CURRICULUM FRAMEWORK FOR POST-GRADUATE PROGRAMME IN FOOD TECHNOLOGY

AS PER NATIONAL EDUCATION POLICY (NEP) – 2020

P.G. DIPLOMA IN FOOD TECHNOLOGY
(Programme Code: FOT-1103)

ONE YEAR/TWO YEAR M. SC. IN FOOD TECHNOLOGY WITH RESEARCH
(Programme Code: FOT-2103)

ONE YEAR/TWO YEAR M. SC. IN FOOD TECHNOLOGY WITH COURSE WORK AND RESEARCH
(Programme Code: FOT-3103)

ONE YEAR/TWO YEAR M. SC. IN FOOD TECHNOLOGY WITH COURSE WORK
(Programme Code: FOT-4103)

DEPARTMENT OF FOOD TECHNOLOGY

RAJIV GANDHI UNIVERSITY - A CENTRAL UNIVERSITY
RONO HILLS, DOIMUKH -791 112
ARUNACHAL PRADESH
(ACADEMIC YEAR: 2024-25 ONWARDS)

1. Preamble

The M.Sc. in Food Technology program is designed to provide students with a comprehensive understanding of the science & technology behind food production, processing, marketing and safety. Through a blend of theoretical coursework and hands-on laboratory experiences, students will explore the intricacies of food Processing, food chemistry, microbiology, quality control, nutrition and food engineering. The program aims to equip students with the knowledge and skills required to address contemporary challenges in the food industry, including sustainability, food safety regulations, and innovative food product development. By fostering critical thinking and research capabilities, this M.Sc. program prepares students for diverse career opportunities in food science & technology, quality control and assurance, research, and development. The course intend to develop competent food scientist and technologist through proactive teaching and learning process, research, entrepreneurship and extension activities leading towards sustainable growth of the society.

The PGP-FOT at RGU, as per National Education Policy-2020 (NEP-2020) currently consists of the 2-year programme, with the second year primarily dedicated to research, for any graduates of 3-year Bachelor's programs. Alternatively, for those completing the 4-year Bachelor's any programme with Honours/Honours with Research would be considered for a 1-year Master's programme.

Minimum Credit Requirements and Eligibility for the Master's Programme

Sr. No.	Programme Name/Qualifications	Level	Credits	Credit Points
1	PG Diploma	6	40	240
2	1-Year PG after a 4-year UG	6.5	40	260
3	2-Year PG after a 3-year UG	6.5	40 + 40	260
4	2-Year PG after a 4-year UG such as B.E., B. Tech. etc.	7	40 + 40	280

1.1 Eligibility for Admission

A

i. Candidate possessing Bachelor degree (B. Sc. /B. Tech. / B. E) in Food Science and Technology/Food Science/Food Technology/Food Science and Quality Control/Food Technology and Management/Food Processing / Food Engineering/ Food Process Engineering/ Food Processing and Preservation/ Post Harvest Technology/ Food Processing and Packaging/Agriculture/Horticulture /Home Science/Nutrition and Dietetics and allied discipline with minimum 50% marks.

OR

ii. Candidate possessing B.Sc. Degree in Botany/ Zoology/ Chemistry/ Biochemistry/Microbiology/Biotechnology from Rajiv Gandhi University or any other Statutory University with minimum 50% marks.

OR

iii. Candidate passing 12th Science and possessing B. Voc. Degree in Food Science and Technology/Food Science/ Food Technology/ Food Processing/ Food Processing and Management/ Food Processing and Technology/ Food Processing/ Post Harvest Technology/ Food Processing and Preservation/ Food Processing and Packaging with minimum 50% marks from Rajiv Gandhi University or any other Statutory University.

B. All the candidates eligible as mentioned with above eligibility criteria have to qualify CUET

(SCQP12) and/or University entrance conducted by RGU, Doimukh, Arunachal Pradesh.

1.2 Medium of Instruction

English shall be the medium of instruction and examination.

1.3. Graduate Attributes of PG Programmes

Qualifications that signify completion of the postgraduate degree will be awarded to students who acquire:

a) Comprehensive knowledge and coherent understanding of the chosen disciplinary/interdisciplinary areas of study in a broad multidisciplinary context, their different learning areas, their linkages with related fields of study, and current and emerging developments associated with the chosen disciplinary/interdisciplinary areas of learning.

b) Practical, professional, and procedural knowledge required for carrying out highly skilled work/tasks related to the chosen field(s) of learning, including knowledge required for undertaking self-employment initiatives, and knowledge and mindset required for entrepreneurship involving enterprise creation, improved product development, or a new mode of organization.

c) Skills in areas related to specialization in the chosen disciplinary/interdisciplinary area(s) of learning in a broad multidisciplinary context, including wide-ranging practical knowledge, involving variable routine and non-routine contexts relating to the chosen field(s) of learning.

d) Capacity to extrapolate from what has been learnt, to real-life situations and apply acquired competencies in new/unfamiliar contexts, rather than merely replicate curriculum content knowledge, to generate solutions to specific problems.

e) The ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships.

1.4 Curricular Components at Entry Level for a Post Graduate Programme

a) **One-year PG Diploma in Food Technology:** Students entering after 1-year of 2-year of PG with a min. credit earned equivalent to 40 will be awarded with PG Diploma in Food Technology.

b) **One-year year Master of Science in Food Technology:** Students entering one-year Master of Science in Food Technology after a 4-year UG programme can choose to do (i) only coursework or (ii) research or (iii) coursework and research.

c) **Two-year Master of Science in Food Technology:** Students entering 2-year Master of Science in Food Technology after a 3-year UG programme can choose to do (i) only course

work in the third and fourth semester or (ii) course work in the third semester and research in the fourth semester or (iii) only research in the third and fourth semester.

1.5. Credit Distribution

a) For one-year Master of Science in Food Technology

Department of Food Technology shall follow Coursework + Research Model for one-year Master of Science in Food Technology.

Curricular Components	One -Year Master of Science in Food Technology Programme Minimum Credits			
	Course Level	Coursework	Research thesis/project/Patent	Total Credits
Coursework + Research	500	20	20	40

b) Two-Year Master of Science in Food Technology

Curricular Components	Two-Year Master of Science in Food Technology Programme Minimum Credits			
	Course Level	Coursework	Research Thesis/Project/Patent	Total Credits
1st Year (1st & 2nd Semester)	400 500	20 20	--	40
Students who exit at the end of 1st year shall be awarded a PG Diploma in Food Technology				
2nd Year (3rd & 4th Semester)	Course Work and Research	**500**	**20**	**20**	**40**

1.6 Exit Point

a) In case of M. Sc. in Food Technology (One- Year) programme, there shall be no exit point. All enrolled students have to complete their post-graduation within 1-year duration/two semesters.

b) In case of M. Sc. in Food Technology (Two-Year) programme, there shall only be one exit point for those who join two-year PG programme. However, students who exit at the end of 1st year shall be awarded a Postgraduate Diploma in Food Technology and they shall have to complete their PG within duration of 4 years.

1.6.1 Course Levels

a) **400-499**: Advanced courses which would include lecture courses with practicum, seminar- based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year Postgraduate theoretical and practical courses.

b) **500-599**: For students who have graduated with a 4-year bachelor's degree. It provides an opportunity for original study or investigation in the major or field of specialization, on an individual and more autonomous basis at the postgraduate level.

1.7 Flexibility

a) Flexibility is one of the hallmarks of NEP 2020. The benefit of pursuing M. Sc. in Food Technology is that it offers great flexibility viz. enrolling in online programmes, pursuing two postgraduate programmes simultaneously, creditizing work experience, etc.

b) Another opportunity for students is the facility to pursue two academic programmes simultaneously 1) in two full-time academic programmes in the physical mode provided that there is no overlapping of class timings between the two programmes.

c) Creditization of relevant work experience is another initiative to make education more holistic. The UGC-NCrF enables the assignment of credits for the experience attained by a person after undergoing a particular educational programme. In case a learner through employment gains experience relevant to the PG programme he/she wants to pursue; the work experience can be creditized after assessment. Accordingly, the duration can be adjusted by the RGU. The maximum weightage provided for under this dimension is two (2) i.e. a candidate/ trained person can at best earn credits equal to the credits acquired for the base qualification/ skill, provided he has more than a certain number of years of work experience. The redemption of credits so earned, however, shall be based on the principle of assessment bands given in the National Curriculum Framework (NCrF).

d) The credit points may be redeemed as per Academic Bank of Credit (ABC) guidelines for entry or admission in higher education at multiple levels enabling horizontal and vertical mobility with various lateral entry options

e) The principle of calculating credits acquired by a candidate by virtue of relevant experiential learning including relevant experience and professional levels acquired and attaining proficiency levels (post-completion of an academic grade/ skill-based program) gained by the learner/student in the industry is given in the Table 1.7.1 below.

1.7.1 Credit Assignment for Relevant Experience / Proficiency

Experience cum Proficiency Levels	Description of the relevant Experiential learning including relevant experience and professional levels acquired and attaining proficiency levels	Weightage/ multiplication Factor	No. of years of experience (Only indicative)
Trained/ Qualification Attained	Someone who has completed the coursework/ education/ training and has been taught the skills and knowledge needed for a particular job or activity.	1	Less than or equal to 1 year
Proficient	Proficient would mean having the level of advancement in a particular profession, skillset, or knowledge.	1.33	More than 1 less than or equal to 4
Expert	Expert means having high level of knowledge and experience in a trade or profession.	1.67	More than 4 less than or equal to 7

Master	Master is someone having exceptional skill or knowledge of a subject/domain.	2	More than 7

1.8 Assessment Strategy

The NEP-2020 emphasizes upon formative and continuous assessment rather than summative assessment. Therefore, the scheme of assessment will have components of these two types of assessments. Assessment have to have correlations with the learning outcomes that are to be achieved by a student after completion of the course. Therefore, the mode and system of assessments have to be guided by the learning outcomes.

1.8.1 Course Evaluation/Assessment

The evaluation system in the form of marks distribution for each course in Post Graduate Programme in Food Technology is depicted in the credit system.

1.9 Letter Grades and Grade Points

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

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

1.10 Computation of SGPA and CGPA

UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

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

$$\mathbf{SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci}$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Example for Computation of SGPA is given below:

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

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

$$\mathbf{CGPA = \sum(Ci \times Si) / \sum Ci}$$

-where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester. Example for Computation of CGPA

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

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

2.0 Nomenclature Used in the Syllabus as per NEP-2020

- **Programme Educational Objective (PEO)**
  PEOs are broad statements that describe the career and professional accomplishments that graduates of a programme are expected to achieve within a few years of graduation.
- **Programme Outcome (PO)**
  POs are specific statements that describe what students are expected to know and be able to do by the time they complete a programme.
- **Programme Specific Outcome (PSO)**
  PSOs are similar to POs but are more specific to a particular specialization or focus area within a programme.
- **Course Outcome (CO)**
  COs are statements that describe the specific learning objectives of individual courses within a programme.

2.1 PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

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

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

2.2 PROGRAMME OUTCOMES (POs)

	Type of Programme Outcome (PO)	**Programme Outcome (PO) Descriptor**
PO 1	**Problem-Solving**	A graduate student should be able to demonstrate the capability to: ● solve problems of familiar and non-familiar contexts that are best approached with critical thinking and apply the learning to real-life situations.
PO 2	**Analytical Reasoning & Critical Thinking**	The graduates should be able to demonstrate the capability to: ● apply analytical thought to a body of knowledge, including the analysis, evaluation and practices, as well as evidence, arguments, claims, beliefs, and the reliability and relevance of evidence, ● identify relevant assumptions or implications; and formulate coherent arguments, ● identify logical flaws in the arguments, ● analyse and synthesise data from various sources, draw valid conclusions and support them with evidence and examples.
PO 3	**Creativity**	The graduates should be able to demonstrate the ability to: ● create, perform, or think in different and diverse ways about the same objects or scenarios, ● deal with problems and situations that do not have simple solutions, ● innovate and perform tasks in a better manner, ● view a problem or a situation from multiple perspectives, ● think 'out of the box' and generate solutions to complex problems in unfamiliar contexts, ● adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence.

PO 4	**Communication Skills**	The graduates should be able to demonstrate the skills that enable them to: ● listen carefully, read texts and research papers analytically, and present complex information clearly and concisely to peers and the public at large, ● express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media, ● confidently share views and express herself/himself, ● construct logical arguments using correct technical language related to a field of learning, work/vocation, or an area of professional practice, ● convey ideas, thoughts, and arguments using respectful and sensitive language to gender and other minority groups.
PO 5	**Research-related Skills**	The graduates should be able to demonstrate: ● a keen sense of observation, inquiry, and capability for asking relevant/ appropriate questions, ● the ability to problematise, synthesize and articulate issues and design research proposals, ● the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships, ● the capacity to develop appropriate methodology and tools of data collection, ● the appropriate use of statistical and other analytical tools and techniques, ● the ability to plan, execute and report the results of an experiment or investigation, ● the ability to understand basic research ethics and skills in practising/doing ethics in the field/ in personal research work, regardless of the funding authority or field of study.
PO 6	**Leadership Development**	The graduates should be able to demonstrate the capability for: ● mapping out the tasks of a team or an organization and setting direction. ● formulating an inspiring vision and building a team that can help achieve the vision, motivating and inspiring team members to engage with that vision. ● using management skills to guide people to the right destination.
PO 7	**Digital and technological skills**	The graduates should be able to demonstrate the capability to: ● use ICT in a variety of learning and work situations, ● access, evaluate, and use a variety of relevant information sources, ● use appropriate software for analysis of data.

PO 8	**Value inculcation**	The graduates should be able to demonstrate the acquisition of knowledge and attitude that are required to: ● embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values, ● formulate a position/argument about an ethical issue from multiple perspectives ● practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies, ● identify ethical issues related to work and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights, ● adopt objective, unbiased, and truthful actions in all aspects of work, ● instil integrity, identify ethical issues related to work, and follow ethical practices.
PO 9	**Environmental awareness and action**	The graduates should be able to demonstrate the acquisition of and ability to apply the knowledge, skills, attitudes, and values required to take appropriate actions for: ● recognize environmental and sustainability issues, and participate in actions to promote sustainable development. ● mitigating the effects of environmental degradation, climate change, and pollution, ● effective waste management, conservation of biological diversity, management of biological resources and biodiversity,
PO 10	**Community engagement and service**	The graduates should be able to demonstrate the capability to: ● participate in community-engaged services/ activities for promoting the well-being of society.

2.3 PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

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

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

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

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

2.4 Structure of the PG Diploma/One/Two Year Post-graduate Programme in Food Technology

*1 credit for lecture = 15 hours in a semester
**1 credit for tutorial = 15 hours in a semester
***1 credit for practicum = 30 hours in a semester

Course Structure for PG Diploma in Food Technology
(Programme Code: FOT-1103) /
One Year M. Sc. in Food Technology with Research / Two Years M. Sc. in Food Technology with Research
(Programme Code: FOT-2103)

NCRF Credit Level	Semester	Core Papers (Core Course/Elective/Course Work)	Course Level	Credit	Total Credit	Credit Distribution	Max. Marks (Theory)			Max. Marks (Practical)			Contact Hours
		Course Name				L:T:P	Internal	End Sem	Total	Internal	End Sem	Total	
6	Sem-I	FOT-103-CC-5110-Principles of Food Processing and Preservation	400	3	20	2:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5120-Food Chemistry	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5130-Food Microbiology	400	3		2:0:1	20	80	100	20	80	100	60
		FOT-103-CC-5140-Food Engineering	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5150-Food Safety and Quality Assurance	400	2		2:0:0	20	80	100	-	-	-	30
		FOT-103-RC-5110-Research Methodology/MOOCS or SWAYAM equivalent	500	4		3:1:0	20	80	100	-	-	-	45
	Sem -II	FOT-103-CC-5210-Technology of Cereals, Pulses and Oilseeds	400	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52010-Food Nutrition and Biochemistry (Elective-I)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52020-Food Additives (Elective-I)											
		FOT-103-DE-52030-Advance Analytical Techniques (Elective-II)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52040-Meat, Fish and Poultry Processing (Elective-II)											
		FOT-103-DE-52050-Advances in Food Processing Technology (Elective-III)	500	4		3:1:0	20	80	100	-	-	-	45
		FOT-103-DE-52060-New Product Development (Elective-III)											
		FOT-103-RC-5210-Research Publication Ethics/ MOOCS or SWAYAM equivalent	400	4		4:0:0	20	80	100	-	-	-	45
Total Credit (First Year)					**40**								
Exit option with Post-Graduate Diploma in Food Technology on completion of courses equal to a minimum of 40 credits or Entry to One Year M. Sc. in Food Technology with Coursework													
6.5	Sem- III / Sem-IV	FOT-103-RP-6110-Dissertation/ Research Thesis/ Industrial Project	500	40	**40**	0:0:40	-	-	-	-	-	100	1200
Total Credit (Aggregate)					**80**								
Post-Graduate Degree in Food Technology with Coursework on completion of courses equal to a minimum of 80 credits													

SEMESTER – I

FOT-103-CC-5110: PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 hrs per week, **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To know the different spoilage agents and the ways in which they act on food.
LO2: To understand the principles behind the various methods of food preservation.
LO3: To know how to use these principles to preserve different types of foods.
LO4: To study the method of action of different preservatives.

Course Outcomes:

CO1: Students will be able to know various food preservation techniques, including thermal, non-thermal processing and fermentation and other advance technology.
CO2: Understanding the advance methods of processing and preservation in industries.
CO3: Critical analysis of preservation methods based on efficacy and sustainability.
CO4: Learners could know the applications of preservation principles in real-world food industry settings.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Food Spoilage: Definition, types of spoilage - physical, enzymatic, chemical and biological spoilage. Mechanism of spoilage and its end products, shelf life determination. Sorting, Grading, Washing, Peeling, Cutting.	7	1, 3
2	Preservation by using Preservatives: Food preservation: Definition, principles, importance of food preservation, traditional and modern methods of food preservation. Food additives – definition, types, Class I and Class II preservatives.	7	3, 4
3	Preservation by use of high temperature: Pasteurization: Definition, types, Sterilization, Canning - history and steps involved, spoilage encountered in canned foods, types of containers used for canning foods. Drying, Dehydration, Food irradiation – Principles, merits and demerits, effects of irradiation and photochemical methods.	8	1,2,3
4	Preservation by use of Low Temperature: Refrigeration - advantages and disadvantages, freezing: Types of freezing, common spoilages occurring during freezing, difference between refrigeration, freezing, chilling. Water activity, Intermediate moisture foods.	8	2,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	2.0	2.0	1.0	-	3.0
CO2	2.0	3.0	3.0	-	2.0	3.0	-	1.0	-	3.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	2.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	3.0	3.0
Average	**2.7**	**2.7**	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.5**	**2.3**	**3.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practicals:

1. Blanching of fresh fruits/vegetables.
2. Performing lye peeling for vegetables.
3. Determination of PPO and POD enzyme activity.
4. Determination of water activity in food products.
5. Drying of different local food products by sun, shade and tray drying.
6. Freeze drying of foods.
7. Osmotic dehydration of foods.
8. Retort processing of fruits/vegetable products.

Books recommended:

1. Desrosier (2006). The Technology of Food Preservation, 4th edition, CBS Publishers & Distributers, New Delhi.
2. Potter and HotchKiss (2006). Food Science, 5th edition, CBS Publishers & Distributers, New Delhi.
3. Zueth (2005). Food Preservation Techniques, CBS Publishers & Distributers, New Delhi.
4. Non-destructive Evaluation of Food Quality: Theory and Practice (2010) Jha, Shyam N. (Ed.) Springer.
5. Manay, N. S., & Shadaksharaswamy M. (2002). Foods, facts and principles (second edition). New age international publishers, New Delhi.
6. Fellows, P. (2004). Food processing Technology: Principles & Practices, 2nd edition, CRC Press USA.
7. Bhat R, Alias AK, and Paliyath G. 2012. Progress in Food Preservation. First Edition. Wiley-Blackwell.
8. Food Processing Principle and Application by HS Ramaswamy and M Marcotte.Taylor and Francis (2006).
9. Food Science: Research and Technology by AK Haghi. Apple Academic Press(2011).
10. Handbook of Food Process Equipment by G Saravakos and AK Kostaropoulos.Springer (2016).
11. Frazier, W. C. & Westhoff, D. C. (1996). *Food Microbiology*, Tata McGraw Hill and Co.

FOT-103-CC-5120: FOOD CHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding of structure and reactions and functional properties of the different food constituents

LO2: Students will understand the functional properties of different food constituents.

LO3: Students will learn the fundamentals of chemical processes and their significance with respect to food processing and preservation.

LO4: To provide conceptual understanding of utilizing food constituents and their modifications for food applications.

Course Outcomes:

CO1: Understand chemical properties of food components (water, carbohydrates, proteins, lipids, vitamins, minerals, and pigments).

CO2: To relate properties and structures of chemical constituents in foods to their functional and chemical properties.

CO3: To relate the physical and chemical interaction between food constituents during processing and their impact on final quality.

CO4: To understand the importance and role of chemistry in preservation/shelf- life.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Definition of food chemistry, historic development of food chemistry. Approach to the study of food chemistry. Water in food, Physical properties and structure of ice and water. Colligative properties of aqueous solutions. Concept of water activity, moisture sorption isotherms, phase diagram, ice crystal growth. Relation of water activity and food preservation. Vitamins and minerals: Importance, functions and impact upon processing. Plant pigments, structure and impact upon processing.	10	1,2,3,4
2	Carbohydrates: Introduction and classification carbohydrates. Chemical reaction of monosaccharides: oxidation, reduction, caramelization. Polysaccharides: starch, glycogen, cellulose, gums, pectin, lignins, hemicelluloses. Starch structure, properties and modifications. Pectin types and gel formation mechanism. Structure and functional properties of Gums. Concept of dietary fiber.	10	1,2,3
3	Fats- Classification and structure of fats and fatty acids. Autoxidation of fats and its factors. Mechanism off lipid oxidation and measurement, Photo-oxidation of fats. Antioxidants and pro-	10	1,2,3

	oxidants. Frying and fat changes. Concept of inherent stability of oils, falvor reversion. Fat modification. Emulsions and emulsifiers; hydrophile lipophile balance. Novel oils and fat replacers.		
4	Proteins: Protein structural hierarchy, classifications, sources. Protein denaturation and coagulation, non-enzymatic browning or maillard reaction steps and mechanisms. Functional property of proteins, surface activity, gel formation. Protein characteristics of different foods. Protein hydrolysis and advantages. Enzymes- types and chemical nature, factors influencing enzyme action, enzyme inactivation, coenzymes. Importance of enzymes in food processing.	15	1,2,3,4

Practical:

1. Determination of moisture on dry/wet basis.
2. Determination of protein by Kjeldhal/Lowry method/Bradford method.
3. Estimation of reducing and non-reducing sugars by Anthrone Method.
4. Iodine value, free fatty acids, acid value, peroxide value and rancidity tests for fats and oils.
5. Estimation of crude fat content by Soxhlet method.
6. Determination of total ash, acid soluble and insoluble ash
7. Estimation of total crude fibre and total dietary fibre.
8. Estimation of curcumin in turmeric.
9. pH and Total titratable acidity in food samples
10. Total soluble solids measurement in food samples.

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	-	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	2.0	-	2.0	2.0	3.0	2.0	2.0
CO3	2.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	2.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.3**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**2.0**	**2.5**	**2.5**	**2.3**	**2.0**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Damodaran, S., & Parkin KL. (2017). *Fennema's Food Chemistry*, 5th Edn. CRC Press USA.
2. DeMan, J.M, Finely, J.W., Hurst, W.J., & Lee, C.Y. (2018). *Principles of Food Chemistry, 4th Edn.* Spinger, Switzerland.
3. Potter, N.N., & Hotchkiss, J.H. (2007). *Food Science*. 5th Edn. CBS Publishers.
4. AOAC & Latimer, G.W.J. (2023). *Official Methods of Analysis of AOAC International,* 22nd Edn. AOAC International, USA.
5. Nielson, S.S. (2017). *Food Analysis,* 5th Edn. Spinger.
6. Ranganna, S. (2017). *Hand Book of Analysis and Quality control for fruits and vegetables*. 2nd Edn. McGraw Hill Education.
7. Sadasivam, S, & Manikam, A (2022). *Biochemical Methods*. 4th Edn. New Age International Private Limited, New Delhi.
8. B. Srilakshmi. (2003), *Food Science*, 3rd Edn., New Age International Publications.
9. Meyer, L. H. (2022). *Food Chemistry,* CBS Publishers & Distributors, New Delhi.
10. Vaclavik, V & Elizabeth, C.W (2014). *Essentials of Food Science,* 4th Edn, Spinger.

FOT-103-CC-5130: FOOD MICROBIOLOGY

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding about the role and significance of various categories of microbes.
LO2: To provide knowledge about different environmental & processing factors responsible for food changes.
LO3: Understand the various factors associated with growth, food spoilage and food-borne diseases from the microorganisms.
LO4: To familiarize the students with industrial standards concerning safe food production and the existent national and international systems that ensure food quality.

Course Outcomes:
CO1: Understand the principles involving food spoilage and preservation involving microorganisms.
CO2: Describe the characteristics of food-borne diseases, infections, and intoxications and their identification.
CO3: Demonstrate the use of standard methods and procedures for the microbiological analysis of food.
CO4: Explain different types of industrially important microorganisms and their role in food.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classifications, Procaryotes and Eucaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.	8	1,2
2	Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food products. Microbiology of food preservation, heating process, irradiation, low-temperature storage, chemical preservatives, high-pressure processing, control of water activity.	7	3
3	Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein.	8	3
4	Food microbiology and public health: food poisoning and	7	4

	microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, hurdle technology and its applications.		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	2.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	2.0	3.0	-	2.0	-	2.0	2.0	3.0	3.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.0**	**3.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Instruments of microbiology laboratory and their functions.
2. Preparation of nutrient medium slant, broths.
3. Demonstration of serial dilution method and techniques of isolation and enumeration of microorganisms.
4. To study the effect of temperature, pH and aeration on growth of microorganisms.
5. To demonstrate acid fast staining.
6. To stain the given bacteria by Gram's staining method.
7. To measure the size of given microorganisms by ocular micrometre.
8. To determine the number of microorganisms by Haemocytometer.
9. To determine the motility of bacteria by hanging drop method.
10. Biochemical tests for the micro-organisms.

Books recommended:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication,New Delhi.
2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry,Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants.* Prentice Hall, New Jersey.
6. Frazier, W. C. & Westhoff, D. C. (1995). *Food Microbiology (*4th ed.). TMH, New Delhi

FOT-103-CC-5140: FOOD ENGINEERING

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 hrs per week, **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the physical properties of biomaterials and basic principles of various unit operations in the food industry.

LO2: To provide more in-depth knowledge about momentum, heat and mass transfer and their applications in food processing and engineering.

LO3: To acquire knowledge about size reduction, heat exchanger, and dehydration processes and their application.

LO4: To make the student understand low-temperature processing methods and their importance in food processing.

Course Outcomes:

CO1: Ability to describe the basic physical properties of food materials and able to correlate these properties to process design and quality control during processing.

CO2: Knowledge about the calculation of heat transfer, mass transfer, and momentum analysis for food processing unit operations.

CO3: Understand the problems related to size reduction, and heat exchangers and be able to design evaporators and dehydration systems.

CO4: Acquired details about appropriate refrigerant, estimated freezing time, and able to design a cold storage.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Physical properties of biomaterials and their importance in food processing and its measurement techniques: size, shape, sphericity, volume, density, porosity, surface area, coefficients of friction, and angle of repose. Classification of unit operations and transport processes. Units, Dimensions and conversion. Energy and mass balances: their basic principles and applications in different unit operations.	6	1
2	*Momentum transfer:* Newton's law of viscosity, types of fluid flow, Continuity and Bernoulli equation, Velocity profile of power law fluid, Newtonian and Non-Newtonian fluids, Effect of temperature on viscosity, Viscosity measurement. *Heat transfer:* Fourier's law, conduction heat transfer through slab and cylinder, natural and forced convection, Overall heat transfer coefficient, Radiation: Principles and laws, radiation between two bodies, radiation heat transfer from surroundings. *Mass transfer:* Fick's law, Theories of mass transfer, Mass transfer rate. Analogies among momentum,	8	2

	heat and mass transfer.		
3	Size reduction of solid food: methods and laws, sieve analysis. Filtration, sedimentation and Centrifugation: principles, equipment and application. Mixing of solids and pastes, equipment, applications, mixing effectiveness. Heat exchanger: fouling factors, LMTD concept, Shell and Tube, Plate Heat Exchanger. Types of evaporators, design of single and multi-effect evaporators. Psychrometric chart and its applications. Drying mechanism, Drying rate curves, dehydration systems and equipment design.	9	3
4	Refrigeration: Selection of refrigerant, components of refrigeration system, pressure enthalpy charts. Freezing: Types of freezing systems, Temperature profile of food during freezing, Rate of freezing and Quality of Frozen Food, Calculation of Freezing time. Cryogenic freezing and its application. Thawing and its methods. Design example of a cold store.	7	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	-	1.0	3.0	-	2.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	1.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	1.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.3**	**2.0**	**3.0**	**3.0**	**1.3**	**3.0**	**1.5**	**1.8**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Determination of moisture content of food material on wet and dry basis.
2. Determination of bulk density, tap density, and true density of food materials.
3. Determination of sphericity, porosity, and angle of repose of food materials.
4. Determination of rehydration ratio of dehydrated foods.
5. Estimation of heat transfer co-efficient.
6. Determination of Dry bulb and wet bulb temperature.
7. Moisture sorption isotherm
8. Study of drying kinetics in any food material.

Books recommended:

1. D G Rao 2012. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi
2. Sanjaya K. Dash, Pitam Chandra, Abijit Kar 2024. Food Engineering Principles and Practices. CRC Press, Taylor & Francis Group
3. Romeo T. Toledo 2007. Fundamentals of Food Process Engineering 3rd edition. Springer
4. R. Paul Singh and Dennis R. Heldman 2014. Introduction to Food Engineering 5th edition. Academic Press, Elsevier.
5. P J Fellows 2000. Food Processing Technology, Principles and Practice.
6. KA/PP Publ. Mohsenin NN. 1986. Physical Properties of Plant and Animal Materials.

Gordon & Breach Science Publ.
7. Watson EL & Harper JC.1989. Elements of Food Engineering. AVI Publ.
8. Figura, L.O And Teixeira, A.A. 2007. Food Physics. Springer.
9. Sahin S. and Sumun S.G (2006) Physical Properties of Food . Springer
10. Steffe J. 1996. Rheological Methods in Food Process Engineering. Freeman Press. East Lansing, MI USA.Available Online WWW,egr.msu.edu/~steffe/
11. Rao M.A.; Rizvi, S.S H.; Datta, Ashim K. 2005, Engineering properties of Foods. Taylor & Francis

FOT-103-CC-5150: FOOD SAFETY AND QUALITY ASSURANCE

Credit: 2; **Lecture:** 2 Hrs per week; **Contact Hours:** 30; **Full Marks:** 100

Learning Objectives:

LO1: To create understanding of quality control and assurance, risk assessments, GMPs, and regulations inthe food sector.

LO2: To illustrate the importance of food safety, food quality, food laws and regulations in Food industry.

LO3: To describe the food quality management systems and explain the nationals and international food laws and regulations.

LO4: To exemplify different food adulterants.

Course Outcomes:

The graduates will be able to demonstrate the ability to:

CO1: Describe various aspects of food safety, safety management systems, standards and quality control.

CO2: Explain Sensory/ Organoleptic evaluation -Difference, Preference and Scoring tests.

CO3: Grasp knowledge of the quality assessments of food products.

CO4: Comprehend food quality managements systems and apprehend the Indian and International food laws.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Definition, objectives and scope of food standards and quality assurance, including role of various national and international agencies. Total quality management– general awareness and role of management practices in quality control, concept of HACCP and ISO series and their importance. Plant/food industry sanitation, maintenance sanitary conditions and hygienic practices.	08	1, 4
2	Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Food inspection and safety measurements, food regulations and grades. Statistical analysis in quality control-sampling design of experiments and evaluation of results.	08	1,3
3	Methods of sensory evaluation, introduction to sensory analysis. Sensory evaluation techniques for fresh fruits and vegetable procured products. Food testing: hedonic test, general acceptability tests and other desirable ranking tests of sensory	06	2,3

	evaluation of flavour, aroma, taste, texture, and overall acceptability of food products.		
4	Various food standards and their regulating national and international agencies viz. FSSAI, Codex etc. Methods of quality analysis: Moisture, proteins, carbohydrates, minerals, vitamins, fats, crude fibres and related substances. Raw material and finished products quality assurance: cereals, legumes, oil seeds, fruits and vegetables, laboratory methods for quality control.	08	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	1.0	-	2.0	3.0	-	2.0	-	1.0	3.0	2.0	1.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	1.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**1.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.0**	**2.0**	**2.5**	**2.0**	**2.0**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co. Lucknow.
2. Metha, R. & George, J. (2005). *Food Safety regulation concerns and trade: A DevelopingCountry Perspective.*
3. Pomeranz, Y. & Meloan, R. (1995). *Food Analysis: Theory and Practice:* AVI Publication, NewYork.
4. Askar, A. & Treptow, H. (1993). *Quality assurance in Tropical Fruit Processing.*
5. Mahindru, S. N. (2000). *Food Safety: A Techno-legal Analysis:* Tata Mc, India.

FOT-103-RC-5110: RESEARCH METHODOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 Hr per week; **Contact Hours:** 60 Hr; **Full Marks**: 100

Learning Objectives:

LO1: To help students to formulate well defined hypothesis, aims, objectives for research

LO2: To impart the knowledge of sampling techniques and record scientific data in a proper way.

LO3: To inculcate knowledge of scientific methodology in analyzing and representing research data.

LO4: To provide basic understanding about different statistical methods.

Course Outcomes:

CO1: Problematize, synthesize and articulate issues scientifically and design accurate research proposal.

CO2: Analyze data from various sources, draw valid evidence based conclusions and present complex information in a clear and concise manner to their peers.

CO3: Generate good research hypothesis, design, sampling, appropriate experiments, collect and interpret the data using appropriate statistical methods for experimental validation.

CO4: Understand basics of control chart for variables and for attributes with its application.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Introduction to Research Methodology: An introduction to basics of scientific research: objectives of research, types of research, research process and steps involved. Identification, selection and formulation of research problem. Intellectual property rights. Scientific Report Writing and Publication Process: Forms and types of scientific reports. Steps involved in scientific article writing. Publication process, selection of journals. Writing research proposals and steps involved. Dissertation/Thesis writing: format, content and chapterization. Bibliography and references, referencing styles. Appendices.	15	1
2	Sampling, Data Collection and representation: Sampling: design and types; steps involved in sampling; sampling types, sample size; sampling errors, advantages and limitations. Data types and collection: qualitative and quantitative, data processing. Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion. Application of mean, mode, median, variance, standard deviation	5	1,2
3	Computational Methods for hypothesis testing and Data Analysis: Test of significance: null hypothesis, level of significance and	15	2,3

	degree of freedom, steps involved in testing of hypothesis. Significance testing z-test, t-test for testing sample mean and difference between two means, paired t-test, chi-square test, F-test, analysis of variance. Usage of software packages for data analysis including MS Excel, SPSS, Design Expert, ORIGIN, etc.		
4	Statistical quality control: Introduction, advantages and limitations; Techniques of statistical quality control, control charts for variations, $\bar{x}$ and R chart, control chart for attribution, c chart, p chart, np chart; consumer risk, producer risk; Acceptance quality level (AQL); Lot tolerance percentage quality level (LTPD), process average fraction defective. Operative characteristic curve, simple and double sampling plans for pre-packaged foods.	10	2,4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	3.0	3.0	3.0	-	2.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Kothari, C. K.; Garg, G. *Research Methodology-Methods and Techniques*, 3rd Ed., New Age International, New Delhi, 2014.
2. Kumar, R. *Research Methodology–A Step-By-Step Guide for Beginners*; 2nd Ed., Pearson Education: New Delhi, 2005.
3. Montgomery, D. C. *Design & Analysis of Experiments*; 8th Ed., Wiley India: Noida, 2013.
4. Hubbard M. R. (2005) *Statistical quality control for food industry*, Springer Publishers.
5. Gupta S. C. & Kapoor V. K. (2014) *Fundamentals of Applied Statistics*

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – II

FOT-103-CC-5210: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

To enable the students to:

LO1: Know the structure and composition of cereal grains, pulses and oil seeds

LO2: Learn Post harvest technology and processing of cereals, pulses and oilseeds

LO3: Understand the mechanism of preparation of extruded and fermented products from cereals and pulses

LO4: To know the anti-nutritional factors, present in pulses and methods to remove them

Course Outcomes:

On successful completion of the subject, the students will be able to:

CO1: Comprehend the recent advancement in the quality of major cereal, pulses and oilseed grains.

CO2: Understand the mechanism underlying the interaction of various flour components and their role in end use quality.

CO3: Grasp the basic and advanced milling methods for wheat, rice, maize.

CO4: Know about extraction and refining techniques of oils from oilseeds.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Production and utilization trends of different cereals, pulses and oilseeds; Structure and composition of common cereals, pulses and oil seeds. Wheat: Varieties, principles of milling, products and by-products, flour treatment, dough rheology, Rice-classification, milling, physico-chemical and cooking quality, accelerated ageing, milled rice products and by-product utilization, parboiling of rice and processed products based on rice.	12	1, 2
2	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	2, 3
3	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	1,2, 3

4	Oilseeds: Importance of oilseeds processing industry in India. Pre-conditioning of oilseeds for improving extraction efficiency. Expeller and solvent extraction process and equipment. Principles and methods of filtration of oil. Oil refining and hydrogenation process, utilization of oilseeds.	13	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	1.0	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	1.0	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	1.0	2.0	2.0	3.0
CO4	-	3.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.3**	**3.0**	**3.0**	**2.3**	**3.0**	**2.0**	**1.8**	**2.5**	**2.5**	**2.0**	**2.3**	**2.0**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Determination of physical characteristics of cereals.
2. Milling of wheat into flours.
3. Determination of wet and dry gluten.
4. Parboiling of rice.
5. Determination of crude fibre in wheat flour.
6. Visit to local roller flour mill.
7. Visit to local bakery.
8. Visit to local rice hulling unit.
9. Determination of ash and sugars in flour and bakery products.
10. Cooking quality of rice.

Books recommended:

1. A Chakraverty: Post-harvest Technology of Cereal, pulses and oilseeds
2. Kent NL. 1983. Technology of Cereals. Fourth Edition. Pergamon Press.
3. Kulp K. & Ponte J. G. (2014). Handbook of Cereal Science & Technology, 2nd edition: CRC press.
4. Matz SA. 1969. Cereal Science. AVI Publ.
5. Pomeranz Y. 1987. Modern Cereal Science & Technology. VCH Publ.
6. Wrigley C.W. & Batey I. L. (2010). Cereal grains, assessing and managing quality, CRC press.
7. Dendy D. A. V. & Dobsasoczyk B. J. (2001). Cereal and Cereal Products, Chemistry and Technology: An ASPEN publication.
8. Owens G. (2000). Cereal Processing Technology: CRC Press.
9. Faridi H. & Faubin J. M. (1997). Dough Rheology & Baked product Texture: CBS Publishers.

FOT-103-DE-52010: FOOD NUTRITION AND BIOCHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the concepts of food and nutrition.

LO2: To learn about food groups, RDA, and diet planning steps.

LO3: To familiarize students with the classification of nutrients, and their metabolism in the human body.

LO4: To impart in-depth knowledge about the integration of metabolism, regulation of metabolism, and Interrelationship of nutrients.

Course Outcomes:

CO1: Understand the critical Concepts of Food and Nutrition.

CO2: Acquire knowledge on RDA, and various food groups.

CO3: Understand the fundamental concepts of metabolism and metabolic pathways.

CO4: Comprehend and summarize the interconnection, regulation, and significance of various biochemical reactions in maintaining an adequate nutritional status and health**.**

Course Content:

Unit No.	Content	Contact Hours	CO
1	Concepts of food and nutrition. Role of nutrition in maintaining health. Diet charts, therapeutic nutrition. Basic food groups. Nutritional- Biochemistry. National nutritional policy, Balanced Diet, and RDA for all age groups. Classification of foods. Units of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR	11	1,2
2	Metabolic pathways. Carbohydrates-Aerobic and anaerobic degradation. Hormonal regulations of blood glucose. ATP cycle, formation of ATP- Biological oxidation and electron transport chain-Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain. Significances of enzymes in food metabolism. Enzyme pattern in diseases.	12	3
3	Protein and amino acids. Protein degradation, fate of nitrogen (urea cycle). Protein quality evaluation. Nucleic acids- metabolism of nucleic acid components, biosynthesis of nucleotides. Lipids- Metabolism of triaclyglycerol, β oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies. Oxidative stress and antioxidants. Free radicals	12	3

	and defense against free radicals.		
4	Integration of metabolism. Regulation of metabolism- Interrelationship of carbohydrate, protein and lipid metabolism. Role of Vitamins and Minerals in Metabolism, metabolic adaptation during starvation, exercise, stress and diabetes mellitus. Organ function tests, Water, electrolyte and acid-base balance. Tissue proteins and body fluids	10	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	1.0	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.5**	**1.5**	**2.3**	**2.5**	**2.5**	**2.5**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Calibration of volumetric glassware (Burette, pipette and measuring cylinder).
2. Calculation, preparation of normal, molar and percentage solutions.
3. Determination of Saponification Number
4. Determination of Acid Number
5. Tests for ketone bodıes in urıne by Gerhard test (for acetoacetic acid)
6. Estimation of starch from wheat flour
7. Estimation of lactose from milk
8. Estimation of Glycogen from liver
9. Estimation of Cellulose from plant material

Books recommended:

1. Lehninger, A.L.; Nelson D.L. and Cox. M.M., Principles of Biochemistry 3rd ed. New York. Worth Publishers McMullan Press, 2000
2. Conn & Stump: Outlines of Biochemistry.
3. Davis, I. D. H. (2006). Fundamentals of biochemistry. *Instructor*.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2013). *Fundamentals of biochemistry: life at the molecular level* (No. 577.1 VOE).
5. Champe, P. C., Harvey, R. A., & Ferrier, D. R. (2005). *Biochemistry*. Lippincott Williams & Wilkins.
6. Schowen, R. L. (1993). Principles of biochemistry 2nd ed. (Lehninger, Albert L.; Nelson, David L.; Cox, Michael M.).
7. U, Satyanarayna and U, Chakrapani. Biochemistry with clinical concepts and case studies.

FOT-103-DE-52020: FOOD ADDITIVES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:
To enable the students to:
LO1: Know the role of food additives in the design and innovation of new food ingredients, products and processes.
LO2: Study the classification of food additives.
LO3: Know the toxicological legislation aspects of additives.
LO4: Know the role of natural and synthetic preservatives and other additives

Course Outcomes:
On successful completion of the subject, the students should:
CO1: Understand the role of food additives in the design and innovation of new innovative value added products.
CO2: Understand the general aspects of the use of additives and processing aids such as definitions and classification.
CO3: Know toxicological studies required for the authorization of additives and use of legal criteria and safety aspects.
CO4: Know the health implication of natural and artificial food additives.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to Food Additives; Scope of food additives; Functions and uses of Food Additives; Classification- Intentional & Unintentional Food additives; Types of food additives, their toxicology and safety evaluation; Naturally occurring food additives.	12	1, 2,3
2	Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial colours), pigments, their importance and utilization as food color; Processing of natural and artificial food colorants. Food Preservatives: Classification- Natural & chemical preservatives; Mode of action. Antioxidants & chelating agents: Types of antioxidants -natural & synthetic; Mode of action of antioxidants in foods; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents.	10	2,4
3	Stabilizers, thickeners and Emulsifiers: Types; Applications in food processing; Sweeteners: Introduction; Classification-	10	1,2, 3

	Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role of sweeteners in food processing. Flour bleaching & maturing agents; leavening agents; Acidity regulators.		
4	Taste and Flavoring agents: Classification of flavors- natural & synthetic; Flavor enhancer/ Potentatior; Importance of taste and flavours; Role of flavoring agents in food processing. Humectants/polyhydric alcohol, anticaking agent, firming agent; Starch modifiers; Antimicrobial agents, Clarifying agents, antifoaming agents, Fat mimetics and replacers.	13	2,3

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	1.0	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.5**	**2.0**	**3.0**	**2.5**	**1.5**	**2.0**	**2.5**	**2.5**	**2.0**	**1.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. E numbers of different food additives
2. Qualitative tests for presence of benzoic acid in foods
3. Qualitative test for presence of sulphurous acid in foods
4. Determination of total chlorophyll by spectrophotometric method
5. Study of effect of acidulants in fruit juices
6. Study of the effect of stabilizers/ thickeners on quality of foods
7. Study of the effect of clarifying agents on the fruit juices
8. Role of emulsifiers in foods
9. Role of leavening agents in baked food products
10. Role and mode of action of antioxidants in food products

Books Recommended

1. Belitz, H.D. Grosch W. and Schieberle. P. 2009. Food Chemistry. 4th Edition. Springer-Verlag, Berlin, Heidelberg.
2. Mahindru, S.N. 2008. Food Additives: Characteristics, Detection and Estimation. Aph Publishing Corporation, New Delhi.
3. Deshpande, S.S. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland.

FOT-103-DE-52030: ADVANCE ANALYTICAL TECHNIQUES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory100 + Practical 100)

Learning Objectives:

LO1: To develop an understanding about the advanced analytical and instrumental techniques.

LO2: To illustrate the principle and mechanism of different analytical instruments.

LO3: To illustrate applications of different analytical instruments for food analysis.

LO4: To describe bio-chemical analysis of food components.

Course Outcomes:

CO1: Explain theoretical aspects of important analytical techniques used in food analysis.

CO2: Describe the physical and chemical principles which underlie instrumental techniques for testing and analysing food raw materials and finished products

CO3: Select appropriate analytical techniques for specific food constituent analysis.

CO4: Compare advanced and conventional techniques and instruments to analyse chemical and physical properties of foods.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Microscopic techniques: History, Basics of Light microscopy, concept of resolution in microscope. Principles, instrumentation, advantages limitations and application of different light microscopic techniques. Electron microscopy: principle of working and advantages and limitations. Applications in evaluating food microstructures and others. Color measurement systems in food applications. Texture and rheology: Introduction, Definition/s and importance Application of texture analyser in food texture evaluation.	10	1,2,3
2	Spectroscopy: Principles of colorimetry and UV-VIS spectrophotometry. Instrumentation and working of colorimeter and spectrophotometer. Concept of Absorbance and transmittance. Beers and Lambert's Law; Extinction coefficient. Fluorescence and phosphorescence spectroscopy. Infrared Spectroscopy: Fourier transform infrared (FTIR) and FTIR-ATR spectroscopy instrumentation and working principle. Application of IR spectroscopy in food analysis. Atomic absorption spectroscopy principles, instrumentation and applications.	10	1,2,3,4
3	Chromatographic techniques, adsorption and partition, theory of chromatographic separation, distribution coefficient, retention factor. Types of chromatographic techniques and working principles: HPLC, Size-exclusion, Ion Exchange, Affinity chromatography etc. Instrumentation for HPLC and GC: columns, pumps, detectors, techniques and applications. Concept of theoretical plates, retention time, separation efficiency,	10	1,2,3,4

	resolution and applications.		
4	Electrophoretic Techniques: General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis. Thermal techniques in food analysis, principles, instrumentation and application of Differential scanning calorimetry (DSC), Thermo-gravimetric analysis (TGA) and Bomb calorimetry in food analysis.	15	1,2,3,4

Practical:

1. Determination of food adulterants in given food samples.
2. Refractive index of oil by using Abbe's Refractometer.
3. Determination of water activity of given a food product.
4. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
5. Texture profile analysis of foods samples.
6. Estimation of Ascorbic Acid content in given food samples by HPLC/ Dye method.
7. Mineral profile analysis of food samples by Atomic Absorption Spectroscopy/chemical method.
8. Qualitative and quantitative analysis of amino acids/plant pigments by paper chromatography
9. Estimation of colour of different food products using Hunter colour Lab.
10. Determination of antioxidant activity of given food sample using HPLC.
11. Morphological characteristics of Food Samples using Light microscopy/SEM/TEM.

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	3.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	2.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**2.7**	**2.5**	**2.0**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Cruz, R.M.S., Khmelinskii, I, & Viera. (2014). *Methods in Food Analysis.*1st Edn. CRC press.
2. Pico, Y. (2012). *Chemical Analysis of Food: Techniques and Applications*. Academic Press.
3. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier.
4. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* 3rd Edn., Spinger.
5. Winton, A. L. (2001). *Techniques of Food Analysis:* Agrobios, Jodhpur.
6. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.

7. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
8. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons

FOT-103-DE-52040: MEAT, FISH AND POULTRY PROCESSING

Credit: 4; **Lecture:** 3 Hrs per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To describe the muscle composition, structure and properties of meat muscle.

LO2: To explain the structural changes that take place post-mortem during conversion of muscle to meat.

LO3: To illustrate the manufacture and handling of meat and fish products and to assess the factors that affects the safety and quality of meat products.

LO4: To describe the manufacture and handling of egg and poultry products and to assess the factors that affects the safety and quality of poultry products.

Course Outcomes:

CO1: Understand the muscle composition, structure and properties of muscle meat.

CO2: Apply the process of manufacturing of various value added meat, poultry and products.

CO3: Inculcate the process of manufacturing of various value added fish products.

CO4: Learn about the various food standards in relation to meat, fish, poultry and egg.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Muscle structures and composition, conversion of muscle into meat. Meat composition from different sources. Pre-Slaughtering practices and methods. Ante and post-mortem inspection and grading of meat. Quality of meat. Plant layout, design and construction of an abattoir. Meat Microbiology and safety.	11	1,2
2	Meat tenderization. Processing and preservation of meat. Thermal processing and non- thermal processing. Meat Products - uncooked comminuted and restructured meat products, sausages, meat emulsions, dried meats, intermediate moisture meats and meat extracts, ready to eat (RTE) meat products. Packaging of meat products. Meat plant hygiene – GMP and HACCP. By product utilization	12	2
3	Fish classification and composition. Post mortem changes in fish muscle. Fish products processing. By product utilization. Quality control of processed fish. Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish , Freezing of fish and shell fish. Commercially important marine products from India	12	3
4	Poultry types and classes. Classification of chickens. Nutritive value and composition of poultry meat. Methods of slaughtering, slaughtering equipment and operations, dressing, handling,	10	2,4

	storage. Preservation of poultry meat. Spoilage and its control. Egg: structure and composition, Quality evaluation of shell eggs. Egg processing, Spoilage and its control. Packaging of egg and egg products. FSSAI guidelines on FSMS compliance for meat and meat product		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	1.0	1.0	1.0	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	1.0	2.0	2.0
CO3	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	-	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.0**	**2.0**	**2.7**	**2.0**	**1.5**	**2.0**	**2.5**	**2.5**	**1.8**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Fish cutting and handling.
2. Dressing of poultry.
3. Study of external anatomy/body parts of cattle, buffalo, sheep and goat
4. Determination of water holding capacity of meat
5. Carcass inspection for detection the efficiency of bleeding
6. Blotting paper test
7. Determination of glycogen in meat
8. Dehydration of meat
9. Quality evaluation of egg
10. Preparation of fish pickle

Books recommended:

1. Mead G. (2004) *Poultry Meat Processing and Quality,* Woodhead Publishers.
2. Panda P. C. (1992) *Text Book on Egg and Poultry Technology*, Vikas Publishers.
3. Hui Y. H. (2012) *Handbook of meat & meat processing, 2nd Edition,* CRS Press.
4. Gracey JF. 1999. Thornton's Meat hygiene. 11th Ed. WB Saunders.
5. Stadelman W & Cotterill OJ. 2002. Eggs Science and Technology. 4th Ed. CBS.
6. Mountney GJ. Poultry Products Technology. 2nd Ed. AVI Publ.
7. Elton D. Aberle, John C. Forrest, David E. Gerrard, Edward W. Mills (2012). Principles of Meat Science, 5th Ed. Kendall Hunt Publishing Company.
8. Sharma, B.D. Outlines of Meat Science and Technology, (2011). Jaypee Brothers Medical Publishers.

FOT-103-DE-52050: ADVANCES IN FOOD PROCESSING TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Contact Hours:** 45; **Tutorials:** 1 Hr per week; **Contact Hours:** 15; **Full Marks:** 100

Learning Objectives*:*

To enable the students to:

LO1: To familiarize students with various advanced thermal processing methods.

LO2: To acquaint students with the emerging non-thermal technologies.

LO3: To describe the principles and working mechanism of electromagnetic radiation-based techniques.

LO4: To describe the process mechanism and application of advance extraction and dehydration processes.

Course Outcomes:

On completion of the course the students would be able to:

CO1: Ability to explain various novel thermal and non-thermal emerging technologies that can be applied to food processing for quality improvement of the processed foods.

CO2: Student can be able to explain the advantages and limitations of the emerging food processing technologies and methods to overcome the limitations.

CO3: Ability to develop ideas for research and development using the advanced food processing technologies.

CO4: Ability to explore the application of advanced hybrid drying technique to produced quality processed products.

Course Content:

Unit No.	Content	Contact Hours	CO
1	**Pulsed Electric Field Technology (PEFT)**: Definitions, Pulsed electric field treatment system, Microbial inactivation mechanism, Determinant factors in PEFT, Alternative applications of PEFT. **Food Irradiation**: Mechanisms, sources and applications of Food Irradiation. Beneficial chemical and biological effects of Irradiation on Foods. Safety of Irradiated Foods. Benefits of Food Irradiation, Consumer attitudes toward irradiated foods, Government regulations on irradiated foods.	10	1,2,3
2	**High-Pressure Processing (HPP)**: Principles and process, Packaging requirements, Microorganisms and enzymes inhibition in HPP, Effects of HPP on Food Quality, Other application. **Cold plasma (CP) processing**: The chemistry of CP, Categories of CP	13	1,2

	Technologies, Types of CP generator, microbial inactivation mechanism, application and Economics of CP. **Ultrasound processing**: The physics and chemistry of ultrasound, processing equipment, inactivation of microorganisms and enzymes, Ultrasound as a processing aid.		
3	**Microwave (MW) heating**: Heating mechanism, MW properties of foods, equipment, comparison of MW and convectional heating, benefits and application of MW heating in food Industry. **Radio-Frequency (RF) Processing**: Principle of RF heating, Dielectric Properties of foods at RF, RF Generators and Applicators, Differences between RFs and MWs, applications of RF. **Ohmic heating:** Fundamentals of ohmic heating, Electrical conductivity, Generic Configurations, application of Ohmic heating.	12	3,4
4	**Supercritical fluid extraction:** Principle, equipment and process description, application in food processing, constraints in Supercritical fluid extraction processing. **Superheated steam drying:** Basic principle, types, inversion temperature, advantages and disadvantages. **Recent advances in Hybrid drying technologies:** classification, key advantages and limitation, Electromagnetic radiation-based hybrid drying techniques.	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	3.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	1.0	1.0
CO4	1.0	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**2.0**	**2.0**	**2.7**	**2.5**	**1.5**	**2.7**	**2.5**	**2.5**	**2.3**	**1.7**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Barry G. S. and Özlem T. *Improving Food Quality with Novel Food Processing Technologies,* (CRC Press, 2018)
2. DA-WEN SUN. *Emerging Technologies for Food Processing,* (Academic Press, 2014).
3. Tadeusz Kudra and Arun S. Mujumdar. *Advanced Drying Technologies,* (CRC Press, 2009 2nd edition).
4. P.J. Cullen, Brijesh K. Tiwari, and Vasilis P. Valdramidis. *Novel Thermal and Non-Thermal Technologies for Fluid Foods*, (Academic Press, 2012)

FOT-103-DE-52060: NEW PRODUCT DEVELOPMENT

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To understand the process of development of new food product.

LO2: To understand the role of research and development in food product development and food manufacture.

LO3: To development of new food product, which are nutritious, cost effective and marketable.

LO4: To acquired knowledge on quality, safety & regulatory aspects of new food product.

Course Outcomes:

CO1: Design new products using need based perspective and application.

CO2: Develop standards for new products.

CO3: Understand phases in food product development.

CO4: Formulate regulatory aspects on Intellectual property rights.

Course Content:

Unit No.	Content	Contact Hours	CO
1	New Food Products: Definition, Classification, characterization and factors shaping new product development. Nutritive value of foods. Food needs and consumer preference. Use of Ready Reckoners /Exchange list/ NIN Food database/ USDA Food Database. Product life cycle. The SWOT analysis.	15	1
2	Designing new products. Market-oriented NPD methodologies, use of novel food ingredients and novel processing technologies. Recipe development for infants, preschool, sports person, elderly, Selection of raw materials, portion size, standardization methods, calculation of nutritive values, cost production, shelf life. Food safety and food spoilage.	15	2, 3
3	Standardization and large- scale preparation. Brief introduction of phases in food product development. Developing standards products- various food ingredients used, use of additives. Sensory Evaluation Test – Designing score card, objective evaluation, Instruments used for texture evaluation.	15	2,3
4	Quality, safety & regulatory aspects. Developing packaging systems. Approval for Proprietary Product. Evaluation of the Launch, product performance testing. Developing test market strategies. Patent, patent laws, international code for Intellectual property rights (IPR). Storage and transportation. Role of government in promoting agricultural marketing.	15	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	2.0	2.0	3.0	-	1.0	2.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.0**	**2.3**	**1.7**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Book recommended:

1. Jacqueline H. Beckley, M. Michele Foley Elizabeth J. Topp &_J. C. Huang Witoon Prinyawiwatkul (2007). Accelerating New Food Product Design and Development. Blackwell Publishing Company. IFT Press. USA
2. Howard R. Moskowitz, I. Sam Saguy & Tim Straus (2009). An Integrated Approach to New Food Product Development. Taylor and Francis Group, LLC.USA
3. Mary Earle and Richard Earle (2008). Case studies in food product development Wood head Publishing Limited and CRC Press LLC.USA
4. Creating New Foods. The Product Developer's Guide: Marie D. Earle and Richard L. Earle (2001). Chadwick House Group Ltd. New Zeeland.
5. David H. Lyon, Mariko A. Francombe, Terry A. Hasdell and Ken Lawson (1992). Guidelines for sensory analysis in food product development and quality control. Chapman & Hall, 2-6 Boundary Row, London.

FOT-103-RC-5210: RESEARCH PUBLICATION ETHICS

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To help students understand the philosophy of research and ethics in scientific research.

LO2: Familiarise with plagiarism and the scientific misconduct in research activity.

LO3: Get familiar with publication Misconduct and predatory journals and publishers.

LO4: Get informed about the open access publishing and understand the publishing databases and research metrics.

Course Outcomes:

On completion of this course the students will be able to:

CO1: Learn about philosophy of research and publication ethics.

CO2: Understand the scientific misconduct in research.

CO3: Learn publication misconduct and able to identify predatory journals.

CO4: Become aware of the open access publishing and learn about publication database and research metrics

Unit No.	Content	Contact Hours	CO
1	Introduction to Philosophy: definition, nature and scope, concept, branches**.** Ethics: Definition, moral philosophy, nature of moral judgments and reactions. Common characteristics of ethical problems in social research. Ethics in Scientific Research: issues of authorship, criteria for authorship and contributorship, peer review's role, research ethics in human and animal subjects, research ethics committees, conflict of interest.	15	1, 2
2	Scientific Misconduct: Falsification, Fabrication, and Image Manipulation. Institutional Responses to Scientific Misconduct, Misconduct in Regulated Research. Plagiarism, main sources and its types. Redundant Publications, redundant authorship, Problems caused by redundant publication, Acceptability and consequences of redundancy, prevention of redundancy, Salami Slicing and its parameters, Misrepresentation of Data.	15	1,2,4
3	Publication ethics: introduction and importance. Function and guidelines of COPE, WAME etc. Publication Misconduct: Misconduct by Editors, Publishers, and Peer-Reviewers, Types of Publication Misconduct, Violation of Publication Ethics, Concept	15	3,4

	of Spin, Predatory Publishers and Journals and their criteria for identification of predatory journals and publishers.		
4	Open Access Publishing, its merits and demerits. Benefits of Open Educational Resources for learners and teachers, Gray Literature, Preprint and Other Modes, Access tools and services to Open Access, Elsevier Journal Finder, Springer Journal Suggester. Database and its types, Citation databases: Web of Science, Scopus, Research Gate, Google Scholar. Calculation of Journal Impact Factor, Immediacy Index, h-Index and i-10 index, Altmetrics, Indian Citation Index.	15	1,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	3.0	2.0	-	-	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	2.0	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.5**	**3.0**	**2.0**	**2.7**	**2.5**	**1.7**	**2.5**	**2.5**	**2.5**	**2.3**	**2.3**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books Recommended

1. MacIntyre, A., *A Short History of Ethics: A History of Moral Philosophy from the Homeric Age to the 20th Century*; 2nd Ed., Routledge: London, U.K., 1998.
2. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. *On Being a Scientist: A Guide to Responsible Conduct in Research*; 3rd Ed., The National Academic Press: Washington DC, USA, 2009.
3. Muralidhar, K.; Ghosh. A.; Singhvi, A. K., Eds. *Ethics in Science Education, Research and Governance*; Indian National Science Academy: New Delhi, India, 2019.
4. Yadav, Santosh Kumkar. 2000. Research and Publications Ethics. Ishwar Books.
5. Deakin, L. (2014). Best practice guidelines on publishing ethics: A publisher's perspective. Wiley.

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – III & IV (RESEARCH)

FOT-103-RP-6110: DISSERTATION/RESEARCH THESIS/INDUSTRIAL PROJECT

Credit: 40; **Contact Hours:** 1200; **Full Marks:** 100

Learning Objectives*:*

This course is designed to enable students to:

LO1: Identify and discuss the role and importance of research in Food Technology.

LO2: Identify and discuss the issues and concepts salient to the research process.

LO3: Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

LO4: Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.

Course Outcomes:

On completion the participants should be able to:

CO1: Carry out a substantial research-based project

CO2: Demonstrate an understanding of the ethical issues associated with practitioner research

CO3: Analyse data and report research findings in written and verbal forms

CO4: Use research findings to advance education theory and practice.

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	3.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	1.0	1.0
CO4	1.0	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**2.0**	**2.0**	**2.7**	**2.5**	**1.5**	**2.7**	**2.5**	**2.5**	**2.3**	**1.7**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Course Structure for PG Diploma in Food Technology
(Programme Code: FOT-1103) /
Two Year M. Sc. in Food Technology with Coursework and Research
(Programme Code: FOT-3103)

NCRF Credit Level	Semester	Core Papers (Core Course/Elective/Course Work)	Course Level	Credit	Total Credit	Credit Distribution	Max. Marks (Theory)			Max. Marks (Practical)			Contact Hours
		Course Name				L:T:P	Internal	End Sem	Total	Internal	End Sem	Total	
6	Sem-I	FOT-103-CC-5110-Principles of Food Processing and Preservation	400	3	20	2:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5120-Food Chemistry	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5130-Food Microbiology	400	3		2:0:1	20	80	100	20	80	100	60
		FOT-103-CC-5140-Food Engineering	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5150-Food Safety and Quality Assurance	400	2		2:0:0	20	80	100	-	-	-	30
		FOT-103-RC-5110-Research Methodology/ MOOCS or SWAYAM equivalent	500	4		3:1:0	20	80	100	-	-	-	45
	Sem -II	FOT-103-CC-5210-Technology of Cereals, Pulses and Oilseeds	400	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52010-Food Nutrition and Biochemistry (Elective-I)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52020-Food Additives (Elective-I)											
		FOT-103-DE-52030-Advance Analytical Techniques (Elective-II)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52040-Meat, Fish and Poultry Processing (Elective-II)											
		FOT-103-DE-52050-Advances in Food Processing Technology (Elective-III)	500	4		3:1:0	20	80	100	-	-	-	45
		FOT-103-DE-52060-New Product Development (Elective-III)											
		FOT-103-RC-5210-Research Publication Ethics/ MOOCS or SWAYAM equivalent	400	4		4:0:0	20	80	100	-	-	-	45
Total Credit (First Year)					**40**								
Exit option with Post-Graduate Diploma in Food Technology on completion of courses equal to a minimum of 40 credits or Entry to One Year M. Sc. in Food Technology with Coursework													
6.5	Sem- III	FOT-103-CW-61010-Food Packaging (Coursework 1)	500	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61020-Processing of Fruits and Vegetables (Coursework 2)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61030-Dairy Technology (Coursework 3)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61040-Bakery and Confectionery Technology (Coursework 4)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61050-Nutraceuticals and Functional Foods (Coursework 5)	500	4		4:0:0	20	80	100	-	-	-	60
	Sem-IV	FOT-103-RP-6210-Dissertation/ Research Thesis/ Industrial Project	500	20	**20**	0:0:20	-	-	-	-	-	100	600
Total Credit (Aggregate)					**80**								
Post-Graduate Degree in Food Technology with Coursework on completion of courses equal to a minimum of 80 credits													

SEMESTER – I

FOT-103-CC-5110: PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 hrs per week, **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To know the different spoilage agents and the ways in which they act on food.
LO2: To understand the principles behind the various methods of food preservation.
LO3: To know how to use these principles to preserve different types of foods.
LO4: To study the method of action of different preservatives.

Course Outcomes:

CO1: Students will be able to know various food preservation techniques, including thermal, non-thermal processing and fermentation and other advance technology.
CO2: Understanding the advance methods of processing and preservation in industries.
CO3: Critical analysis of preservation methods based on efficacy and sustainability.
CO4: Learners could know the applications of preservation principles in real-world food industry settings.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Food Spoilage: Definition, types of spoilage - physical, enzymatic, chemical and biological spoilage. Mechanism of spoilage and its end products, shelf life determination. Sorting, Grading, Washing, Peeling, Cutting.	7	1, 3
2	Preservation by using Preservatives: Food preservation: Definition, principles, importance of food preservation, traditional and modern methods of food preservation. Food additives – definition, types, Class I and Class II preservatives.	7	3, 4
3	Preservation by use of high temperature: Pasteurization: Definition, types, Sterilization, Canning - history and steps involved, spoilage encountered in canned foods, types of containers used for canning foods. Drying, Dehydration, Food irradiation – Principles, merits and demerits, effects of irradiation and photochemical methods.	8	1,2,3

4	Preservation by use of Low Temperature: Refrigeration - advantages and disadvantages, freezing: Types of freezing, common spoilages occurring during freezing, difference between refrigeration, freezing, chilling. Water activity, Intermediate moisture foods.	8	2,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	2.0	2.0	1.0	-	3.0
CO2	2.0	3.0	3.0	-	2.0	3.0	-	1.0	-	3.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	2.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	3.0	3.0
Average	**2.7**	**2.7**	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.5**	**2.3**	**3.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practicals:

1. Blanching of fresh fruits/vegetables.
2. Performing lye peeling for vegetables.
3. Determination of PPO and POD enzyme activity.
4. Determination of water activity in food products.
5. Drying of different local food products by sun, shade and tray drying.
6. Freeze drying of foods.
7. Osmotic dehydration of foods.
8. Retort processing of fruits/vegetable products.

Books recommended:

1. Desrosier (2006). The Technology of Food Preservation, 4th edition, CBS Publishers & Distributers, New Delhi.
2. Potter and HotchKiss (2006). Food Science, 5th edition, CBS Publishers & Distributers, New Delhi.
3. Zueth (2005). Food Preservation Techniques, CBS Publishers & Distributers, New Delhi.
4. Non-destructive Evaluation of Food Quality: Theory and Practice (2010) Jha, Shyam N. (Ed.) Springer.
5. Manay, N. S., & Shadaksharaswamy M. (2002). Foods, facts and principles (second edition). New age international publishers, New Delhi.
6. Fellows, P. (2004). Food processing Technology: Principles & Practices, 2nd edition, CRC Press USA.

7. Bhat R, Alias AK, and Paliyath G. 2012. Progress in Food Preservation. First Edition. Wiley-Blackwell.
8. Food Processing Principle and Application by HS Ramaswamy and M Marcotte.Taylor and Francis (2006).
9. Food Science: Research and Technology by AK Haghi. Apple Academic Press(2011).
10. Handbook of Food Process Equipment by G Saravakos and AK Kostaropoulos.Springer (2016).
11. Frazier, W. C. & Westhoff, D. C. (1996). *Food Microbiology*, Tata McGraw Hill and Co.

FOT-103-CC-5120: FOOD CHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding of structure and reactions and functional properties of the different food constituents

LO2: Students will understand the functional properties of different food constituents.

LO3: Students will learn the fundamentals of chemical processes and their significance with respect to food processing and preservation.

LO4: To provide conceptual understanding of utilizing food constituents and their modifications for food applications.

Course Outcomes:

CO1: Understand chemical properties of food components (water, carbohydrates, proteins, lipids, vitamins, minerals, and pigments).

CO2: To relate properties and structures of chemical constituents in foods to their functional and chemical properties.

CO3: To relate the physical and chemical interaction between food constituents during processing and their impact on final quality.

CO4: To understand the importance and role of chemistry in preservation/shelf- life.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Definition of food chemistry, historic development of food chemistry. Approach to the study of food chemistry. Water in food, Physical properties and structure of ice and water. Colligative properties of aqueous solutions. Concept of water activity, moisture sorption isotherms, phase diagram, ice crystal growth. Relation of water activity and food preservation. Vitamins and minerals: Importance, functions and impact upon processing. Plant pigments, structure and impact upon processing.	10	1,2,3,4
2	Carbohydrates: Introduction and classification carbohydrates. Chemical reaction of monosaccharides: oxidation, reduction, caramelization. Polysaccharides: starch, glycogen, cellulose, gums, pectin, lignins, hemicelluloses. Starch structure, properties and modifications. Pectin types and gel formation mechanism. Structure and functional properties of Gums. Concept of dietary fiber.	10	1,2,3

3	Fats- Classification and structure of fats and fatty acids. Autoxidation of fats and its factors. Mechanism off lipid oxidation and measurement, Photo-oxidation of fats. Antioxidants and pro-oxidants. Frying and fat changes. Concept of inherent stability of oils, falvor reversion. Fat modification. Emulsions and emulsifiers; hydrophile lipophile balance. Novel oils and fat replacers.	10	1,2,3
4	Proteins: Protein structural hierarchy, classifications, sources. Protein denaturation and coagulation, non-enzymatic browning or maillard reaction steps and mechanisms. Functional property of proteins, surface activity, gel formation. Protein characteristics of different foods. Protein hydrolysis and advantages. Enzymes- types and chemical nature, factors influencing enzyme action, enzyme inactivation, coenzymes. Importance of enzymes in food processing.	15	1,2,3,4

Practical:

1. Determination of moisture on dry/wet basis.
2. Determination of protein by Kjeldhal/Lowry method/Bradford method.
3. Estimation of reducing and non-reducing sugars by Anthrone Method.
4. Iodine value, free fatty acids, acid value, peroxide value and rancidity tests for fats and oils.
5. Estimation of crude fat content by Soxhlet method.
6. Determination of total ash, acid soluble and insoluble ash
7. Estimation of total crude fibre and total dietary fibre.
8. Estimation of curcumin in turmeric.
9. pH and Total titratable acidity in food samples
10. Total soluble solids measurement in food samples.

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	-	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	2.0	-	2.0	2.0	3.0	2.0	2.0
CO3	2.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	2.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.3**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**2.0**	**2.5**	**2.5**	**2.3**	**2.0**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Damodaran, S., & Parkin KL. (2017). *Fennema's Food Chemistry*, 5th Edn. CRC Press USA.
2. DeMan, J.M, Finely, J.W., Hurst, W.J., & Lee, C.Y. (2018). *Principles of Food Chemistry, 4th Edn.* Spinger, Switzerland.
3. Potter, N.N., & Hotchkiss, J.H. (2007). *Food Science*. 5th Edn. CBS Publishers.

4. AOAC & Latimer, G.W.J. (2023). *Official Methods of Analysis of AOAC International,* 22nd Edn. AOAC International, USA.
5. Nielson, S.S. (2017). *Food Analysis,* 5th Edn. Spinger.
6. Ranganna, S. (2017). *Hand Book of Analysis and Quality control for fruits and vegetables*. 2nd Edn. McGraw Hill Education.
7. Sadasivam, S, & Manikam, A (2022). *Biochemical Methods*. 4th Edn. New Age International Private Limited, New Delhi.
8. B. Srilakshmi. (2003), *Food Science*, 3rd Edn., New Age International Publications.
9. Meyer, L. H. (2022). *Food Chemistry,* CBS Publishers & Distributors, New Delhi.
10. Vaclavik, V & Elizabeth, C.W (2014). *Essentials of Food Science,* 4th Edn, Spinger.

FOT-103-CC-5130: FOOD MICROBIOLOGY

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding about the role and significance of various categories of microbes.
LO2: To provide knowledge about different environmental & processing factors responsible for food changes.
LO3: Understand the various factors associated with growth, food spoilage and food-borne diseases from the microorganisms.
LO4: To familiarize the students with industrial standards concerning safe food production and the existent national and international systems that ensure food quality.

Course Outcomes:
CO1: Understand the principles involving food spoilage and preservation involving microorganisms.
CO2: Describe the characteristics of food-borne diseases, infections, and intoxications and their identification.
CO3: Demonstrate the use of standard methods and procedures for the microbiological analysis of food.
CO4: Explain different types of industrially important microorganisms and their role in food.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classifications, Procaryotes and Eucaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.	8	1,2
2	Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food products. Microbiology of food preservation, heating process, irradiation, low-temperature storage, chemical preservatives, high-pressure processing, control of water activity.	7	3
3	Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein.	8	3
4	Food microbiology and public health: food poisoning and	7	4

	microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, hurdle technology and its applications.		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	2.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	2.0	3.0	-	2.0	-	2.0	2.0	3.0	3.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.0**	**3.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Instruments of microbiology laboratory and their functions.
2. Preparation of nutrient medium slant, broths.
3. Demonstration of serial dilution method and techniques of isolation and enumeration of microorganisms.
4. To study the effect of temperature, pH and aeration on growth of microorganisms.
5. To demonstrate acid fast staining.
6. To stain the given bacteria by Gram's staining method.
7. To measure the size of given microorganisms by ocular micrometre.
8. To determine the number of microorganisms by Haemocytometer.
9. To determine the motility of bacteria by hanging drop method.
10. Biochemical tests for the micro-organisms.

Books recommended:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication,New Delhi.
2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry,Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants.* Prentice Hall, New Jersey.
6. Frazier, W. C. & Westhoff, D. C. (1995). *Food Microbiology (*4th ed.). TMH, New Delhi

FOT-103-CC-5140: FOOD ENGINEERING

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 hrs per week, **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the physical properties of biomaterials and basic principles of various unit operations in the food industry.

LO2: To provide more in-depth knowledge about momentum, heat and mass transfer and their applications in food processing and engineering.

LO3: To acquire knowledge about size reduction, heat exchanger, and dehydration processes and their application.

LO4: To make the student understand low-temperature processing methods and their importance in food processing.

Course Outcomes:

CO1: Ability to describe the basic physical properties of food materials and able to correlate these properties to process design and quality control during processing.

CO2: Knowledge about the calculation of heat transfer, mass transfer, and momentum analysis for food processing unit operations.

CO3: Understand the problems related to size reduction, and heat exchangers and be able to design evaporators and dehydration systems.

CO4: Acquired details about appropriate refrigerant, estimated freezing time, and able to design a cold storage.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Physical properties of biomaterials and their importance in food processing and its measurement techniques: size, shape, sphericity, volume, density, porosity, surface area, coefficients of friction, and angle of repose. Classification of unit operations and transport processes. Units, Dimensions and conversion. Energy and mass balances: their basic principles and applications in different unit operations.	6	1
2	*Momentum transfer:* Newton's law of viscosity, types of fluid flow, Continuity and Bernoulli equation, Velocity profile of power law fluid, Newtonian and Non-Newtonian fluids, Effect of temperature on viscosity, Viscosity measurement. *Heat transfer:* Fourier's law, conduction heat transfer through slab and cylinder, natural and forced convection, Overall heat transfer coefficient, Radiation: Principles and laws, radiation between two bodies, radiation heat transfer from surroundings. *Mass transfer:* Fick's law, Theories of	8	2

	mass transfer, Mass transfer rate. Analogies among momentum, heat and mass transfer.		
3	Size reduction of solid food: methods and laws, sieve analysis. Filtration, sedimentation and Centrifugation: principles, equipment and application. Mixing of solids and pastes, equipment, applications, mixing effectiveness. Heat exchanger: fouling factors, LMTD concept, Shell and Tube, Plate Heat Exchanger. Types of evaporators, design of single and multi-effect evaporators. Psychrometric chart and its applications. Drying mechanism, Drying rate curves, dehydration systems and equipment design.	9	3
4	Refrigeration: Selection of refrigerant, components of refrigeration system, pressure enthalpy charts. Freezing: Types of freezing systems, Temperature profile of food during freezing, Rate of freezing and Quality of Frozen Food, Calculation of Freezing time. Cryogenic freezing and its application. Thawing and its methods. Design example of a cold store.	7	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	-	1.0	3.0	-	2.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	1.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	1.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.3**	**2.0**	**3.0**	**3.0**	**1.3**	**3.0**	**1.5**	**1.8**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Determination of moisture content of food material on wet and dry basis.
2. Determination of bulk density, tap density, and true density of food materials.
3. Determination of sphericity, porosity, and angle of repose of food materials.
4. Determination of rehydration ratio of dehydrated foods.
5. Estimation of heat transfer co-efficient.
6. Determination of Dry bulb and wet bulb temperature.
7. Moisture sorption isotherm
8. Study of drying kinetics in any food material.

Books recommended:

1. D G Rao 2012. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi
2. Sanjaya K. Dash, Pitam Chandra, Abijit Kar 2024. Food Engineering Principles and Practices. CRC Press, Taylor & Francis Group
3. Romeo T. Toledo 2007. Fundamentals of Food Process Engineering 3rd edition. Springer
4. R. Paul Singh and Dennis R. Heldman 2014. Introduction to Food Engineering 5th edition. Academic Press, Elsevier.

5. P J Fellows 2000. Food Processing Technology, Principles and Practice.
6. KA/PP Publ. Mohsenin NN. 1986. Physical Properties of Plant and Animal Materials. Gordon & Breach Science Publ.
7. Watson EL & Harper JC.1989. Elements of Food Engineering. AVI Publ.
8. Figura, L.O And Teixeira, A.A. 2007. Food Physics. Springer.
9. Sahin S. and Sumun S.G (2006) Physical Properties of Food . Springer
10. Steffe J. 1996. Rheological Methods in Food Process Engineering. Freeman Press. East Lansing, MI USA.Available Online WWW,egr.msu.edu/~steffe/
11. Rao M.A.; Rizvi, S.S H.; Datta, Ashim K. 2005, Engineering properties of Foods. Taylor & Francis

FOT-103-CC-5150: FOOD SAFETY AND QUALITY ASSURANCE

Credit: 2; **Lecture:** 2 Hrs per week;
Contact Hours: 30; **Full Marks:** 100

Learning Objectives:

LO1: To create understanding of quality control and assurance, risk assessments, GMPs, and regulations inthe food sector.

LO2: To illustrate the importance of food safety, food quality, food laws and regulations in Food industry.

LO3: To describe the food quality management systems and explain the nationals and international food laws and regulations.

LO4: To exemplify different food adulterants.

Course Outcomes:

The graduates will be able to demonstrate the ability to:

CO1: Describe various aspects of food safety, safety management systems, standards and quality control.

CO2: Explain Sensory/ Organoleptic evaluation -Difference, Preference and Scoring tests.

CO3: Grasp knowledge of the quality assessments of food products.

CO4: Comprehend food quality managements systems and apprehend the Indian and International food laws.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Definition, objectives and scope of food standards and quality assurance, including role of various national and international agencies. Total quality management– general awareness and role of management practices in quality control, concept of HACCP and ISO series and their importance. Plant/food industry sanitation, maintenance sanitary conditions and hygienic practices.	08	1, 4
2	Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Food inspection and safety measurements, food regulations and grades. Statistical analysis in quality control-sampling design of experiments and evaluation of results.	08	1,3
3	Methods of sensory evaluation, introduction to sensory analysis. Sensory evaluation techniques for fresh fruits and vegetable procured products. Food testing: hedonic test, general acceptability tests and other desirable ranking tests of sensory	06	2,3

	evaluation of flavour, aroma, taste, texture, and overall acceptability of food products.		
4	Various food standards and their regulating national and international agencies viz. FSSAI, Codex etc. Methods of quality analysis: Moisture, proteins, carbohydrates, minerals, vitamins, fats, crude fibres and related substances. Raw material and finished products quality assurance: cereals, legumes, oil seeds, fruits and vegetables, laboratory methods for quality control.	08	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	1.0	-	2.0	3.0	-	2.0	-	1.0	3.0	2.0	1.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	1.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**1.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.0**	**2.0**	**2.5**	**2.0**	**2.0**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co. Lucknow.
2. Metha, R. & George, J. (2005). *Food Safety regulation concerns and trade: A DevelopingCountry Perspective.*
3. Pomeranz, Y. & Meloan, R. (1995). *Food Analysis: Theory and Practice:* AVI Publication, NewYork.
4. Askar, A. & Treptow, H. (1993). *Quality assurance in Tropical Fruit Processing.*
5. Mahindru, S. N. (2000). *Food Safety: A Techno-legal Analysis:* Tata Mc, India.

FOT-103-RC-5110: RESEARCH METHODOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 Hr per week; **Contact Hours:** 60 Hr; **Full Marks**: 100

Learning Objectives:

LO1: To help students to formulate well defined hypothesis, aims, objectives for research

LO2: To impart the knowledge of sampling techniques and record scientific data in a proper way.

LO3: To inculcate knowledge of scientific methodology in analyzing and representing research data.

LO4: To provide basic understanding about different statistical methods.

Course Outcomes:

CO1: Problematize, synthesize and articulate issues scientifically and design accurate research proposal.

CO2: Analyze data from various sources, draw valid evidence based conclusions and present complex information in a clear and concise manner to their peers.

CO3: Generate good research hypothesis, design, sampling, appropriate experiments, collect and interpret the data using appropriate statistical methods for experimental validation.

CO4: Understand basics of control chart for variables and for attributes with its application.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Introduction to Research Methodology: An introduction to basics of scientific research: objectives of research, types of research, research process and steps involved.Identification, selection and formulation of research problem. Intellectual property rights. Scientific Report Writing and Publication Process: Forms and types of scientific reports. Steps involved in scientific article writing. Publication process, selection of journals. Writing research proposals and steps involved. Dissertation/Thesis writing: format, content and chapterization. Bibliography and references, referencing styles. Appendices.	15	1
2	Sampling, Data Collection and representation: Sampling: design and types; steps involved in sampling; sampling types, sample size; sampling errors, advantages and limitations. Data types and collection: qualitative and quantitative, data processing. Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion. Application of mean, mode, median, variance, standard deviation	5	1,2
3	Computational Methods for hypothesis testing and Data Analysis:	15	2,3

	Test of significance: null hypothesis, level of significance and degree of freedom, steps involved in testing of hypothesis. Significance testing z-test, t-test for testing sample mean and difference between two means, paired t-test, chi-square test, F-test, analysis of variance. Usage of software packages for data analysis including MS Excel, SPSS, Design Expert, ORIGIN, etc.		
4	Statistical quality control: Introduction, advantages and limitations; Techniques of statistical quality control, control charts for variations, $\bar{x}$ and R chart, control chart for attribution, c chart, p chart, np chart; consumer risk, producer risk; Acceptance quality level (AQL); Lot tolerance percentage quality level (LTPD), process average fraction defective. Operative characteristic curve, simple and double sampling plans for pre-packaged foods.	10	2,4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	3.0	3.0	3.0	-	2.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Kothari, C. K.; Garg, G. *Research Methodology-Methods and Techniques*, 3rd Ed., New Age International, New Delhi, 2014.
2. Kumar, R. *Research Methodology–A Step-By-Step Guide for Beginners*; 2nd Ed., Pearson Education: New Delhi, 2005.
3. Montgomery, D. C. *Design & Analysis of Experiments*; 8th Ed., Wiley India: Noida, 2013.
4. Hubbard M. R. (2005) *Statistical quality control for food industry*, Springer Publishers.
5. Gupta S. C. & Kapoor V. K. (2014) *Fundamentals of Applied Statistics*

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – II

FOT-103-CC-5210: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

To enable the students to:

LO1: Know the structure and composition of cereal grains, pulses and oil seeds

LO2: Learn Post harvest technology and processing of cereals, pulses and oilseeds

LO3: Understand the mechanism of preparation of extruded and fermented products from cereals and pulses

LO4: To know the anti-nutritional factors, present in pulses and methods to remove them

Course Outcomes:

On successful completion of the subject, the students will be able to:

CO1: Comprehend the recent advancement in the quality of major cereal, pulses and oilseed grains.

CO2: Understand the mechanism underlying the interaction of various flour components and their role in end use quality.

CO3: Grasp the basic and advanced milling methods for wheat, rice, maize.

CO4: Know about extraction and refining techniques of oils from oilseeds.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Production and utilization trends of different cereals, pulses and oilseeds; Structure and composition of common cereals, pulses and oil seeds. Wheat: Varieties, principles of milling, products and by-products, flour treatment, dough rheology, Rice-classification milling, physico-chemical and cooking quality, accelerated ageing milled rice products and by-product utilization, parboiling of rice and processed products based on rice.	12	1, 2
2	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	2, 3
3	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	1,2, 3

4	Oilseeds: Importance of oilseeds processing industry in India. Pre-conditioning of oilseeds for improving extraction efficiency. Expeller and solvent extraction process and equipment. Principles and methods of filtration of oil. Oil refining and hydrogenation process, utilization of oilseeds.	13	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	1.0	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	1.0	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	1.0	2.0	2.0	3.0
CO4	-	3.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.3**	**3.0**	**3.0**	**2.3**	**3.0**	**2.0**	**1.8**	**2.5**	**2.5**	**2.0**	**2.3**	**2.0**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Determination of physical characteristics of cereals.
2. Milling of wheat into flours.
3. Determination of wet and dry gluten.
4. Parboiling of rice.
5. Determination of crude fibre in wheat flour.
6. Visit to local roller flour mill.
7. Visit to local bakery.
8. Visit to local rice hulling unit.
9. Determination of ash and sugars in flour and bakery products.
10. Cooking quality of rice.

Books recommended:

1. A Chakraverty: Post-harvest Technology of Cereal, pulses and oilseeds
2. Kent NL. 1983. Technology of Cereals. Fourth Edition. Pergamon Press.
3. Kulp K. & Ponte J. G. (2014). Handbook of Cereal Science & Technology, 2nd edition: CRC press.
4. Matz SA. 1969. Cereal Science. AVI Publ.
5. Pomeranz Y. 1987. Modern Cereal Science & Technology. VCH Publ.
6. Wrigley C.W. & Batey I. L. (2010). Cereal grains, assessing and managing quality, CRC press.
7. Dendy D. A. V. & Dobsasoczyk B. J. (2001). Cereal and Cereal Products, Chemistry and Technology: An ASPEN publication.
8. Owens G. (2000). Cereal Processing Technology: CRC Press.
9. Faridi H. & Faubin J. M. (1997). Dough Rheology & Baked product Texture: CBS Publishers.

FOT-103-DE-52010: FOOD NUTRITION AND BIOCHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the concepts of food and nutrition.

LO2: To learn about food groups, RDA, and diet planning steps.

LO3: To familiarize students with the classification of nutrients, and their metabolism in the human body.

LO4: To impart in-depth knowledge about the integration of metabolism, regulation of metabolism, and Interrelationship of nutrients.

Course Outcomes:

CO1: Understand the critical Concepts of Food and Nutrition.

CO2: Acquire knowledge on RDA, and various food groups.

CO3: Understand the fundamental concepts of metabolism and metabolic pathways.

CO4: Comprehend and summarize the interconnection, regulation, and significance of various biochemical reactions in maintaining an adequate nutritional status and health**.**

Course Content:

Unit No.	Content	Contact Hours	CO
1	Concepts of food and nutrition. Role of nutrition in maintaining health. Diet charts, therapeutic nutrition. Basic food groups. Nutritional- Biochemistry. National nutritional policy, Balanced Diet, and RDA for all age groups. Classification of foods. Units of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR	11	1,2
2	Metabolic pathways. Carbohydrates-Aerobic and anaerobic degradation. Hormonal regulations of blood glucose. ATP cycle, formation of ATP- Biological oxidation and electron transport chain-Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain. Significances of enzymes in food metabolism. Enzyme pattern in diseases.	12	3

3	Protein and amino acids. Protein degradation, fate of nitrogen (urea cycle). Protein quality evaluation. Nucleic acids- metabolism of nucleic acid components, biosynthesis of nucleotides. Lipids- Metabolism of triaclyglycerol, β oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies. Oxidative stress and antioxidants. Free radicals and defense against free radicals.	12	3
4	Integration of metabolism. Regulation of metabolism- Interrelationship of carbohydrate, protein and lipid metabolism. Role of Vitamins and Minerals in Metabolism, metabolic adaptation during starvation, exercise, stress and diabetes mellitus. Organ function tests, Water, electrolyte and acid-base balance. Tissue proteins and body fluids	10	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	1.0	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.5**	**1.5**	**2.3**	**2.5**	**2.5**	**2.5**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Calibration of volumetric glassware (Burette, pipette and measuring cylinder).
2. Calculation, preparation of normal, molar and percentage solutions.
3. Determination of Saponification Number
4. Determination of Acid Number
5. Tests for ketone bodıes in urıne by Gerhard test (for acetoacetic acid)
6. Estimation of starch from wheat flour
7. Estimation of lactose from milk
8. Estimation of Glycogen from liver
9. Estimation of Cellulose from plant material

Books recommended:

1. Lehninger, A.L.; Nelson D.L. and Cox. M.M., Principles of Biochemistry 3rd ed. New York. Worth Publishers McMullan Press, 2000
2. Conn & Stump: Outlines of Biochemistry.
3. Davis, I. D. H. (2006). Fundamentals of biochemistry. *Instructor*.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2013). *Fundamentals of biochemistry: life at the molecular level* (No. 577.1 VOE).
5. Champe, P. C., Harvey, R. A., & Ferrier, D. R. (2005). *Biochemistry*. Lippincott Williams & Wilkins.

6. Schowen, R. L. (1993). Principles of biochemistry 2nd ed. (Lehninger, Albert L.; Nelson, David L.; Cox, Michael M.).
7. U, Satyanarayna and U, Chakrapani. Biochemistry with clinical concepts and case studies.

FOT-103-DE-52020: FOOD ADDITIVES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:
To enable the students to:
LO1: Know the role of food additives in the design and innovation of new food ingredients, products and processes.
LO2: Study the classification of food additives.
LO3: Know the toxicological legislation aspects of additives.
LO4: Know the role of natural and synthetic preservatives and other additives

Course Outcomes:
On successful completion of the subject, the students should:
CO1: Understand the role of food additives in the design and innovation of new innovative value added products.
CO2: Understand the general aspects of the use of additives and processing aids such as definitions and classification.
CO3: Know toxicological studies required for the authorization of additives and use of legal criteria and safety aspects.
CO4: Know the health implication of natural and artificial food additives.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to Food Additives; Scope of food additives; Functions and uses of Food Additives; Classification- Intentional & Unintentional Food additives; Types of food additives, their toxicology and safety evaluation; Naturally occurring food additives.	12	1, 2,3
2	Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial colours), pigments, their importance and utilization as food color; Processing of natural and artificial food colorants. Food Preservatives: Classification- Natural & chemical preservatives; Mode of action. Antioxidants & chelating agents: Types of antioxidants -natural & synthetic; Mode of action of antioxidants in foods; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents.	10	2,4
3	Stabilizers, thickeners and Emulsifiers: Types; Applications in	10	1,2, 3

	food processing; Sweeteners: Introduction; Classification- Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role of sweeteners in food processing. Flour bleaching & maturing agents; leavening agents; Acidity regulators.		
4	Taste and Flavoring agents: Classification of flavors- natural & synthetic; Flavor enhancer/ Potentatior; Importance of taste and flavours; Role of flavoring agents in food processing. Humectants/polyhydric alcohol, anticaking agent, firming agent; Starch modifiers; Antimicrobial agents, Clarifying agents, antifoaming agents, Fat mimetics and replacers.	13	2,3

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	1.0	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.5**	**2.0**	**3.0**	**2.5**	**1.5**	**2.0**	**2.5**	**2.5**	**2.0**	**1.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. E numbers of different food additives
2. Qualitative tests for presence of benzoic acid in foods
3. Qualitative test for presence of sulphurous acid in foods
4. Determination of total chlorophyll by spectrophotometric method
5. Study of effect of acidulants in fruit juices
6. Study of the effect of stabilizers/ thickeners on quality of foods
7. Study of the effect of clarifying agents on the fruit juices
8. Role of emulsifiers in foods
9. Role of leavening agents in baked food products
10. Role and mode of action of antioxidants in food products

Books Recommended

1. Belitz, H.D. Grosch W. and Schieberle. P. 2009. Food Chemistry. 4th Edition. Springer-Verlag, Berlin, Heidelberg.
2. Mahindru, S.N. 2008. Food Additives: Characteristics, Detection and Estimation. Aph Publishing Corporation, New Delhi.
3. Deshpande, S.S. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland.

FOT-103-DE-52030: ADVANCE ANALYTICAL TECHNIQUES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory100 + Practical 100)

Learning Objectives:

LO1: To develop an understanding about the advanced analytical and instrumental techniques.

LO2: To illustrate the principle and mechanism of different analytical instruments.

LO3: To illustrate applications of different analytical instruments for food analysis.

LO4: To describe bio-chemical analysis of food components.

Course Outcomes:

CO1: Explain theoretical aspects of important analytical techniques used in food analysis.

CO2: Describe the physical and chemical principles which underlie instrumental techniques for testing and analysing food raw materials and finished products

CO3: Select appropriate analytical techniques for specific food constituent analysis.

CO4: Compare advanced and conventional techniques and instruments to analyse chemical and physical properties of foods.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Microscopic techniques: History, Basics of Light microscopy, concept of resolution in microscope. Principles, instrumentation, advantages limitations and application of different light microscopic techniques. Electron microscopy: principle of working and advantages and limitations. Applications in evaluating food microstructures and others. Color measurement systems in food applications. Texture and rheology: Introduction, Definition/s and importance Application of texture analyser in food texture evaluation.	10	1,2,3
2	Spectroscopy: Principles of colorimetry and UV-VIS spectrophotometry. Instrumentation and working of colorimeter and spectrophotometer. Concept of Absorbance and transmittance. Beers and Lambert's Law; Extinction coefficient. Fluorescence and phosphorescence spectroscopy. Infrared Spectroscopy: Fourier transform infrared (FTIR) and FTIR-ATR spectroscopy instrumentation and working principle. Application of IR spectroscopy in food analysis. Atomic absorption spectroscopy principles, instrumentation and applications.	10	1,2,3,4
3	Chromatographic techniques, adsorption and partition, theory of chromatographic separation, distribution coefficient, retention factor. Types of chromatographic techniques and working principles: HPLC, Size-exclusion, Ion Exchange, Affinity	10	1,2,3,4

	chromatography etc. Instrumentation for HPLC and GC: columns, pumps, detectors, techniques and applications. Concept of theoretical plates, retention time, separation efficiency, resolution and applications.		
4	Electrophoretic Techniques: General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis. Thermal techniques in food analysis, principles, instrumentation and application of Differential scanning calorimetry (DSC), Thermo-gravimetric analysis (TGA) and Bomb calorimetry in food analysis.	15	1,2,3,4

Practical:

1. Determination of food adulterants in given food samples.
2. Refractive index of oil by using Abbe's Refractometer.
3. Determination of water activity of given a food product.
4. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
5. Texture profile analysis of foods samples.
6. Estimation of Ascorbic Acid content in given food samples by HPLC/ Dye method.
7. Mineral profile analysis of food samples by Atomic Absorption Spectroscopy/chemical method.
8. Qualitative and quantitative analysis of amino acids/plant pigments by paper chromatography
9. Estimation of colour of different food products using Hunter colour Lab.
10. Determination of antioxidant activity of given food sample using HPLC.
11. Morphological characteristics of Food Samples using Light microscopy/SEM/TEM.

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	3.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	2.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**2.7**	**2.5**	**2.0**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Cruz, R.M.S., Khmelinskii, I, & Viera. (2014). *Methods in Food Analysis*.1st Edn. CRC press.
2. Pico, Y. (2012). *Chemical Analysis of Food: Techniques and Applications*. Academic Press.
3. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier.
4. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* 3rd Edn., Spinger.

5. Winton, A. L. (2001). *Techniques of Food Analysis:* Agrobios, Jodhpur.
6. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
7. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
8. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons

FOT-103-DE-52040: MEAT, FISH AND POULTRY PROCESSING

Credit: 4; **Lecture:** 3 Hrs per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To describe the muscle composition, structure and properties of meat muscle.

LO2: To explain the structural changes that take place post-mortem during conversion of muscle to meat.

LO3: To illustrate the manufacture and handling of meat and fish products and to assess the factors that affects the safety and quality of meat products.

LO4: To describe the manufacture and handling of egg and poultry products and to assess the factors that affects the safety and quality of poultry products.

Course Outcomes:

CO1: Understand the muscle composition, structure and properties of muscle meat.

CO2: Apply the process of manufacturing of various value added meat, poultry and products.

CO3: Inculcate the process of manufacturing of various value added fish products.

CO4: Learn about the various food standards in relation to meat, fish, poultry and egg.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Muscle structures and composition, conversion of muscle into meat. Meat composition from different sources. Pre-Slaughtering practices and methods. Ante and post-mortem inspection and grading of meat. Quality of meat. Plant layout, design and construction of an abattoir. Meat Microbiology and safety.	11	1,2
2	Meat tenderization. Processing and preservation of meat. Thermal processing and non- thermal processing. Meat Products - uncooked comminuted and restructured meat products, sausages, meat emulsions, dried meats, intermediate moisture meats and meat extracts, ready to eat (RTE) meat products. Packaging of meat products. Meat plant hygiene – GMP and HACCP. By product utilization	12	2
3	Fish classification and composition. Post mortem changes in fish muscle. Fish products processing. By product utilization. Quality control of processed fish. Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish , Freezing of fish and shell fish. Commercially important marine products from India	12	3
4	Poultry types and classes. Classification of chickens. Nutritive value and composition of poultry meat. Methods of slaughtering,	10	2,4

	slaughtering equipment and operations, dressing, handling, storage. Preservation of poultry meat. Spoilage and its control. Egg: structure and composition, Quality evaluation of shell eggs. Egg processing, Spoilage and its control. Packaging of egg and egg products. FSSAI guidelines on FSMS compliance for meat and meat product		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	1.0	1.0	1.0	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	1.0	2.0	2.0
CO3	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	-	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.0**	**2.0**	**2.7**	**2.0**	**1.5**	**2.0**	**2.5**	**2.5**	**1.8**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Fish cutting and handling.
2. Dressing of poultry.
3. Study of external anatomy/body parts of cattle, buffalo, sheep and goat
4. Determination of water holding capacity of meat
5. Carcass inspection for detection the efficiency of bleeding
6. Blotting paper test
7. Determination of glycogen in meat
8. Dehydration of meat
9. Quality evaluation of egg
10. Preparation of fish pickle

Books recommended:

1. Mead G. (2004) *Poultry Meat Processing and Quality,* Woodhead Publishers.
2. Panda P. C. (1992) *Text Book on Egg and Poultry Technology*, Vikas Publishers.
3. Hui Y. H. (2012) *Handbook of meat & meat processing, 2nd Edition,* CRS Press.
4. Gracey JF. 1999. Thornton's Meat hygiene. 11th Ed. WB Saunders.
5. Stadelman W & Cotterill OJ. 2002. Eggs Science and Technology. 4th Ed. CBS.
6. Mountney GJ. Poultry Products Technology. 2nd Ed. AVI Publ.
7. Elton D. Aberle, John C. Forrest, David E. Gerrard, Edward W. Mills (2012). Principles of Meat Science, 5th Ed. Kendall Hunt Publishing Company.
8. Sharma, B.D. Outlines of Meat Science and Technology, (2011). Jaypee Brothers Medical Publishers.

FOT-103-DE-52050: ADVANCES IN FOOD PROCESSING TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Contact Hours:** 45; **Tutorials:** 1 Hr per week; **Contact Hours:** 15; **Full Marks:** 100

Learning Objectives*:*

To enable the students to:

LO1: To familiarize students with various advanced thermal processing methods.

LO2: To acquaint students with the emerging non-thermal technologies.

LO3: To describe the principles and working mechanism of electromagnetic radiation-based techniques.

LO4: To describe the process mechanism and application of advance extraction and dehydration processes.

Course Outcomes:

On completion of the course the students would be able to:

CO1: Ability to explain various novel thermal and non-thermal emerging technologies that can be applied to food processing for quality improvement of the processed foods.

CO2: Student can be able to explain the advantages and limitations of the emerging food processing technologies and methods to overcome the limitations.

CO3: Ability to develop ideas for research and development using the advanced food processing technologies.

CO4: Ability to explore the application of advanced hybrid drying technique to produced quality processed products.

Course Content:

Unit No.	Content	Contact Hours	CO
1	**Pulsed Electric Field Technology (PEFT)**: Definitions, Pulsed electric field treatment system, Microbial inactivation mechanism, Determinant factors in PEFT, Alternative applications of PEFT. **Food Irradiation**: Mechanisms, sources and applications of Food Irradiation. Beneficial chemical and biological effects of Irradiation on Foods. Safety of Irradiated Foods. Benefits of Food Irradiation, Consumer attitudes toward irradiated foods, Government regulations on irradiated foods.	10	1,2,3
2	**High-Pressure Processing (HPP)**: Principles and process, Packaging requirements, Microorganisms and enzymes inhibition in HPP, Effects of HPP on Food Quality, Other application. **Cold plasma (CP) processing**: The chemistry of CP, Categories of CP Technologies, Types of CP generator, microbial inactivation	13	1,2

	mechanism, application and Economics of CP. **Ultrasound processing**: The physics and chemistry of ultrasound, processing equipment, inactivation of microorganisms and enzymes, Ultrasound as a processing aid.		
3	**Microwave (MW) heating**: Heating mechanism, MW properties of foods, equipment, comparison of MW and convectional heating, benefits and application of MW heating in food Industry. **Radio-Frequency (RF) Processing**: Principle of RF heating, Dielectric Properties of foods at RF, RF Generators and Applicators, Differences between RFs and MWs, applications of RF. **Ohmic heating:** Fundamentals of ohmic heating, Electrical conductivity, Generic Configurations, application of Ohmic heating.	12	3,4
4	**Supercritical fluid extraction:** Principle, equipment and process description, application in food processing, constraints in Supercritical fluid extraction processing. **Superheated steam drying:** Basic principle, types, inversion temperature, advantages and disadvantages. **Recent advances in Hybrid drying technologies:** classification, key advantages and limitation, Electromagnetic radiation-based hybrid drying techniques.	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	3.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	1.0	1.0
CO4	1.0	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**2.0**	**2.0**	**2.7**	**2.5**	**1.5**	**2.7**	**2.5**	**2.5**	**2.3**	**1.7**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Barry G. S. and Özlem T. *Improving Food Quality with Novel Food Processing Technologies,* (CRC Press, 2018)
2. DA-WEN SUN. *Emerging Technologies for Food Processing,* (Academic Press, 2014).
3. Tadeusz Kudra and Arun S. Mujumdar. *Advanced Drying Technologies,* (CRC Press, 2009 2nd edition).
4. P.J. Cullen, Brijesh K. Tiwari, and Vasilis P. Valdramidis. *Novel Thermal and Non-Thermal Technologies for Fluid Foods*, (Academic Press, 2012)

FOT-103-DE-52060: NEW PRODUCT DEVELOPMENT

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To understand the process of development of new food product.

LO2: To understand the role of research and development in food product development and food manufacture.

LO3: To development of new food product, which are nutritious, cost effective and marketable.

LO4: To acquired knowledge on quality, safety & regulatory aspects of new food product.

Course Outcomes:

CO1: Design new products using need based perspective and application.

CO2: Develop standards for new products.

CO3: Understand phases in food product development.

CO4: Formulate regulatory aspects on Intellectual property rights.

Course Content:

Unit No.	Content	Contact Hours	CO
1	New Food Products: Definition, Classification, characterization and factors shaping new product development. Nutritive value of foods. Food needs and consumer preference. Use of Ready Reckoners /Exchange list/ NIN Food database/ USDA Food Database. Product life cycle. The SWOT analysis.	15	1
2	Designing new products. Market-oriented NPD methodologies, use of novel food ingredients and novel processing technologies. Recipe development for infants, preschool, sports person, elderly, Selection of raw materials, portion size, standardization methods, calculation of nutritive values, cost production, shelf life. Food safety and food spoilage.	15	2, 3
3	Standardization and large- scale preparation. Brief introduction of phases in food product development. Developing standards products- various food ingredients used, use of additives. Sensory Evaluation Test – Designing score card, objective evaluation, Instruments used for texture evaluation.	15	2,3
4	Quality, safety & regulatory aspects. Developing packaging systems. Approval for Proprietary Product. Evaluation of the Launch, product performance testing. Developing test market strategies. Patent, patent laws, international code for Intellectual property rights (IPR). Storage and transportation. Role of government in promoting agricultural marketing.	15	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	2.0	2.0	3.0	-	1.0	2.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.0**	**2.3**	**1.7**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Book recommended:

1. Jacqueline H. Beckley, M. Michele Foley Elizabeth J. Topp &_J. C. Huang Witoon Prinyawiwatkul (2007). Accelerating New Food Product Design and Development. Blackwell Publishing Company. IFT Press. USA
2. Howard R. Moskowitz, I. Sam Saguy & Tim Straus (2009). An Integrated Approach to New Food Product Development. Taylor and Francis Group, LLC.USA
3. Mary Earle and Richard Earle (2008). Case studies in food product development Wood head Publishing Limited and CRC Press LLC.USA
4. Creating New Foods. The Product Developer's Guide: Marie D. Earle and Richard L. Earle (2001). Chadwick House Group Ltd. New Zeeland.
5. David H. Lyon, Mariko A. Francombe, Terry A. Hasdell and Ken Lawson (1992). Guidelines for sensory analysis in food product development and quality control. Chapman & Hall, 2-6 Boundary Row, London.

FOT-103-RC-5210: RESEARCH PUBLICATION ETHICS

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To help students understand the philosophy of research and ethics in scientific research.

LO2: Familiarise with plagiarism and the scientific misconduct in research activity.

LO3: Get familiar with publication Misconduct and predatory journals and publishers.

LO4: Get informed about the open access publishing and understand the publishing databases and research metrics.

Course Outcomes:

On completion of this course the students will be able to:

CO1: Learn about philosophy of research and publication ethics.

CO2: Understand the scientific misconduct in research.

CO3: Learn publication misconduct and able to identify predatory journals.

CO4: Become aware of the open access publishing and learn about publication database and research metrics

Unit No.	Content	Contact Hours	CO
1	Introduction to Philosophy: definition, nature and scope, concept, branches**.** Ethics: Definition, moral philosophy, nature of moral judgments and reactions. Common characteristics of ethical problems in social research. Ethics in Scientific Research: issues of authorship, criteria for authorship and contributorship, peer review's role, research ethics in human and animal subjects, research ethics committees, conflict of interest.	15	1, 2
2	Scientific Misconduct: Falsification, Fabrication, and Image Manipulation. Institutional Responses to Scientific Misconduct, Misconduct in Regulated Research. Plagiarism, main sources and its types. Redundant Publications, redundant authorship, Problems caused by redundant publication, Acceptability and consequences of redundancy, prevention of redundancy, Salami Slicing and its parameters, Misrepresentation of Data.	15	1,2,4
3	Publication ethics: introduction and importance. Function and guidelines of COPE, WAME etc. Publication Misconduct: Misconduct by Editors, Publishers, and Peer-Reviewers, Types of Publication Misconduct, Violation of Publication Ethics, Concept	15	3,4

	of Spin, Predatory Publishers and Journals and their criteria for identification of predatory journals and publishers.		
4	Open Access Publishing, its merits and demerits. Benefits of Open Educational Resources for learners and teachers, Gray Literature, Preprint and Other Modes, Access tools and services to Open Access, Elsevier Journal Finder, Springer Journal Suggester. Database and its types, Citation databases: Web of Science, Scopus, Research Gate, Google Scholar. Calculation of Journal Impact Factor, Immediacy Index, h-Index and i-10 index, Altmetrics, Indian Citation Index.	15	1,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	3.0	2.0	-	-	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	2.0	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.5**	**3.0**	**2.0**	**2.7**	**2.5**	**1.7**	**2.5**	**2.5**	**2.5**	**2.3**	**2.3**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books Recommended

1. MacIntyre, A., *A Short History of Ethics: A History of Moral Philosophy from the Homeric Age to the 20th Century*; 2nd Ed., Routledge: London, U.K., 1998.
2. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. *On Being a Scientist: A Guide to Responsible Conduct in Research*; 3rd Ed., The National Academic Press: Washington DC, USA, 2009.
3. Muralidhar, K.; Ghosh. A.; Singhvi, A. K., Eds. *Ethics in Science Education, Research and Governance*; Indian National Science Academy: New Delhi, India, 2019.
4. Yadav, Santosh Kumkar. 2000. Research and Publications Ethics. Ishwar Books.
5. Deakin, L. (2014). Best practice guidelines on publishing ethics: A publisher's perspective. Wiley.

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – III (COURSE WORK & RESEARCH)

FOT-103-CW-61010: FOOD PACKAGING

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 0 per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To explain packaging scope, importance & functions in the Food Industry

LO2: To impart knowledge on Packaging Systems and advance methods

LO3: To aware students about the recycling of packaging materials, biodegradable packaging materials and safety and legislative aspects.

LO4: To explain students about FSSAI regulations for packaging and food labelling.

Course Outcomes:

CO1: Comprehend advance knowledge on the properties and production of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality

CO2: Understand various types of scavengers and emitters for improving the food shelf life.

CO3: Learn about consumer response about new packaging systems and safety and legislative requirements

CO4: Acquaint about food-package interaction between package-flavour, gas storage systems for food storage, recycling and use of green plastics for reducing the pollution and their effect on food quality.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to food packaging. Packaging scope & importance. Functions of food packaging, Factors affecting shelf life of food material during storage. Effect of these materials on packed commodities. Food- packaging interaction and migration. Packaging techniques-Active and intelligent packaging. Polymers with immobilized bioactive compounds.	10	1
2	Types of packaging materials and properties. Optical, mechanical and barrier properties of packaging materials. Structure and properties of plastic materials and processing and converting of thermoplastics. Paper and paper based packaging materials including tetra pack. Metal and glass packaging materials.	11	2, 3
3	Packaging Systems and advance methods: Vacuum Packaging, Controlled atmospheric packaging, Aseptic Packaging, Retort processing, Microwave packaging, Shrink and stretch packaging. Modified atmosphere packaging (MAP). Liquid and powder filling machines – like aseptic system, form and fill. Bottling machines. Form Fill Seal (FFS) and multilayer aseptic packaging	12	2,3

	machines.		
4	Green plastics, biopolymers, integrating intelligent packaging**.** Testing methods for flexible materials, rigid materials and semi rigid materials. Recycling packaging materials, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, FSSAI regulations for packaging and food labelling.	12	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	1.0	3.0	-	3.0	1.0	3.0	1.0	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	3.0	2.0
CO3	2.0	-	-	-	2.0	3.0	3.0	2.0	3.0	1.0	3.0	2.0	3.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.0**	**2.5**	**2.3**	**2.7**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Classification of various packages based on material and rigidity.
2. Measurement of thickness of packaging materials.
3. Measurement of basic weight and grammage of paper and paperboards.
4. Measurement of water absorption of paper and paperboards (Cobb Test).
5. Measurement of grease resistance of papers.
6. Drop test, Box compression test.
7. Measurement of grease resistance of papers.
8. Head space analysis of packaged food.

Books recommended:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.
2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*:CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.
5. Robertson GL,(2012) *Food Packaging – Principles and Practice*, CRC Press Taylor and Francis Group
6. RaijaAhvenainen (2003) *Novel food packaging techniques*, Published by Woodhead Publishing Limited.

FOT-103-CW-61020: PROCESSING OF FRUITS AND VEGETABLES

Credit: 4; **Lecture:** 3 Hrs per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: Attain an overview on the post-harvest losses, maturity indices and Physiological stages of fruits and vegetables.

LO2: Acquaint with the post-harvest handling technologies and storage methods of fruits and vegetables to reduce postharvest losses.

LO3: Equip with the knowledge of processing and preservation of fruits and vegetables.

LO4: Impart the expertise in production and manufacture of fruits and vegetable-based food products and by-product utilization.

Course Outcomes:

CO1: Understand about the maturity indices and causes of various post-harvest losses in fruits and vegetables.

CO2: Gain knowledge about different storage methods and primary processing of fresh agricultural produce.

CO3: Understand the commercial canning and bottling process for various fruits, and vegetables.

CO4: Develop various types of processed products using fruits and vegetables and know about by-product utilization of waste of fruits and vegetables processing plants.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Objectives of F&V processing. Structure, composition and nutritive value of fruits and vegetables. Maturity indices for F&V and their methods of determination, Types of post-harvest losses, Factors affecting post-harvest losses. Physiological development of F&V. Respiration and transpiration processes. Ripening of climacteric and non-climacteric fruits. Role of ethylene in fruit ripening.	10	1
2	Harvesting Practices of fruits and vegetables. Storage methods for fresh fruits and vegetables: Controlled atmosphere storage, Modified atmosphere packaging, Hypobaric storage, Pre-cooling and Cold storage, Zero energy cool chamber. Transportation, Packaging, and Marketing of Fresh Produce. Primary Processing Techniques: grading, sorting, cleaning, washing, peeling, slicing, and blanching.	11	2

3	Canning and Bottling: Guidelines for the location of processing units, steps involve in canning process, Can manufacturing, testing of can, size of cans, preparation of sugar and brine for caning. Canning of fruits: apple, banana, jackfruit, orange, pineapple. Canning of vegetables: beans, mushroom, tomato, peas. Spoilage in canned foods: discoloration in canned food products, spoilage by micro-organisms and fungi, storage life of canned product.	12	3
4	***Fruit products:*** Processing of fruit beverages, Juice extraction, clarification techniques, Processing for jam, jellies, marmalades, preserves, candies and crystallized fruits, Theories and testing methods of jellies. ***Vegetable products:*** Processing for tomato-based products, Pickles, Sauces and Soups. Dehydrated F&V products. Quality standards and specifications of F&V-based products. Utilization of waste from F&V processing plant. Pectin manufacturing process and its uses.	12	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	2.0	3.0	-	2.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.5**	**2.0**	**2.5**	**2.3**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Quality Standard Measurements of fruit and Vegetable Products
2. Determination of enzymatic browning in fruit-based products
3. Blanching of vegetables and its determination
4. Determination of Ascorbic acid in fruit/fruit-based products
5. Preparation of fermented products from vegetables
6. Preparation of osmo-dehydrated fruits products
7. Preparation of Dehydrated Vegetables
8. Preparation of tomato ketchup
9. Preparation of jam and jellies
10. Preparation of pickles

Books recommended:

1. Lal G, Siddapa GS and Tandon GL.1986. *Preservation of Fruits and Vegetables*. ICAR.

2. S. Ranganna 2014. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products, 2nd edition. McGraw Hill Education (India) Private Limited.
3. Kadar AA.1992. *Post-harvest Technology of Horticultural Crops*. Second Edition. University of California.
4. Thompson AK. 1995. *Post-Harvest Technology of Fruits and Vegetables*. Blackwell Sci.
5. Verma LR. & Joshi VK. 2000. *Post-Harvest Technology of Fruits and Vegetables*. Indus Publ.
6. D.K. Salunkhe and S.S. Kadam, 2013. A handbook of Fruit Science and Technology. CRC Press

FOT-103-CW-61030: DAIRY TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (100 Theory + 100 Practical)

Learning Objectives*:*

LO1: To understand about the products that can be made from milk.
LO2: To understand the processing and storage of dairy products.
LO3: To know about the quality control measures applied in dairy industries.
LO4: To have a basic idea about their processing and products which can be made at a small scale

Course Outcomes:

On completion of the course, the students will be able to:
CO1: Understand the processes related to storage, processing and distribution of milk and milk Products.
CO2: Grasp the technology of fat rich dairy products.
CO3: Comprehend the technology of condensed milk, dried milk, cheese, yoghurt and indigenous products will be understood.
CO4: Have knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Unit No.	Content	Contact Hours	CO
1	Introduction: Milk - Definition, sources, and composition of milk, chemistry of milk constituents, factors effecting composition of milk, physiochemical properties of milk, grading of milk-definition and types of grades, collection and transportation of milk.	10	1, 4
2	Processing of market milk: Flowchart of milk processing, Reception, Different types of cooling systems. Clarification and filtration process, standardization- Pearson's square method, pasteurization-LTLT, HTST and UHT process- continuous pasteuriser, Sterilisation and Homogenisation, Cream separation- centrifugal cream separator, bactofugation.	13	1,2,3
3	Special milks: Skim milk, evaporated milk, condensed milk, standardized milk, toned milk, double toned milk, flavoured milk, reconstituted milk. Spray drying system: dried milk- whole milk and skim milk powder. Instantization of milk.	12	3,4
4	Indigenous and Fermented milk products: Product description, methods for manufacture of butter, cheese, ice cream, khoa, channa, paneer, shrikhand, ghee, Curd, Yoghurt, Acidophilus milk, Kefir, Kumis	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	1.0	3.0	1.0	2.0	2.0	-	2.0	-	2.0	3.0	1.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0
Average	**2.7**	**2.0**	**3.0**	**2.0**	**1.7**	**2.7**	**2.5**	**1.8**	**2.5**	**2.0**	**2.5**	**1.8**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Sampling equipment and sampling of milk.
2. Platform tests (Acidity, COB and Alcohol test).
3. Determination of milk fat percentage by Gerber's method.
4. Determination of specific gravity by lactometer.
5. Microbial examination of milk samples.
6. Methylene blue reduction test of milk.
7. Analysis of milk: total solids, fat, SNF, protein, lactose, acidity, ash, total bacterial count,
8. Preparation of ghee from cream/ butter
9. Preparation of yoghurt/dahi
10. Dairy Industrial Visit (optional)

Books recommended:

1. Smit, Gerrit (2003). Dairy processing: improving quality, Woodhead publishing limited, England.
2. De, Sukumar (1991). Outlines of dairy technology, Oxford university press, Delhi. Edition : 46th Edition, 2019 · Media : Paper Back · ISBN : 9780195611946.
3. Varnam, A.H., Sutherland, J.P. (1994). Milk and milk products, Chapman and Hall, New York, USA.
4. Walstra, P., Geurts, T.J., Noomen, A., Jellema, A., Boekel, M.A.J.S (1999). Dairy Technology: Principles of milk properties and processes, Marcel Dekker, Inc, New York.
5. Winton, A. L. and Winton, K. B. (2000). Milk and Milk Products: Agrobios, India.
6. Kutty, C. I. and Khamer, S. (2004). Milk Production and Processing: Daya, Delhi.
7. Fox, P. F. and McSweeney, P. L. H. (1998). Dairy Chemistry and Biochemistry: Kluwer Academic, New York.
8. Kurmann, J. A., Rasic, J. L. and Kroger, M. (1992). Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products: CBS Publications, New Delhi.
9. Davis, J. G. (1994). Milk Testing: The Laboratory Control of Milk: Agro Botanical, Bikaner.

FOT-103-CW-61040: BAKERY AND CONFECTIONARY TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical**: 2 Hours per week; **Contact Hours:** 75; **Full Marks:** 200 (100 Theory + 100 Practical)

Learning Objectives:

LO1: To enable the students to understand the concept and technology of bakery & confectionary.

LO2: To make aware a student with knowledge and understanding of the raw material used for preparation of various bakery and confectionary products.

LO3: To make aware a student with knowledge and understanding in the basic operation and working of various equipment's involved in bakery and confectionary technology.

LO4: To make aware a student with knowledge and understanding in the basic steps and operation in preparation of bread, biscuits, cakes and other bakery products

Course Outcomes:

After completing this course students will be able to:

CO1: Understand various raw materials used for preparation of various bakery and confectionary products.

CO2: Have knowledge on basic operation and working of various equipment involved in bakery and confectionary industry.

CO3: Understand the various processes used for the manufacturing of bakery products like bread, biscuits, cakes etc. and their quality determination.

CO4: Acquire knowledge of the various processes used for the manufacturing of confectionary products like chocolate, candies, toffees etc. and their quality determination.

.

Unit No.	Content	Contact Hours	CO
1	Status of bakery and confectionery industries in India; Raw materials for bakery and their functions and standards- Flour, Leavening agents, sugars, fats and other minor ingredients. Bakery equipment: Different types of mixers and ovens used in bakery, dough divider, rounder, proofer, moulder, slicer etc.	10	1, 2
2	Hard wheat flour based products: Bread- Ingredients, various types of bread, equipments and types of mixing methods, preparation of bread, Product quality characteristics, Bread staling. Soft wheat flour based products: cookies, crackers, biscuits– Ingredients, types, equipments, method of preparation, Product quality characteristics, faults and corrective measures. Ingredient used in Cake Making, types and varieties, cake making methods, Product quality characteristics, faults and corrective measures of cakes.	14	1,2,3

	Other bakery products, Rheological testing, Hygiene and sanitation in bakery unit.		
3	Cocoa & Chocolate Processing: Cocoa bean- Introduction, history & Composition: Processing of cocoa bean, processed products of cocoa, historical developments in chocolate processing, ingredients and their role on chocolate, processing steps in chocolate- mixing, refining, conching, tempering, molding, cooling, coating, enrobing etc.	11	1, 4
4	Candy & Toffee Processing: High boiled sweets/candies- composition, processing & preparation of high boiled sweets- traditional, batch and continuous methods. Toffee- composition, types, ingredients & their role, batch and continuous methods of toffee manufacturing.	10	2, 4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	3.0	1.0	2.0	-	2.0	1.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	2.0	-	3.0	3.0	-	1.0	-	2.0	2.0	3.0	2.0	1.0
CO3	2.0	1.0	-	-	2.0	3.0	3.0	2.0	3.0	1.0	3.0	1.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.0**	**2.0**	**3.0**	**2.0**	**2.7**	**2.5**	**1.8**	**2.0**	**2.0**	**2.3**	**2.0**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Quality analysis of raw materials used in bakery industry.
2. Tests for the Rheological Properties of Dough
3. Preparation of Bakery Products – Bread, Biscuits, cookies, cakes, pasta, pizza etc.
4. Preparation of Chocolate
5. Preparation of Coated Confectionery
6. Quality Evaluation of the Bakery Products
7. Visits to bakery and confectionary industry. Local market survey for bakery and confectionary product

Books recommended:

1. Cruz, R.M.S., Khmelinskii, I, & Viera. (2014). *Methods in Food Analysis.*1st Edn. CRC press.
2. Khatkar B. S. (2011) Baking Science and Technology, Arihant Publication.
3. Amendola J. & Rees N. (2003) Understanding Baking: The Art and Science of Baking, Wiley. 3. Dubey S. C. (2002) Basic Baking, The Society of Indian Bakers.
4. Manley D. (2000) Technology of Biscuits, Crackers & Cookies. 2nd Edition, CRC Press.

5. NPCS Board of Food Technologists (2014) Confectionery Products Handbook (Chocolate, Toffees, Chewing Gum & Sugar Free Confectionery), Asia Pacific Business Press Inc.
6. Edwards W.P. (2007) The Science of bakery products, RSC Publications.
7. Mohos F. (2010) Confectionery & chocolate engineering, principles & applications, Wiley Blackwell Publishing Ltd.

FOT-103-CW-61050: NUTRACEUTICALS AND FUNCTIONAL FOODS

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To impart the concept of nutraceutical and functional ingredients in foods, and to determine their role in health and disease prevention.

LO2: To learn about various phytochemicals-their sources, functions and usefulness.

LO3: To understand basics of Extraction methods of Phyto-chemicals and development of functional foods.

LO4: To cater to the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects.

Course Outcomes:

On completion of the subject, the students will be able to:

CO1: Acquire knowledge on various bio molecules showing health benefits.

CO2: Understand various physiological and biochemical aspects of life threatening and chronic diseases.

CO3: Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.

CO4: Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Unit No.	Content	Contact Hours	CO
1	Nutraceutical and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, basis of claims for a compound as a nutraceutical, Nutraceutical for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc	10	1, 2
2	Photochemical and their usefulness Role of nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels, contraindications if any etc.	12	1,2,4
3	Extraction of Phyto-chemicals and development of functional foods: Extraction methods for maximum recovery, manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids,	10	3,4

	glucosamine, phytosterols etc.; formulation of functional foods containing nutraceuticals – stability and analytical issues, labelling issues.		
4	Prebiotics and Probiotics: Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits, Examples of useful microbes and their benefits, Prebiotic ingredients in foods, types of prebiotics and their effects on gut microbes, Probiotic foods and their functional role, Marketing and regulatory issues for functional foods and nutraceuticals.	13	1,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	2.0	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	1.0	2.0	-	3.0	-	3.0	3.0	3.0	2.0	2.0
CO3	3.0	-	2.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	-	-	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.5**	**3.0**	**1.3**	**2.7**	**2.3**	**2.0**	**2.5**	**3.0**	**2.5**	**2.3**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books Recommended

1. Mine, Y and Fereidoon, S. (2006). *Nutraceutical Proteins and Peptides in Health and Disease*: TF, Bocaraton.
2. Bagchi, D. (2008). *Nutraceutical and Functional Food Regulations in United States and Around the World*: Elsevier, London.
3. Shi, J. (2007). *Functional Food Ingredients and Nutraceuticals*: Processing Technologies: CRC Press, London.
4. Guo, M. (2009). *Functional Food*: Principles and Technology: WP, New Delhi.
5. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
6. Shi J. (Ed) 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies, CRC.

SEMESTER – IV (COURSE WORK & RESEARCH)

FOT-103-RP-6210: DISSERTATION/RESEARCH THESIS/INDUSTRIAL PROJECT

Credit: 20; Contact Hours: 600; Full Marks: 100

Learning Objectives:

This course is designed to enable students to:

LO1: Identify and discuss the role and importance of research in Food Technology.

LO2: Identify and discuss the issues and concepts salient to the research process.

LO3: Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.

LO4: Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.

Course Outcomes:

On completion the participants should be able to:

CO1: Carry out a substantial research-based project

CO2: Demonstrate an understanding of the ethical issues associated with practitioner research

CO3: Analyse data and report research findings in written and verbal forms

CO4: Use research findings to advance education theory and practice.

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	3.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	1.0	1.0
CO4	1.0	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**2.0**	**2.0**	**2.7**	**2.5**	**1.5**	**2.7**	**2.5**	**2.5**	**2.3**	**1.7**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Course Structure for PG Diploma in Food Technology
(Programme Code: FOT-1103) /
Two Year M. Sc. in Food Technology with Coursework
(Programme Code: FOT-4103)

NCRF Credit Level	Semester	Core Papers (Core Course/Elective/Course Work) / Course Name	Course Level	Credit	Total Credit	Credit Distribution L:T:P	Max. Marks (Theory) Internal	End Sem	Total	Max. Marks (Practical) Internal	End Sem	Total	Contact Hours
6	Sem-I	FOT-103-CC-5110-Principles of Food Processing and Preservation	400	3	20	2:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5120-Food Chemistry	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5130-Food Microbiology	400	3		2:0:1	20	80	100	20	80	100	60
		FOT-103-CC-5140-Food Engineering	400	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CC-5150-Food Safety and Quality Assurance	400	2		2:0:0	20	80	100	-	-	-	30
		FOT-103-RC-5110-Research Methodology/ MOOCS or SWAYAM equivalent	500	4		3:1:0	20	80	100	-	-	-	45
	Sem-II	FOT-103-CC-5210-Technology of Cereals, Pulses and Oilseeds	400	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52010-Food Nutrition and Biochemistry (Elective-I)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52020-Food Additives (Elective-I)											
		FOT-103-DE-52030-Advance Analytical Techniques (Elective-II)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-DE-52040-Meat, Fish and Poultry Processing (Elective-II)											
		FOT-103-DE-52050-Advances in Food Processing Technology (Elective-III)	500	4		3:1:0	20	80	100	-	-	-	45
		FOT-103-DE-52060-New Product Development (Elective-III)											
		FOT-103-RC-5210-Research Publication Ethics/ MOOCS or SWAYAM equivalent	400	4		4:0:0	20	80	100	-	-	-	45
Total Credit (First Year)					**40**								
Exit option with Post-Graduate Diploma in Food Technology on completion of courses equal to a minimum of 40 credits or Entry to One Year M. Sc. in Food Technology with Coursework													
6.5	Sem-III	FOT-103-CW-61010-Food Packaging (Coursework 1)	500	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61020-Processing of Fruits and Vegetables (Coursework 2)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61030-Dairy Technology (Coursework 3)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61040-Bakery and Confectionery Technology (Coursework 4)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-61050-Nutraceuticals and Functional Foods (Coursework 5)	500	4		4:0:0	20	80	100	-	-	-	60
	Sem-IV	FOT-103-CW-62010-Sensory Evaluation (Coursework 6)	500	4	20	3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-62020-Fermentation Technology (Coursework 7)	500	4		3:0:1	20	80	100	20	80	100	75
		FOT-103-CW-62030--Food Plant Layout and Design (Coursework 8)	500	4		4:0:0	20	80	100	-	-	-	60
		FOT-103-CW-62040-Spices and Plantation Crops Technology (Coursework 9)	500	4		3:1:0	20	80	100	-	-	-	60
		FOT-103-CW-62050-Food by-product Utilization (Coursework 10)	500	4		4:0:0	20	80	100	-	-	-	60
Total Credit (Aggregate)					**80**								
Post-Graduate Degree in Food Technology with Coursework on completion of courses equal to a minimum of 80 credits													

SEMESTER – I
(COURSE WORK)

FOT-103-CC-5110: PRINCIPLES OF FOOD PROCESSING AND PRESERVATION

Credit: 3; **Lecture:** 2 Hrs per week; **Practical:** 2 Hrs per week, **Contact Hours:** 60; **Full Marks** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To know the different spoilage agents and the ways in which they act on food.
LO2: To understand the principles behind the various methods of food preservation.
LO3: To know how to use these principles to preserve different types of foods.
LO4: To study the method of action of different preservatives.

Course Outcomes:

CO1: Students will be able to know various food preservation techniques, including thermal, non-thermal processing and fermentation and other advance technology.
CO2: Understanding the advance methods of processing and preservation in industries.
CO3: Critical analysis of preservation methods based on efficacy and sustainability.
CO4: Learners could know the applications of preservation principles in real-world food industry settings.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Food Spoilage: Definition, types of spoilage - physical, enzymatic, chemical and biological spoilage. Mechanism of spoilage and its end products, shelf life determination. Sorting, Grading, Washing, Peeling, Cutting.	7	1, 3
2	Preservation by using Preservatives: Food preservation: Definition, principles, importance of food preservation, traditional and modern methods of food preservation. Food additives – definition, types, Class I and Class II preservatives.	7	3, 4
3	Preservation by use of high temperature: Pasteurization: Definition, types, Sterilization, Canning - history and steps involved, spoilage encountered in canned foods, types of containers used for canning foods. Drying, Dehydration, Food irradiation – Principles, merits and demerits, effects of irradiation and photochemical	8	1,2,3

	methods.		
4	Preservation by use of Low Temperature: Refrigeration - advantages and disadvantages, freezing: Types of freezing, common spoilages occurring during freezing, difference between refrigeration, freezing, chilling. Water activity, Intermediate moisture foods.	8	2,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	2.0	2.0	1.0	-	3.0
CO2	2.0	3.0	3.0	-	2.0	3.0	-	1.0	-	3.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	2.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	3.0	3.0
Average	**2.7**	**2.7**	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.5**	**2.3**	**3.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practicals:

1. Blanching of fresh fruits/vegetables.
2. Performing lye peeling for vegetables.
3. Determination of PPO and POD enzyme activity.
4. Determination of water activity in food products.
5. Drying of different local food products by sun, shade and tray drying.
6. Freeze drying of foods.
7. Osmotic dehydration of foods.
8. Retort processing of fruits/vegetable products.

Books recommended:

1. Desrosier (2006). The Technology of Food Preservation, 4th edition, CBS Publishers & Distributers, New Delhi.
2. Potter and HotchKiss (2006). Food Science, 5th edition, CBS Publishers & Distributers, New Delhi.
3. Zueth (2005). Food Preservation Techniques, CBS Publishers & Distributers, New Delhi.
4. Non-destructive Evaluation of Food Quality: Theory and Practice (2010) Jha, Shyam N. (Ed.) Springer.
5. Manay, N. S., & Shadaksharaswamy M. (2002). Foods, facts and principles (second edition). New age international publishers, New Delhi.

6. Fellows, P. (2004). Food processing Technology: Principles & Practices, 2nd edition, CRC Press USA.
7. Bhat R, Alias AK, and Paliyath G. 2012. Progress in Food Preservation. First Edition. Wiley-Blackwell.
8. Food Processing Principle and Application by HS Ramaswamy and M Marcotte.Taylor and Francis (2006).
9. Food Science: Research and Technology by AK Haghi. Apple Academic Press(2011).
10. Handbook of Food Process Equipment by G Saravakos and AK Kostaropoulos.Springer (2016).
11. Frazier, W. C. & Westhoff, D. C. (1996). *Food Microbiology*, Tata McGraw Hill and Co

FOT-103-CC-5120: FOOD CHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding of structure and reactions and functional properties of the different food constituents

LO2: Students will understand the functional properties of different food constituents.

LO3: Students will learn the fundamentals of chemical processes and their significance with respect to food processing and preservation.

LO4: To provide conceptual understanding of utilizing food constituents and their modifications for food applications.

Course Outcomes:

CO1: Understand chemical properties of food components (water, carbohydrates, proteins, lipids, vitamins, minerals, and pigments).

CO2: To relate properties and structures of chemical constituents in foods to their functional and chemical properties.

CO3: To relate the physical and chemical interaction between food constituents during processing and their impact on final quality.

CO4: To understand the importance and role of chemistry in preservation/shelf- life.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Definition of food chemistry, historic development of food chemistry. Approach to the study of food chemistry. Water in food, Physical properties and structure of ice and water. Colligative properties of aqueous solutions. Concept of water activity, moisture sorption isotherms, phase diagram, ice crystal growth. Relation of water activity and food preservation. Vitamins and minerals: Importance, functions and impact upon processing. Plant pigments, structure and impact upon processing.	10	1,2,3,4
2	Carbohydrates: Introduction and classification carbohydrates. Chemical reaction of monosaccharides: oxidation, reduction, caramelization. Polysaccharides: starch, glycogen, cellulose, gums, pectin, lignins, hemicelluloses. Starch structure, properties and modifications. Pectin types and gel formation mechanism. Structure and functional properties of Gums. Concept of dietary fiber.	10	1,2,3

3	Fats- Classification and structure of fats and fatty acids. Autoxidation of fats and its factors. Mechanism off lipid oxidation and measurement, Photo-oxidation of fats. Antioxidants and pro-oxidants. Frying and fat changes. Concept of inherent stability of oils, falvor reversion. Fat modification. Emulsions and emulsifiers; hydrophile lipophile balance. Novel oils and fat replacers.	10	1,2,3
4	Proteins: Protein structural hierarchy, classifications, sources. Protein denaturation and coagulation, non-enzymatic browning or maillard reaction steps and mechanisms. Functional property of proteins, surface activity, gel formation. Protein characteristics of different foods. Protein hydrolysis and advantages. Enzymes- types and chemical nature, factors influencing enzyme action, enzyme inactivation, coenzymes. Importance of enzymes in food processing.	15	1,2,3,4

Practical:

1. Determination of moisture on dry/wet basis.
2. Determination of protein by Kjeldhal/Lowry method/Bradford method.
3. Estimation of reducing and non-reducing sugars by Anthrone Method.
4. Iodine value, free fatty acids, acid value, peroxide value and rancidity tests for fats and oils.
5. Estimation of crude fat content by Soxhlet method.
6. Determination of total ash, acid soluble and insoluble ash
7. Estimation of total crude fibre and total dietary fibre.
8. Estimation of curcumin in turmeric.
9. pH and Total titratable acidity in food samples
10. Total soluble solids measurement in food samples.

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	-	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	2.0	-	2.0	2.0	3.0	2.0	2.0
CO3	2.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	2.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.3**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**2.0**	**2.5**	**2.5**	**2.3**	**2.0**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Damodaran, S., & Parkin KL. (2017). *Fennema's Food Chemistry*, 5th Edn. CRC Press USA.
2. DeMan, J.M, Finely, J.W., Hurst, W.J., & Lee, C.Y. (2018). *Principles of Food Chemistry, 4th Edn.* Spinger, Switzerland.
3. Potter, N.N., & Hotchkiss, J.H. (2007). *Food Science*. 5th Edn. CBS Publishers.
4. AOAC & Latimer, G.W.J. (2023). *Official Methods of Analysis of AOAC International,* 22nd Edn. AOAC International, USA.

5. Nielson, S.S. (2017). *Food Analysis,* 5th Edn. Spinger.
6. Ranganna, S. (2017). *Hand Book of Analysis and Quality control for fruits and vegetables*. 2nd Edn. McGraw Hill Education.
7. Sadasivam, S, & Manikam, A (2022). *Biochemical Methods*. 4th Edn. New Age International Private Limited, New Delhi.
8. B. Srilakshmi. (2003), *Food Science*, 3rd Edn., New Age International Publications.
9. Meyer, L. H. (2022). *Food Chemistry,* CBS Publishers & Distributors, New Delhi.
10. Vaclavik, V & Elizabeth, C.W (2014). *Essentials of Food Science,* 4th Edn, Spinger.

FOT-103-CC-5130: FOOD MICROBIOLOGY

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To provide an understanding about the role and significance of various categories of microbes.
LO2: To provide knowledge about different environmental & processing factors responsible for food changes.
LO3: Understand the various factors associated with growth, food spoilage and food-borne diseases from the microorganisms.
LO4: To familiarize the students with industrial standards concerning safe food production and the existent national and international systems that ensure food quality.

Course Outcomes:
CO1: Understand the principles involving food spoilage and preservation involving microorganisms.
CO2: Describe the characteristics of food-borne diseases, infections, and intoxications and their identification.
CO3: Demonstrate the use of standard methods and procedures for the microbiological analysis of food.
CO4: Explain different types of industrially important microorganisms and their role in food.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classifications, Procaryotes and Eucaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.	8	1,2
2	Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food products. Microbiology of food preservation, heating process, irradiation, low-temperature storage, chemical preservatives, high-pressure processing, control of water activity.	7	3
3	Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein.	8	3

4	Food microbiology and public health: food poisoning and microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, hurdle technology and its applications.	7	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	2.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	2.0	3.0	-	2.0	-	2.0	2.0	3.0	3.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.0**	**3.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Instruments of microbiology laboratory and their functions.
2. Preparation of nutrient medium slant, broths.
3. Demonstration of serial dilution method and techniques of isolation and enumeration of microorganisms.
4. To study the effect of temperature, pH and aeration on growth of microorganisms.
5. To demonstrate acid fast staining.
6. To stain the given bacteria by Gram's staining method.
7. To measure the size of given microorganisms by ocular micrometre.
8. To determine the number of microorganisms by Haemocytometer.
9. To determine the motility of bacteria by hanging drop method.
10. Biochemical tests for the micro-organisms.

Books recommended:

1. Frazier, W. C. and Weshoff, D. C. (2015). *Food Microbiology*: Tata McGraw Hill Publication,New Delhi.
2. Adam, M. R. & Moss, M. O. (2008). *Food Microbiology:* Royal Society of Chemistry,Cambridge.
3. James, M. J. (2005). *Modern Food Microbiology* (5th ed.): CBS Publishers, New Delhi.
4. Stanier, R.Y. (1996). *General Microbiology* (5th ed.): MacMillan, Hampshire.
5. Creager, J. G., Black, J. G. & Davison, V. E. (1990). *Microbiology: Principles & Applicants.* Prentice Hall, New Jersey.
6. Frazier, W. C. & Westhoff, D. C. (1995). *Food Microbiology (*4th ed.). TMH, New Delhi

FOT-103-CC-5140: FOOD ENGINEERING

Credit: 3; **Lecture:** 2 Hrs per week; Practical: 2 hrs per week, **Contact Hours:** 60; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the physical properties of biomaterials and basic principles of various unit operations in the food industry.

LO2: To provide more in-depth knowledge about momentum, heat and mass transfer and their applications in food processing and engineering.

LO3: To acquire knowledge about size reduction, heat exchanger, and dehydration processes and their application.

LO4: To make the student understand low-temperature processing methods and their importance in food processing.

Course Outcomes:

CO1: Ability to describe the basic physical properties of food materials and able to correlate these properties to process design and quality control during processing.

CO2: Knowledge about the calculation of heat transfer, mass transfer, and momentum analysis for food processing unit operations.

CO3: Understand the problems related to size reduction, and heat exchangers and be able to design evaporators and dehydration systems.

CO4: Acquired details about appropriate refrigerant, estimated freezing time, and able to design a cold storage.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Physical properties of biomaterials and their importance in food processing and its measurement techniques: size, shape, sphericity, volume, density, porosity, surface area, coefficients of friction, and angle of repose. Classification of unit operations and transport processes. Units, Dimensions and conversion. Energy and mass balances: their basic principles and applications in different unit operations.	6	1
2	*Momentum transfer:* Newton's law of viscosity, types of fluid flow, Continuity and Bernoulli equation, Velocity profile of power law fluid, Newtonian and Non-Newtonian fluids, Effect of temperature on viscosity, Viscosity measurement. *Heat transfer:* Fourier's law, conduction heat transfer through slab and cylinder, natural and forced convection, Overall heat transfer coefficient, Radiation: Principles and laws, radiation between two bodies, radiation heat transfer from surroundings. *Mass transfer:* Fick's law, Theories of	8	2

	mass transfer, Mass transfer rate. Analogies among momentum, heat and mass transfer.		
3	Size reduction of solid food: methods and laws, sieve analysis. Filtration, sedimentation and Centrifugation: principles, equipment and application. Mixing of solids and pastes, equipment, applications, mixing effectiveness. Heat exchanger: fouling factors, LMTD concept, Shell and Tube, Plate Heat Exchanger. Types of evaporators, design of single and multi-effect evaporators. Psychrometric chart and its applications. Drying mechanism, Drying rate curves, dehydration systems and equipment design.	9	3
4	Refrigeration: Selection of refrigerant, components of refrigeration system, pressure enthalpy charts. Freezing: Types of freezing systems, Temperature profile of food during freezing, Rate of freezing and Quality of Frozen Food, Calculation of Freezing time. Cryogenic freezing and its application. Thawing and its methods. Design example of a cold store.	7	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	-	1.0	3.0	-	2.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	1.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	1.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.3**	**2.0**	**3.0**	**3.0**	**1.3**	**3.0**	**1.5**	**1.8**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Determination of moisture content of food material on wet and dry basis.
2. Determination of bulk density, tap density, and true density of food materials.
3. Determination of sphericity, porosity, and angle of repose of food materials.
4. Determination of rehydration ratio of dehydrated foods.
5. Estimation of heat transfer co-efficient.
6. Determination of Dry bulb and wet bulb temperature.
7. Moisture sorption isotherm
8. Study of drying kinetics in any food material.

Books recommended:

1. D G Rao 2012. Fundamentals of Food Engineering. PHI Learning Private Limited, New Delhi
2. Sanjaya K. Dash, Pitam Chandra, Abijit Kar 2024. Food Engineering Principles and Practices. CRC Press, Taylor & Francis Group
3. Romeo T. Toledo 2007. Fundamentals of Food Process Engineering 3rd edition. Springer
4. R. Paul Singh and Dennis R. Heldman 2014. Introduction to Food Engineering 5th edition. Academic Press, Elsevier.

5. P J Fellows 2000. Food Processing Technology, Principles and Practice.
6. KA/PP Publ. Mohsenin NN. 1986. Physical Properties of Plant and Animal Materials. Gordon & Breach Science Publ.
7. Watson EL & Harper JC.1989. Elements of Food Engineering. AVI Publ.
8. Figura, L.O And Teixeira, A.A. 2007. Food Physics. Springer.
9. Sahin S. and Sumun S.G (2006) Physical Properties of Food . Springer
10. Steffe J. 1996. Rheological Methods in Food Process Engineering. Freeman Press. East Lansing, MI USA.Available Online WWW,egr.msu.edu/~steffe/
11. Rao M.A.; Rizvi, S.S H.; Datta, Ashim K. 2005, Engineering properties of Foods. Taylor & Francis

FOT-103-CC-5150: FOOD SAFETY AND QUALITY ASSURANCE

Credit: 2; **Lecture:** 2 Hrs per week;
Contact Hours: 30; **Full Marks:** 100

Learning Objectives:

LO1: To create understanding of quality control and assurance, risk assessments, GMPs, and regulations inthe food sector.

LO2: To illustrate the importance of food safety, food quality, food laws and regulations in Food industry.

LO3: To describe the food quality management systems and explain the nationals and international food laws and regulations.

LO4: To exemplify different food adulterants.

Course Outcomes:

The graduates will be able to demonstrate the ability to:

CO1: Describe various aspects of food safety, safety management systems, standards and quality control.

CO2: Explain Sensory/ Organoleptic evaluation -Difference, Preference and Scoring tests.

CO3: Grasp knowledge of the quality assessments of food products.

CO4: Comprehend food quality managements systems and apprehend the Indian and International food laws.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Definition, objectives and scope of food standards and quality assurance, including role of various national and international agencies. Total quality management– general awareness and role of management practices in quality control, concept of HACCP and ISO series and their importance. Plant/food industry sanitation, maintenance sanitary conditions and hygienic practices.	08	1, 4
2	Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Food inspection and safety measurements, food regulations and grades. Statistical analysis in quality control-sampling design of experiments and evaluation of results.	08	1,3
3	Methods of sensory evaluation, introduction to sensory analysis. Sensory evaluation techniques for fresh fruits and vegetable procured products. Food testing: hedonic test, general acceptability tests and other desirable ranking tests of sensory evaluation of flavour, aroma, taste, texture, and overall	06	2,3

	acceptability of food products.		
4	Various food standards and their regulating national and international agencies viz. FSSAI, Codex etc.. Methods of quality analysis: Moisture, proteins, carbohydrates, minerals, vitamins, fats, crude fibres and related substances. Raw material and finished products quality assurance: cereals, legumes, oil seeds, fruits and vegetables, laboratory methods for quality control.	08	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	1.0	-	2.0	3.0	-	2.0	-	1.0	3.0	2.0	1.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	1.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**1.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.0**	**2.0**	**2.5**	**2.0**	**2.0**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co. Lucknow.
2. Metha, R. & George, J. (2005). *Food Safety regulation concerns and trade: A DevelopingCountry Perspective.*
3. Pomeranz, Y. & Meloan, R. (1995). *Food Analysis: Theory and Practice:* AVI Publication, NewYork.
4. Askar, A. & Treptow, H. (1993). *Quality assurance in Tropical Fruit Processing.*
5. Mahindru, S. N. (2000). *Food Safety: A Techno-legal Analysis:* Tata Mc, India.

FOT-103-RC-5110: RESEARCH METHODOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 Hr per week; **Contact Hours:** 60 Hr; **Full Marks**: 100

Learning Objectives:

LO1: To help students to formulate well defined hypothesis, aims, objectives for research

LO2: To impart the knowledge of sampling techniques and record scientific data in a proper way.

LO3: To inculcate knowledge of scientific methodology in analyzing and representing research data.

LO4: To provide basic understanding about different statistical methods.

Course Outcomes:

CO1: Problematize, synthesize and articulate issues scientifically and design accurate research proposal.

CO2: Analyze data from various sources, draw valid evidence based conclusions and present complex information in a clear and concise manner to their peers.

CO3: Generate good research hypothesis, design, sampling, appropriate experiments, collect and interpret the data using appropriate statistical methods for experimental validation.

CO4: Understand basics of control chart for variables and for attributes with its application.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Introduction to Research Methodology: An introduction to basics of scientific research: objectives of research, types of research, research process and steps involved. Identification, selection and formulation of research problem. Intellectual property rights. Scientific Report Writing and Publication Process: Forms and types of scientific reports. Steps involved in scientific article writing. Publication process, selection of journals. Writing research proposals and steps involved. Dissertation/Thesis writing: format, content and chapterization. Bibliography and references, referencing styles. Appendices.	15	1
2	Sampling, Data Collection and representation: Sampling: design and types; steps involved in sampling; sampling types, sample size; sampling errors, advantages and limitations. Data types and collection: qualitative and quantitative, data processing. Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion. Application of mean, mode, median, variance, standard deviation	5	1,2
3	Computational Methods for hypothesis testing and Data Analysis:	15	2,3

	Test of significance: null hypothesis, level of significance and degree of freedom, steps involved in testing of hypothesis. Significance testing z-test, t-test for testing sample mean and difference between two means, paired t-test, chi-square test, F-test, analysis of variance. Usage of software packages for data analysis including MS Excel, SPSS, Design Expert, ORIGIN, etc.		
4	Statistical quality control: Introduction, advantages and limitations; Techniques of statistical quality control, control charts for variations, $\bar{x}$ and R chart, control chart for attribution, c chart, p chart, np chart; consumer risk, producer risk; Acceptance quality level (AQL); Lot tolerance percentage quality level (LTPD), process average fraction defective. Operative characteristic curve, simple and double sampling plans for pre-packaged foods.	10	2,4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	3.0	2.0
CO3	3.0	-	-	-	3.0	3.0	3.0	3.0	3.0	-	2.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**3.0**	**3.0**	**2.3**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Kothari, C. K.; Garg, G. *Research Methodology-Methods and Techniques*, 3rd Ed., New Age International, New Delhi, 2014.
2. Kumar, R. *Research Methodology–A Step-By-Step Guide for Beginners*; 2nd Ed., Pearson Education: New Delhi, 2005.
3. Montgomery, D. C. *Design & Analysis of Experiments*; 8th Ed., Wiley India: Noida, 2013.
4. Hubbard M. R. (2005) *Statistical quality control for food industry*, Springer Publishers.
5. Gupta S. C. & Kapoor V. K. (2014) *Fundamentals of Applied Statistics*

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – II
(COURSE WORK)

FOT-103-CC-5210: TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

To enable the students to:

LO1: Know the structure and composition of cereal grains, pulses and oil seeds

LO2: Learn Post harvest technology and processing of cereals, pulses and oilseeds

LO3: Understand the mechanism of preparation of extruded and fermented products from cereals and pulses

LO4: To know the anti-nutritional factors, present in pulses and methods to remove them

Course Outcomes:

On successful completion of the subject, the students will be able to:

CO1: Comprehend the recent advancement in the quality of major cereal, pulses and oilseed grains.

CO2: Understand the mechanism underlying the interaction of various flour components and their role in end use quality.

CO3: Grasp the basic and advanced milling methods for wheat, rice, maize.

CO4: Know about extraction and refining techniques of oils from oilseeds.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Production and utilization trends of different cereals, pulses and oilseeds; Structure and composition of common cereals, pulses and oil seeds. Wheat: Varieties, principles of milling, products and by-products, flour treatment, dough rheology, Rice-classification, milling, physico-chemical and cooking quality, accelerated ageing, milled rice products and by-product utilization, parboiling of rice and processed products based on rice.	12	1, 2
2	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	2, 3
3	Corn: Types, milling and manufacture of value-added products. Processing of barley, oats, sorghum and millets. Extruded Products: Macaroni, noodles, spaghetti and vermicelli. Fermented and health foods from grains.	10	1,2, 3

4	Oilseeds: Importance of oilseeds processing industry in India. Pre-conditioning of oilseeds for improving extraction efficiency. Expeller and solvent extraction process and equipment. Principles and methods of filtration of oil. Oil refining and hydrogenation process, utilization of oilseeds.	13	4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	2.0	3.0	1.0	2.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	1.0	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	1.0	2.0	2.0	3.0
CO4	-	3.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.3**	**3.0**	**3.0**	**2.3**	**3.0**	**2.0**	**1.8**	**2.5**	**2.5**	**2.0**	**2.3**	**2.0**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Determination of physical characteristics of cereals.
2. Milling of wheat into flours.
3. Determination of wet and dry gluten.
4. Parboiling of rice.
5. Determination of crude fibre in wheat flour.
6. Visit to local roller flour mill.
7. Visit to local bakery.
8. Visit to local rice hulling unit.
9. Determination of ash and sugars in flour and bakery products.
10. Cooking quality of rice.

Books recommended:

1. A Chakraverty: Post-harvest Technology of Cereal, pulses and oilseeds
2. Kent NL. 1983. Technology of Cereals. Fourth Edition. Pergamon Press.
3. Kulp K. & Ponte J. G. (2014). Handbook of Cereal Science & Technology, 2nd edition: CRC press.
4. Matz SA. 1969. Cereal Science. AVI Publ.
5. Pomeranz Y. 1987. Modern Cereal Science & Technology. VCH Publ.
6. Wrigley C.W. & Batey I. L. (2010). Cereal grains, assessing and managing quality, CRC press.
7. Dendy D. A. V. & Dobsasoczyk B. J. (2001). Cereal and Cereal Products, Chemistry and Technology: An ASPEN publication.
8. Owens G. (2000). Cereal Processing Technology: CRC Press.
9. Faridi H. & Faubin J. M. (1997). Dough Rheology & Baked product Texture: CBS Publishers.

FOT-103-DE-52010: FOOD NUTRITION AND BIOCHEMISTRY

Credit: 4; **Lecture:** 3 Hrs per week; Practical: 2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To acquaint students with the concepts of food and nutrition.

LO2: To learn about food groups, RDA, and diet planning steps.

LO3: To familiarize students with the classification of nutrients, and their metabolism in the human body.

LO4: To impart in-depth knowledge about the integration of metabolism, regulation of metabolism, and Interrelationship of nutrients.

Course Outcomes:

CO1: Understand the critical Concepts of Food and Nutrition.

CO2: Acquire knowledge on RDA, and various food groups.

CO3: Understand the fundamental concepts of metabolism and metabolic pathways.

CO4: Comprehend and summarize the interconnection, regulation, and significance of various biochemical reactions in maintaining an adequate nutritional status and health**.**

Course Content:

Unit No.	Content	Contact Hours	CO
1	Concepts of food and nutrition. Role of nutrition in maintaining health. Diet charts, therapeutic nutrition. Basic food groups. Nutritional- Biochemistry. National nutritional policy, Balanced Diet, and RDA for all age groups. Classification of foods. Units of energy. Calorific and nutritive value of foods. Measurement of Calories by bomb calorimeter. Basal metabolic rate (BMR) - definition, determination of BMR and factors affecting BMR	11	1,2
2	Metabolic pathways. Carbohydrates-Aerobic and anaerobic degradation. Hormonal regulations of blood glucose. ATP cycle, formation of ATP- Biological oxidation and electron transport chain-Reduction potentials, anatomical site and components of oxidative phosphorylation, enzymes involved membrane location of electron transport, chemiosmotic theory, inhibitors of respiratory chain. Significances of enzymes in food metabolism. Enzyme pattern in diseases.	12	3
3	Protein and amino acids. Protein degradation, fate of nitrogen (urea cycle). Protein quality evaluation. Nucleic acids- metabolism of nucleic acid components, biosynthesis of nucleotides. Lipids- Metabolism of triaclyglycerol, β oxidation of fatty acids, cholesterol. Regulation of lipid metabolism and ketone bodies. Oxidative stress and antioxidants. Free radicals	12	3

	and defense against free radicals.		
4	Integration of metabolism. Regulation of metabolism-Interrelationship of carbohydrate, protein and lipid metabolism. Role of Vitamins and Minerals in Metabolism, metabolic adaptation during starvation, exercise, stress and diabetes mellitus. Organ function tests, Water, electrolyte and acid-base balance. Tissue proteins and body fluids	10	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	1.0	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	3.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.5**	**1.5**	**2.3**	**2.5**	**2.5**	**2.5**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Calibration of volumetric glassware (Burette, pipette and measuring cylinder).
2. Calculation, preparation of normal, molar and percentage solutions.
3. Determination of Saponification Number
4. Determination of Acid Number
5. Tests for ketone bodıes in urıne by Gerhard test (for acetoacetic acid)
6. Estimation of starch from wheat flour
7. Estimation of lactose from milk
8. Estimation of Glycogen from liver
9. Estimation of Cellulose from plant material

Books recommended:

1. Lehninger, A.L.; Nelson D.L. and Cox. M.M., Principles of Biochemistry 3rd ed. New York. Worth Publishers McMullan Press, 2000
2. Conn & Stump: Outlines of Biochemistry.
3. Davis, I. D. H. (2006). Fundamentals of biochemistry. *Instructor*.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2013). *Fundamentals of biochemistry: life at the molecular level* (No. 577.1 VOE).
5. Champe, P. C., Harvey, R. A., & Ferrier, D. R. (2005). *Biochemistry*. Lippincott Williams & Wilkins.
6. Schowen, R. L. (1993). Principles of biochemistry 2nd ed. (Lehninger, Albert L.; Nelson, David L.; Cox, Michael M.).
7. U, Satyanarayna and U, Chakrapani. Biochemistry with clinical concepts and case studies.

FOT-103-DE-52020: FOOD ADDITIVES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:
To enable the students to:
LO1: Know the role of food additives in the design and innovation of new food ingredients, products and processes.
LO2: Study the classification of food additives.
LO3: Know the toxicological legislation aspects of additives.
LO4: Know the role of natural and synthetic preservatives and other additives

Course Outcomes:
On successful completion of the subject, the students should:
CO1: Understand the role of food additives in the design and innovation of new innovative value added products.
CO2: Understand the general aspects of the use of additives and processing aids such as definitions and classification.
CO3: Know toxicological studies required for the authorization of additives and use of legal criteria and safety aspects.
CO4: Know the health implication of natural and artificial food additives.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to Food Additives; Scope of food additives; Functions and uses of Food Additives; Classification- Intentional & Unintentional Food additives; Types of food additives, their toxicology and safety evaluation; Naturally occurring food additives.	12	1, 2,3
2	Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial colours), pigments, their importance and utilization as food color; Processing of natural and artificial food colorants. Food Preservatives: Classification- Natural & chemical preservatives; Mode of action. Antioxidants & chelating agents: Types of antioxidants -natural & synthetic; Mode of action of antioxidants in foods; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents.	10	2,4
3	Stabilizers, thickeners and Emulsifiers: Types; Applications in food processing; Sweeteners: Introduction; Classification-	10	1,2, 3

	Artificial sweeteners & Non-nutritive sweeteners; Health implications; Role of sweeteners in food processing. Flour bleaching & maturing agents; leavening agents; Acidity regulators.		
4	Taste and Flavoring agents: Classification of flavors- natural & synthetic; Flavor enhancer/ Potentatior; Importance of taste and flavours; Role of flavoring agents in food processing. Humectants/polyhydric alcohol, anticaking agent, firming agent; Starch modifiers; Antimicrobial agents, Clarifying agents, antifoaming agents, Fat mimetics and replacers.	13	2,3

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	1.0	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	1.0	2.0	2.0	3.0	3.0	2.0	3.0	-	3.0	1.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.5**	**2.0**	**3.0**	**2.5**	**1.5**	**2.0**	**2.5**	**2.5**	**2.0**	**1.7**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. E numbers of different food additives
2. Qualitative tests for presence of benzoic acid in foods
3. Qualitative test for presence of sulphurous acid in foods
4. Determination of total chlorophyll by spectrophotometric method
5. Study of effect of acidulants in fruit juices
6. Study of the effect of stabilizers/ thickeners on quality of foods
7. Study of the effect of clarifying agents on the fruit juices
8. Role of emulsifiers in foods
9. Role of leavening agents in baked food products
10. Role and mode of action of antioxidants in food products

Books Recommended

1. Belitz, H.D. Grosch W. and Schieberle. P. 2009. Food Chemistry. 4th Edition. Springer-Verlag, Berlin, Heidelberg.
2. Mahindru, S.N. 2008. Food Additives: Characteristics, Detection and Estimation. Aph Publishing Corporation, New Delhi.
3. Deshpande, S.S. 2002. Handbook of Food Toxicology. Marcel and Dekker AG, Basel, Switzerland.

FOT-103-DE-52030: ADVANCE ANALYTICAL TECHNIQUES

Credit: 4; **Lecture:** 3 Hrs per week; **Practical** : 2 Hrs per week **Contact Hours:** 75 Hrs; **Full Marks**: 200 (Theory100 + Practical 100)

Learning Objectives:

LO1: To develop an understanding about the advanced analytical and instrumental techniques.

LO2: To illustrate the principle and mechanism of different analytical instruments.

LO3: To illustrate applications of different analytical instruments for food analysis.

LO4: To describe bio-chemical analysis of food components.

Course Outcomes:

CO1: Explain theoretical aspects of important analytical techniques used in food analysis.

CO2: Describe the physical and chemical principles which underlie instrumental techniques for testing and analysing food raw materials and finished products

CO3: Select appropriate analytical techniques for specific food constituent analysis.

CO4: Compare advanced and conventional techniques and instruments to analyse chemical and physical properties of foods.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Microscopic techniques: History, Basics of Light microscopy, concept of resolution in microscope. Principles, instrumentation, advantages limitations and application of different light microscopic techniques. Electron microscopy: principle of working and advantages and limitations. Applications in evaluating food microstructures and others. Color measurement systems in food applications. Texture and rheology: Introduction, Definition/s and importance Application of texture analyser in food texture evaluation.	10	1,2,3
2	Spectroscopy: Principles of colorimetry and UV-VIS spectrophotometry. Instrumentation and working of colorimeter and spectrophotometer. Concept of Absorbance and transmittance. Beers and Lambert's Law; Extinction coefficient. Fluorescence and phosphorescence spectroscopy. Infrared Spectroscopy: Fourier transform infrared (FTIR) and FTIR-ATR spectroscopy instrumentation and working principle. Application of IR spectroscopy in food analysis. Atomic absorption spectroscopy principles, instrumentation and applications.	10	1,2,3,4
3	Chromatographic techniques, adsorption and partition, theory of chromatographic separation, distribution coefficient, retention factor. Types of chromatographic techniques and working principles: HPLC, Size-exclusion, Ion Exchange, Affinity	10	1,2,3,4

	chromatography etc. Instrumentation for HPLC and GC: columns, pumps, detectors, techniques and applications. Concept of theoretical plates, retention time, separation efficiency, resolution and applications.		
4	Electrophoretic Techniques: General principles, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis. Thermal techniques in food analysis, principles, instrumentation and application of Differential scanning calorimetry (DSC), Thermo-gravimetric analysis (TGA) and Bomb calorimetry in food analysis.	15	1,2,3,4

Practical:

1. Determination of food adulterants in given food samples.
2. Refractive index of oil by using Abbe's Refractometer.
3. Determination of water activity of given a food product.
4. Extraction and estimation of plant phenolic substances by colorimetric and spectrophotometric techniques.
5. Texture profile analysis of foods samples.
6. Estimation of Ascorbic Acid content in given food samples by HPLC/ Dye method.
7. Mineral profile analysis of food samples by Atomic Absorption Spectroscopy/chemical method.
8. Qualitative and quantitative analysis of amino acids/plant pigments by paper chromatography
9. Estimation of colour of different food products using Hunter colour Lab.
10. Determination of antioxidant activity of given food sample using HPLC.
11. Morphological characteristics of Food Samples using Light microscopy/SEM/TEM.

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	3.0	-	3.0	3.0	2.0	2.0	1.0
CO3	3.0	-	-	-	2.0	2.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**2.7**	**2.5**	**2.0**	**2.5**	**3.0**	**2.5**	**2.0**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Cruz, R.M.S., Khmelinskii, I, & Viera. (2014). *Methods in Food Analysis.*1st Edn. CRC press.
2. Pico, Y. (2012). *Chemical Analysis of Food: Techniques and Applications*. Academic Press.
3. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier.
4. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* 3rd Edn., Spinger.

5. Winton, A. L. (2001). *Techniques of Food Analysis:* Agrobios, Jodhpur.
6. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
7. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
8. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons

FOT-103-DE-52040: MEAT, FISH AND POULTRY PROCESSING

Credit: 4; **Lecture:** 3 Hrs per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To describe the muscle composition, structure and properties of meat muscle.

LO2: To explain the structural changes that take place post-mortem during conversion of muscle to meat.

LO3: To illustrate the manufacture and handling of meat and fish products and to assess the factors that affects the safety and quality of meat products.

LO4: To describe the manufacture and handling of egg and poultry products and to assess the factors that affects the safety and quality of poultry products.

Course Outcomes:

CO1: Understand the muscle composition, structure and properties of muscle meat.

CO2: Apply the process of manufacturing of various value added meat, poultry and products.

CO3: Inculcate the process of manufacturing of various value added fish products.

CO4: Learn about the various food standards in relation to meat, fish, poultry and egg.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Muscle structures and composition, conversion of muscle into meat. Meat composition from different sources. Pre-Slaughtering practices and methods. Ante and post-mortem inspection and grading of meat. Quality of meat. Plant layout, design and construction of an abattoir. Meat Microbiology and safety.	11	1,2
2	Meat tenderization. Processing and preservation of meat. Thermal processing and non- thermal processing. Meat Products - uncooked comminuted and restructured meat products, sausages, meat emulsions, dried meats, intermediate moisture meats and meat extracts, ready to eat (RTE) meat products. Packaging of meat products. Meat plant hygiene – GMP and HACCP. By product utilization	12	2
3	Fish classification and composition. Post mortem changes in fish muscle. Fish products processing. By product utilization. Quality control of processed fish. Handling, Preservation and transportation of fish. Indices of fish quality, Microbiology of fish and shell fish , Freezing of fish and shell fish. Commercially important marine products from India	12	3
4	Poultry types and classes. Classification of chickens. Nutritive value and composition of poultry meat. Methods of slaughtering, slaughtering equipment and operations, dressing, handling, storage. Preservation of poultry meat. Spoilage and its control.	10	2,4

	Egg: structure and composition, Quality evaluation of shell eggs. Egg processing, Spoilage and its control. Packaging of egg and egg products. FSSAI guidelines on FSMS compliance for meat and meat product		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	1.0	1.0	1.0	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	1.0	2.0	2.0
CO3	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	-	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**2.0**	**2.0**	**2.7**	**2.0**	**1.5**	**2.0**	**2.5**	**2.5**	**1.8**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Fish cutting and handling.
2. Dressing of poultry.
3. Study of external anatomy/body parts of cattle, buffalo, sheep and goat
4. Determination of water holding capacity of meat
5. Carcass inspection for detection the efficiency of bleeding
6. Blotting paper test
7. Determination of glycogen in meat
8. Dehydration of meat
9. Quality evaluation of egg
10. Preparation of fish pickle

Books recommended:

1. Mead G. (2004) *Poultry Meat Processing and Quality,* Woodhead Publishers.
2. Panda P. C. (1992) *Text Book on Egg and Poultry Technology*, Vikas Publishers.
3. Hui Y. H. (2012) *Handbook of meat & meat processing, 2nd Edition,* CRS Press.
4. Gracey JF. 1999. Thornton's Meat hygiene. 11th Ed. WB Saunders.
5. Stadelman W & Cotterill OJ. 2002. Eggs Science and Technology. 4th Ed. CBS.
6. Mountney GJ. Poultry Products Technology. 2nd Ed. AVI Publ.
7. Elton D. Aberle, John C. Forrest, David E. Gerrard, Edward W. Mills (2012). Principles of Meat Science, 5th Ed. Kendall Hunt Publishing Company.
8. Sharma, B.D. Outlines of Meat Science and Technology, (2011). Jaypee Brothers Medical Publishers.

FOT-103-DE-52050: ADVANCES IN FOOD PROCESSING TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Contact Hours:** 45; **Tutorials:** 1 Hr per week; **Contact Hours:** 15; **Full Marks:** 100

Learning Objectives*:*

To enable the students to:

LO1: To familiarize students with various advanced thermal processing methods.

LO2: To acquaint students with the emerging non-thermal technologies.

LO3: To describe the principles and working mechanism of electromagnetic radiation-based techniques.

LO4: To describe the process mechanism and application of advance extraction and dehydration processes.

Course Outcomes:

On completion of the course the students would be able to:

CO1: Ability to explain various novel thermal and non-thermal emerging technologies that can be applied to food processing for quality improvement of the processed foods.

CO2: Student can be able to explain the advantages and limitations of the emerging food processing technologies and methods to overcome the limitations.

CO3: Ability to develop ideas for research and development using the advanced food processing technologies.

CO4: Ability to explore the application of advanced hybrid drying technique to produced quality processed products.

Course Content:

Unit No.	Content	Contact Hours	CO
1	**Pulsed Electric Field Technology (PEFT)**: Definitions, Pulsed electric field treatment system, Microbial inactivation mechanism, Determinant factors in PEFT, Alternative applications of PEFT. **Food Irradiation**: Mechanisms, sources and applications of Food Irradiation. Beneficial chemical and biological effects of Irradiation on Foods. Safety of Irradiated Foods. Benefits of Food Irradiation, Consumer attitudes toward irradiated foods, Government regulations on irradiated foods.	10	1,2,3
2	**High-Pressure Processing (HPP)**: Principles and process, Packaging requirements, Microorganisms and enzymes inhibition in HPP, Effects of HPP on Food Quality, Other application. **Cold plasma (CP) processing**: The chemistry of CP, Categories of CP Technologies, Types of CP generator, microbial inactivation	13	1,2

	mechanism, application and Economics of CP. **Ultrasound processing**: The physics and chemistry of ultrasound, processing equipment, inactivation of microorganisms and enzymes, Ultrasound as a processing aid.		
3	**Microwave (MW) heating**: Heating mechanism, MW properties of foods, equipment, comparison of MW and convectional heating, benefits and application of MW heating in food Industry. **Radio-Frequency (RF) Processing**: Principle of RF heating, Dielectric Properties of foods at RF, RF Generators and Applicators, Differences between RFs and MWs, applications of RF. **Ohmic heating:** Fundamentals of ohmic heating, Electrical conductivity, Generic Configurations, application of Ohmic heating.	12	3,4
4	**Supercritical fluid extraction:** Principle, equipment and process description, application in food processing, constraints in Supercritical fluid extraction processing. **Superheated steam drying:** Basic principle, types, inversion temperature, advantages and disadvantages. **Recent advances in Hybrid drying technologies:** classification, key advantages and limitation, Electromagnetic radiation-based hybrid drying techniques.	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	3.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	1.0	3.0	2.0	-	1.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	1.0	1.0
CO4	1.0	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**2.0**	**2.0**	**2.7**	**2.5**	**1.5**	**2.7**	**2.5**	**2.5**	**2.3**	**1.7**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Barry G. S. and Özlem T. *Improving Food Quality with Novel Food Processing Technologies,* (CRC Press, 2018)
2. DA-WEN SUN. *Emerging Technologies for Food Processing,* (Academic Press, 2014).
3. Tadeusz Kudra and Arun S. Mujumdar. *Advanced Drying Technologies,* (CRC Press, 2009 2nd edition).
4. P.J. Cullen, Brijesh K. Tiwari, and Vasilis P. Valdramidis. *Novel Thermal and Non-Thermal Technologies for Fluid Foods*, (Academic Press, 2012)

FOT-103-DE-52060: NEW PRODUCT DEVELOPMENT

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 1 per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To understand the process of development of new food product.

LO2: To understand the role of research and development in food product development and food manufacture.

LO3: To development of new food product, which are nutritious, cost effective and marketable.

LO4: To acquired knowledge on quality, safety & regulatory aspects of new food product.

Course Outcomes:

CO1: Design new products using need based perspective and application.

CO2: Develop standards for new products.

CO3: Understand phases in food product development.

CO4: Formulate regulatory aspects on Intellectual property rights.

Course Content:

Unit No.	Content	Contact Hours	CO
1	New Food Products: Definition, Classification, characterization and factors shaping new product development. Nutritive value of foods. Food needs and consumer preference. Use of Ready Reckoners /Exchange list/ NIN Food database/ USDA Food Database. Product life cycle. The SWOT analysis.	15	1
2	Designing new products. Market-oriented NPD methodologies, use of novel food ingredients and novel processing technologies. Recipe development for infants, preschool, sports person, elderly, Selection of raw materials, portion size, standardization methods, calculation of nutritive values, cost production, shelf life. Food safety and food spoilage.	15	2, 3
3	Standardization and large- scale preparation. Brief introduction of phases in food product development. Developing standards products- various food ingredients used, use of additives. Sensory Evaluation Test – Designing score card, objective evaluation, Instruments used for texture evaluation.	15	2,3
4	Quality, safety & regulatory aspects. Developing packaging systems. Approval for Proprietary Product. Evaluation of the Launch, product performance testing. Developing test market strategies. Patent, patent laws, international code for Intellectual property rights (IPR). Storage and transportation. Role of government in promoting agricultural marketing.	15	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	2.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	2.0	2.0	3.0	-	1.0	2.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	2.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.0**	**2.3**	**1.7**	**2.0**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Book recommended:

1. Jacqueline H. Beckley, M. Michele Foley Elizabeth J. Topp &_J. C. Huang Witoon Prinyawiwatkul (2007). Accelerating New Food Product Design and Development. Blackwell Publishing Company. IFT Press. USA
2. Howard R. Moskowitz, I. Sam Saguy & Tim Straus (2009). An Integrated Approach to New Food Product Development. Taylor and Francis Group, LLC.USA
3. Mary Earle and Richard Earle (2008). Case studies in food product development Wood head Publishing Limited and CRC Press LLC.USA
4. Creating New Foods. The Product Developer's Guide: Marie D. Earle and Richard L. Earle (2001). Chadwick House Group Ltd. New Zeeland.
5. David H. Lyon, Mariko A. Francombe, Terry A. Hasdell and Ken Lawson (1992). Guidelines for sensory analysis in food product development and quality control. Chapman & Hall, 2-6 Boundary Row, London.

FOT-103-RC-5210: RESEARCH PUBLICATION ETHICS

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To help students understand the philosophy of research and ethics in scientific research.

LO2: Familiarise with plagiarism and the scientific misconduct in research activity.

LO3: Get familiar with publication Misconduct and predatory journals and publishers.

LO4: Get informed about the open access publishing and understand the publishing databases and research metrics.

Course Outcomes:

On completion of this course the students will be able to:

CO1: Learn about philosophy of research and publication ethics.

CO2: Understand the scientific misconduct in research.

CO3: Learn publication misconduct and able to identify predatory journals.

CO4: Become aware of the open access publishing and learn about publication database and research metrics

Unit No.	Content	Contact Hours	CO
1	Introduction to Philosophy: definition, nature and scope, concept, branches**.** Ethics: Definition, moral philosophy, nature of moral judgments and reactions. Common characteristics of ethical problems in social research. Ethics in Scientific Research: issues of authorship, criteria for authorship and contributorship, peer review's role, research ethics in human and animal subjects, research ethics committees, conflict of interest.	15	1, 2
2	Scientific Misconduct: Falsification, Fabrication, and Image Manipulation. Institutional Responses to Scientific Misconduct, Misconduct in Regulated Research. Plagiarism, main sources and its types. Redundant Publications, redundant authorship, Problems caused by redundant publication, Acceptability and consequences of redundancy, prevention of redundancy, Salami Slicing and its parameters, Misrepresentation of Data.	15	1,2,4
3	Publication ethics: introduction and importance. Function and guidelines of COPE, WAME etc. Publication Misconduct: Misconduct by Editors, Publishers, and Peer-Reviewers, Types of Publication Misconduct, Violation of Publication Ethics, Concept of Spin, Predatory Publishers and Journals and their criteria for	15	3,4

	identification of predatory journals and publishers.		
4	Open Access Publishing, its merits and demerits. Benefits of Open Educational Resources for learners and teachers, Gray Literature, Preprint and Other Modes, Access tools and services to Open Access, Elsevier Journal Finder, Springer Journal Suggester. Database and its types, Citation databases: Web of Science, Scopus, Research Gate, Google Scholar. Calculation of Journal Impact Factor, Immediacy Index, h-Index and i-10 index, Altmetrics, Indian Citation Index.	15	1,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	3.0	2.0	-	-	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	2.0	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.5**	**3.0**	**2.0**	**2.7**	**2.5**	**1.7**	**2.5**	**2.5**	**2.5**	**2.3**	**2.3**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books Recommended

1. MacIntyre, A., *A Short History of Ethics: A History of Moral Philosophy from the Homeric Age to the 20th Century*; 2nd Ed., Routledge: London, U.K., 1998.
2. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. *On Being a Scientist: A Guide to Responsible Conduct in Research*; 3rd Ed., The National Academic Press: Washington DC, USA, 2009.
3. Muralidhar, K.; Ghosh. A.; Singhvi, A. K., Eds. *Ethics in Science Education, Research and Governance*; Indian National Science Academy: New Delhi, India, 2019.
4. Yadav, Santosh Kumkar. 2000. Research and Publications Ethics. Ishwar Books.
5. Deakin, L. (2014). Best practice guidelines on publishing ethics: A publisher's perspective. Wiley.

Note: Students might also opt for MOOC's equivalent courses.

SEMESTER – III
(COURSE WORK)

FOT-103-CW-61010: FOOD PACKAGING

Credit: 4; **Lecture:** 3 Hrs per week; **Tutorial:** 0 per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To explain packaging scope, importance & functions in the Food Industry

LO2: To impart knowledge on Packaging Systems and advance methods

LO3: To aware students about the recycling of packaging materials, biodegradable packaging materials and safety and legislative aspects.

LO4: To explain students about FSSAI regulations for packaging and food labelling.

Course Outcomes:

CO1: Comprehend advance knowledge on the properties and production of various packaging materials and effect of various indicators used in supply chain management to indicate the food quality

CO2: Understand various types of scavengers and emitters for improving the food shelf life.

CO3: Learn about consumer response about new packaging systems and safety and legislative requirements

CO4: Acquaint about food-package interaction between package-flavour, gas storage systems for food storage, recycling and use of green plastics for reducing the pollution and their effect on food quality.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Introduction to food packaging. Packaging scope & importance. Functions of food packaging, Factors affecting shelf life of food material during storage. Effect of these materials on packed commodities. Food- packaging interaction and migration. Packaging techniques-Active and intelligent packaging. Polymers with immobilized bioactive compounds.	10	1
2	Types of packaging materials and properties. Optical, mechanical and barrier properties of packaging materials. Structure and properties of plastic materials and processing and converting of thermoplastics. Paper and paper based packaging materials including tetra pack. Metal and glass packaging materials.	11	2, 3
3	Packaging Systems and advance methods: Vacuum Packaging, Controlled atmospheric packaging, Aseptic Packaging, Retort processing, Microwave packaging, Shrink and stretch packaging. Modified atmosphere packaging (MAP). Liquid and powder filling machines – like aseptic system, form and fill. Bottling	12	2,3

	machines. Form Fill Seal (FFS) and multilayer aseptic packaging machines.		
4	Green plastics, biopolymers, integrating intelligent packaging**.** Testing methods for flexible materials, rigid materials and semi rigid materials. Recycling packaging materials, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, FSSAI regulations for packaging and food labelling.	12	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	1.0	3.0	-	3.0	1.0	3.0	1.0	1.0	-	3.0	2.0	1.0	-	3.0
CO2	3.0	-	3.0	-	3.0	3.0	-	1.0	-	2.0	3.0	3.0	3.0	2.0
CO3	2.0	-	-	-	2.0	3.0	3.0	2.0	3.0	1.0	3.0	2.0	3.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.5**	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**1.5**	**2.5**	**2.0**	**2.5**	**2.3**	**2.7**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Classification of various packages based on material and rigidity.
2. Measurement of thickness of packaging materials.
3. Measurement of basic weight and grammage of paper and paperboards.
4. Measurement of water absorption of paper and paperboards (Cobb Test).
5. Measurement of grease resistance of papers.
6. Drop test, Box compression test.
7. Measurement of grease resistance of papers.
8. Head space analysis of packaged food.

Books recommended:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.
2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*:CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.
5. Robertson GL,(2012) *Food Packaging – Principles and Practice*, CRC Press Taylor and Francis Group
6. Raija Ahvenainen (2003) *Novel food packaging techniques*, Published by Woodhead Publishing Limited.

FOT-103-CW-61020: PROCESSING OF FRUITS AND VEGETABLES

Credit: 4; **Lecture:** 3 Hrs per week; Practical:2 Hrs per week; **Contact Hours:** 75; **Full Marks:** 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: Attain an overview on the post-harvest losses, maturity indices and Physiological stages of fruits and vegetables.

LO2: Acquaint with the post-harvest handling technologies and storage methods of fruits and vegetables to reduce postharvest losses.

LO3: Equip with the knowledge of processing and preservation of fruits and vegetables.

LO4: Impart the expertise in production and manufacture of fruits and vegetable-based food products and by-product utilization.

Course Outcomes:

CO1: Understand about the maturity indices and causes of various post-harvest losses in fruits and vegetables.

CO2: Gain knowledge about different storage methods and primary processing of fresh agricultural produce.

CO3: Understand the commercial canning and bottling process for various fruits, and vegetables.

CO4: Develop various types of processed products using fruits and vegetables and know about by-product utilization of waste of fruits and vegetables processing plants.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Objectives of F&V processing. Structure, composition and nutritive value of fruits and vegetables. Maturity indices for F&V and their methods of determination, Types of post-harvest losses, Factors affecting post-harvest losses. Physiological development of F&V. Respiration and transpiration processes. Ripening of climacteric and non-climacteric fruits. Role of ethylene in fruit ripening.	10	1
2	Harvesting Practices of fruits and vegetables. Storage methods for fresh fruits and vegetables: Controlled atmosphere storage, Modified atmosphere packaging, Hypobaric storage, Pre-cooling and Cold storage, Zero energy cool chamber. Transportation, Packaging, and Marketing of Fresh Produce. Primary Processing Techniques: grading, sorting, cleaning, washing, peeling, slicing, and blanching.	11	2

3	Canning and Bottling: Guidelines for the location of processing units, steps involve in canning process, Can manufacturing, testing of can, size of cans, preparation of sugar and brine for caning. Canning of fruits: apple, banana, jackfruit, orange, pineapple. Canning of vegetables: beans, mushroom, tomato, peas. Spoilage in canned foods: discoloration in canned food products, spoilage by micro-organisms and fungi, storage life of canned product.	12	3
4	***Fruit products:*** Processing of fruit beverages, Juice extraction, clarification techniques, Processing for jam, jellies, marmalades, preserves, candies and crystallized fruits, Theories and testing methods of jellies. ***Vegetable products:*** Processing for tomato-based products, Pickles, Sauces and Soups. Dehydrated F&V products. Quality standards and specifications of F&V-based products. Utilization of waste from F&V processing plant. Pectin manufacturing process and its uses.	12	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	2.0	3.0	-	2.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**1.7**	**3.0**	**2.5**	**1.8**	**2.5**	**2.0**	**2.5**	**2.3**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Practical:

1. Quality Standard Measurements of fruit and Vegetable Products
2. Determination of enzymatic browning in fruit-based products
3. Blanching of vegetables and its determination
4. Determination of Ascorbic acid in fruit/fruit-based products
5. Preparation of fermented products from vegetables
6. Preparation of osmo-dehydrated fruits products
7. Preparation of Dehydrated Vegetables
8. Preparation of tomato ketchup
9. Preparation of jam and jellies
10. Preparation of pickles

Books recommended:

1. Lal G, Siddapa GS and Tandon GL.1986. *Preservation of Fruits and Vegetables*. ICAR.

2. S. Ranganna 2014. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products, 2nd edition. McGraw Hill Education (India) Private Limited.
3. Kadar AA.1992. *Post-harvest Technology of Horticultural Crops*. Second Edition. University of California.
4. Thompson AK. 1995. *Post-Harvest Technology of Fruits and Vegetables*. Blackwell Sci.
5. Verma LR. & Joshi VK. 2000. *Post-Harvest Technology of Fruits and Vegetables*. Indus Publ.
6. D.K. Salunkhe and S.S. Kadam, 2013. A handbook of Fruit Science and Technology. CRC Press

FOT-103-CW-61030: DAIRY TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75; **Full Marks:** 200 (100 Theory + 100 Practical)

Learning Objectives*:*

LO1: To understand about the products that can be made from milk.
LO2: To understand the processing and storage of dairy products.
LO3: To know about the quality control measures applied in dairy industries.
LO4: To have a basic idea about their processing and products which can be made at a small scale

Course Outcomes:

On completion of the course, the students will be able to:
CO1: Understand the processes related to storage, processing and distribution of milk and milk Products.
CO2: Grasp the technology of fat rich dairy products.
CO3: Comprehend the technology of condensed milk, dried milk, cheese, yoghurt and indigenous products will be understood.
CO4: Have knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Unit No.	Content	Contact Hours	CO
1	Introduction: Milk - Definition, sources, and composition of milk, chemistry of milk constituents, factors effecting composition of milk, physiochemical properties of milk, grading of milk-definition and types of grades, collection and transportation of milk.	10	1, 4
2	Processing of market milk: Flowchart of milk processing, Reception, Different types of cooling systems. Clarification and filtration process, standardization- Pearson's square method, pasteurization-LTLT, HTST and UHT process- continuous pasteuriser, Sterilisation and Homogenisation, Cream separation-centrifugal cream separator, bactofugation.	13	1,2,3
3	Special milks: Skim milk, evaporated milk, condensed milk, standardized milk, toned milk, double toned milk, flavoured milk, reconstituted milk. Spray drying system: dried milk- whole milk and skim milk powder. Instantization of milk.	12	3,4
4	Indigenous and Fermented milk products: Product description, methods for manufacture of butter, cheese, ice cream, khoa, channa, paneer, shrikhand, ghee, Curd, Yoghurt, Acidophilus milk, Kefir, Kumis	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	1.0	3.0	1.0	2.0	2.0	-	2.0	-	2.0	3.0	1.0	2.0	1.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	2.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	1.0	2.0	3.0	2.0	3.0
Average	**2.7**	**2.0**	**3.0**	**2.0**	**1.7**	**2.7**	**2.5**	**1.8**	**2.5**	**2.0**	**2.5**	**1.8**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Sampling equipment and sampling of milk.
2. Platform tests (Acidity, COB and Alcohol test).
3. Determination of milk fat percentage by Gerber's method.
4. Determination of specific gravity by lactometer.
5. Microbial examination of milk samples.
6. Methylene blue reduction test of milk.
7. Analysis of milk: total solids, fat, SNF, protein, lactose, acidity, ash, total bacterial count,
8. Preparation of ghee from cream/ butter
9. Preparation of yoghurt/dahi
10. Dairy Industrial Visit (optional)

Books recommended:

1. Smit, Gerrit (2003). Dairy processing: improving quality, Woodhead publishing limited, England.
2. De, Sukumar (1991). Outlines of dairy technology, Oxford university press, Delhi. Edition : 46th Edition, 2019 · Media : Paper Back · ISBN : 9780195611946.
3. Varnam, A.H., Sutherland, J.P. (1994). Milk and milk products, Chapman and Hall, New York, USA.
4. Walstra, P., Geurts, T.J., Noomen, A., Jellema, A., Boekel, M.A.J.S (1999). Dairy Technology: Principles of milk properties and processes, Marcel Dekker, Inc, New York.
5. Winton, A. L. and Winton, K. B. (2000). Milk and Milk Products: Agrobios, India.
6. Kutty, C. I. and Khamer, S. (2004). Milk Production and Processing: Daya, Delhi.
7. Fox, P. F. and McSweeney, P. L. H. (1998). Dairy Chemistry and Biochemistry: Kluwer Academic, New York.
8. Kurmann, J. A., Rasic, J. L. and Kroger, M. (1992). Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products: CBS Publications, New Delhi.
9. Davis, J. G. (1994). Milk Testing: The Laboratory Control of Milk: Agro Botanical, Bikaner.

FOT-103-CW-61040: BAKERY AND CONFECTIONARY TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical**: 2 Hours per week; **Contact Hours:** 75; **Full Marks:** 200 (100 Theory + 100 Practical)

Learning Objectives:

LO1: To enable the students to understand the concept and technology of bakery & confectionary.

LO2: To make aware a student with knowledge and understanding of the raw material used for preparation of various bakery and confectionary products.

LO3: To make aware a student with knowledge and understanding in the basic operation and working of various equipment's involved in bakery and confectionary technology.

LO4: To make aware a student with knowledge and understanding in the basic steps and operation in preparation of bread, biscuits, cakes and other bakery products

Course Outcomes:

After completing this course students will be able to:

CO1: Understand various raw materials used for preparation of various bakery and confectionary products.

CO2: Have knowledge on basic operation and working of various equipment involved in bakery and confectionary industry.

CO3: Understand the various processes used for the manufacturing of bakery products like bread, biscuits, cakes etc. and their quality determination.

CO4: Acquire knowledge of the various processes used for the manufacturing of confectionary products like chocolate, candies, toffees etc. and their quality determination.

.

Unit No.	Content	Contact Hours	CO
1	Status of bakery and confectionery industries in India; Raw materials for bakery and their functions and standards- Flour, Leavening agents, sugars, fats and other minor ingredients. Bakery equipment: Different types of mixers and ovens used in bakery, dough divider, rounder, proofer, moulder, slicer etc.	10	1, 2
2	Hard wheat flour based products: Bread- Ingredients, various types of bread, equipments and types of mixing methods, preparation of bread, Product quality characteristics, Bread staling. Soft wheat flour based products: cookies, crackers, biscuits– Ingredients, types, equipments, method of preparation, Product quality characteristics, faults and corrective measures. Ingredient used in Cake Making, types and varieties, cake making methods, Product quality characteristics, faults and corrective measures of cakes.	14	1,2,3

	Other bakery products, Rheological testing, Hygiene and sanitation in bakery unit.		
3	Cocoa & Chocolate Processing: Cocoa bean- Introduction, history & Composition: Processing of cocoa bean, processed products of cocoa, historical developments in chocolate processing, ingredients and their role on chocolate, processing steps in chocolate- mixing, refining, conching, tempering, molding, cooling, coating, enrobing etc.	11	1, 4
4	Candy & Toffee Processing: High boiled sweets/candies- composition, processing & preparation of high boiled sweets- traditional, batch and continuous methods. Toffee- composition, types, ingredients & their role, batch and continuous methods of toffee manufacturing.	10	2, 4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	3.0	1.0	2.0	-	2.0	1.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	2.0	-	3.0	3.0	-	1.0	-	2.0	2.0	3.0	2.0	1.0
CO3	2.0	1.0	-	-	2.0	3.0	3.0	2.0	3.0	1.0	3.0	1.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.0**	**2.0**	**2.0**	**3.0**	**2.0**	**2.7**	**2.5**	**1.8**	**2.0**	**2.0**	**2.3**	**2.0**	**2.3**	**2.3**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Quality analysis of raw materials used in bakery industry.
2. Tests for the Rheological Properties of Dough
3. Preparation of Bakery Products – Bread, Biscuits, cookies, cakes, pasta, pizza etc.
4. Preparation of Chocolate
5. Preparation of Coated Confectionery
6. Quality Evaluation of the Bakery Products
7. Visits to bakery and confectionary industry. Local market survey for bakery and confectionary product

Books recommended:

1. Cruz, R.M.S., Khmelinskii, I, & Viera. (2014). *Methods in Food Analysis.*1st Edn. CRC press.
2. Khatkar B. S. (2011) Baking Science and Technology, Arihant Publication.
3. Amendola J. & Rees N. (2003) Understanding Baking: The Art and Science of Baking, Wiley. 3. Dubey S. C. (2002) Basic Baking, The Society of Indian Bakers.
4. Manley D. (2000) Technology of Biscuits, Crackers & Cookies. 2nd Edition, CRC Press.

5. NPCS Board of Food Technologists (2014) Confectionery Products Handbook (Chocolate, Toffees, Chewing Gum & Sugar Free Confectionery), Asia Pacific Business Press Inc.
6. Edwards W.P. (2007) The Science of bakery products, RSC Publications.
7. Mohos F. (2010) Confectionery & chocolate engineering, principles & applications, Wiley Blackwell Publishing Ltd.

FOT-103-CW-61050: NUTRACEUTICALS AND FUNCTIONAL FOODS

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To impart the concept of nutraceutical and functional ingredients in foods, and to determine their role in health and disease prevention.

LO2: To learn about various phytochemicals-their sources, functions and usefulness.

LO3: To understand basics of Extraction methods of Phyto-chemicals and development of functional foods.

LO4: To cater to the newly emerging area of nutraceuticals with respect to the types, mechanisms of action, manufacture of selected nutraceuticals, product development, clinical testing and toxicity aspects.

Course Outcomes:

On completion of the subject, the students will be able to:

CO1: Acquire knowledge on various bio molecules showing health benefits.

CO2: Understand various physiological and biochemical aspects of life threatening and chronic diseases.

CO3: Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.

CO4: Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Unit No.	Content	Contact Hours	CO
1	Nutraceutical and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, basis of claims for a compound as a nutraceutical, Nutraceutical for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc	10	1, 2
2	Photochemical and their usefulness Role of nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels, contraindications if any etc.	12	1,2,4
3	Extraction of Phyto-chemicals and development of functional foods: Extraction methods for maximum recovery, manufacturing aspects of selected nutraceuticals such as lycopene, isoflavonoids,	10	3,4

	glucosamine, phytosterols etc.; formulation of functional foods containing nutraceuticals – stability and analytical issues, labelling issues.		
4	Prebiotics and Probiotics: Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits, Examples of useful microbes and their benefits, Prebiotic ingredients in foods, types of prebiotics and their effects on gut microbes, Probiotic foods and their functional role, Marketing and regulatory issues for functional foods and nutraceuticals.	13	1,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	2.0	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	1.0	2.0	-	3.0	-	3.0	3.0	3.0	2.0	2.0
CO3	3.0	-	2.0	-	2.0	3.0	3.0	2.0	3.0	-	3.0	-	-	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.5**	**3.0**	**1.3**	**2.7**	**2.3**	**2.0**	**2.5**	**3.0**	**2.5**	**2.3**	**2.0**	**2.5**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books Recommended

1. Mine, Y and Fereidoon, S. (2006). *Nutraceutical Proteins and Peptides in Health and Disease*: TF, Bocaraton.
2. Bagchi, D. (2008). *Nutraceutical and Functional Food Regulations in United States and Around the World*: Elsevier, London.
3. Shi, J. (2007). *Functional Food Ingredients and Nutraceuticals*: Processing Technologies: CRC Press, London.
4. Guo, M. (2009). *Functional Food*: Principles and Technology: WP, New Delhi.
5. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
6. Shi J. (Ed) 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies, CRC.

SEMESTER – IV
(COURSE WORK)

FOT-103-CW-62010: SENSORY EVALUATION

Credit: 4; **Lecture:** 3 Hrs per week; **Practical**: 2 Hours per week; **Contact Hours:** 75; **Full Marks:** 200 (100 Theory + 100 Practical)

Learning Objectives:

LO1: To study the appropriate sensory evaluation tests related to the sensory quality of foods.

LO2: To understand the relationship between sensory and instrumental methods for the evaluation of food quality.

LO3: To determine the quality of food product through sensory evaluation.

LO4: To acquire knowledge on statistical methods for sensory evaluation.

Course Outcomes:

After completing this course students will be able to:

CO1: Know about sensory test methods.

CO2: Know procedures used to evaluate the flavor, color and texture of foods which helps to enhance acceptance of a product.

CO3: Understand the acceptable and rejection levels of food products.

CO4: Determine the quality of food products without laboratory testing.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Human sense organs, stimulus, perception, definition of sensory evaluation; basic tastes; threshold value, psychophysics, Tongue surface, Structure of eyes, Factors affecting sensory evaluation	10	1, 3
2	Sample preparation and presentation for sensory evaluation, Environment and test room design; product controls; types of sensory panels, panellist controls; factors influencing measurements: psychological and physiological errors	12	1,4
3	Statistical Methods for Sensory Evaluation, Classification of test methods; discrimination tests: paired-comparison, duo-trio and triangle tests; affective tests: qualitative-interview and focus group and quantitative tests-paired preference and acceptance tests; Two sample test, Ranking test, numeric scoring test, hedonic ranking test	13	1,3,4
4	Subjective and objective methods, Texture analyser- mechanical characteristics- chewiness, brittleness, and geometric characteristics, Sensory panel-types-criteria for panel selection, e-tongue, e-nose	10	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	2.0	-	2.0	1.0	-	3.0	-	3.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	2.0	2.0	2.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**1.7**	**2.3**	**2.5**	**2.0**	**2.5**	**3.0**	**2.3**	**2.3**	**2.0**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Practical:

1. Testing of Human sense organs
2. To perform Duo Trio test
3. To perform Triangle Test
4. To perform Paired Comparison test
5. To perform Two Sample Test
6. To perform Ranking Test
7. Analysis of any product through Hedonic scale
8. Texture analysis of food products mechanical/manual

Books Recommended:

1. Herbert Stone, Joel L. Sidel, (2012), "Sensory Evaluation Practices", Academic Press Publishers.
2. Maynard A. Amerine, Rose Marie Pangborn, Edward B. Roessler, (2013), "Principles of Sensory Evaluation of Food", Elsevier Publications.
3. Harry T. Lawless, Hildegarde Heymann, (2010), "Sensory Evaluation of Food: Principles and Practices", Springer Science & Business Media.

FOT-103-CW-62020: FERMENTATION TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; **Practical:** 2 Hr per week; **Contact Hours:** 75 Hr; **Full Marks**: 200 (Theory 100 + Practical 100)

Learning Objectives:

LO1: To develop understanding about basics of fermentation and microbes involved.
LO2: To illustrated different types of fermentation, microbial growth kinetics
LO3: To describe relevant technology and processes for manufacturing fermented foods.
LO4: To understand fermenter design, fermenter types, instrumentation and control.

Course outcomes:

CO1: Understand basics of fermentation, types, factors and application for specific food products.
CO2: Prepare and preserve starter culture, and evaluate growth kinetics and optimize fermentation conditions.
CO3: Processes involved in production of various fermented foods and production of ingredients.
CO4: Understand different fermenter design, instrumentation and process control.

Course Content:

Unit no.	Content	Contact Hours	CO
1	Definition and terminology in fermentation. History of food fermentations. Range of food products and others resulting from microbial fermentation (Microbial biomass, enzymes, metabolites, recombinant products, transformation process). Acid, alkaline, alcoholic fermentations. Microbes used in fermentations: Yeast, bacteria, other fungi. Component parts of a fermentation process. Safety assurance of fermented foods.	10	1,2,3
2	Fermentation methods: Submerged and solid state fermentation. Growth measurement during fermentation process; Microbial growth kinetics. Batch and continuous culture. Factors affecting microbial growth in fermentation: temperature, pH, oxygen and growth media constituents. Sterilization processes involved in fermentations. Culture preservation and inoculum development.	11	1,2,3, 4
3	Manufacture of fermented food products. Semi-solid and solid cultured dairy products (yogurt, curd, cream, cheeses etc); Fermented meat products; fermented soy products; fermented vegetable products (Kimchi, sauerkraut, pickles); fermented cereal foods (sourdough bread and bakery products); fermented beverages (beer, wine, distilled beverages). Organic acid production, fermentation derived food and feed ingredients	12	1,2,3, 4
4	Basic fermenters, Fermenter design: body construction materials, aerator and agitator. Types of fermenters: bubble column	12	1,2,3,

	fermenter, cylindro-conical fermentation vessel, air lift fermenters, deep jet fermenter. Instrumentation and control in fermenters. Oxygen transfer kinetics, K_La-values determination and factors affecting K_La-values.		4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	1.0	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	3.0	3.0	-	3.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	2.0	3.0	2.0	3.0	2.0	-	1.0	-	3.0	-	3.0	-
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**2.0**	**3.0**	**2.0**	**3.0**	**2.0**	**2.0**	**1.5**	**2.5**	**2.5**	**2.3**	**2.3**	**2.7**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Lee, B.H.(2022). *Advance Fermentation and Cell technology*. Volume 1 & 2. 1st Ed. Wiley Blackwell.
2. Berenjian, A. (2019). *Essentials in Fermentation technology*. 1st Ed. Spinger.
3. Stanbury, P. F., Whitaker and Hall, A. S. J. (2016) *Principles of Fermentation Technology*. 3rd Ed. Elsevier.
4. Hui, Y.H., Meunier-Goddik, L., Hansen, A.S., Josephsen, J., Nip, W.K., Stanfield, P.S. & Toldra, F.(2004). *Handbook of Food and beverage Fermentation Technology*. 1st Ed. Marcel Dekker Switzerland.
5. Lee, B.H.(2022). *Advance Fermentation and Cell technology*. Volume 1 & 2. 1st Ed. Wiley Blackwell.
6. Reed, G., Prescott and Dunn's Industrial Microbiology, AVI publication

F0T-103-CW-62030: FOOD PLANT LAYOUT AND DESIGN

Credit: 4; **Lecture:** 4 Hrs per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives:

LO1: To make students familiar with the overall integration of man, materials, machinery, and supporting activities.

LO2: To acquaint the students with the simplification of production processes in terms of equipment utilization.

LO3: To acquire knowledge on factory building and cost analysis.

LO4: To understand various process of plant maintenance.

Course Outcomes:

CO1: Implement appropriate guidelines for the food industry site selection.

CO2: Understand and apply the various network analysis techniques.

CO3: Evaluate food plant design, economics involved and cost evaluation.

CO4: Maintain food plant hygiene, record maintenance and record keeping in real time settings.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Plant Location and Layout-Concept and factors governing for selection of plant location. Comparison of rural vs urban plant sites, Classes of layout problems, objectives, principles and types of layouts – process layout, product layout, combination layout, fixed position layout; Layouts of different types of food industries – canning, dairy, bread, biscuit, beer, tomato processing, rice mill and wheat mill.	15	1
2	Planning for overhauling- Gantt bar chart, milestone chart, activity slack bar chart and its merits and limitations, Network Analysis of Processes-Basic terms, objectives and advantages of network analysis. Various network techniques-PERT and CPM techniques, their advantages and limitations.	15	2
3	Development of the pilot layout, Factory Building design and Cost Analysis- Considerations in building design, types of factory buildings, building construction materials for floors, walls, roofs, etc. Fixed cost, variable cost, depreciation, methods of economic analysis, profitability analysis of a plant.	15	3
4	Plant Maintenance: Objectives and importance of maintenance, types of maintenance – corrective or breakdown maintenance, scheduled maintenance, preventive maintenance and predictive maintenance, hygiene maintenance in food plant, hygiene of	15	4

	factory workers, record maintenance.		

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	1.0	1.0	1.0	3.0	2.0	1.0	-	3.0
CO2	1.0	-	3.0	2.0	3.0	3.0	-	1.0	-	2.0	3.0	3.0	2.0	3.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	1.0	2.0	1.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.3**	**2.5**	**3.0**	**2.5**	**2.0**	**3.0**	**2.0**	**1.5**	**2.0**	**2.5**	**2.0**	**2.3**	**1.7**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books Recommended:

1. Douglas ,J.M. , "Conceptual Designs of Chemical Processes",. McGraw Hill, 1989.
2. Peters ,M.s and Timmerhaus ,K.D, "Plant Designs and Economics for Chemical Engineers'' 4th Edition McGraw Hill,1 991.
3. S. N. Jha (2006). Dairy and Food Processing Plant Maintenance: Theory and Practice (ISBN No. 81-8189—088-4). Publisher: International Book Distributing Company (Publication division), Lucknow
4. Biegler L.,grossmann I.E.and Westeberg A.W. "Systematic Methods of Chemical Engineering and Process Designs ," prentice Hall ,1997.

FOT-103-CW-62040: SPICES AND PLANTATION CROPS TECHNOLOGY

Credit: 4; **Lecture:** 3 Hrs per week; Tutorial: 1 Hr per week; **Contact Hours:** 60; **Full Marks:** 100

Learning Objectives: To enable the students to:
LO1: Gain basic knowledge of spices and plantation crops.
LO2: Introduce to major and minor spice processing aspects.
LO3: Introduce to post-harvest technology and processing of plantation crops.
LO4: Gain basic knowledge of extraction techniques for spice oil and oleoresins

Course Outcomes:
On successful completion of the subject, the students should gain:
CO1: Detailed knowledge about the processing of Spices, and Plantation crops.
CO2: Detailed knowledge about the processing of minor spices.
CO3: Detailed knowledge of standard specification of spices as well as the functional packaging of spices and spice products
CO4: The skills to get internship opportunities in spice processing companies.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Production and processing scenario of spice, flavor and plantation crops and its scope; Major spices: Post harvest technology, composition; processed products of spices: Ginger, chilli, turmeric, onion and garlic, pepper, cardamom.	15	1, 2
2	Minor spices: Herbs, leaves and spartan seasonings and their processing and utilization; allspice, Annie seed, sweet basil; caraway seed, cassia, cinnamon; clove, coriander, cumin, dill seed; fennel seed, nutmeg, mace, mint, marjoram, rosemary, saffron, sage; savory, thyme, ajowan; asafetida, curry leaves.	15	2,4
3	Plantation crops: Tea, coffee, cocoa, sugarcane processing; vanilla and annatto processing; processing of areca nut, cashew nut, oil palm; Flavors of minor and major spices.	15	1,2, 3
4	Spice oil and oleoresins: Extraction techniques; Standard specification of spices; Functional packaging of spices and spice products; By-products of plantation crops and spices.	15	2,3,4

Mapping of POs/PSOs with COs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3.0	3.0	-	-	1.0	3.0	-	1.0	-	3.0	2.0	1.0	-	3.0
CO2	2.0	-	3.0	-	3.0	3.0	-	2.0	-	2.0	3.0	3.0	2.0	2.0
CO3	3.0	-	-	-	2.0	3.0	3.0	2.0	3.0	-	3.0	3.0	3.0	3.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	2.0	3.0
Average	**2.7**	**2.5**	**3.0**	**3.0**	**2.0**	**3.0**	**2.5**	**1.8**	**2.5**	**2.5**	**2.5**	**2.5**	**2.3**	**2.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [**3**: High; **2**: Medium; **1**: Low; -: No Correlation]

Books recommended:

1. Shanmugavelu, K.G. Spices and Plantation Crops. Oxford & IBH Publishing Co., New Delhi
2. Purseglave, J.W., Brown, E.G., Green and Robins C.L. Spices, Vol. I and II. SRJ Academic Press, New Delhi.
3. Pruthi, J.S. 2001. Spices and Condiments – Major Spices of India. National Book Trust, New Delhi.
4. Kenji Hirasa and Mitsuo Takemasa. 1998. Spice Science and Technology. Marcel Dekker, NY, USA.
5. Panda, H. Handbook on Spices and Condiments (Cultivation, Processing and Extraction). Asia Pacific Business Press Inc., New Delhi.
6. Gupta., S. Handbook of Spices and Packaging with Formulae. Engineers India Research Institute, New Delhi.

FOT-103-CW-62050 : FOOD BY-PRODUCT UTILIZATION

Credit: 4; **Lecture:** 4 Hrs per week; Hrs per week; **Contact Hours: 60**; **Full Marks:** 100

Learning Objectives:

LO1: To acquaint students with importance of food wastes for resource generation.
LO2: To make the students familiar with various aspects of food waste management in food industries.
LO3: To make the students aware about different aspects of biological conversion of solid waste to compost and biogas.
LO4: To gain knowledge on effluent treatment methods.

Course Outcomes:

CO1: Understand the processing techniques and disposal methods used for food waste.
CO2: Know about the production of different hazardous wastes from food industries.
CO3: Broaden their knowledge about conversion of waste to energy in perspectives of sustainable development.
CO4: Acquire fair amount of knowledge for waste management in urban areas.

Course Content:

Unit No.	Content	Contact Hours	CO
1	Origin and types of wastes and by-products. Present Scenario of Waste Management in India. Basic unit operations, techniques & equipment for food waste treatment. Types, availability and utilization method of byproducts of cereals, legumes and oilseeds processing industries.	15	1
2	Status and types of fruits and vegetables based waste and by-products. Utilization of fruits and vegetables waste. Distillation for production of alcohol. SCP production, organic acid production. Utilization of moringa, leafy vegetable and other wastes from fruit and vegetable processing industries.	15	2
3	Status and types of Meat, fish and poultry waste. Methods and production of meat, and poultry by-products, Fishmeal, Fish protein concentrate/isolate-fish body oils. Waste management and its recycling.	15	3
4	Pollution and global warming from different types of industrial food waste and their disposal methods. Various methods for waste treatment; Bio- methanation and bio-composting technology for organic waste; Incineration; Efficient combustion technology; Effluent treatment. Waste water utilization.	15	4

Mapping of POs/PSOs with Cos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2.0	3.0	-	3.0	1.0	2.0	2.0	1.0	1.0	3.0	1.0	1.0	-	2.0
CO2	3.0	-	1.0	-	2.0	3.0	-	1.0	-	2.0	3.0	3.0	1.0	2.0
CO3	3.0	-	2.0	-	2.0	1.0	1.0	2.0	2.0	-	2.0	3.0	3.0	2.0
CO4	-	2.0	-	3.0	-	-	2.0	2.0	2.0	-	2.0	3.0	3.0	1.0
Average	**2.7**	**2.5**	**1.5**	**3.0**	**1.7**	**2.0**	**1.7**	**1.5**	**1.7**	**2.5**	**2.0**	**2.5**	**2.3**	**1.8**

The Mapping Level Contribution between COs-POs/PSOs are Categorized as [3: High; 2: Medium; 1: Low; -: No Correlation]

Books recommended:

1. Waste Management for Food Industries by S Ioannis. Elsevier (2008).
2. Food Science by NN Potter. CBS Publishers (2007).
3. Essentials of Food Science by V Vaclavik and CW Elizabeth. Springer (2014).