--**	**2.5**	**2.5**

In Plant Training

Paper code: MSc/FST/3/CC13

Credits: Non credit

Period: 42 Days

Course objective: In plant training provides practical knowledge to the students for processing of various products and advanced processing techniques used in food industries.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Skill for doing work in efficient and optimal manner will develop.
CO2	Knowledge about how an industry actually works in processing as well as in research and development field will enhance.
CO3	Students get trained for developing solution cantered approach for handling any problem in food industry.
CO4	Job opportunities as well as self-business scope will increase for trained students

Course Code: **MSc/FST/3/CC13** Course Title: **In Plant Training** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	1	2	2	1	1	1	1	1	1	1	0
	CO2	3	3	1	2	1	2	1	1	2	1	2	2

	CO3	2	3	1	2	3	1	2	1	2	1	1	1
	CO4	2	2	1	0	1	3	3	3	1	1	3	3
Average		**2.25**	**2.25**	**1.25**	**1.5**	**1.5**	**1.75**	**1.75**	**1.5**	**1.5**	**1.0**	**1.75**	**1.5**

Laboratory-V
Food Analysis
Paper code: MSc/FST/3/CC14

Credits: 4 Lectures: 120 **Max. Marks: 100**

Periods per week: 8 Hrs. **Duration of Exam: 6 Hrs**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The knowledge regarding different method of analysis would make the students skilful for analytical work in research and food industry.
CO2	Analysis techniques of various food components would make the students capable of analysing various food components.
CO3	Students would know about the principles and applications of different analytical tools which are used in food industry.
CO4	The students would be able to make their career in quality control labs in food industry.

1. Analysis of given food sample for its moisture, fat, protein and ash contents.
2. Determination of vitamin C content in a given sample of citrus juice.
3. Estimation of calcium and phosphorus content in a given sample of food.
4. Calculation of iodine value and saponification value of given sample of fat or oil.
5. Estimation of tannins in a given sample of tea.
6. To study the process of Thin Layer Chromatography (TLC) to separate out various components in a given sample.
7. To estimate the amount of reducing sugars in a given food sample.
8. Calculation of smoke point, flash point and fire point of a given sample of vegetable oil.
9. Estimation of caffeine content in a given sample of coffee.
10. Determination of crude fiber content in given sample of vegetable/fruit.
11. Determination of non-reducing sugars, total sugars and starch in fruit sample.

12. Determination of total ash, acid insoluble and soluble ash in a given flour sample.
13. Estimation of rancidity in rancid oil/fat.
14. Detection of adulterants in oil/fat samples.
15. Estimation of free fatty acids (FFA) in crude and refined oil sample.
16. Sensory analysis of various processed food products like jam, bread, biscuit.
17. Determination of % moisture, fat and curd content of table butter.

Course Code: **MSc/FST/3/CC14** Course Title: **Laboratory-V Food Analysis** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
	Program Outcome (PO)									**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	---	1	---	2	3	3	3	3	2	1
	CO2	2	2	---	1	---	2	2	3	2	3	2	2
	CO3	3	2	---	1	---	2	2	2	3	2	2	2
	CO4	2	2	---	1	---	2	2	2	2	2	2	1
	Average	**2.5**	**2**	**---**	**1**	**---**	**2**	**2.25**	**2.5**	**2.5**	**2.5**	**2**	**1.5**

Cardinal Principles of Academic Integrity and Publications Ethics
Paper code: MSc/FST/3/CC15

Credits: 2 **Lectures: 60** **Max. Marks: 50**

Periods per week: 4 Hrs. **Final Term Exam : 30**

Duration of Exam: 2 Hrs. **Internal Assessement : 20**

Course outcomes: At the end of the course, the students will know:	
CO1	Academic Integrity, Plagiarism (prevention and detection) and UGC regulations
CO2	Research and Publications ethics and best practices

Note for the paper setter: *The question paper will consist of five questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, four more questions will be set unit-wise comprising of two questions from each unit. The candidates are required to attempt two more questions selecting at least one from each unit.*

Unit I

Academic Integrity: Introduction, Academic Integrity Values- Honesty and Trust, Fairness and Respect, Responsibility and Courage, Violations of Academic Integrity-types and consequences, Plagiarism -definition, Plagiarism arising out of misrepresentation-contract cheating, collusion, copying and pasting, recycling, Avoiding Plagiarism through referencing and writing skills, UGC Policy for Academic Integrity and prevention, Some Plagiarism detection tools

Unit II

Research and Publication ethics: Scientific misconducts- Falsifications, Fabrication and Plagiarism (FPP), Publication ethics- definition, introduction and importance, Best practices/standard setting initiatives and guidelines-COPE, WAME etc., Violation of publication ethics, authorship and contributor-ship, Identification of publications misconduct, complains and appeals, Conflicts of Interest, Predatory publisher and journals,

References Books/Papers:

1. MacIntyre A (1967) A short History of Ethics, London
2. Chaddah P (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized. ISBN: 978-9387480865
3. National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009) On being a Scientist: A guide to Responsible Conduct in research: Third Edition. National Academics press.
4. Resnik D. B. (2011) What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10.
5. Beall J (2012). Predatory publishers are corrupting open access, Nature, 489 (7415), 179.
6. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019). ISBN: 978-81-939482-1-7.
7. UGC regulations (2018) for Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutes.
8. Ulrike kestler, Academic Integrity, Kwantlen Polytechnic University.

Course Code: **MSc/FST/3/CC15** Course Title: **Cardinal Principles of Academic Integrity and Publications Ethics** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
	Program Outcome (PO)									**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	--	--	2	1	2	2	2	2	3	2
	CO2	2	2	--	--	3	1	2	1	2	3	2	2
Average		**2**	**2**	--	--	**2.5**	**1**	**2**	**1.5**	**2**	**2.5**	**2.5**	**2**

Food Chemistry

Paper code: MSc/FST/3/DSC1-A

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Course Objective: To acquaint the students about chemistry of various foods including their chemical composition, chemical behavior and changes during processing and storage.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Students would come to know about the chemical properties of the major food constituents.
CO2	Course will provide understanding of the chemical and functional properties of various food constituents and optimization of the various food processing and preservation conditions
CO3	This course will provide basic information about food allergen and anti-nutrient constituents present in food and method of their removal.
CO4	After studying this course, the students shall be aware of the underlying chemistry, properties and effects of processing on food components.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Food chemistry: Definition, scope and importance, Chemistry and functionality of water and fat soluble vitamins; minerals and their bioavailability,

Food allergy: Allergens, toxic constituents and anti-nutritional factors of foods.

Carbohydrates: Classification, chemical and physical properties, functions.

Unit II

Starches: Functionality of starch in foods, modified starches, resistant starch, gelatinization and retrogaradation of starches.

Pectic substances: Structure, properties and uses in food.

Gums: Occurrence, types and uses in food.

Dietery fibers: Types, soluble fibers, insoluble fibers and their important functions

Unit III

Proteins and amino acids: Classifications, types of amino acids and proteins, chemical, physical and functional properties, texturized proteins, denaturation of protein, coagulation of proteins.

Lipids: Classification, functions, physico-chemical properties, oxidation of oils and fats.

Unit IV

Food enzymes: A brief account, characteristics, enzyme activity, and factors affecting enzyme activity.

Applications of enzymes in food industry: meat industry, baking industry, beverage and fruit industry, starch and sugar industry.

Browning reactions in food: Enzymatic and non-enzymatic browning, their occurrence and applications in food.

Recommended Books:

1. Meyer, L.H.(1998) Food Chemistry, Van Nostrand, Reinhold Company Publication, New York,
2. Nehra M,Nain V, Thory R(2021) Principles of Food Chemistry, SLM Publishers,New Delhi
3. Pomeranz, Y and Meloon, R. (1995) Food Analysis : Theory and Practice, Westport, An AVI Publication, New York, Sydney, Toronto.
4. Fennema, R.O (1997) Food Chemistry, Second Edition, Food Science & Technology series, Marcel Dekker, INC., New York

Course Code: **MSc/FST/3/DSC1-A** Course Title: **Food Chemistry**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	1	2	2	3	2	2	2
	CO2	1	2	2	2	--	2	--	2	2	2	2	2
	CO3	2	2	1	2	2	3	2	2	2	3	2	3
	CO4	1	1	2	1	1	2	2	2	2	2	2	2
Average		**1.5**	**1.75**	**1.75**	**1.75**	**1**	**2**	**1.5**	**2**	**2.25**	**2.25**	**2**	**2.25**

Food Analysis

Paper code: MSc/FST/3/DSC1-B

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Course objectives: The course aims to provide detailed information and knowledge about various method and instruments used in the analysis of food components.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The knowledge regarding sampling methods would make the students skilful for analytical work in research and food industry.
CO2	Study of different analytical methods would make the students capable of analysing various nutritive components of foods.
CO3	The knowledge regarding the principles and applications of different instruments would prepare the students for analytical purpose and quality control labs in food research and industries.
CO4	Study of different method of sensory evaluation help for development and analysis of new products.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT I

Introduction to food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results.

Various analytical methods for food samples such as, pH value, turbidity, moisture content etc. Analysis of principal food constituents such as carbohydrates, proteins, fat, crude fibre and minerals by various methods.

UNIT II

Instrumentation in food analysis: Principles of spectroscopy, UV, visible and fluorescence spectroscopy.

Electrophoresis: Principle, types of electrophoresis and applications, basic and advance instrumentation and their applications in food industries.

UNIT III

Chromatography: Ion exchange chromatography, affinity chromatography, liquid chromatography, gas chromatography, high performance liquid chromatography (HPLC), gas liquid chromatography (GLC), gas chromatograph mass spectrophotometers (GCMS), Ultra performance liquid chromatography (UPLC), and applications.

Texture analysis in foods, color measurement in foods; X-ray analysis of foods and its applications.

UNIT IV

Methods for measuring rheological and viscoamylographic properties of foods– viscoamylograph, extensograph, alveograph instruments.

Sensory evaluation: Introduction, methods, panel screening, selection methods, Sensory and instrumental analysis in quality control, hedonic scale testing of flavor, aroma, taste, texture, and overall acceptability of food products.

Recommended Books:

1. Nehra M, Nain V, Thory R(2021) Principles of Food Chemistry, SLM Publishers, New Delhi
2. Ronald S. Kirk, Ronald, Sawyer (1991).*Pearson;s Composition & Analysis of Foods*, 9th Edition Longman scientific & Technical , U.K.
3. Pomeranz , Y. &Mrloan (1978) . *Food Analysis : Theory and Practice , Westport,*connectiant :
4. Birk, G.G., Herman, J.G. and Parker, K.J. Ed. -1977. Sensory Properties of Foods. Applied Science, London.

Course Code: **MSc/FST/3/DSC1-B** Course Title: **Food Analysis**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)									**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	---	---	---	2	2	---	2	3	2	2	1
	CO2	2	---	---	---	1	2	---	3	3	2	2	2
	CO3	3	---	---	---	1	3	---	3	2	2	2	3
	CO4	2	---	---	---	---	1	---	2	2	3	2	2
	Average	**2.5**	**---**	**---**	**---**	**1**	**2**	**---**	**2.5**	**2.5**	**2.25**	**2**	**2**

Food Packaging

Paper code: MSc/FST/3/DSC2-A

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To understand different types of packaging systems and materials for different foods and their labeling/safety considerations in food packaging. Also, to elaborate basic principle behind aseptic, active and edible film packaging/coating to enhance the shelf life of different food materials.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be able to know about the requirement and characteristics of packaging materials for different types of foods along with package labelling and safety considerations.
CO2	Knowledge regarding paper and plastic packaging materials, their processing and different functional properties would be helpful for the student to understand and design/optimize different packaging requirements of different

	foods processed/stored under different conditions.
CO3	The student will be able to understand about manufacturing of glass and metal containers and understanding of their different properties would be helpful in deciding their use for packaging of different food products. Students would also know about the usefulness of active packaging.
CO4	The information regarding principles/mechanism of active and edible food packaging will be useful in optimizing the use of different materials and storage conditions for various foods depending on specific requirements. The students would be able to serve in food industries, which deal in packaging for different types of food materials.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Introduction to food packaging: primary food packaging and secondary packaging, factors involved in the evolution and selection of a food package, functions of food packaging

Packaging requirements of selected foods: cereals and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen food, horticultural products.

Safety considerations in food packaging: Food safety problems associated with package, package labelling and food safety, recycling of packaging materials.

UNIT-II

Paper and paper based packaging materials: Types of paper (Kraft, bleached, greaseproof) paper products (paper bags, cartoons, drums and molded paper containers), functional properties of paper, testing of paper packaging materials.

Plastic packaging materials: Classification of polymers, functional and mechanical, properties of thermoplastic polymers, processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing).

UNIT-III

Metal packaging materials: Functional properties of metal containers, tin plate containers -quality control tests, can manufacturing and protective coatings.

Glass packaging materials: Composition and manufacturing of glass containers, glass container nomenclature, mechanical and optical properties of glass containers, testing of glass containers.

Aseptic packaging of foods: Sterilization of packaging material, food contact surfaces & aseptic packaging systems, retort pouches.

UNIT-IV

Active food packaging: Definition, physical and chemical principles involved.

Edible films and coatings as active layer: Concept, different edible films used, use of edible active layers to control water vapour transfer and gas exchange

Oxygen absorbents: Classification and main type of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf -life extension of foods, disadvantages of oxygen absorbents.

Text/Reference Books:

1. Sacharow, S. and Griffin, R. C. (1980) *Principles of food packaging,* 2nd Ed., Avi, PublicationCo.Westport, Connecticut, USA.
2. Athalye. A.S. (1992) *Plastics in packaging,* Tata McGraw - Hill Publishing Co., New Delhi.
3. Rooney, M.L (1995) *Active Food Packaging*, Blackie Academic & Professional, Glasgow, UK.

4. Bakker, M. (1986) *The Wiley Encyclopaedia* of packaging Technology, john Willey Sons. inc: New York.

Course Code: **MSc/FST/3/DSC2-A** Course Title: **Food Packaging** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
		Program Outcome (PO)								**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	2	-	2	3	2	2	2
	CO2	2	1	1	1	-	1	-	1	2	1	1	1
	CO3	2	1	1	1	-	1	-	1	2	1	1	1
	CO4	3	2	2	2	-	1	-	2	3	2	1	2
Average		**2.25**	**1.5**	**1.5**	**1.5**	**0.25**	**1.25**	**-**	**1.5**	**2.5**	**1.5**	**1.25**	**1.5**

Nutrition and Health

Paper code: MSc/FST/3/DSC2-B

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Course objective: To understand different attributes of foods and nutrition which might be directly related to human health and to generate better understanding about consumption of different food in different situations and stages of age.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students will be able to know relationships of various foods with human body regarding nutrients and energy given by these foods.
CO2	The students will get knowledge about various health complications which occurs due to bad eating habits.
CO3	The students will get knowledge about various essential food components required for wellbeing of human body and it will be beneficial for their job prospective as a food and diet expert.
CO4	The students will be benefitted by getting knowledge about various therapeutic functional foods required to combat chronic health problems.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Foods and nutrients: Basic definitions, Functions of food and nutrients, Levels of nutritional status, changing concepts of nutrition.

Energy: Energy content of foods, physiological fuel value - review, measurement of energy expenditure. Estimating energy requirements of individuals and groups.Regulation of energy metabolism, control of food intake and weight.

Energy balance: Food energy measure, Energy control in human metabolism, Basal metabolic rate (B.M.R.), Factors affecting B.M.R., Measuring B.M.R., Energy requirements and its estimation

Unit II

Nutrition and weight management: Obesity and its causes, Body composition, B.M.I., Weight for height measures, Health implications of obesity, Problems of weight management.

Glycaemic index of foods: Control its importance.

Recommended dietary allowances (R.D.A.), ICMR standards, Food guide, Exchange lists, Health promotion guidelines.

Carbohydrates: Classification, Dietary importance, Special functions of carbohydrates in body tissues, Relationship between dietary fiber and various health problems

Unit III

Fats: Functions of EFA, role of ω-3, ω-6 fatty acids in health and disease. Trans fatty acids and prostaglandins, essential fatty acids, cholesterol, LDL and HDL and their health importance

Proteins: Nature and essentiality of amino acids and proteins, Functions of protein, the concept of protein balance, Comparative quality of food proteins, Biological value, Net protein utilization, Protein efficiency ratio, Therapeutic applications of specific amino acids

Vitamins: Clinical applications, sources, requirements and functions of Vitamin A, D, E, K, C and 'B' complex, vitamins toxicity problems

Unit IV

Minerals: Minerals in human health, macro and micro minerals, trace minerals- functions, clinical applications, food sources and requirements

Functional foods: concept and categories of functional foods and their importance

Food security: Problem and prospects

Recommended Books:

1. Insel, P., Turner R.E. & Ross, D. (2006). Discovering Nutrition, IInd Edition. ADA, Jones and Bartlett Publishers Inc., USA.
2. Williams,S.R. (1990). Essentials of Nutrition and Diet Therapy. Times Mirror/MosbyCollege Publishing.
3. Nehra M, Nain V, Thory Rahul (2021). Vitamins and minerals: Boon to Human Health and Nutrition, Readers Paradise Publications, New Delhi
4. Nehra M,Nain V, Amanjyoti,.(2020).Miraculous Food World,Shree Publishers, New Delhi
5. Brian, A.F., Allen, G. (1995). Food Science, Nutrition & Health. Edward Arnold, A member of Hodder Headline Group London, Sydney, Auckland.
6. Mudambi Sumati R. & Rajagopal, M.V. (1995). Fundamentals of Food & Nutrition. New Age International (P) Limited, Publishers.
7. ICMR (1995). Nutrient Requirement & RDA, ICMR, New Delhi.
8. Gibney, M.J., Elia, M., Ljungqvist, O. & Dowsett, J. (2005). Clinical Nutrition. The Nutrition society textbook series, Blackwell publishing company.

Course Code: **MSc/FST/3/DSC2-B** Course Title: **Nutrition and Health**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	3	--	2	2	3	2	2	1	2
	CO2	2	2	2	2	--	2	2	1	2	2	1	2
	CO3	2	2	2	2	--	2	2	1	2	2	2	3
	CO4	2	3	3	3	--	3	2	3	3	2	2	3
Average		**2**	**2.25**	**2.25**	**2.5**	**--**	**2.25**	**2**	**2**	**2.25**	**2**	**1.5**	**2.5**

Industrial Microbiology

Paper code: MSc/FST/3/DSC3-A

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Objective: Acquaintance with importance of industrial microbiology and food fermentation and its application in food sector.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	It will provide basic information to students about industrial setup of fermenter for large scale production of various products.
CO2	Downstream process will enable students to recover the product from a mixture of product obtained from the fermentation process.
CO3	Study of microorganism based waste management enable student to degrade the industrial waste safely.
CO4	The students can pursue for the career industrial production of food additive from microbial sources.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Overview of fermentation: Fermentation as an ancient art, modern era of fermentation technology.

Biology of industrial microorganisms: Isolation, screening and genetic improvement of industrially important microorganisms.

Unit II

Fermentation systems: Batch and continuous systems, fed-batch culture, fermenter design, solid substrate fermentation, instrumentation and control.

Fermentation raw materials: Criteria used in media formulation, influence of medium, and raw materials for process control.

Unit III

Downstream processing: Objectives, steps, problems, separation processes with examples.

Microbial production of various primary and secondary metabolites: Alcohol, amino-acids (glutamic acid and lysine), organic acids (citric acid & acetic acid) & enzymes. Principles of over-production of metabolites.

Unit IV

Biomass production: Microbial production of single cell protein, Baker's yeast.

Immobilized Enzyme Technology: Methods of immobilization, reactors and applications.

Waste treatment: Introduction, waste treatment systems, microbial inoculants and enzymes for waste treatments.

Recommended Books:

1. Prescott & Dunn (1992). Industrial Microbiology, 4th Edition. CBS Publishers, NewDelhi.
2. Ward, O.P. (1989). Fermentation Biotechnology- Principles, Process and Products. Prentice Hall Publishers, New Jersey.
3. Stansbury, P.F., Whitakar, A and Hall, S.J. (1995). Principles of Fermentation Technology, Pergamen Press, Oxford.
4. Young, M.Y. (1984). Comprehensive Biotechnology (Vol. 1-4), Pergamon Press, Oxford.
5. Rehm, H.J., Read, G.B., Puhler, A and Stadler (1999). Biotechnology, Vol. 1-8, VCH Publications.

6. Crueger and Crueger (2000) Biotechnology – A Text book of Industrial Microbiology. IInd edition. Panima Publishing Company.

Course Code: **MSc/FST/3/DSC3-A** Course Title: **Industrial Microbiology** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
	Program Outcome (PO)									**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	1	1	1	1	1	2	1	2	1	1	1
	CO2	2	2	1	2	1	2	3	1	2	2	1	1
	CO3	2	3	3	2	1	2	2	2	2	2	3	2
	CO4	2	2	2	2	1	2	2	3	2	2	2	2
Average		**2**	**2**	**1.75**	**1.75**	**1**	**1.75**	**2.25**	**1.75**	**2**	**1.75**	**1.75**	**1.5**

Food Biotechnology

Paper code: MSc/FST/3/DSC3B

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To provide knowledge on the basic concepts and use of bio-technological techniques for the development and improvement of food products, bio-preservatives and useful bio-compounds.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be able to explain and apply various bio-technological techniques for the improvement of food products.
CO2	The knowledge of food bio-technology would strengthen the students to render their scientific skills in their genetic engineering and protein engineering for the production of food products, bio-preservatives and other useful bio components.
CO3	The students would be able to get career opportunities in the bio-tech foods industries.
CO4	The students would have option to pursue their research career in emerging areas of food biotechnology.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Introduction to food Biotechnology: Introduction to Food biotechnology, basic principles of genetic engineering,

Genetic engineering and food safety: Improvement of the processing of various crops by genetic engineering, food safety and biotechnology.

UNIT-II

Natural antimicrobials: Natural antimicrobials for food preservation: Phytoalexins, essential oils and their components, bacteriocins of LAB, nisin, pediocins etc,

Applications of bacetriocins: Applications of bacetriocins in food systems. Aflatoxins - production, control and reduction using molecular strategy.

UNIT-III

Protein engineering: Protein engineering in Food technology - methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus Beta-galactosidase and peptide antibiotic nisin).

Biotechnology and Food ingredients: Biogums, fats, oils, fatty acids and oilseed crops, fat substitutes, natural and modified starches, citric, fumaric and malic acids.

UNIT-IV

Food Biotechnology and Intellectual Property Rights (IPR): benefits of securing IPRs; bioethics in food biotechnology

Transgenic plants and animals: their contribution to food production enhancement.

Text/Reference Books:

Suggested Readings:

1. Lee, B.H. (1996). Fundamentals of Food Biotechnology , VCH Publishers.
2. Tombs, M.P. (1991). Biotechnology in Food Industry , Open University Press , Milton Keyness.
3. Knorr, D .(1987). Food Biotechnology , Marcel Dekker , INC , new yark.
4. Schwartzberg, A & Rao (1990) . Biotechnology & Food Process Engineering , Marcel Dekker , INC , New York.
5. Goldberg, I & Williams , R . (1991) .Biotechnology and food Ingredients , Van Nostrand Reinhold , New York.
6. King , R . D. and Cheetham , P.S.J. (1986)). Food biotechnology , Elsevier Applied Science, London.

Course Code: **MSc/FST/3/DSC3B** Course Title: **Food Biotechnology** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
	Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	0	2	1	3	1	1	3	2	1	1
	CO2	3	3	2	3	3	3	2	2	3	3	3	2
	CO3	2	1	1	1	3	1	1	3	2	2	1	2
	CO4	1	1	1	1	3	1	1	3	2	2	3	3
Average		**2.25**	**1.75**	**1**	**1.75**	**2.5**	**2**	**1.25**	**2.25**	**2.5**	**2.25**	**2**	**2**

Laboratory-VI

Food Packaging

Paper code: MSc/FST/3/DSC4-A

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 8 Hrs. **Duration of Exam: 6 Hrs.**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be able to know about different types of packaging materials used in food packaging.
CO2	Knowledge regarding different physical characteristics of packaging material will be useful in assessing their storage capacity which could further help in deciding its end uses for packaging of different foods.
CO3	The student will be able to understand about different quality test of packaging materials which would be useful in minimizing in losses during processing, storage and transportation of different food products.
CO4	An understanding about different packaging material, their behavior towards different conditions, physical and functional properties would be useful in deciding/designing novel packaging systems for food products and can help to pursue career in packaging industry.

1. Designing of an ideal packaging material for different type of food products.
2. Identification of different packaging materials.
3. Testing of paper based packaging materials.
4. Equilibrium Relative Humidity (ERH) study of foods.
5. To study uniformity and amount of wax in wax paper for packaging of hygroscopic foods.
6. To study chemical resistance of plastic and paper packaging materials.
7. To study Water Vapour Transmission Rates (WVTR) of paper and plastic polymers.
8. Shelf life studies of packaged foods.
9. Study of grease resistance of paper, plastic laminates and aluminium foil for the packaging of fatty foods.
10. To perform various functional tests on corrugated fibreboard boxes.
11. Determination of Cobb value of different types of paper board.
12. Shrink Packaging of poultry products.
13. Aseptic packaging of different food products.
14. Vacuum Packaging of dry powders.
15. Testing of glass containers for thermal shock resistance.
16. Determination of tensile strength and heat seal strength of different plastics.
17. To conduct drop and vibration tests on different types of corrugated fiberboard boxes.
18. Determination of tin coating weight and porosity of tin plate container.
19. Determination of lacquer coating in tin containers.
20. Study of manufacture of 2 piece and 3 piece metal cans.
21. Visit to paper manufacturing industry.

Course Code: **MSc/FST/3/DSC4-A** Course Title: **Laboratory-VI Food Packaging**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
		Program Outcome (PO)								**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	1	1	-	2	-	2	3	2	1	2
	CO2	3	2	1	1	-	2	-	1	2	2	1	2
	CO3	2	2	1	1	-	2	-	1	2	2	1	2
	CO4	2	2	2	2	-	2	-	2	3	2	1	2
Average		**2.25**	**2**	**1.25**	**1.25**	**-**	**2**	**-**	**1.5**	**2.5**	**2**	**1**	**2**

Laboratory-VII Nutrition and Health

Paper code: MSc/FST/3/DSC4-B

Credits: 4 Lectures: 120 **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6 Hrs.**

Course outcomes:

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students became capable of making diet plans for different age groups, different life cycle and chronic health problem conditions and for different body activity levels.
CO2	The students became capable assessing nutritive values for different foods according to their preparation methods and preparation food charts.
CO3	The students became capable of estimating qualitative nutritional attributes of different foods.
CO4	Knowledge regarding this helps them to find jobs in R&D and as a diet expert in various food and drug sector industries.

Practicals:

1) Diet plan for infants
2) Diet planning for lactating women
3) Diet planning for women above 45 years
4) Diet planning for athletic persons
5) Diet planning for geriatric persons
6) Diet planning for diabetic patients
7) Diet planning for heart patients
8) Effect of processing methods on nutritive value of different food preparation
9) Preparation of food charts
10) To estimate the calorific value of different food items
11) To estimate PER, NPU, BMR, BV and glycemic index of food stuffs
12) Diet planning using food exchange methods

Course Code: **MSc/FST/3/DSC4-B** Course Title: **Laboratory-VII Nutrition and Health** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	1	2	1	2	1	2	2	2	2	1
	CO2	2	2	2	2	1	2	2	2	2	2	2	2
	CO3	2	2	1	2	1	2	1	2	2	2	3	--
	CO4	2	3	2	2	1	2	2	1	2	2	1	2
Average		**2**	**2.25**	**1.5**	**2**	**1**	**2**	**1.5**	**1.75**	**2**	**2**	**2**	**1.66**

Research Project

Paper code: MSc/FST/4/CC16

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6Hrs.**

Course objective: To develop the scientific temperament in students.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students will acquire the knowledge regarding investigation and problem solving related to food materials.
CO2	The students became capable of critical analysis on simple and sophisticated instrumentation facilities.
CO3	The students became capable of writing reports and statistical analysing the data.
CO4	The students would be able to find jobs in R&D in the food and drug industries and formation and novel food product development.

Course Code: **MSc/FST/4/CC16** Course Title: **Research Project** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	2	1	1	3	2	2	2
	CO2	1	3	2	2	1	3	2	2	3	3	2	3
	CO3	1	2	1	1	1	3	3	2	3	3	2	3
	CO4	1	1	1	1	1	2	1	3	1	2	2	2
Average		**1.25**	**2.0**	**1.5**	**1.5**	**1**	**2.5**	**1.75**	**2.0**	**2.5**	**2.5**	**2.0**	**2.5**

Credit Seminar

Paper code: MSc/FST/4/CC 17

Credits: 2 **Max. Marks: 50**

Periods per week: 2 Hrs.

Course objective: Student will acquire the knowledge for collection of literature and its presentation.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Report writing and presentation skill of student will improve.
CO2	Communication skill of student will improve.
CO3	Interdisciplinary knowledge of student will increase.
CO4	To develop the capability of critical thinking based on the contextual knowledge of food science and technology.

Course Code: **MSc/FST/4/CC 17**Course Title: **Credit Seminar**
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	1	1	---	---	---	2	1	2	2	3	1
	CO2	2	1	1	---	---	---	2	1	3	2	2	1
	CO3	3	2	1	---	---	---	2	1	2	2	2	1
	CO4	2	2	1	---	---	---	3	1	2	2	2	1
Average		**2.25**	**1.5**	**1**	**---**	**---**	**---**	**2.25**	**1**	**2.25**	**2**	**2.25**	**1**

Technology of Beverages

Paper code: MSc/FST/4/DSC5-A

Credits: 4 **Lectures: 60**

Periods per week: 4 Hrs.

Duration of Exam: 3 Hrs.

Max. Marks: 100

Final Term Exam : 70

Internal Assessement : 30

Course objectives: The course objectives are to enhance the knowledge of students about water treatment, processing of various alcoholic, and non-alcoholic beverages.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be acquainted with the different water treatment methods, water processing and alcoholic beverages.
CO2	The knowledge of processing and technology of non-alcoholic beverage would facilitate the students to seek their career in the beverage industries.
CO3	Students having familiarization with the processing methods of tea and coffee.
CO4	The students would be able to make their career in bottled water and chocolate manufacturing and processing sector.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Beverages: Definition, types, importance of beverages in our diets.

Treatment of water for food industry.

Technology of alcoholic beverages: Wine, cider, brandy, Perry, toddy, bear and whisky.

Unit II

Manufacturing of carbonated beverages and technology of carbonation.

Technology of soft drinks, ingredients and additives used in production of soft drinks.

Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.

Unit III

Production, processing and chemistry of tea manufacturing and types of tea.

Production, processing, roasting and brewing of coffee, soluble coffee, decaffeinated coffee, monsoon coffee, coffee brew concentrate and chicory.

Unit IV

Cocoa processing, cocoa beverages and chocolate.

Packaged drinking water- manufacturing processes, quality evaluation of raw and processed water, methods of water treatment, BIS quality standards of bottled water.

Recommended Books:

1. Tressler, Donald K. and Joslyn, Maynard A. 1971 Fruit and Vegetable Juice processinTechnology, Second Edition. The AVI Pub. Com., Inc. USA.

2. ManayShakuntala N and Shadaksharaswamy, M. Foods : Facts and Principles. 2nd edition New Age Inter. Publishers, New Delhi.

3. Haard, N.F. and Salunkhe, D.K. 1975. Postharvest Biology and Handling of Fruits and Vegetables. AVI, Westport.

4. Kader, A. A. 1992. Postharvest Technology of Horticultural Crops, 2nd Ed. University of California, Division of Agriculture and National Resources, California

Course Code: **MSc/FST/4/DSC5-A** Course Title: **Technology of Beverages** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	2	--	---	3	2	3	3	2	3	1
	CO2	2	2	2	---	---	3	2	3	2	3	2	2
	CO3	3	1	1	---	---	2	2	2	3	3	3	2
	CO4	2	1	2	---	---	2	2	2	2	2	2	2
Average		**2.5**	**1.5**	**1.75**	**---**	**--**	**2.5**	**2**	**2.5**	**2.5**	**2**	**2.5**	**1.75**

Nutraceuticals and Functional Foods

Paper code: MSc/FST/4/DSC5-B

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To know various attributes of foods having novel properties and their best utilization for human beings in combating with various chronic health problems and other co-morbidities across the world, subsequently declining the use of harmful pharmaceutical drugs.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The student's knowledge explored about various functional foods and their functional nutraceutical compounds with their basic health benefits.
CO2	The student's knowledge explored about the use of various functional foods and their useful bioactive compounds for curing of different chronic health problems. With this knowledge students would be able to advise and counsel regarding the role of different functional foods in disease prevention and community health issues like cancer, diabetes, coronary health problems and obesity etc.
CO3	Knowledge regarding nutraceuticals of various cereal, legumes, oilseeds, milk, fruits, vegetables, tea, coffee and sea foods would be able to explore their knowledge about developing various beneficial functional foods.
CO4	The students would be able to find jobs in R&D in the food and drug industries related with isolation and utilization of various nutraceutical compounds for functional food formation and novel food product development.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Basic concepts of nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods.

Nutraceutical and functional food applications and their health benefits. Nutraceutical compounds and their classification on the basis of food source and chemical/biochemical nature.

Unit II

Nutraceuticals for specific situations such as cancer, CVDs, diabetes, stress, joints and bone problems.

Antioxidants and other phytochemicals (flavonoids, alkaloids, terpenoids and carotenoids), their role as nutraceuticals in various functional foods.

Dietary fibers and complex carbohydrates as functional food ingredients.

Unit III

Cereal products as functional foods – oats, wheat bran, rice bran etc. oilseeds (such as flaxseeds), legumes and sea foods as functional foods.

Concept of prebiotics and probiotics: their functional role in human health.

Functional vegetables (cruciferous family vegetables) and functional vegetable products and their functional roles.

Coffee, tea and other beverages as functional foods/drinks and their prospective effects.

Unit IV

Regulatory system for functional foods and nutraeuticals; safety issues and functional food regulations in India and International regulations. Functional foods available in the market.

Basic concept behind the preparation of functional foods and extraction of nutraceutical compounds from them. Effect of processing, storage and interaction of various factors on the potential of functional foods such as probiotics and other functional food products.

Recommended Books:

1. Nehra M, Nain V, Thory Rahul (2021). Vitamins and minerals: Boon to Human Health and Nutrition, Readers Paradise Publications, New Delhi
2. Nehra M,Nain V, Amanjyoti,.(2020). Miraculous Food World,Shree Publishers, New Delhi
3. Robert E.C. Wildman (2007). Handbook of Nutraceuticals and Functional Foods. (2nd edition) CRC Press. Boca Raton, London, New York, Washington, D.C.
4. Robert E.C. Wildman (2001). Handbook of Nutraceuticals and Functional Foods. CRC Press. Boca Raton, London, New York, Washington, D.C.
5. Wildman, REC (2007). Handbook of nutraceuticals and functional foods. Official Methods of Analysis (2003). Association of official analytical chemists, USA.

Course Code: **MSc/FST/4/DSC5-B** Course Title: **Nutraceuticals and Functional Foods**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	2	2	1	2	1	1	2	2	2	2
	CO2	1	1	2	3	1	2	1	1	3	2	3	2
	CO3	1	1	2	3	1	2	1	1	3	2	3	2
	CO4	1	1	1	1	1	3	1	3	2	3	2	3
Average		**1.5**	**1.25**	**1.75**	**2.25**	**1**	**2.25**	**1**	**1.5**	**2.5**	**2.25**	**2.5**	**2.25**

Technology of Pulses and oilseeds

Paper code: MSc/FST/4/DSC6A

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: The aims of this course is trained the students for various processing for oil extraction and legumes. Knowledge of students about various properties of oil and fats is also improved.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be acquainted with knowledge of processing oil and legumes.
CO2	The students would be able to make their career in legume milling and oil industry. Knowledge of soybean processing would be helpful for the students to serve in food industries based on soya products and by-products. The students would be able to understand the different processing methods of pulses.
CO3	Knowledge of soybean processing would be helpful for the students to serve in food industries based on soya products and by-products.
CO4	The students would be able to understand the different processing methods of pulses.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Importance and properties of fats and oils in human nutrition: Importance, Chemical, physical and functional properties of fats and oils.

Oil seed processing in India: Importance of oilseeds processing in India.

UNIT-II

Commercial oil resources and basic processing of fats and oils - oil extraction, expeller pressing and solvent extraction, degumming, refining, bleaching, hydrogenation, fractional crystallization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering.

Protein concentrates and isolates: Preparation of protein concentrates and isolates and their use in high protein foods, fermented and traditional products.

UNIT-III

Fat substitutes and mimetics.

Common pulses produced in the country.

Soybean: processing and utilization.

Milling methods for pulses: Home scale commercial and recent methods with equipments**.**

UNIT-IV

Anti-nutrients: Anti-nutrients in pulses and modes of elimination.

Main processing methods: Cooking, germination, sprouting, fermentation, roasting, puffing, frying and extrusion cooking etc.

Products from legumes and uses: Starch, flour, protein concentrates and isolates.

Text/Reference Books:

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

Course Code: **MSc/FST/4/DSC6A** Course Title: **Technology of Pulses and oilseeds** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
	Program Outcome (PO)									**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	3	1	2	2	2	2	1	2	3	2	0
	CO2	1	2	2	2	2	3	1	2	2	2	2	3
	CO3	2	2	2	1	1	1	2	2	3	2	2	2
	CO4	1	0	1	0	1	2	1	3	1	1	3	3
Average		**1.5**	**1.75**	**1.5**	**1.25**	**1.5**	**2.0**	**1.5**	**2.0**	**2.0**	**2.0**	**2.25**	**2.0**

Advances in Food Processing and Preservation

Paper code: MSc/FST/4/DSC6-B

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: The course provides an understanding for various advanced processing techniques which can be useful in designing of novel processing operations and food products.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	An understanding of advanced and novel technology such as extrusion and high hydrostatic pressure technology of food processing and preservation would be useful in new products development.
CO2	The knowledge of technology such as hurdle technology will help in optimizing the processing and preservation of different food products without affecting their nutritional and sensory attributes. An understanding of different membranes would be useful in deciding the application of these technologies.
CO3	Information regarding novel non-thermal technologies such as high intensity electric field pulses and irradiation technology would be useful in deciding their application in different food processing operations and minimizing losses due to thermal processing.
CO4	An understanding of ultrasound technology, microwave processing and formulated foods would be helpful to the students in developing novel food products with improved quality characteristics.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Extrusion technology: General principles, extrusion process, advantages of extrusion, extrusion equipment, single screw extruders and twin screw extruders, effect of extrusion on food properties, extrusion of starch based foods.

Hydrostatic Pressure Technology: General principles, effect of hydrostatic pressure on microorganisms-possible mode of action, application of hydrostatic pressure technology in food industry.

UNIT-II

Hurdle Technology: Principles and basic aspects of hurdle technology, different hurdles, hurdle effect, application of hurdle technology in dairy products, intermediate moisture foods, fermented products, heated foods and chilled foods.

Membrane Technology: Introduction of membrane, their classification and function, principles of reverse osmosis and ultrafiltration, nanofilteration and microfilteration, applications of membranes in food processing industry, modules for using membrane filters.

UNIT-III

High intensity electric field pulses (HIEFP): Principles, generation of electric field pulses, applications in foods, effect on bread making and wheat dough and bread making properties, effect of HIEFP on microorganisms.

Food Irradiation Technology: General aspects of irradiation, ionizing radiation, irradiation process, units, mechanism, advantages and disadvantages of irradiation process, recent studies, wholesomeness of irradiated foods, general purposes of irradiation process; inactivation of micro-organisms, inhibition of sprouting, delay of ripening and senescence and miscellaneous effects on food properties.

UNIT-IV

Ultrasound in food processing and preservation: Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, heat transfer and homogenization and emulsification.

Microwave Processing: Microwave, properties, heating mechanism, difference between conventional and microwave heating, microwave oven, factors affecting the heating of food in microwave oven, applications of microwave in food processing, effect of microwave on food nutrients, recent studies.

Formulated Foods: Recent advances in formulated and value added foods, seafoods, and infant and weaning foods, emergency foods, soy fortified products, complementary foods.

Text/Reference Books:

1. Gloud, G. W. (1995). *New Methods of Food Preservation*, Blackie Academic & Professional, U.K.
2. Holdswarth, S. D. (1993). *Aseptic Processing and Packaging of Food Products*, Elsevier, London.
3. Church, P. N. (1993). *Principles and Applications of Modified Atmosphere Packaging of Food*, Blackie Academic & Professional, U.K.

Course Code: **MSc/FST/4/DSC6-B** Course Title: **Advances in Food Processing and Preservation**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	2	1	1	-	1	-	2	2	2	1	2
	CO2	3	2	2	1	-	2	-	2	2	2	1	2
	CO3	2	2	1	1	-	2	-	2	2	2	1	2
	CO4	2	1	1	1	-	2	-	2	2	2	1	2
Average		**2.5**	**1.75**	**1.25**	**1**	**-**	**1.75**	**-**	**2**	**2**	**2**	**1**	**2**

Laboratory-VIII
Technology of Beverages
Paper code: MSc/FST/4/DSC7-A

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 8 Hrs. **Duration of Exam: 6 Hrs**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	Student would be able to assess various quality parameters of beverages
CO2	Analysis techniques of various beverages would make the students capable of analysing various components of beverages.
CO3	Students would know about the different analytical tools which are used in food industry.
CO4	The students would be able to make their career in beverage industry.

1. Determination of water quality parameters for beverage industry:
   i. Hardness of water
   ii. Determination of pH
   iii. Microbiology of water
2. Determination of quality parameters for alcoholic and non-alcoholic beverages.
3. Extraction and clarification of juices from different sources.
4. Extraction and debittering of citrus juice.
5. Evaluation of quality testing parameters of wines.
6. Chemical and sensory quality analysis of soft drink.
7. Preparation of whey based beverages.

8. Decaffeination and sensory evaluation of coffee beverages: Process optimization and sensory evaluation of cocoa beverages.

9. Determination of brewing quality parameters of tea and coffee.

10. Packaging and bottling of different beverages.

11. Shelf life studies of different beverages.

Course Code:**MSc/FST/4/DSC7-A** Course Title: **Laboratory-VIII Technology of Beverages** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	1	---	1	---	2	2	2	2	3	2	1
	CO2	2	1	---	1	---	1	2	3	2	3	2	1
	CO3	3	1	--	1	---	1	2	2	2	2	2	1
	CO4	2	1	---	1	---	2	2	2	2	2	2	1
Average		**2.5**	**2**	**--**	**1**	**---**	**2**	**2**	**2.25**	**2**	**2.5**	**2**	**1**

Laboratory-IX Nutraceuticals and Functional foods

Paper code: MSc/FST/4/DSC7-B

Credits: 4 **Lectures: 120** **Max. Marks: 100**

Periods per week: 4 Hrs. **Duration of Exam: 6 Hrs.**

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students became capable to extract and estimate (qualitatively as well as quantitatively) various bioactive nutraceutical compounds from different natural raw food materials.
CO2	The students became capable to evaluate nutritional and medicinal potential of different functional foods.
CO3	Knowledge regarding use of different nutraceutical bioactive compounds to formulate various functional foods.
CO4	Knowledge regarding this helps them to find jobs in R&D of the food and drug sector industries.

Practical:

1. Study and demonstration of the antimicrobial effects of plant tannins, alkaloids and sulfur compounds.
2. Preparation and evaluations of probiotic foods and study their health benefits.
3. Extraction and estimation of nutraceuticals from various foods: isoflavones (legumes) capsaicinoids (peppers), organ sulfur compounds (onions and garlic) and monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) (oil seeds) and lecithins (legumes seeds).
4. Extraction and estimation of lycopene from tomato and tomato products.
5. Extraction and estimation of carotene from raw carrot samples.
6. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
7. Determination of DPPH radical scavenging activity of different raw and processed food samples.
8. Determination and quantifications of some nutraceutical compounds by GLC and HPLC.

9. New product development by incorporation of bioactive compounds extracted from different sources.

Course Code: **MSc/FST/4/DSC7-B** Course Title: **Laboratory-IX Nutraceuticals and Functional foods** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak												
		Program Outcome (PO)								**Program Specific Outcome (PSO)**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	1	1	2	2	1	2	2	2	2	2	2	2
	CO2	1	1	2	3	1	2	3	3	3	3	2	3
	CO3	1	1	2	3	1	2	3	3	3	3	2	3
	CO4	1	1	2	1	1	2	2	2	2	2	2	2
Average		**1**	**1**	**2**	**2.25**	**1**	**2**	**2.5**	**2.5**	**2.5**	**2.5**	**2**	**2.5**

Industrial Food Waste Management
Paper code: MSc/FST/4/DSC8-A

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To evaluate waste generated from different food processing industries quantitatively and qualitatively and its management by converting it into valuable secondary by products.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students became capable of understanding types of waste generated from different food processing industries and converting them into valuable by products.
CO2	The students know the biological and non-biological ways by which food processing industry waste can be disposed off and stored.
CO3	Knowledge regarding this helps the students to understand different waste water treatment methods.
CO4	Students became capable of understanding Environment management systems (ISO14000) in relation with pollution caused due to food processing industries.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Introduction: types of waste generated; non degradable and biodegradable wastes; food industrial wastes from fruit and vegetable processing industry, fish, meat and poultry industry and dairy industry.

Utilization of waste: methods of utilizing wastes to make value added products; pectin, food colorants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, enzymes from meat processing, single cell proteins.

Unit II

Storage and disposal of solid waste: solid waste storage and disposal methods, land filling, burial, incineration, recycling; biological treatment of food industry wastes, storage and disposal of liquid and gaseous waste; legal aspects related to storage and disposal.

Unit III

Waste water treatment: Physical, chemical and biological characteristics of waste water;

Primary treatment of waste water: Screening, Grit removal, Sedimentation,

Secondary treatment of waste water: Aeration tank, Trickling filter, Rotating biological contractor (RBC), Moving bed biological reactor (MBBR),

Tertiary treatment of waste water: Nutrient removal, Disinfection, Filtration.

Unit IV

Environment management systems (ISO14000) and its application in food industry; legislation related to waste management.

General concept of sewage treatment plant (STP) and effluent treatment plant (ETP).

Recommended Books:

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

Course Code: **MSc/FST/4/DSC8-A** Course Title: **Industrial Food Waste Management**

(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	1	2	1	2	2	2	2	2
	CO2	1	3	3	3	1	2	1	2	2	2	2	3
	CO3	1	2	3	3	1	2	1	2	2	2	2	3
	CO4	1	1	2	2	1	2	1	2	2	2	2	2

Average	**1**	**2**	**2.5**	**2.5**	**1**	**2**	**1**	**2**	**2**	**2**	**2**	**2.5**

Food Additives

Paper code: MSc/FST/4/DSC8B

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To expose the students regarding use of various chemical additives in foods during food processing and preservation, international and national legislation on the use of food additives as well as advantages and risks of additives.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students would be able to explain the properties and applications of food additives and preservatives used in food products.
CO2	Knowledge of natural and synthetic colouring as well as flavouring agents would make the students able to detect the issues regarding adulteration in foods.
CO3	Students will gain knowledge about processing aspects of various spices.
CO4	The students would be able to pursue their career in various food industries involved in food colours, flavours, sweeteners and other food additives manufacturing.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

UNIT-I

Introduction to food additives: General classification, types, uses, functions, legal aspects, risks and benefits.

Preservatives: Antimicrobial agents (types, mode of action and their application), antioxidants (types and mechanism of oxidation inhibition), anti-browning agents (types, functions and mode of action).

Chelating agents and sequestrants: Types, uses and mode of action

UNIT-II

Acidulants and pH control agents: Types, uses and mode of action.

Coloring agents: Synthetic food colorants, color chemistry, applications and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), misbranded colors, color extraction techniques, color stabilization.

Flavoring agents: flavors (natural and synthetic flavors), off flavor in foods, flavor enhancers, flavor stabilization, flavor encapsulation.

UNIT-III

Sweeteners: Natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohals (polyols) as sweeteners in food products.
Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.
Stabilizers: Types, uses and functions.

UNIT-IV

Food spices and condiments: Types and uses spices and condiments, chemical composition, extraction, general processing, uses and special attributes of important Indian spices like pepper, cinnamon, clove, ginger, turmeric, cardamom, fenugreek and fennel etc., seasonings and condiments blends.

Advances in Food Additives: Classification, functions, safety aspects, recent advances with relevance to color, flavor enhancement, sweeteners and preservatives.

Recommended Books:

1. Branen,A.L. (2002). Food Additives. Marcel Dekker Inc.
2. Purseglove J.W. (1998). 'Spices' Vol. I and II. Longman Publishers
3. Tainter, D.R. and Grenis, A.T. (1993). Spices and Seasonings- A Food Technology Handlook. VCH Publishers, Inc.
4. Nehra M, (2020). Dictionary of terms in Food science and technology. The Readers Paradise Publications, New Delhi

Course Code: **MSc/FST/4/DSC8B FST-** Course Title: **Food Additives**
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								Program Specific Outcome (PSO)			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	3	3	0	2	2	1	1	2	3	1	1	1
	CO2	2	2	2	3	2	3	3	1	3	3	3	3
	CO3	2	2	2	2	3	2	2	3	3	3	2	2
	CO4	1	1	0	2	3	2	1	3	2	2	3	3
Average		**2**	**2**	**2**	**2.25**	**2.5**	**2**	**1.75**	**2.25**	**2.75**	**2.25**	**2.25**	**2.25**

(Open Elective)

Food Nutrition & Health

Paper code: MSc/FST/9/OEC1

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Course objective: To understand different attributes of foods and nutrition which might be directly related to human health and to generate better understanding about consumption of different food in different situations and stages of age.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	The students will be able to know about various nutrients and their requirements for various conditions and age groups.
CO2	The students will be to know relationships among food consumption, body mass and energy requirements of human body.
CO3	The students will get knowledge about various health complications which occurs due to bad eating habits and their prevention with various foods.

CO4	The students will get knowledge about diet planning and food charts for various age groups and conditions for wellbeing of human body and it will be beneficial for their job prospective as a food and diet expert.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Food and nutrients: Basic definitions, changing concepts of nutrition.

Eenergy requirements of individuals and groups, Control of food intake and weight.

Unit II

Obesity and its causes, Body composition, Body Mass Index (B.M.I.),

Basal metabolic rate (B.M.R.), Factors affecting B.M.R.

Unit III

Cardio vascular disease, Diabetics, Hypertension, Inflammatory bowel disorder (IBD): causes, precaution and preventive measures.

Functional foods, role in controlling various diseases.

Unit IV

Diet planning for specific age groups.

Diet planning for diabetic patients.

Preparation of food charts.

Text and Reference Books:

1. Insel, P., Turner R.E. & Ross, D. (2006). Discovering Nutrition, IInd Edition. ADA, Jones and Bartlett Publishers Inc., USA.
2. Nehra M, Nain V, Thory Rahul (2021). Vitamins and minerals: Boon to Human Health and Nutrition, Readers Paradise Publications, New Delhi
3. Nehra M,Nain V, Amanjyoti,.(2020).Miraculous Food World,Shree Publishers, New Delhi
4. Nehra M, (2020). Dictionary of terms in Food science and technology.TheReaders Paradise Publications, New Delhi
5. Hegarty, Vincent. (1995). Nutrition Food and the Environment. Eagen Press.
6. Brian, A.F., Allen, G. (1995). Food Science, Nutrition & Health. Edward Arnold, A member of Hodder Headline Group London, Sydney, Auckland.
7. Mudambi Sumati R. & Rajagopal, M.V. (1995). Fundamentals of Food & Nutrition. New Age International (P) Limited, Publishers.

Course Code: **MSc/FST/9/OEC1** Course Title: **Nutrition and Health** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak													
		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	1	2	1	1	1	1	2	1	1	1
	CO2	1	2	1	2	1	1	1	1	1	1	1	1
	CO3	1	1	1	2	1	2	1	1	1	1	1	1
	CO4	1	2	1	2	1	2	2	2	2	1	2	2
Average		**1.25**	**1.75**	**1**	**2**	**1**	**1.5**	**1.25**	**1.25**	**1.5**	**1**	**1.25**	**1.25**

Open elective Paper

Food adulteration
MSc/FST/9/OEC/2

Credits: 4 **Lectures: 60** **Max. Marks: 100**

Periods per week: 4 Hrs. **Final Term Exam : 70**

Duration of Exam: 3 Hrs. **Internal Assessement : 30**

Objective: To understand the role and significance of food adulteration in human life and public health.

Course outcomes (CO): At the end of the course, the students will be able to describe:	
CO1	This course will provide understanding of adulteration and their adverse health and economic effects in our life. Students come to know the importance of Food adulteration in common life.
CO2	Milk and Species are two main ingredients of almost every food preparation. Here students would be equipped with the information and general testing to detect adulteration in milk and spices.
CO3	Students would get the legal rights and remedies against the act of Food adulteration on national and international level.
CO4	Knowledge of Public health and its association with food enable students to selection of right food at right place.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit I

Introduction and concept: Food Adulteration – Definition, concept, classification of adulterants, Food Contaminants, difference between adulterants and contaminants List of foods commonly adulterated, harmful effects of adulterants.

Unit II

Adulteration in milk and milk products: Common adulterants in milk and milk products. Household and laboratory scale methods to detect the adulterants in milk and milk products

Adulteration in spices and additives: Common adulterants in spices and food additive. Household and laboratory scale methods to detect the adulterants in these commodities.

Unit III

Food Laws and standards for adulteration: National and international Laws and regulations to minimize adulteration in food commodities.

Unit IV

Public health hazards and food safety: Food borne illness, food poisoning, types of food poisonings, bacterial agents of food borne illness, food poisoning by *Clostridium, Salmonella, E. coli, Staphylococcus.*

Recommended Books:

1. N. ShakuntalaManay and M. Shadaksharaswamy (2008) Food Facts and Principles
2. Shyam Narayan Jha (2016) Rapid Detection of Food Adulterants and Contaminants
3. Nehra M, Nain V, Thory Rahul (2021). Vitamins and minerals: Boon to Human Health and Nutrition, Readers Paradise Publications, New Delhi
4. Nehra M, (2020). Dictionary of terms in Food science and technology. The Readers Paradise Publications, New Delhi

Course Code: **MSc/FST/9/OEC/2** Course Title: **Food adulteration**
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak

		Program Outcome (PO)								**Program Specific Outcome (PSO)**			
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
Course Outcome (CO)	**CO1**	2	2	2	2	2	1	1	1	2	2	2	1
	CO2	2	2	2	2	1	2	2	1	2	2	2	1
	CO3	2	2	1	1	3	1	1	1	2	1	3	1
	CO4	2	3	2	2	1	2	1	1	2	1	1	1
Average		**2**	**2.25**	**1.75**	**1.75**	**1.75**	**1.5**	**1.25**	**1**	**2**	**1.5**	**2**	**1**

Open elective Paper

Food Safety, Hygiene and Sanitation

Paper code: MSc/FST/9/OEC3

Credits: 4 Lectures: 60	**Max. Marks: 100**
Periods per week: 4 Hrs.	**Final Term Exam : 70**
Duration of Exam: 3 Hrs.	**Internal Assessement : 30**

Course Objectives: To improve the knowledge of students about food adulteration, food laws, hygiene and sanitation process used in food industries.

Course outcomes (CO): At the end of the course, the students will be able to describe:

CO1	The knowledge of food safety and food adulteration issues would empower the students to detect for the various adulterations and safety threats in food.
CO2	The students would be enabled to develop food quality and safety management systems in food industries.
CO3	The students would be able to understand various food standards.
CO4	The students would become familiar with various food laws and regulations.

Note for the paper setter: *The question paper will consist of nine questions in all. The first question will be compulsory and will consist of five short questions of 2 marks each covering the whole syllabus. In addition, eight more questions will be set unit-wise comprising of two questions from each of the four units. The candidates are required to attempt four more questions selecting at least one question from each unit.*

Unit 1

Food hygiene: definition, requirement, importance.Food adulteration in India, Types of adulterants: Intentional and incidental, adverse effects of adulteration.Measures and approaches for control of food adulteration.

Unit II

Food contamination and spoilage: types of contaminants, natural toxins, pesticides residues and microbiological contamination.Cleaning and personal hygiene: introduction, necessity. Health of staff, sanitary practices and importance.

Unit III

Food Safety: Definition and importance, HACCP-Definition and principles. Good Manufacturing Practices (GMP)/ Good Hygienic Practices (GHP)/Good Laboratory Practices (GLP).

Unit IV

Food Laws and Regulation: introduction, regulatory agencies, control of food quality,Food Safety and Standards Authority of India (FSSAI),BIS, FPO.

Recommended Books:

1. SunetraRoday (2017). Food hygiene and sanitation with case studies, McGraw Hill Education (India) Private Limited.
2. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Siva Kiran, R.R. (2012). Manual for Detection of Common Food Adulterants, First Edition, IAPEN.
6. Battershal, J.P. (2013). Food Adulteration & its detection, General Books LLC.
7. Prevention of Food Adulteration Act, 4th Edition, Ashoka Law House, 2002

Course Code: **MSc/FST/9/OEC3** Course Title: **Food Safety, Hygiene and Sanitation (Open-elective)** (1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak		
	Program Outcome (PO)	**Program Specific Outcome (PSO)**

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	**CO1**	3	2	---	---	2	2	2	2	2	2	2	2
	CO2	3	2	---	---	2	1	1	1	2	2	2	1
	CO3	2	--	---	---	2	2	2	2	3	2	2	1
	CO4	2	---	---	---	2	2	2	2	2	2	2	1
	Average	2.5	1	---	---	2	1.75	1.75	1.75	2.25	2	2	1.25