St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A" Grade

Course Structure and Syllabus

of

M.Sc. Food Science and Technology

Learning Outcomes – Based Curriculum Framework for Postgraduate Food Science and Technology

(2021-22 ONWARDS)

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Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

Date: 16-02-2021

NOTIFICATION

Sub: Syllabus of **M.Sc. Food Science and Technology** under Choice Based Credit Scheme.

Ref: 1. Decision of the Academic Council meeting held on 12-12-2020 vide Agenda No: 5(2021-22)
2. Office Notification dated 16-02-2021

Pursuant to the above, the Syllabus of **M.Sc. Food Science and Technology** under Choice Based Credit Scheme which was approved by the Academic Council at its meeting held on 12-12-2020 is hereby notified for implementation with effect from the academic year **2021-22**.

ST. ALOYSIUS COLLEGE MANGALURU 575 003 (AUTONOMOUS)

PRINCIPAL **REGISTRAR**

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library
4. PG Office

Preamble

Just as society has evolved over time, our food system has also evolved over centuries into a global system of immense size and complexity. The commitment of food science and technology professionals to advancing the science of food, ensuring a safe and abundant food supply, and contributing to healthier people everywhere is integral to that evolution. Food scientists and technologists are versatile, interdisciplinary, and collaborative practitioners in a profession at the crossroads of scientific and technological developments. As the food system has drastically changed, from one centered around family food production on individual farms and home food preservation to the modern system of today, most people are not connected to their food nor are they familiar with agricultural production and food manufacturing designed for better food safety and quality.

Food Technology provides an effective and timely platform for researchers in universities, research institutions, and industries, to conduct research in cutting-edge processing technologies, involved from the beginning of the food supply source to the dinner table of the consumers. The potential exists for the agri-food industry to improve process efficiency, enhance product quality and, extend shelf-life of fresh and processed agri-food products and to establish processes, innovative and emerging technologies, and trends and future research in food and bio products processing are particularly important.

The two-year M.Sc. Food Science and Technology programme in the college offers 15 theory courses in Food Science and Technology, two open electives, seven laboratory courses and a project over a period of four semesters.

1. Introduction to Food Science and Technology

Agricultural production in the country is growing at the rate of 3.5% per annum resulting in marketable surplus in food grains and other agricultural commodities such as horticultural produce, fisheries and animal products etc. The post-harvest losses in the country today are very high (about approximately 30% of total production) in comparison with the post-harvest losses (about 5% or less) in most developed countries and some of the developing countries. This is causing tremendous economic loss and making the agricultural activity a commercially unviable proposition to the farmers. Keeping in view the globalization, privatization and liberalization policies in international trade for agriculture-based produce and products, the food processing industry will grow and expand rapidly. To operate this sector most efficiently, increased skilled manpower will be required.

The challenges for the food preservation, distribution and processing sectors are diverse and demanding, and need to be addressed on several fronts to derive maximum market benefits. Presently, the organizations addressing the educational and R & D requirements are too few, and there is a pressing need for supplementing their efforts. In the emerging scenario, the food science professional needs to develop sufficient awareness and appreciation of the relevant principles of life sciences, and physical sciences, as well as of a wide variety of other topics including: nutrition, preservation and storage techniques, processing unit operations, bio-processing, waste management, distribution and supply chain management, food laws and regulations and so on. Besides, the professional needs to develop an appreciation of R&D and innovation in critical technology areas such as: newer or novel process development in preservation and storage techniques, rheology, colloids and dispersal systems, packaging polymers and composites, sensors for detection and process control, bioprocess engineering, and so on.

The course contents have been so crafted that it can keep pace with the rapidly growing food industry. Since, Food Science and Technology is an interdisciplinary science it is recommended that subjects like Biochemistry, Biotechnology, Chemistry, Biostatistics etc. can be preferably chosen as the Open Elective (OE) by the students as they are synergistic to the curriculum. However, students are free to pick up any of the Open Elective Courses offered by other departments.

The learning outcomes-based curriculum framework (LOCF) for the postgraduate program in Food Science and technology is intended to provide a broad framework within which the program helps to create an academic base that responds to the need of the students to understand

the basics of Food Science and technology, its ever-evolving nature of applications in the applied sciences with a global perspective. The curriculum framework is designed and formulated in order to acquire and maintain standards of achievement in terms of knowledge, understanding and skills in Food Science and their applications to the industry as well as the development of scientific attitudes and values appropriate for rational reasoning, critical thinking and developing skills for problem solving and initiating research which are competitive globally and are on par in excellence with the standard Higher Education Institutions (HEI) across the globe.

The learning outcome-based curriculum framework in Food science and technology should also allow for the flexibility and innovation in the program design of the PG education, and its syllabi development, teaching learning process and the assessment procedures of the learning outcomes. The process of learning is defined by the following steps which should form the basis of final assessment of the achievement at the end of the program.

- The ability to use this knowledge to analyze new situations and learn skills and tools like food science, statistics, engineering and technology to find the solution, interpret the results and make predictions for the novel / innovative food product development.
- The development in understanding and knowledge of the basic Food Science i.e. food composition along with its physico-chemical, nutritional, microbiological and sensory aspects.
- The ability to apply the various food processing and preservation techniques for plant and animal foods; cereals, pulses, oilseeds, fruits vegetables, spices, meat, fish, poultry, sea food, milk and dairy products.
- The understanding on national and international food laws and regulations as well as importance of food engineering and packaging in food industry.
- The ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of food industry problems and to create new skills and tools for their possible solutions.

2. Learning Outcomes based approach to Curriculum planning

a. Nature and extent of PG program in Food Science and Technology:

The PG programs in Food Science and technology builds on the basic Food Science and Technology taught at the UG level in all the colleges in the country. Ideally, the undergraduate

education should aim and achieve a sound grounding in understanding the basic Food Science and Technology with sufficient content of topics from modern Food Science and Technology and contemporary areas of exciting developments in food industry to ignite the young minds. The curricula and syllabi should be framed and implemented in such a way that the basic connection between theory and experiment and its importance in understanding Food Science and Technology should be apparent to the student. This is very critical in developing a scientific temperament and urge to innovate, create and discover in Food Science.

Aims of PG program in Food Science and Technology.

The aims and objectives of our PG educational programs in Food Science and Technology is structured to

- Create the facilities and environment to consolidate the knowledge acquired at undergraduate level and to motivate and inspire the students to create deep interest in Food Science and Technology, to develop broad and balanced knowledge and understanding of concepts, processes and engineering aspects of Food Science.
- Learn, design and perform experiments in the labs to demonstrate the concepts, processes and engineering aspects learned in the classrooms.
- Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Food Science and Technology.
- Expose the student to the vast scope of Food Science and Technology as a theoretical and experimental science with applications in solving most of the problems of farmers and food industry
- Emphasize the discipline of Food Science and Technology to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.
- To develop the understanding and knowledge of the basic Food Science i.e. food composition along with its physico-chemical, nutritional, microbiological and sensory aspects.
- To acquaint the students with technologies of food processing and preservation techniques for plant and animal foods and enable to understand the national and international food laws and regulations for food safety and management as well as importance of food engineering and packaging in food industry.

- To emphasize the importance of Food Science and Technology as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

In view of opening the new windows in higher education and research and opening job opportunities at all levels from technicians to innovator scientists, this program is offered in our college and other higher education institutions (HEI) at the entry level of our higher education system.

3. Attributes of a Post Graduate in Food Science and Technology

Some of the characteristic attributes of a postgraduate in Food Science and Technology are

- **Disciplinary knowledge and skills:**
    i. Students are able to demonstrate comprehensive knowledge and understanding of one or more disciplines such as food chemistry, food engineering, food microbiology, food safety and management, quality control, technology of plant and animal-based foods and nutritional profiling etc.

    ii. Ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Food Science listed above in (i).

- **Research aptitude**: Students develop ability to demonstrate a sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing and articulating, demonstrate the ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships, plan, execute and report the results of an experiment or investigation in the food science as well as interdisciplinary subjects.
- **Skilled communicator:** Ability to express thoughts, technical information and ideas effectively in writing and orally, communicate with others using appropriate media, confidently share one's views and express herself/himself, demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- **Critical thinking:** Apply analytic thought to a body of knowledge, analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate processes,

food safety policies and food engineering theories by following scientific approach to knowledge development.

- **Problem Solving:** Demonstrate capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge and apply one's learning to real life situations.
- **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Food Science and Technology, and planning, executing and reporting the results of experimental investigation.
- **Team player/worker**: Capable of working effectively in diverse teams in facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team in both classroom, laboratory or pilot plant and industry.
- **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct; and safety and laboratory hygiene regulations and practices.
- **Digitally Efficient*:*** Capable of using computers for instrumental studies in Food Science and Technology and statistical analysis of data, and employing modern e-library search tools like Inflibnet, various websites of the renowned Food Science and Technology labs across the globe to follow the current research developments in the field of food science.
- **Ethical awareness / reasoning:** The graduate should be capable of demonstrating the ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Demonstrate the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
- **National and international perspective*:*** The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.
- **Self-Directed Learning:** Demonstrate ability to work independently, identify appropriate

resources required for a project, and manage a project through to completion.

- **Multicultural Competence:** Demonstrate knowledge of the values and beliefs of multiple cultures and a global perspective, effectively engage in a multicultural society, interact respectfully with diverse groups.
- **Community Engagement:** Demonstrate responsible behavior and ability to engage in the intellectual life of the educational institution, and participate in community and civic affairs.
- **Leadership Readiness/Qualities:** Demonstrate capability for mapping out where one needs to go to "win" as a team or an organization, and set direction, formulate an inspiring vision, build a team who can help achieve the vision, motivate and inspire team members to engage with that vision, and use management skills to guide people to the right destination, in a smooth and efficient way.
- **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Food Science and Technology.

4. Qualification descriptors for a PG program in Food Science and Technology

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification (for example a master's degree). The qualification descriptors also describe the academic standard for a specific qualification in terms of the levels of knowledge and understanding and the skills and competencies that the holders of the qualification are expected to attain and demonstrate. Qualification descriptors include a statement of outcomes, the achievement of which a student should be able to demonstrate at the end of the programme of study for the award of the qualification. These descriptors also indicate the national threshold academic standard for the qualification and help the degree-awarding bodies in designing, approving, assessing and reviewing Academic Programmes. The learning opportunities and assessment are expected to be designed to provide every student with the opportunity to achieve, and to demonstrate achievement of, the intended programme learning outcomes. The qualification descriptors reflect both disciplinary knowledge and understanding and generic/global skills and competencies that all students in different academic fields of study should acquire/attain and demonstrate. Some of the desirable outcomes which a postgraduate in Food science and Technology should be able to demonstrate are as follows:

- Demonstrate
  (i) a systematic, extensive and coherent knowledge and understanding of the academic field of study as a whole and its applications, and links to related disciplinary

areas/subjects of study; including a critical understanding of the established processes, technologies, their applications and of a number of advanced and emerging issues in the field of Food Science and Technology.

(ii) procedural knowledge that creates different types of professionals related to the subject area of Food Science and Technology, including research and development, teaching and government and public service.

(iii) skills in areas related to one's specialization area and current developments in the academic field of Food Science and Technology, including a critical understanding of the latest developments in the area of specialization, and an ability to use established techniques of analysis and enquiry within the area of specialization.

- Demonstrate comprehensive knowledge about materials and methods, including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to various subfields in food science and technology, and techniques and skills required for identifying food science and technology problems and issues in their area of specialization.
- Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources from the Food Science and Technology labs around the world, analysis and interpretation of data using methodologies as appropriate to the subject of Food Science and Technology in the area of his specialization.
- Use knowledge, understanding and skills in Food Science and Technology for critical assessment of a wide range of ideas and complex problems and issues relating to the various sub fields of Food Science.
- Communicate the results of studies undertaken in the academic field of Food Science and Technology accurately in a range of different contexts using the main concepts, constructs and techniques of the subject of Food Science and Technology.
- Address one's own learning needs relating to current and emerging areas of study relating to food science and technology, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge in this field.
- Apply one's knowledge and understandings relating to Food Science and Technology and skills to new/unfamiliar contexts and to identify and analyze problems and issues and seek solutions to real-life problems.
- Demonstrate subject-related and transferable skills that are relevant to some of the Food

Science and Technology- related jobs and employment opportunities.

5. Programme learning outcomes relating to M.Sc. in Food Science and Technology

The student graduating with the Degree M.Sc. in Food Science and Technology should be able to

- Acquire
  i. a fundamental/systematic or coherent understanding of the academic field of Food Science and Technology, its different learning areas and applications in basic food science and technology like food microbiology, food analysis, food safety management, food industry waste management processing and preservation of various plant and animal - based foods, functional foods, nutraceuticals, food physics, space food processing and nutrition and its relevance with related subjects like Biotechnology, Biochemistry, Chemistry, Environmental Sciences and Physics.

  ii. procedural knowledge that creates different types of professionals related to the disciplinary/subject area of food science, including professionals engaged in research and development, teaching and government/public service.

  iii. skills in areas related to one's specialization area within the disciplinary/subject area of food science and technology and current and emerging developments in the same field.

  iv. Relevance and significance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.
- Demonstrate the ability to use skills in food science and its related areas of technology for formulating and tackling agri-business problems and identifying and applying appropriate techniques and methodologies to solve a wide range of problems associated with food science.
- Demonstrate the ability to use the knowledge of food science in formulating and tackling food processing-related problems and identifying and applying appropriate processing techniques and methodologies to solve a wide range of problems associated with food science and technology.
- Recognize the importance of qualitative as well as quantitative data and approaches/methods for fully comprehending the agri-business society.
- Plan and execute Food science and technology-related experiments, analyze and interpret data/information collected using appropriate methods, including the use of appropriate

software such as programming languages and purpose-written packages, and report accurately the findings of the experiments while relating the conclusions/findings to relevant processes of food science.

- Demonstrate relevant generic skills and global competencies such as

  (i) problem-solving skills that are required to solve different types of food industry and agri-business sector problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary- area boundaries;

  (ii) investigative skills, including skills of independent investigation of food science-related issues and problems;

  (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;

  (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed;

  (v) ICT skills;

  (vi) personal skills such as the ability to work both independently and in a group.

- Demonstrate professional behavior such as

  (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;

  (ii) the ability to identify the potential ethical issues in work-related situations;

  (iii) appreciation of intellectual property, environmental and sustainability issues; and

  (iv) promoting safe learning and working environment.

Programme Learning Outcomes

Hard Core courses

S. No.		PH 591.1	PH 592.1	PH 593.1	PH 594.1P	PH 595.1P	PH 591.2	PH 592.2	PH 593.2P	PH 594.2P	PH 591.3	PH 592.3	PH 593.3P	PH 594.3P	PH 591.4	PH 592.4	PH 593.4	PH 594.4P
1.	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.	Application of basic Food Science and Technology concepts	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.	Linkages with related disciplines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.	Procedural knowledge for professional subjects	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.	Skills in related field of specialization	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.	Develop investigative Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7.	Develop Technical Communication skills	-	-	-	X	X	-	X	X	X	-	-	-	X	X	-	-	X
8.	Developing analytical skills and popular communication	-	-	-	-	-	-	-	-	_	_	-	-	X	-	-	-	X
9.	Developing ICT skills	-	-	-	X	-	-	X	_	-	-	-	-	X	-	-	-	X
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Soft core courses

S. No.		PS 596.1	PS 597.1	PS 598.1	PS 595.2	PS 596.2	PS 597.2	PS 595.4	PS 596.4	PS 597.4P
1.	Fundamental understanding of the field	X	X	X	X	X	X	X	X	X
2.	Application of basic Food Science and Technology concepts	X	X	X	X	X	X	X	X	X
3.	Linkages with related disciplines	X	X	X	X	X	X	X	X	X
4.	Procedural knowledge for professional Subjects	X	X	X	X	X	X	X	X	X
5.	Skills in related field of specialization	X	X	X	X	X	X	X	X	X
6.	Develop investigative Skills	X	X	X	X	X	X	X	X	X
7.	Develop Technical Communication skills	-	-	-	X	-	-	X	-	X
8.	Developing analytical skills and popular Communication	-	-	-	-	-	-	-	-	X
9.	Developing ICT skills	-	-	-	X	-	-	X	_	-
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self-reading, etc.,	X	X	X	X	X	X	X	X	X

Open Electives

S. No.		PO 598.2	PO 595.3
1.	Fundamental understanding of the field	X	X
2.	Application of basic Food Science and Technology concepts	X	X
3.	Linkages with related disciplines	X	X
4.	Procedural knowledge for professional Subjects	X	X
5.	Skills in related field of specialization	X	X
6.	Develop investigative Skills	X	X
7.	Develop Technical Communication skills	X	X
8.	Developing analytical skills and popular Communication	X	X
9.	Developing ICT skills	X	X
10.	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self-reading, etc.,	X	X

Structure of Postgraduate programme in Food Science and Technology

The M.Sc. (Food Science and Technology) Programme shall comprise "Core" and "Open Elective" courses. The "Core" courses shall further consist of "Hard core" and "Soft core" courses. Hard core courses shall have 4 credits; soft core courses shall have 3 credits. A candidate has to choose between the two options (A) or (B) for soft core courses. Open electives shall have 3 credits. Total credit for the programme shall be 92 including open electives.

Core courses are related to the discipline of the M. Sc (Food Science and Technology) programme. Hard core courses are compulsorily studied by a student as a core requirement to complete the programme of M.Sc. (Food Science and Technology). Soft core courses are electives but are related to the discipline of the programme. Two open elective courses of 3 credits each shall be offered in the II and III semesters by the department. Open elective will be chosen from an unrelated programme within the faculty.

Out of the total of 92 credits of the programme, the **hard core will make up 60-80% of** the total credits, **soft core 20-30%** while the **open electives will have a fixed 6 credits (3 credits x 2 courses**). Students have to take **minimum of 18 credits and maximum of 26 credits in any semester.**

One credit is equivalent to

(i) One hour of teaching per week,
(ii) Two or one hour per week of tutorial, and
(iii) Two hours or one and half hours of practical work/field work per week.
(iv) Open electives may have 3 hours of instruction for 3 credits

Project work is taken up in the **third and/or fourth semester** and open electives are taken in 2nd and 3rd semesters.

Theory courses

Topics in each theory course are equally distributed in four units for Hard core courses and three units for soft core courses as well as for open electives.

Lab Courses

1. **Processing and preservation technology of plant and animal-based food products:** A course of processing and preservation technology of plant and animal-based food products experiments are pre-scribed for all semesters. A rigorous study of theory of the concerned experiment is made along with the development of experimental skills.
2. **Management of Food safety and quality control:** Last two semesters consist courses on food microbiology, food safety and quality control and food biotechnology which are designed to improve the theoretical and experimental skills in the relevant filed.
3. **Food processing industry operations and waste management:** Two courses on Waste Management and Environmental Sustainability, Food Process Engineering and Instrumentation were introduced in the first and second semesters. This will help to solve typical problems in food processing industry operations and to valorization the food waste by various waste management tools

Project

There shall be a project in the Third semester. Evaluation of the project is done by two examiners (one external and one internal). The project will be evaluated for 100 marks out of which 70 marks is assigned for re-port/dissertation and the remaining 30 marks for internal assessment.

Seminars

A module of seminars has been included in the curriculum to improve presentation skills of the students. Each student has to give one seminar in a semester. The topics for the seminars will be assigned and will be guided

Credit Distribution for M.Sc. Food Science and Technology

Sl. No.	Nature of Papers	Total No. of Papers	Credit in Theory	Credit in Practical	Total Credits
1.	Core Course	10	40	-	40
2.	Discipline Specific Elective	06	18	08	26
3.	Generic Elective/Interdisciplinary	02	06	-	06
4.	Ability Enhancement Course	01	-	04	04
5.	Skill Enhancement Course	05	-	16	16
6.	MOOCs	00	-	-	00
7.	**Total**	**24**			**92**

Paper Distribution for M.Sc. Food Science and Technology

Semester	Compulsory Hard-Core Courses (HC) each with 04 credits (Total no. of Courses 10)	Soft core courses (SC) each with 03 credits. (Total no. of Courses 05)	Open Elective courses for students of other discipline/programme of 03 credits each	Compulsory Skill Enhancement Course (SEC) 08 credits in each semester	Total Credits
Sem I	PH 591.1 PH 592.1 PH 593.1	PS 596.1 PS 597.1	-	PH 594.1P PH 595.1P	**26**
Sem II	PH 591.2 PH 592.2	PS 595.2 PS 596.2	PO 598.2	PH 593.2P PH 594.2P	**25**
Sem III	PH 591.3 PH 592.3	-	PO 595.3	PH 593.3 P PH 594.3 P	**19**
Sem IV	PH 591.4 PH 592.4 PH 593.4	PS 595.4	-	PH 594.4 P PS 597.4 P	**22**
Total Credits	**40**	**15**	**06**	**31**	**92**

Detailed Course contents

I Semester					
Code	**Title**	**Lecture/Lab**	**Tutorial**	**Nature**	**Credits**
PH 591.1	Food Chemistry	**4**	**1**	**HC**	**4**
PH 592.1	Principles of Food Processing and Preservation	**4**	**1**	**HC**	**4**
PH 593.1	Fruits and Vegetables Processing Technology	**4**	**1**	**HC**	**4**
PH 594.1P	**Practical:** Food Chemistry & Principles of Food Processing and Preservation	**8**		**HC**	**4**
PH 595.1P	**Practical:** Fruits and Vegetables Processing Technology & Processing of Milk and Dairy Products	**8**		**HC**	**4**
PS 596.1	Processing of Milk and Dairy Products	**3**	**1**	**SC**	**3**
PS 597.1	Waste Management and Environmental Sustainability	**3**	**1**	**SC**	**3**
PS 598.1	Food Plant Management and Entrepreneurship				
II Semester					
PH 591.2	Food Process Engineering and Instrumentation	**4**	**1**	**HC**	4
PH 592.2	Processing Technology of Cereals, Pulses and Oil Seeds	**4**	**1**	**HC**	4
PH 593.2P	**Practical:** Food Process Engineering and Instrumentation	**8**		**HC**	4
PH 594.2P	**Practical:** Processing Technology of Cereals, Pulses and Oil Seeds & Spices and Plantation Crops Technology	**8**		**HC**	4
PS 595.2	Spices and Plantation Crops Technology	**3**	**1**	**SC**	3
PS 596.2	Research Methodology and Ethics	**3**	**1**	**SC**	3
PS 597.2	Food Product Development				
PO 598.2	Essentials of Food Science	**3**	**1**		3
III Semester					
PH 591.3	Food Microbiology	**4**	**1**	**HC**	4
PH 592.3	Nutraceuticals and Functional Foods in Human Health	**4**	**1**	**HC**	4
PH 593.3P	**Practical:** Food Microbiology & Nutraceuticals and Functional Foods in Human Health	**8**		**HC**	4
PH 594.3P	**Practical:** Project Work / Dissertation	**8**		**HC**	4
P0 595.3	Basics of Food Safety and Labelling	**3**	**1**	**SC**	3
IV Semester					
PH 591.4	Meat, Fish and Poultry Processing Technology	**4**	**1**	**HC**	4
PH 592.4	Food Packaging	**4**	**1**	**HC**	4
PH 593.4	Food Biotechnology	**4**	**1**	**HC**	4
PH 594.4P	**Practical:** Meat, Fish and Poultry Processing Technology	**8**		**HC**	4
PS 595.4	Food Safety and Quality Control	**4**	**1**	**SC**	3
PS 596.4	Food Hygiene and Sanitation				
PS 597.4P	**Practical:** Food Biotechnology & Food Safety and Quality Control	**8**		**SC**	3

First Semester

PH 591.1: Food Chemistry **52 Hours**

Course Learning Objectives:

- To study the relationships between the structure and functional properties of food molecules
- To study chemical processes and interactions of all biological and non-biological components of food
- To understand physico-chemical parameters in food

Unit I

Food chemistry: Definition, scope and importance. Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam. Proximate analysis.

Unit II

Carbohydrates: Definition and importance, classification, sources, functions, physico-chemical Properties of carbohydrates, Cellulose, Guar and Locust Bean Gum, Xanthan, Carrageenan's, Algins, Pectins, Gum Arabica and Dietary fiber. Starch (functionality of starch – gelatinization and retro gradation), Modified starches, resistant starches; Browning reaction in food: Enzymatic and non-enzymatic browning and applications in food.

Unit III

Lipids: Chemical Classification; Properties: Physical and chemical; Lipolysis, rancidity (hydrolytic rancidity, oxidative rancidity and microbial rancidity) and flavour reversion, auto-oxidation, modification of fats and oils (hydrogenation and inter esterification, winterization and acetylation); transfats; nutritional aspects of natural and modified lipids; fat substitutes. Chemistry of fats and oils.

Unit IV

Amino acids and Proteins: Definition and importance, classification, sources, functions. Super secondary structure, physical, chemical and functional properties of food proteins, texturized protein, denaturation of protein, gel formation, modification of food protein in processing and storage and its implications. Digestibility coefficient, biological value, net protein utilization (NPU), protein efficiency ratio (PER).

Unit V

Minor food constituents: Sources, properties and cofactors; Theory of Enzyme catalysis, Kinetics of Enzyme catalyzed reaction, Enzyme utilization in food industries. Minerals, vitamins, flavours and anti-nutritional compounds. Changes in vitamins and minerals during storage and processing.

Broad contents of the course:

- Water soluble interaction,
- Water activity
- Dispersed systems
- Transfats
- Lipolysis
- Texturized protein
- Digestibility coefficient
- Carbohydrates
- Denaturation

Course learning outcome:

- Know the chemistry underlying the properties and reactions of various food components
- Have sufficient knowledge of food chemistry to control reactions in foods.
- Know the major chemical reactions that limit shelf life of foods.
- Use the laboratory techniques common to basic and applied food chemistry.
- Know the principles behind analytical techniques associated with food.

Recommended Books:

1. H. D. Belitz and W. Grosch (2013) Food Chemistry Edition 2, Publisher: Springer Science & Business Media (ISBN 3662072815, 9783662072813)
2. Richard Owusu-Apenten (2004) Introduction to Food Chemistry. Publisher: CRC Press (ISBN 084931724X, 9780849317248)
3. John M. deMan (2013) Principles of Food Chemistry Edition 3, Publisher Springer Science Business Media (ISBN1461463904, 9781461463900)
4. Fennema OR (2017) Food Chemistry 5th Edition edited by Srinivasan Damodaran, Kirk L. Parkin. Publisher: CRC Press (ISBN 9781482208122)
5. Konstantinos N. Papadopoulos (2008) Food Chemistry Research Developments, Nova Publishers, (ISBN1604562625, 9781604562620)
6. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.
7. Coultate, T. P. (2009). Food: the chemistry of its components. Royal Society of Chemistry.
8. Friberg, S., Sjoblom, J., & Larsson, K. (2003). Food emulsions. CRC Press.
9. Whitaker, J. R. (2018). Principles of enzymology for the food sciences. Routledge.
10. Akoh, C. C. (2017). Food lipids: chemistry, nutrition, and biotechnology. CRC press.

PH 592.1: Principles of Food Processing and Preservation

52 Hours

Course Learning Objectives:

- To understand the source and variability of raw food material and their impact on food processing operations.
- To understand the physical, chemical and biological processes involved in conversion of raw materials into finished food products.
- To study the principles and current practices of different processing techniques and its effects on process parameters and product quality.
- To study the spoilage and deterioration mechanisms in foods and its preventive measures.

Unit I

Scope and importance of food processing; Historical developments in food processing; Factors affecting various food spoilage: Physical, Chemical, Microbial & miscellaneous. Heat preservation and processing: UHT and HTST. Thermal death time: Determination of process time. Types of heat treatments and its effects on foods; Canning: Introduction, principles and processing of foods. Packaging materials designed for processed foods.

Unit II

Water activity: Role of water activity in food preservation; Intermediate Moisture Foods (IMF): Principles, Characteristics, advantages and problems of IM foods. Food Frying: Principles and process: shallow frying, deep frying and frying oils. Mechanism of Oil uptake during frying: Factors affecting the frying process.

Food preservation: Types, uses and effects of class I and class II preservatives in foods. Conventional preservation methods: Pickling, Salting, Smoking and Sugar addition.

Unit III

Dehydration and Concentration: Drying, Drying curves, Different drying methods and type of dryers; Separation and concentration of food components. Different types of evaporators and ultra-filtration; Difference between dehydration and concentration; Changes during dehydration and concentration in foods. Rehydration and reconstitution of food.

Unit IV

Refrigeration: Principles, components, refrigeration load and storage; Changes in foods during refrigeration. Freezing: Freezing curves, slow and quick freezing, freezing methods, factors determining freezing rate, frozen storage, changes in food during freezing. Chilling: Equipment, Cold storage, Application in fresh and processed foods.

Unit V

Green Technologies for Food Processing: Super critical fluid extraction & Ultrasound treatment, High pressure processing (HPP), Pulse electrical field (PEF), Ohmic heating, Microwave processing, Food irradiation (x-rays, gamma rays and electron beam), Interaction of radiation with food components, Principles and applications of Hurdle technology.

Broad contents of the course:

- Thermal death time
- Intermediate Moisture Foods
- Dehydration
- Concentration
- Refrigeration
- Evaporators
- Cold storage
- Food irradiation

Course learning outcome:

- Describe the source and variability of raw food material and their impact on food processing operations.
- Explain the spoilage and deterioration mechanisms in foods and methods to control deterioration and spoilage.
- Describe the unit operations required to produce a given food product.
- Explain the principles and current practices of processing techniques and the effects of processing parameters on product quality.

Recommended Books:

1. Smith, J. S., & Hui, Y. H. (Eds.). (2008). *Food processing: principles and applications*. John Wiley & Sons.
2. Kalia M. and Sangita, S. (1996). *Food Preservation and Processing*, First edition, Kalyani Publishers, New Delhi.
3. Sivasankar, B. (2002). *Food Processing and Preservation*, Prentice Hall of India Pvt. Ltd, New Delhi.
4. Khetarpaul N. (2005). *Food Processing and Preservation*, Dya Publishing House, New Delhi.
5. Fellows, P. J. (2009). *Food processing technology: principles and practice*. Elsevier.
6. Heldman, D.R., & Hartel, R. W. (1997). *Principles of food processing*.Springer Science & Business Media.
7. Barbosa-Cánovas, G.V., Tapia,M.S., &Cano,M.P.(Eds.).(2004). *Novel food processing technologies*. CRC press.
8. Irudayaraj, J. M. (2001). *Food processing operations modeling: design and analysis*. CRC press.
9. Earle, R. L. (2013). *Unit operations in food processing*. Elsevier.
10. Ohlsson, T., & Bengtsson, N. (Eds.). (2002). *Minimal processing technologies in the food industries*. Elsevier.
11. Ramaswamy H and Marcott M. (2006). *Food Processing Principles and Applications*. CRC Press,

PH 593.1: Fruits and Vegetables Processing Technology

52 Hours

Course Learning Objectives:

- To have profound and detailed scientific knowledge and understanding of the biochemical processes in biological raw materials during their transformation into food products.
- Can critically evaluate the functionality and safety of foods in the context of human health, including the relation with raw materials and their processing into foods.
- To study about the processing of RTE, RTD and RTS.

Unit I

Classification and composition of fruits and vegetables and their nutritional significance; Climacteric and non-climacteric fruits; Pre-harvest factors influencing post-harvest physiology, post-harvest handling, post-harvest treatments, edible coatings in fruits. Physical and chemical indices of fruit maturity, Biochemical changes during ripening, processing and storage.

Unit II

Pre-processing operations: washing, blanching, peeling, sorting and grading of fruits and vegetables; Minimal processing of fruits and vegetables; Pre-storage treatments; Preserving the colour, flavour and nutrient content of the products. Storage studies: Controlled Atmosphere (CA) and hypobaric storage and recent developments, advantages and disadvantages.

Unit III

Process technologies for development of jam, jellies and marmalades; Role of pectin and theories of gel formation. Juice extraction and clarification, methods of bottling; Physiological and enzymatic aspects of fruit juice production; Fruit juice concentrates, Intermediate Moisture Foods (IMF), powders-preparation and specifications. Fruit beverages: Squash, Cordial, Crush, Ready to Serve (RTS), Ready to Drink (RTD), Ready to Eat (RTE), nectar and syrups.

Unit IV

Canning of fruits and vegetables and their spoilage; Preparation of natural and synthetic syrups, Sherbet and brines; Fruit preserves, candy fruits, Fruit bars. Drying of fruits and vegetables. Freezing of Fruits and Vegetables: Problems associated with specific fruits and vegetables; Fruit and Vegetable Fibres - specific processing.

Unit V

Processed fruit and vegetables products: Sauce, Puree, Ketchup and Tomato paste. Chutneys, Soup powders, Natural colors, mushroom and its value-added products. Fresh Frozen fruits and vegetables, Quality changes in frozen fruits and vegetables. Value added products (Banana products and Beans).

Broad contents of the course:

- Climacteric and non-climacteric fruits
- Pre-harvest factors
- post-harvest physiology
  Fruit maturity
- Pre & Post processing operations
- Controlled Atmosphere (CA)
- Pectin
- Concentrates
- RTS, RTE, IMF

Course learning outcome:

- Better understanding of the concepts of physiological characteristics of fruits and vegetables.
- Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.
- The students acquire insight into specific product and process related factors in the processing of fruits and vegetables.

Recommended Books:

1. W.V Cruess (2004): Commerical Fruit and Vegetable Products. Allied Scientific Publishers. Bikaner (India)
2. A.K. Thompson: Fruit and Vegetables – Harvesting, handling and storage. Edition Blackwell Publishing, 3rd Edition (2014)
3. Srivastava and Sanjeev Kumar : Fruit and Vegetable Preservation–Principles and Practices,
4. Revised and Enlarged Third edition (2017), International Book distributing Co. Lucknow (India)
5. Er. B. Pantastico: Post harvest Physiology, handling and utilization of tropical and Subtropical fruits and vegetables. AVI Publishing Company, Inc.R.P.
6. Girdharilal Preservation of Fruits and Vegetables. ICAR, New Delhi Thord Edition (2009)
7. Dauthy, M.E. Fruit and Vegetable Processing. International Book Distributin Co. Lucknow,
8. India. II *Edition*, NIIR Publications, *India*, 2004 Hamson, L.P. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.
9. Post-Harvest Management and Processing of Fruits and Vegetables (English, Paperback, G K Mathur, S S Chasta, N S Rathore) Edition 2012
10. Advances in Postharvest Fruit and Vegetable Technology (Contemporary Food Engineering) Ron B.H. Wills, John Golding , 1st Edition (June 2015).

PS 596.1: Processing of Milk and Dairy Products

39 Hours

Course Learning Objectives:

- To enlighten the students about Dairy development.
- To provide knowledge in new product development, hygiene practice, processing and by products utilization.
- To study the physic-chemical properties of milk and their products.

Unit I

Dairy industry in India: scope, strengths and opportunities for dairy industry. Milk: definition, composition and nutritive value, sources and types of milk, factors affecting composition of milk. Physico-chemical properties of milk. Milk fat structure, fat destabilization; Milk proteins and their types; Precipitation (casein micellar structure and its aggregation). Quality control tests.

Unit II

Grading of milk and criteria of grading. Storage and processing of milk: chilling, pasteurization (LTHT & HTST), sterilization (Retort), homogenization, UHT Processing. Clarification and standardization of milk. Membrane processing of milk: Microfiltration, Ultrafiltration and Reverse osmosis in dairy industry. Aseptic packaging.

Unit III

Condensed and evaporated milk: Composition, process of manufacture, defects. Technology of milk powders – Whole Milk Powder (WMP) and Skimmed Milk Powder (SMP): Composition, process of manufacture, defects. Instantization of milk powder. Technology of Cheese: Classification, Nutritive value, processing of cheddar, mozzarella cheese, defects. Technology of frozen milk products: Composition, process of manufacture, defects. Technology of milk products: Butter, Shrikhand, Ghee, Channa and Cream.

Unit IV

Novel concepts in dairy products: Cream powder, sterilized cream, butter spread, butter powder, cheese spread, whey protein concentrates, Lactose powder, infant milk powder. Standards for Milk and its products. Dairy plant sanitation: Hygiene in dairy Industry, different types of cleansing and sanitizing agents. Adulterated and Synthetic milk.

Broad contents of the course:

- Milk proteins
- Quality control
- Grading
- Pasteurization
- Sterilization
- Milk products
- Standards
- Sanitation
- Hygiene

Course learning outcome:

- Understand the processes related to storage, processing and distribution of milk and milk products.
- Perceive the different properties of milk and milk products and apprehend the thermal processing of milk.
- Grasp the technology of fat rich dairy products and Comprehend the technology of condensed milk, dried milk, cheese, yoghurt and indigenous products will be understood.
- Have knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Recommended Books:

1. P. Walstra Dairy Technology (1999) Principles of Milk Properties and Processes, Food Science and Technology.Publisher: CRC Press. (ISBN 0824746414, 978082474641)
2. Clark, S., M. Costello, M.A. Drake and F. Body felt. (2009) The Sensory Evaluation of Dairy Products, 2nd ed. Publisher: Springer.
3. Fox, P.F. and P.L.H. Mc Sweeney (2003) Advanced Dairy Chemistry. 3rd ed. Vol. 1. Proteins Vol. 2. Lipids (2006). Vol. 3. Lactose, Water, Salts and Minor Constituents (2009).Publishers: Springer.
4. Edgar Spreer (2017) Milk and Dairy Product Technology: Publisher: Routledge (ISBN1351431358, 9781351431354)
5. Trevor Britz, Richard K. Robinson (2008) Advanced Dairy Science and Technology: Publisher:John Wiley & Sons (ISBN 0470698055, 978047069805)
6. Adnan Y. Tamime (2009) Milk Processing and Quality Management Society of Dairy Technology. Publisher:John Wiley & Sons, (ISBN 1444301659, 9781444301656)
7. Maitan-Alfenas, G. P., & Casarotti, S. N. (2018). Enzymes and dairy products: Focus on functional products. In *Microbial cultures and enzymes in dairy technology* (pp. 1-22). IGI Global.
8. Cusato, S., Gameiro, A. H., Corassin, C. H., Sant'Ana, A. S., Cruz, A. G., Faria, J. D. A. F., & de Oliveira, C. A. F. (2013). Food safety systems in a small dairy factory: Implementation, major challenges, and assessment of systems' performances. *Foodborne pathogens and disease*, *10*(1), 6-12.
9. Fryer, P. J., Christian, G. K., & Liu, W. (2006). How hygiene happens: physics and chemistry of cleaning. *International journal of dairy technology*, *59*(2), 76-84.

Practical

PH 594.1P: Lab-1: Food Chemistry & Principles of Food processing and preservation.

PH 595.1P: Lab-2: Fruits and Vegetables Processing Technology & Processing of Milk and Dairy Products.

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PS 597.1: Waste Management and Environmental Sustainability

39 Hours

Course Learning Objectives:

- To learn about the methods used for the treatment of wastewater biologically.
- To understand modeling and design aspects of biological techniques available.
- To appreciate the importance of sorting and the careful disposal of various types of waste.
- To distinguish between various methods of waste disposal, assessing their advantages and disadvantages and environmental impacts.
- To assess the growth in awareness of the needs to manage waste and waste disposal techniques.

Unit I

Introduction: Classification of waste, types of waste generated and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry.

Unit II

Standards for emission or discharge of environmental pollutants from food processing industries. legislation related to environmental management (NGT, CPCB). Waste regulations-national and international scenario. Legal aspects related to storage and disposal. Solid waste: storage and disposal methods - land-filling, burial, incineration, recycling. Storage and disposal methods of liquid and gaseous waste. Biological treatment of food industry wastes. Recycling of food industry waste.

Unit III

Waste water treatment: Ion exchange treatment of waste water. Physical, chemical and biological characteristics of waste water. Measurement of organic content in waste water. Physical, chemical and biological unit operations in waste water treatment. Effluent treatment plants (ETPs). Zero liquid Discharge: Challenges, Technologies (Solvent extraction, Evaporation technologies, Membrane Bioreactor Technology (MBR).

Unit IV

Characterization and utilization of by-products from cereals, pulses, oilseeds, fruits, vegetables, plantation, dairy, eggs, meat, fish and poultry processing industries. Elements of importance in efficient management of wastes from food industries. Methods of utilizing wastes to make value added products: Pectin, food colourants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, biomolecules and enzymes from food processing industries.

Broad contents of the course:

- Industrial waste
- Effluent treatment plants
- Membrane Bioreactor Technology
- Zero liquid Discharge
- Waste regulations
- Utilization of by-products
- Organic content

Course learning outcome:

- Learn physical/chemical/biological characteristics of and the evaluation technique form various industrial waste water.
- Understand the theory, engineering application, and design technique for the industrial wastewater treatment unit processes.
- Design various environmental structures like water treatment plants, waste water treatment systems and air pollution control equipment's.
- Know solid waste remedial measures and their importance and Undertake projects related to solid waste management.
- Make decision based on the environmental consequences of proposed actions and promote environmentally sound and sustainable development by identifying appropriate measures.
- A sound understanding of the principal environmental policy issues confronting managers in diverse geographical and culture situations.
- A range of relevant practical skills, particularly in the fields of impact assessment, audit and law.

Recommended Books:

1. Robert R. Zall (2004), Managing Food Industry Waste: Common sense methods for Food Processors, Blackwell Publishing.
2. Loannis S. and Arvanito yannis (2008). *Waste Management in Food Industry*, Academic Press.
3. Ioannis S. Arvanitoyannis (2010) Waste Management for the Food Industries, Publisher: Academic Press, London.
4. Charis M. Galanakis (2015) *Food Waste Recovery*: Processing Technologies and Industrial Techniques Academic Press, London.
5. Maria Kosseva and Colin Webb (2013). *Food Industry Wastes: Assessment and Recuperation of Commodities*. Academic Press, London, UK.
6. Vasso Oreopoulou & Winfried Russ (2006). *Utilization of By-Products and Treatment of Waste in the Food Industry*. Springer Science & Business Media.
7. Elena Cristina Rada (2016) *Waste Management and Valorization: Alternative Technologies*. CRC Press.
8. Garrett Leonard Riley (2016) *Food Waste: Practices, Management and Challenges*. Nova Science Publishers.
9. Metcalf and Eddy Inc. (2003). *"Wastewater Engineering - Treatment and Reuse"*. 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

PS 598.1: Food Plant Management and Entrepreneurship

39 Hours

Unit I

Operation Research, definition and scope, techniques in operation research. Food plant management. Factors bearing on location and layout of food plants. Regulatory requirements of food industries. Structure and operation of food plants, Executive design making in a food plant; Evolution and role of management planning, organizing and controlling.

Unit II

Management decision making, problems of productions, production intending, marketing-sales forecasting, inventory and finance. Industrial cost accounting, purchase procedure, stores procedure, material accounting, overhead costing, budget and budgetary control, process and product costing.

Unit III

Introduction: types of waste generated; non-degradable & biodegradable wastes; food industrial wastes from fruit and vegetable processing industry; beverage industry, fish, meat & poultry industry, sugar industry and dairy industry Storage & disposal methods of waste; biological treatment of food industry wastes, Waste water treatment: standards for disposal of water, physical, chemical and biological characteristics of waste water; measurement of organic content in waste water; physical, chemical and biological unit operations, Effluent treatment plants (ETPs).

Unit IV

Concept of Entrepreneurship - Definition of Entrepreneurship, Entrepreneur and Manager - Enterprise and Entrepreneur. Organizational priorities, Managerial responsibilities; Forms of Ownership: Sole Proprietorship, Partnership & Corporation form of Organization - Advantages and Disadvantages, Franchising-Advantages and Disadvantages to Franchising; Project Appraisal Arrangement of funds : Traditional sources of financing – Equity shares, preference shares, Debentures/bonds, loan from financial institutions Project Implementation : Project contracts - Principles, practical aspects of contacts, legal aspects of project management, global tender, Negotiation for projects, Project insurance, Human resource management, network analysis.

Recommended Books:

1. Loannis S. and Arvanito yannis (2008). Waste Management in Food Industry, Academic Press.
2. Vasso Oreopoulou and Winfried Russ (2007). Utilization of byproducts and treatments of waste in Food Industry, Springer publication.
3. Ramachandran (2008) Entrepreneurship Development Publisher: Tata McGraw-Hill Education.
4. Ruth C. Young, Joe D. Francis and Christopher H. Young (1999) Entrepreneurship, Private and Public Publisher: University Press of America.
5. Theunis Christoffel Robberts (2013) Food Plant Engineering Systems, Second Edition, Publisher: CRC Press.
6. Robert R. Zall (2004), Managing Food Industry Waste: Common sense methods for Food Processors, Blackwell Publishing.
7. Vasso Oreopoulou and Winfried Russ (2007). Utilization of byproducts and treatments of waste in Food Industry, Springer publication.
8. Waldron K. (2007). Hand book of waste Management and Co-product Recovery in Food Processing, Wood head Publishing Company.
9. Yasmine Motarjemi & Huub Lelieveld (2013) Food Safety Management: A Practical Guide for the Food Industry Publisher: Academic Press.

Second Semester

PH 591.2: Food Process Engineering and Instrumentation

52 Hours

Course Learning Objectives:

- To study the basics of Units and Dimension
- To study various unit operations in food processing industries
- To study different properties of food materials
- To study the relationship between heat and mass transfer

Unit I

Units and Dimensions: Classification of Dimensions, Classification of Unit Systems, Conversion of Units. Energy: Forms of Energy, Heat Energy and Enthalpy. Steam and Its Properties: Formation of Steam. Humidity and Psychrometric chart.

Unit Operation: Unit operations in Food Processing. Boilers, types of boilers and accessories.

Unit II

Engineering Properties: Mechanical, Thermal and Electrical properties of food, Phase transition phenomena in foods. Materials for food plant construction: Mild Steel (MS), Stainless Steel (SS) and Plastic. Corrosions in metals.

Unit III

Transport Phenomena: Introduction, Nature of properties of fluids, Viscosity and Consistency. Newtonian and Non-Newtonian Liquids. Simple Rheological Models. Viscosity as a Process and Quality Control Tool in the Food Industry. Flow of Fluid through Pipes. Pumps for food plants.

Unit IV

Heat Transfer: Theory of Heat Transfer, Classification of Heat Transfer Processes. Mechanisms of Heat Transfer: Conduction, Convection and Radiation. Mass Transfer: Classification, Theories and Laws of Mass Transfer. Factors affecting Heat and Mass Transfers. Heat exchangers, Boiling, Condensation and Evaporation. Freezing and Thawing. Thermal Processing of Foods. Non-thermal and Alternative Food Processing Technologies.

Unit V

Food samples and sampling techniques, Sensory analysis of foods, Electronic evaluation of sensory attributes – Electronic nose, Electronic tongue. Colour measurement in foods, Texture analysis in foods, Principles and application of Spectrophotometer, GC, HPLC, FTIR, AAS, ICP, DSC and NIR.

Broad contents of the course:

- Humidity
- Psychrometric chart
- Boilers
- Stainless Steel (SS)
- Transport Phenomena
- Electronic nose
- GC, HPLC, AAS

Course learning outcome:

- Learn the basics of units, dimensions and conversions of units
- Know the different types of boilers, accessories and its application in food industries
- Understand the different materials used in plant construction
- Learn the nature and its properties of various fluids
- Learn the various instruments used in food industries

Recommended Books:

1. C. Anandharamakrishnan and S. Padma Ishwarya, (2019) *Essentials and Applications of Food Engineering,* Publisher: Taylor & Francis Group, CRCPress, International Standard Book Number-13: 978-1-138-36655-8.

2. R. Paul Singh and Dennis R. *Introduction to Food Engineering*, Publisher: Elsevier Science & Technology, 5th Edition, ISBN: 9780123985309, 2013.

3. Romeo T. Toledo, (2000) *Fundamentals of Food Process Engineering* Publisher: CBS, 2nd Edition, ISBN: 0-412-05311-X.

4. Hosahalli S. Ramaswamy and Michele Marcotte, (2005) *Food Processing: Principles and Applications,* Publisher: CRC Press. ISBN-13: 978-1587160080,

5. Zeki Berk, (2009) *Food Process Engineering and Technology*, Publisher: Elsevier Science & Technology. ISBN: 978-0-12-373660-4.

6. P.G. Smith, (2009) *Introduction to Food Process Engineering,* Publisher: Springer Press, 2nd Edition, ISBN 978-1-4419-7661-1.

7. Subbulakshmi G. and Shobha A. Udupi, (2001) *Food Processing and Preservation*, Publisher: New Age International Pvt. Ltd., ISBN: 8122412831.

8. Bird, R. Byron, Stewart, Warren E. Lightfoot. (2009). *Transport Phenomena,* Publisher: Academic Internet Publishers 2nd Edition.

9. Pomeranz,Y. and Mrloan (1978). Food Analysis: Theory and Practice, Westport, connectiant: AVI.

10. Amerine, M.A. Pangborn, R.M., and Rosseler, E.B. (1965). *Principles of Sensory Evaluation of Food*. Publisher: Academic Press, New York.

PH 592.2: Processing Technology of Cereals, Pulses and Oilseeds

52 Hours

Course Learning Objectives:

- A greater in-depth understanding of the science and technology associated with grain processing.
- The structure of grains and the impact of grain characteristics on milling and grain utilisation.
- The concept of quality in relation to grains and grain-based products and value addition.

Unit I

Wheat: Structure and chemical composition. Criteria of wheat quality: Physical and chemical factors; Wheat milling: General principles and operations; Flour: Types, grades, physical and chemical tests; Dough rheology and its measurement. Bread manufacturing, role of ingredients, bread faults, staling, and enzymes. Additives used in bakery products: Flour improvers, leavening and bleaching agents. Technology of bakery products: Biscuit, cakes, pasta, macaroni and various processed cereal based foods. Production of starch and vital wheat gluten.

Unit II

Rice: Structure and chemical composition. Milling of rice: types of rice mill; rice whitening; rice bran as byproducts. Rice par boiling technology: Principle, different methods, changes during parboiling, advantages and disadvantages; Cooking characteristics of rice. Rice products: Flaked rice, parched rice, puffed rice; Fermented products (idli, dosa and miso) Aging of rice: Quality changes; processed products.

Unit III

Corn and Millets: Structure and composition. Different types; wet and dry milling, corn sweeteners (high fructose corn syrups) and their uses. Structure and composition of Barley, Barley malting process: Steeping, germination and drying; Classification of malt products, Applications of malt. Oats: Composition, processing of oats, use of oat mill products. Ragi and Jowar: Structure and composition, processing methods.

Unit IV

Pulses and Legumes: Status, production and major growing areas of in India and worldwide; Structure and chemical composition of pulses and legumes; Anti nutritional factors; Milling and processing of pulses; Utilization of pulses and legumes for value added products; Extrusion cooking technology; Snack foods; Development of low cost protein foods; Protein concentrates and isolates.

Unit V

Oilseeds: Sources and composition; Processing of oilseeds: post-harvest handling, oil extraction and refining; Factors affecting extraction; Utilization of oil mill by-products; packing and storage of fats and oils, physio-chemical properties of oils, changes during storage; Nutritional food mixes from oilseeds.

Broad contents of the course:

- wheat quality
- Dough rheology
- leavening and bleaching agents
- par boiling
- Aging
- processing
- Milling
- Extrusion cooking

Course learning outcome:

- Comprehend the recent advancement in the major cereal grains quality and processing aspects.
- Understand the mechanism underlying the interaction of various flour components and their role in end use quality.
- Grasp the basic and advanced milling methods for wheat, rice, maize.
- Know about by-product utilization of various grains.

Recommended Books:

1. Khetarpaul N. (2019). Bakery science and cereal technology. Daya Books.
2. Matz S. A. (1991). Chemistry and technology of cereals as food and feed. Springer Science & Business Media.
3. Liangli L. Yu, Rong Tsao, Fereidoon Shahidi, Cereals and Pulses: Nutraceutical Properties and Health Benefits, edited by, Wiley and Blackwell publisher (2012).
4. Dendy D.A.V & Dobraszczyk, B.J. (2001). Cereal and Cereal Products. Aspen.
5. Pomeranz,Y. (1998) "Wheat: Chemistry and Technology", Vol, 3, Am. Assoc. Cereal Chemists. St. Paul, MN, USA.
6. Rosentrater K.A &Evers A.D (2018). Kent's Technology of Cereals. 5th Edn.woodhead publishing, Oxford, UK.
7. Grain Legumes, Editor Antonio M. De Ron, Springer.
8. James Duke, Handbook of LEGUMES of World Economic Importance, Springer Science & Business Media. Elsevier.
9. Walter E, Green Vegetable Oil Processing: Revised First Edition. Farr Andrew Proctor, Elsevier.
10. Brijesh K Tiwari, Aoife Gowen, Brian McKenna, Pulse Foods: Processing, Quality and Nutraceutical Applications, Food Science and Technology, International series, Academic press, 2011.
11. CW Wrigley, Cereal Grains: Assessing and Managing Quality. Wood head Publishing (2015).
12. Nagi H.P.S, Shrama Savita, Sekhon K.S (2012) Handbook of Cereal Technology. Kalyani publisher. New Delhi
13. Chakraverty.A (2019) Post Harvest Technology Of pulses Legumes and Oilseeds, Oxford & IBH Publishing Company
14. Majumar D.K (2011) Pulse Crop production Principles and Technologies, PHI learning Private Limited.

PS 595.2: Spices and Plantation Crops Technology

39 Hours

Course Learning Objectives:

- To understand the technologies of post-harvest processing and its role in providing better quality produce to the consumer.
- To study the importance in preventing the pre and post- harvest losses.
- To study the importance of quality control and various standards required for domestic and export market.

Unit I

Spices: Classification; Processing of Indian spices: Pepper, Cardamom, Ginger, Chili, Turmeric, Clove, Garlic, Cinnamon, Mint and Vanilla. Adulteration in spices. Processing of Oleo resins and Essential oils; Culinary herbs: Lavender, Saffron and Parsley. Fumigation and irradiation of spices.

Unit II

Coffee: Production, Composition and Processing of coffee: Wet and Dry methods, Grading of coffee, Defects in coffee beans; Brewing of coffee; Instant Coffee technology; Methods of decaffeinating coffee. Types of coffee and different methods of preparation. Quality analysis and specifications of coffee; Processing of chicory and its uses in coffee.

Unit III

Tea: Production, Chemistry and Composition; Processing of different types of tea; Technology of CTC tea. Tea products such as soluble tea, instant tea, tea concentrates, decaffeinated tea and flavored tea; Quality evaluation and grading of tea.

Unit IV

Cocoa: Composition, Processing: Changes during fermentation; Processing of cocoa products (cocoa powder, cocoa liquor and cocoa butter) Quality control during cocoa processing. Chocolates: Nutritive value and Types; Processing of chocolates. Nuts: Composition; Processing of Coconut, Cashew nut, Arecanut and Palm and its value added products.

Broad contents of the course:

- Processing of Indian spices
- Quality analysis
- Specifications
- Quality evaluation
- grading
- Cocoa processing
- Chocolate

Course learning outcome:

- Students will understand practical knowledge on specialized production techniques of vegetables and spices.
- Students understand will Importance of vegetables & spices in human nutrition improved and national economy.
- Students will be acquainted with the knowledge of profitable crop Production technology.
- To understand the scientific cultivation methods of plantation crops like coconut, arecanut, cashew, tea, coffee & rubber.
- To know more about origin, area, climate, soil, improved varieties and cultivation practices such as time and methods of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield.

Recommended Books:

1. Susheela Raghavan (2006) Handbook of Spices, Seasonings, and Flavorings, Second Edition. Publisher:CRC Press.
2. Aliza Green (2015) The Magic of Spice Blends: A Guide to the Art, Science, and Lore of Combining Flavors. Publisher: Quarry Books.
3. Ian Hemphill & Kate Hemphill (2006) The Spice and Herb Bible 2nd Edition, Publisher: R. Rose.
4. John O'Connell (2016) The Book of Spice: From Anise to Zedoary. Publisher: Pegasus Books.
5. Azhar Ali Farooqi, B. S. Sreeramu & K. N. Srinivasappa (2005). Cultivation of Spice Crops. Publisher:Universities Press.
6. Bernard Minifie (2012) Chocolate cocoa and Confectionery: Science and Technology illustrated Springer Science & Business Media.
7. Steve T. Beckett Industrial Chocolate Manufacture and Use, 4th edition, Publisher John Wiley &
8. Sons, 2011.
9. SN Raghavendra (2010). "Application of biotechnological processing for value added products from fresh coconuts". Ph.D. Thesis: http://ir.cftri.com/10750/1/raghavendra_sn.pdf
10. Banerjee B. (2006).Tea Production and Processing. Oxford Univ. Press.
11. J.S. Prithi,(2010) Quality Assurance in Spices and Spice Products. Publisher: Allied Publishers.
12. Kenneth T. Farrel, Spices, Condiments and Seasonings 2nd edition, Publisher: Springer Science &amp Business Media.
13. Post-Harvest Technology of Horticultural Crops, Jan 2007 (Horticulture Science Series)

PS 596.2: Research Methodology and Ethics

39 Hours

Course Objectives:

- To understand the scientific approaches to research
- To understand the significance of research methods in food science
- To appreciate the importance of scientific writings and develop competence in writing skill
- To draft a research proposal and write a scientific paper

Unit I

Research: Types, objectives, research approaches, research and scientific methods, criterions of good research. Research Problem: Definition and techniques involve in defining a problem. Research Designs: Meaning, need for research design, features and types. Experimental Design: Basic principles of experimental design, selection of experimental material, Essential Constituents of Literature Review.

Unit II

Sampling: Need for sampling, unit, population and sample, sampling methods, Important Sampling Distributions, Central Limit Theorem and Sampling Theory. Sampling design: Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design. Data: Collection of Primary Data and Secondary Data. Classification and summarization of data. Presentation of Data - Diagrams and Graphs.

Unit III

Introduction to statistics: Measures of Central Tendency (Mean, Mode and Median); Measures of Central Dispersion (Range, Standard Deviation, Standard Error, Coefficient of Variation); Correlation-Regression-Simple, Multiple (three Variables). Tests of Significance –'t' Test (One Sample and Two Sample Tests), Hypothesis Testing, Level of Significance and Confidence Interval, Analysis of Variation (ANOVA). Multiple comparison test (DMRT), Chi square test for goodness of fit. Probability distributions. Application of computer in research: Basic principles of Statistical Computation using various softwares; design of experiments and analysis of results using various software (SPSS Statistics, Design Expert, etc)

Unit IV

Scientific/technical writing and research presentation: Types, Structure and components of Scientific Reports; Technical Reports and Thesis; Steps in the preparation of reports and thesis layout, structure and language of typical reports, illustrations and tables, bibliography, referencing and foot notes. Citation, Impact factor, h-index and Acknowledgement. **Ethics in research:** Responsible conduct; the regulations and ethics of animal use in research; Research ethics for human subjects; Role of ethics committees in biological research; **Intellectual Property Rights (IPR):** patenting of process and products; reproduction of published material; plagiarism.

Broad contents of the course:

1. Overview of Research
2. Scientific Thinking
3. Elements of Research
4. Quantitative Research Methods
5. Qualitative Research Methods
6. Presentation of Research
7. Ethics in research
8. Intellectual Property Rights (IPR)

Course learning outcome:

- Demonstrate knowledge of research processes (reading, evaluating, and developing)
- Perform literature reviews using print and online databases
- Define and develop a possible hied research interest area using specific research designs
- Compare and contrast quantitative and qualitative research paradigms, and explain the use of each in research
- Describe sampling methods, measurement scales and instruments, and appropriate uses of each
- Explain the rationale for research ethics, and the importance of IPR

Recommended Books:

1. Bandarkar, P.L. and Wilkinson T.S. (2000): Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai.
2. Copper, H.M. (2002). Intergrating research: A guide for literature reviews (2nd Edition). California: Sage Harman, E & Montages, I. (Eds.) (2007). The thesis and the book, New Delhi: Vistar.
3. Mukherjee, R. (1989): The Quality of Life: Valuation in School Research, Sage Publications, New Delhi.
4. Stranss, A and Corbin, J. (1990): Basis of Qualitative Research: Grounded Theory Procedures and Techniques, Sage Publications, California
5. Montgomery, D. C., (2001). Design and Analysis of experiments, Fifth Edition, John Wiley & Sons.
6. Kothari, C.R. (2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi
7. Vining, G. G., Kowalski, S. (2010). Statistical Methods for Engineers.2nd Edn. Cengage Learning (RS), Boston, USA.

PS 597.2: Food Product Development

39 Hours

Course Learning Objectives:

- To study the consumer food preferences and choices
- To enhance the knowledge base for product development
- To study the sensory evaluation of foods and to understand basics statistics

UNIT I

Market survey and its importance in; designing a questionnaire to find consumer needs for a product or a concept New food product development (NPD) process and activities: NPD success factors, new product design, food innovation case studies, market-oriented NPD methodologies, organization for successful NPD; Recipe Development; use of traditional recipe and modification; involvement of consumers, chefs and recipe experts; selection of materials/ingredients for specific purposes; modifications for production on large scale, cost effectiveness, nutritional needs or uniqueness; use of novel food ingredients.

UNIT II

Standardization & large scale production: Process design, equipment needed and Design; establishing process parameters for optimum quality; statistical analysis; application in product development and comparison of market samples; stages of the integration of market and sensory analysis.

UNIT III

Sensory evaluation of foods: Importance and application for product formulation. Sensory Evaluation; Lab requirements, Sensory panel, type, selection and training, Different types of sensory tests Instrumental tests for sensory attributes – colour, texture and odour. Electronic noses (e-noses) and electronic tongues (e-tongues): concept and applications.

UNIT IV

Quality, safety & regulatory aspects: Product Stability; evaluation of shelf life; changes in sensory attributes and effects of environmental conditions; accelerated shelf life determination; developing packaging systems for maximum stability and cost effectiveness; interaction of package with food; Regulatory Aspects; whether standard product and conformation to standards; Approval for Proprietary Product.

UNIT V

Advertisement, Marketing & Case studies: Product performance testing; market positioning, Marketing: developing test market strategies; various tools and methodologies to evaluate consumer attitudes, preferences

and market acceptance factors; Case Studies of some successes and failures- Factors that influence NPD success, innovation case studies to highlight best practice in terms of the integration of technological and marketing approaches to NPD; food choice models and new product trends.

Recommended books:

1. Piggott, J.R. 2008: Sensory Analysis of Foods. Elsevier Applied Science, London.
2. Ranganna S. 2006. Hand Book of Analysis and Quality Control for Fruits and Vegetables Products 2nd Ed. Tata McGraw- Hill Publishing company Limited. New Delhi.
3. Srilakshmi, B., 2001, Food Science, New Age International Pvt. Ltd., ND.
4. Mahendru, S.N., 2000, Food Additives, Tata McGraw Hills, ND.
5. Manay, N.S., 2001, Foods: Facts & Principles, Wiley Eastern Ltd., ND.
6. Robertson, G.L. (2006). Food Packaging: Principles and Practice (2nd), Taylor & Francis
7. Montgomery, D. C. (2007). Introduction to statistical quality control. John Wiley & Sons.
8. Clarke & Wright W., Managing New Product and Process Development. Free Press, 1999.
9. Earle R, Earle R & Anderson A, Food Product Development, Woodhead Publishing, 2001

Open Elective

PO 598.2: Essentials of Food Science

39 Hours

Course Learning Objectives:

- To study the history and evolution of food processing
- To acquire knowledge of the structure, composition, nutritional quality and post-harvest changes in various plant foods.
- To understand the structure and composition of various animal foods.

Unit-I

Dairy Science: Definition, composition and nutritive values, sources and types of milk, Milk fat structure, Milk proteins and types; Processing of milk: Pasteurization (LTHT & HTST). Processing of milk powder – Whole Milk Powder (WMP). Cheese: Classification, types, processing of cheddar cheese. Dairy plant sanitation: Hygiene in dairy Industry.

Unit-II

Cereals: Rice, wheat and Millets - Structure Composition and Nutritive Value. Milling of wheat and rice. Parboiling of rice, Starch: Sources, Principles of Starch cookery. Different types of flour; Gluten properties, Gluten formation, types of Batter and Dough, Dough rheology. Leavening agents, Cake manufacturing and role of ingredients.

Pulses: Sources, Structure and Composition; Milling and processing, Anti-nutritional factors and its elimination. Malting and factors affecting. Protein concentrates and isolates.

Unit-III

Fruits and Vegetables: Composition, Classification, Nutritive value. Pigments in fruits and vegetables; Role of Pectin; Post harvest handling, Biochemical changes during maturation, Pre-processing operations. Canning of fruits and vegetables. Mushroom and its value added products. Hypobaric Storage.

Spices and Condiments: Pepper, Clove, Cinnamon, Ginger and Cardamom; Adulteration in Spices.

Unit-IV

Egg: Structure, Composition, Nutritive value, Quality evaluation of egg, Grading, egg storage and preservation methods, egg products.

Meat: Structure, Composition, Nutritive value, Conversion of muscle into meat, Grading of meat, Methods of stunning and slaughtering, Aging and meat tenderization, Storage and preservation of meat.

Fish: Composition, Nutritive value, classification, post-harvest changes in fish, factors affecting quality of fish, preservation methods.

Broad contents of the course:

- Milk fat
- Pasteurization
- Dough rheology
- Leavening agents
- Hypobaric Storage.
- Quality evaluation
- meat tenderization
- Preservation methods.

Course learning outcome:

- Understand the history and evolution of food processing
- Acquire knowledge of the structure, composition, nutritional quality and post-harvest changes in various plant foods.
- Understand the structure and composition of various animal foods.

Recommended Books:

1. P. Walstra Dairy Technology (1999) Principles of Milk Properties and Processes, Food Science and Technology.Publisher: CRC Press. (ISBN 0824746414, 978082474641)
2. Fox, P.F. and P.L.H. Mc Sweeney (2003) Advanced Dairy Chemistry. 3rd ed. Vol. 1. Proteins
3. Vol. 2. Lipids (2006). Vol. 3. Lactose, Water, Salts and Minor Constituents (2009). Publishers: Springer.
4. A R Sen, M Muthukumar, B M Naveena. (2013) *Meat Science: A Student Guide.* Satish Serial Publishing House
5. Khetarpaul N. (2019). Bakery science and cereal technology. Daya Books.
6. Food Science and experimental foods, Swaminathan, N. (1987) Ganesh Publications, Madras.
7. Foundations of Food Preparation, Peckham, C.G. (1979), The Macmillan co., London.
8. Food Theory and Applications, Paul P.C. and Palmer H.H. (1972), John wiley and Sons, New York.
9. Srivastava and Sanjeev Kumar: Fruit and Vegetable Preservation–Principles and Practices,
10. Er. B. Pantastico: Post harvest Physiology, handling and utilization of tropical and Subtropical fruits and vegetables. AVI Publishing Company, Inc.R.P.
11. Susheela Raghavan (2006) Handbook of Spices, Seasonings, and Flavorings, Second Edition. Publisher:CRC Press.
12. Aliza Green (2015) The Magic of Spice Blends: A Guide to the Art, Science, and Lore of Combining Flavors. Publisher: Quarry Books.
13. Ian Hemphill & Kate Hemphill (2006) The Spice and Herb Bible 2nd Edition, Publisher: R. Rose.

Practicals

PH 593.2P: Lab 3: Experiments based on Food Process Engineering and Instrumentation

PH 594.2P: Lab 4: Experiments based on Processing Technology of Cereals, Pulses and Oilseeds & Spices and Plantation Crops Technology

Third Semester

PH 591.3: Food Microbiology

52 Hours

Course Learning Objectives:

- To understand the fundamentals of food microbiology.
- To learn the novel methods for detection of immunological components.
- To study the criteria for microbiological assessments in various food products.

Unit I

Introduction, Historical developments of General and Food Microbiology; Classifications of microorganisms; Different sources of microorganisms in foods; Microbial growth curve, factors (intrinsic and extrinsic) affecting growth of microorganisms.

Unit II

Natural micro flora of various foods**:** Food spoilage and microbes of Milk, Fish, Meat, Poultry and other products. Contamination, Preservation and Spoilage of Cereals, Sugars, Fruits and Vegetable products. Measures to prevent microbial food poisoning, Microorganisms important in Foods: Foods and Enzymes produced by microorganisms.

Unit III

Isolation and Detection of Microorganisms: Conventional methods, Rapid methods, Immunological methods, Fluorescent anti body, Radioimmunoassay, ELISA and PCR.

Unit IV

Food microbiology and Public health: Food - borne Illness; Food - borne Poisoning, Infections and Intoxications: Bacterial agents of food poisoning by *Salmonella, Bacillus cereus, Listeria, Clostridium, Staphylococcus*. Non-bacterial agents of food poisoning: Poisonous algae and protozoa. Food poisoning by Fungus: Mycotoxins. Food - borne illness by Viruses.

Unit V

Food Sanitation and Control: Indicator microorganisms for monitoring the quality of foods Ex. *E coli*. Emerging food borne pathogens, recent examples of food borne disease outbreaks. Microbiological criteria for foods such as Milk, fish and meat products. GMP and HACCP. Enforcement and Control agencies.

Broad contents of the course:

- Microbial Growth Curve
- Food Spoilage
- Pathogens
- PCR-RT
- Food borne illness
- Rapid methods
- Indicator Microorganisms
- GMP, HACCP

Course learning outcome:

- learn the fundamentals of food microbiology.
- Identify the novel methods for detection of immunological components.
- Acquire the knowledge on various criteria for microbiological assessments in various food products.

Recommended Books:

1. James M. Jay (2000). Modern Food Microbiology, 5th Edition, CBS Publishers.
2. Banwart, G.J. (1997) Basic Food Microbiology, CBS Publishers.
3. Adam M.R.& Moss, M.O.(1995) Food Microbiology, New Age International Pvt. Ltd Publishers.
4. Bibek Ray (1996) Fundamental Food Microbiology, CRC Press.
5. Stanier, R.Y. (1996) General Microbiology, V Edition, MacMillan.
6. Pelezar, M.I and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5th Edition.
7. Frazier, W.C. (2014) Food Microbiology, McGraw Hill Inc. 5th Edition.
8. Doyle, P. Bonehat, L.R. and Mantville, T.J (1997) Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.

PH 592.3: Nutraceuticals and Functional Foods in Human Health

52 Hours

Course Learning Objectives:

- To understand the relationship between food, nutrition and health.
- Explore both the industry and the consumer roles involved in this growing field.
- Appreciate the commercial aspect of nutraceuticals.
- To learn the mechanism of action of probiotics.

Unit I

Nutraceuticals: Introduction, classifications and its concepts; Nutraceuticals as a new dietary ingredient; Biological significance. Nutraceuticals and dietary supplements. Functional foods; World market for nutraceuticals and functional foods; Regulatory issues. Relevance of nutraceuticals and functional foods in the management of diseases and disorders.

Unit II

Sources and Health Benefits: Natural pigments like chlorophyll, chlorophyllin, carotenoids, lycopene and anthocyanins; Glucosinolates; Isoflavonoids; Phytosterols; Phytoestrogens; Omega-3 and omega-6 fattyacids; Conjugated Linoleic Acid, Dietary fiber; Antioxidants. Development of functional foods, isolation, storage, processing and stability of phytochemicals and bioactive compounds. Recent developments in the isolation, purification and delivery of phytochemicals.

Unit III

The role of Nutraceuticals and functional foods in disease prevention: Angiogenesis, Cardiovascular diseases, Cancer, Diabetes, Cholesterol management and Obesity. Dosage for effective control of diseases and health benefits with adequate safety. Relation between nutraceuticals and Parkinsons, Alzheimer's diseases. Toxicity potential of nutraceuticals.

Unit IV

Prebiotics, Probiotics and Symbiotics: Introduction, criteria for selection, Role of gastro intestinal microbiota in health and disease; health effects of prebiotics and probiotics. Mechanism of action; Different types of prebiotics and their effects on gut microbes: Resistant starch, Fructo-oligosaccharides; Recent advances in probiotics; Challenges and regulatory issues related to probiotic products.

Unit V

Development of functional foods, isolation, storage, processing and stability of phytochemicals/bioactive compounds. Nutrigenomics: nutrigenomics an introduction and its relation to nutraceuticals. FOSHU Foods.

Broad contents of the course:

- Nutraceuticals
- Phytosterols
- Phytoestrogens
- Dietary fiber
- Antioxidants
- disease prevention
- Prebiotics & Probiotics

Course learning outcome:

- Acquire knowledge on various bio molecules showing health benefits.
- Understand various physiological and biochemical aspects of life threatening and chronic diseases.
- Apply their knowledge regarding extraction, isolation, characterization and application of nutraceuticals in food industries.
- Identify various aspects about safety, quality and toxicology of food products including, nutraceutical and functional foods.

Recommended Books:

1. Hand book of Nutraceuticals and Functional Foods Edited by. Robert E.C. Wildman, Robert Wildman. Taylor C. Wallace, Routledge Publishers, 2nd Edition, April 26, 2007, ISBN-13: 978-0849364099 ISBN-10: 0849364094

2. Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press, ISBN-13: 978-0853696599 ISBN-10: 0853696594 Edition: 2nd, April 26, 2007

3. Nutrition for the Older Adult by Melissa Bernstein, and Ann Schmidt Luggen (Author), ISBN-13: 978-0763736248 ISBN-10: 0763736244 Edition: 1st, August, 2009

4. Brigelius-Flohé, J & amp; Joos HG. (2006). Nutritional Genomics: Impact on Health and Disease. Wiley VCH.

5. Losso JN. (2007). Angi-angiogenic Functional and Medicinal Foods. CRC Press.

6. Robert EC. (2006). Hand book of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

7. Shi J. (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.

8. Webb GP. (2006). Dietary Supplements and Functional Foods. Blackwell Pub.

Practicals

PH 593.3P: Lab 5: Experiments based on Food Microbiology & Nutraceuticals and Functional Foods in Human Health.

PH 594.3P: Project work / Dissertation.

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Open Elective

PO 595.3: Basics of Food Safety and Labelling

39 Hours

Course Learning Objectives:

- To study the systematic approach to controlling food safety hazards within a food business.
- To understand the laws, standards and regulation of Food safety.
- To study the principles and current practices of different processing techniques and its effects on process parameters and product quality.
- To study the spoilage and deterioration mechanisms in foods and its preventive measures.

Unit I

Food Safety Basics: Importance of food safety in the food processing industry. Food hazards, Food quality assurance: Objectives, Importance, Functions and Principles. Food quality control: Objectives, Importance, Functions and Principles. Pest prevention and control. Current Scenario: Challenges to food safety.

Unit II

Quality Systems: Total Quality Management (TQM); Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Lab Practices (GLP), Standard Operating Procedures (SOP). Food Adulteration: Nature of adulterants, methods of evaluation.

Unit III

Food Safety: Hazard Analysis Critical Control Point (HACCP) system. Evaluation of severity of a hazard controlling food hazards. Traceability: Tracking and Recalling Program. Food Hygiene Program: Training programs. Personal habits, Hygiene verification. Food quality Standards: FSSAI and BIS.

Unit IV

Introduction to Food labeling, Regulations and Guidelines; Declaration of ingredients and additives; Allergens Labeling. Energy and References for intake. Nutritional labeling regulations: Mandatory and optional nutrients; Nutritional descriptors and approved health claims. Front of Pack (FOP) Nutrition Labeling; Date Labels, Storage instructions and Shelf life indications. Role of food labeling in food traceability.

Broad contents of the course:

- Food safety
- Food hazards
- quality assurance
- Quality Systems
- Adulteration
- Hazard Analysis Critical Control Point
- Traceability
- Quality Standards
- Food labeling

Course learning outcome:

- Understand the concept of food safety, types of hazards and their control measures.
- Identify and prevent potential sources of food contamination and comprehend the need of hygiene and sanitation for ensuring food safety.
- Understand National and International Food Safety Laws and Regulations.
- Practical knowledge to detect and quantify microorganisms from various routes of contamination of food.
- Understand various areas of Food Safety & Quality Assurance.
- Grasp knowledge of the quality assessments of food products.
- Comprehend food quality managements systems.
- Apprehend the Indian and International food laws.
- Conceive the concept of adulteration in food products.

Recommended Books:

1. Early, R. (2005): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (2006). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Bryan, F.L. (2000): Hazard Analysis Critical Control Point Evaluations a Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
4. Jerry D'Souza, Jatin Pradhan. , (2010) *Handbook of Food Processing, Packaging & Labeling*
5. James L. Summers, Elizabeth J. (Betty) Campbell (2008) Food Labeling Compliance Review, 3rd Edition ISBN: 978-0-470-75250-0

6. Pomeraz, Y. and MeLoari, C.E. (2006): *Food Analysis: Theory and Practice,* CBS publishers and Distributor, New Delhi.
7. FSSAI, FSIS, EU and FAO website for updates
8. Ronald H. Schmidt, Gary E. Rodrick (2005) Food Safety Handbook, John Wiley & Sons Publisher (ISBN 047143227X, 9780471432272)
9. Rajesh, M., and George, J. (2005) "Food Safety Regulations, Concerns and Trade: The Developing Country Perspective", Macmillan.
10. Naomi, R., and Watson, D. (2007) "International Standards for Food Safety", Aspen Publication.

Fourth Semester

PH 591.4: Meat, Fish, and Poultry Processing Technology

52 Hours

Course Learning Objectives:

- To familiarize the learners with basics and applied principles of meat biochemistry.
- To learn more about meat further processing and value addition.
- To understand more about fish biochemistry and fish processing.

Unit I

Status and scope of meat, poultry and fish industries, Structure and physico-chemical properties of muscle meat: meat pigments, composition and nutritive value, conversion of muscle into meat, Factors influencing the quality of meat (Intrinsic and extrinsic factors), postmortem changes in meat- rigor mortis, cold shortening.

Unit II

Pre-rigor processing; Stunning types, Slaughtering. Steps in slaughtering and dressing (Poultry, Pig, Cattle, Sheep and Goat); Modern abattoirs-layout and operations, Grading of meat (retail and whole sale cuts); Aging of meat, meat tenderization-natural and artificial methods, By-product utilization. Meat plant hygiene-GMP and HACCP, Microbiological and hygienic quality of meat.

Unit III

Cooking methods for meat: Roasting, frying and braising; changes during cooking of meat; Storage and preservation of meat: chilling, freezing, curing, smoking, dehydration, irradiation, canning and novel methods of meat processing (cold plasma, High pressure processing, ohmic heating) Restructured meat products (sausages, salami, kebab), meat analogs, intermediate moisture meat products.

Unit IV

Egg: Structure, composition and nutritive value; Quality evaluation of eggs: Internal and external quality evaluation like, candling, albumen index, Haugh unit, yolk index. Grading of eggs. Abnormalities in egg, Egg storage and preservation: Whole egg preservation, pasteurization, dehydration, freezing and spray drying. Egg and Poultry products: Types, chemical composition and nutritive value.

Unit V

Fish: Composition, Post harvest changes in fish, factors affecting quality of fresh fish, Handling, Preservation (chilling, freezing, glazing, salting and canning of fish) and transportation of fish. Processing of fish by products and their utilization (fish meal, fish oil, fish silage, chitin, fish maws), indices for fish quality, surimi and fish paste products-fish sausage and fish cake, Fish protein concentrates and fish hydrolysates.

Broad contents of the course:

- Muscle meat
- Postmortem
- Rigor mortis
- Stunning
- Slaughtering
- Abattoirs
- Cooking
- Egg
- Fish
- Fish by products
- Poultry products

Course learning outcome:

After the completion of the course, the students will be able to:

- Understand the need and importance of livestock, egg and poultry industry
- Understand the structure, composition and nutritional quality of animal products.
- Understand the concept and methods of processing and preservation of animal foods.
- Understand the technology behind preparation of various animal food products and byproduct utilization
- Understand egg production practices and egg preservation methods
- Understand factors affecting egg quality and measures of egg quality.

Recommended Books:

1. A R Sen, M Muthukumar, B M Naveena. (2013) *Meat Science: A Student Guide.* Satish Serial Publishing House
2. Vacklavic Vickie, A., and W. Christian Elizabeth. (2008). *Essential of Food Science.* Texas: Springer Science Business Media, LLC
3. Joshi , B.P. (1994). *Meat Hygiene for Developing Country,* Shree Almora Book Depot, India.
4. William J. & Owen J., (1977). Egg Science & Technology, AVI Publishing Company, INC. West port, Connecticut.
5. Balachandra K.K. (2013) Post harvest Technology of Fish & Fish Products. Daya Publishing House
6. Mead, G. (2004). Poultry Meat Processing and Quality. Wood head Publishers.

7. Panda, P.C. (1992).Text Book on Egg and Poultry Technology, Vikas Publishers
8. Pearson, A. M., & Tauber, F. W. (1984). *Processed Meats* (pp. 351-388). Springer Netherlands.
9. P. D. Warris, Meat Science, An Introductory Text, CABI International, 2000.
10. Ninawe, A.S and K. Rathnakumar. 2008. Fish processing Technology and Product Development. Narendra publishing house Delhi
11. Singh VP& Sachan N (2011), Priciples of Meat Technology , New India publishing Agency
12. Toldra F(2010) Handbook of Meat Processing , Wiley Black Well.
13. Legarreta IG (Ed) (2010) Poultry Science and technology, John Wiley &sons Publishers
14. Meyer, L.H. (1998) Food Chemistry, Van Nostrand, Reinhold Company Publication, New york, London.

PH 592.4: Food Packaging

52 Hours

Course Learning Objectives:

- To provide insight into the scope of packaging technology in food industries.
- To learn about different packaging materials used in food industries.
- To provide greater understanding for various food products w.r.t. different packaging requirements.

Unit I

Introduction to Food Packaging: Definition, functions of food packaging (containment, protection, convenience and communication), Primary, secondary and tertiary packaging, Designing of packaging materials, Principles of safe and protective packaging. Packaging media and materials.

Unit II

Packaging Systems: Vacuum and Modified Atmosphere Packaging Systems; Aseptic packaging: Sterilization of packaging material food contact surfaces and packaging systems: Retort pouch packaging; Active and Intelligent food packaging; Edible films and coatings. Nanotechnology in food packaging.

Unit III

Plastic packaging materials: Classification of polymers, Properties of thermoplastic polymers; Processing and converting of thermo plastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing); Testing of plastic packaging materials. Processing of paper, types of paper and paper products, Properties of paper; Testing of paper packaging materials.

Unit IV

Metal packaging materials: Container making processes (Two piece, three-piece and end can manufacturing and protective and decorative coatings); Tinplate containers, Tinning process, Types of cans, Aluminum containers. Corrosion of metal packaging. Glass packaging materials: Composition and manufacture of glass containers; Glass container nomenclature; Glass containers-closure; Properties of glass containers: Mechanical, thermal and optical; Testing of glass containers.

Unit V

Safety aspects of packaging materials: Sources of toxic materials and migration of toxins into food materials; Package labeling; Packaging Standards and Regulations; Recycling, Economic and Environmental issues; Packaging requirements of selected foods: Cereals and snack food; Milk and dairy products; Eggs, poultry and red meat; Spices, Beverages, frozen foods, horticultural products and microwavable foods.

Broad contents of the course:

- Packaging Systems
- Nanotechnology
- Designing
- Edible films
- extrusion
- molding
- Testing
- Corrosion
- Properties

Course learning outcome:

The students will be able to

- Comprehend the overview of the scientific and technical aspects of food packaging
- Understand packaging machinery, systems, testing
- An insight to food packaging laws and regulations
- An understanding of packaging requirement and packaging designing of food.
- 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
- Understand various types of scavengers and emitters for improving the food shelf life.
- Learn about consumer response about new packaging systems and safety and legislative requirements
- 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.

Recommended Books:

1. Robertson, G.L. (2016). Food Packaging: Principles and Practice (3rd Edition), Taylor & Francis
2. Sacharow, S. and Griffin, R.C. (1980) Principles of Foods Packaging, 2nd Ed., Avi, Publication Co. Westport, Connecticut, USA.
3. Athalye, A.S. (1992), Plastics in Packaging, Tata Mc Graw–Hill Publishing Co., New Delhi.
4. Rooney, M.L. (1995). Active Food Packaging, Blackie Academic & Professional, Glasgow, UK.
5. Bakker, M. (1986) The Wiley Encyclopaedia of Packaging Technology, John Willey & Sons. Inc;

New York.

6. Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003.
7. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, 2003
8. Han, J.H. (Ed.) Innovations in Food Packaging, 2nd Edition Elsevier Academic Press, 2013
9. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press, 2003.
10. Walter Soroka, Fundamentals of Packaging Technology –Fourth Edition.
11. Robertson, G.L Food packaging and shelf life : A practical guide, 2010
12. Miquel Angelo Parente Ribeiro Cerqueira, Ricardo Nuno Correia Pereira(2017) ,Edible Food Packaging, CRC press ,Taylor and Francis group
13. Ebnesajiad.S (Ed). Plastic Films in Food Packaging. Elsevier Academic press (2013)
14. Cruz .(Ed) Food Packaging:innovations and shelf life CRC press Taylor and Francis group(2019)

PH 593.4: Food Biotechnology **52 Hours**

Course Learning Objectives:

- To impact knowledge about biological and biochemical technology, with a focus on fermented products, the design and operation of industrial practices.
- To evaluate factors that contributes in enhancement of cell and product formation during fermentation process.
- To study about the various equipments used for fermented product recovery at industrial level.

Unit 1

Introduction to fermentation: Types of fermentations; Submerged fermentation and Solid-state fermentation, fermentation kinetics, fermenter design, Types of fermenters; Stirred tank bioreactor, Airlift bioreactor, Fluidized bed bioreactor, Membrane bioreactor, Photo bioreactor, Innovative and special bioreactor, Laboratory scale fermenter system and Industrial scale fermenter system. Fermentation systems: batch, continuous and fed batch culture systems, instrumentation and control,

Unit II

Media for industrial fermentations: Media ingredients and formulation; Oxygen requirements, Antifoams; Media sterilization and optimization; Sterilization of fermenter and other ancillaries; Filter sterilization of air. Inoculum development for fermenters; Aseptic method of inoculation. Microbial based products; Fermentations to make enzymes for the food industry, Production of organic acids (natural vinegar) microbial biomass protein (MBP), additives and "smart foods". Traditional Indian fermented products like *idli, dosa, dhokla, shrikhand*, Advantages of fermented foods.

Unit III

Fermented products: Process description; malting, mashing, hops, primary & secondary fermentation: Biotechnological improvements: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.classification (distilled and non-distilled) wines, whisky, beer and vodka, rum; fermentation in tea, coffee, Cheeseand cocoa processing, fermented soy based products (soy sauce, miso, natto), Fermented vegetable products (sauerkraut, Gherkins and bamboo shoots). Fermented fish.

Unit IV

Downstream processing: Objectives and problems with downstream processing; Extraction; Liquid-Liquid extraction, Solid phase separations and Supercritical fluid extraction and its application in the food industry. Concentration, purification and polishing; filtration; Membrane systems (MF, UF, NF and RO). Centrifugation, Precipitation, Fractionation of fats.

Unit V

Basics of genetic engineering; Application of genetic engineering in food science and technology. Genetically modified foods, Ethical issues concerning GM foods; Current guidelines for the production, labeling and traceability of GM foods. Bio-safety, Risk assessment, Risk management and Public perception of GM foods. IPR; patenting inventions in food biotechnology, GMO Act 2004. Case study (Golden rice and Bt-Brinjal).

Broad contents of the course:

- Fermenters
- Media ingredients
- Fermented products
- Downstream processing
- Membranes
- GM Foods
- Genetic engineering

Course learning outcome:

On completion of this course,

- Students shall become aware of fundamentals of food biotechnology, genetics and also gain basic knowledge of cell culture technology.
- Have developed an understanding of the application of biotechnology in animal, plant and food production.
- Have acquired practical skills in using nucleic acids sequences and bioinformatics data on computers.
- Be able to recommend appropriate measures to solve technical problems

Recommended Books:

1. Joshi, V.K. and Ashok Pandey, edition (2009), Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology, Vol. I & vol. II Educational Publisher.
2. Bioprocess Engineering, Basic Concepts, II Ed. Michael L Shuler, Fikret Kargi, Prentice Hall of India pvt. Ltd. 2nd edition (2015).
3. Manual of Industrial Microbiology & biotechnology, Arnold Demain & Julian E. Davis, II Ed, ASM Press. Washington DC, 3rd edition (2010).
4. Industrial Biotechnology by Rita Singh, S. Ghosh, Global Vision Publishing Ho, 2nd edition (2018)
5. Industrial Biotechnology: Sustainable Growth and Economic success by Wim Soetaert, Erick J. Vandamme, (21st April 2010)
6. Vogel, H.C. and Todaro, C.L. (2005). Fermentation and Biochemical Engineering Handbook:
7. Stanbury, P.F., A. Whitaker and S.J. Hall, (2016), Principles of Fermentation Technology, 3rd Edition Aditya Books (P) Ltd.
8. Peppler, H.J. and D. Perlman, (2004), Microbial Technology: Fermentation Technology, 2nd Edition, Vol. II Academic Press / Elsevier.
9. El-Mansi, E.M.T. (2007). Fermentation Microbiology and Biotechnology, CRC/Taylor & Francis.

PS 595.4: Food Safety and Quality Control

39 Hours

Course Learning Objectives:

- To study the systematic approach to controlling food safety hazards within a food business.
- To understand the laws, standards and regulation of Food safety.
- To understand guidelines of food safety.

Unit I

Food safety concept: Importance of food safety in the food processing industry. Nutritional and Ingredient labeling: Mandatory and optional nutrients; Nutritional descriptors and approved health claims; Product Identification: Traceability Systems. Food Hazards: Physical, Chemical and Microbial. Quality Control and Assurance: Objectives, Principles, Importance and Functions. Statistical quality control in food industry.

Unit II

Quality Systems: Total Quality Management (TQM); Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Lab Practices (GLP). Standard Operating Procedures (SOP). Sanitation Program: Sanitation Standard Operating Procedures (SSOPs).

Food adulteration: Nature of adulterants, methods of evaluation and toxic constituents.

Unit III

Hazard Analysis Critical Control Point (HACCP) system. Evaluation of severity of a hazard controlling food hazards. Food Hygiene Program: Training programs, Hygiene verification. Water Quality in Food Industry; Cleaning and Sanitation: Cleaning agents, Sanitizing agents and Evaluation of sanitation efficacy. Pest Classification: Insects, Rodents and Birds; Integrated Pest Management (IPM) and control measures. Organic Farming.

Unit IV

Food Safety regulations and management systems: National and International food quality regulations: BIS, FSSAI, ISO (9000; 14,000; 15,161 and 22,000) and EU. Codex Alimentarius Commission; Introduction to the legal system, Principles of self-quality, Risk analysis on food. WTO agreements: SPS and TBT agreements. Current challenges in food safety.

Broad contents of the course:

- Food safety concept
- Traceability Systems
- Statistical quality
- Quality Systems
- Food adulteration
- Hazard Analysis Critical Control Point (HACCP) system.
- Food Safety regulations and management systems
- Codex Alimentarius Commission

Course learning outcome:

The students will be able to:

- Understand, use and apply the knowledge, skills of quality management in food processing.
- Understand and critically evaluate the presence of contaminants in food quality assurance.
- Understand the chemical, technological and toxicological aspects of food additives in food preservation.
- Understand the concept of food safety, types of hazards and their control measures
- Comprehend the need of hygiene and sanitation for ensuring food safety
- Practical knowledge to detect and quantify microorganisms from various routes of contamination of food.

Recommended Books:

1. Early, R. (2005): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (2006). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (2006): Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (2000): Hazard Analysis Critical Control Point Evaluations a Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva.
5. FSSAI, FSIS, EU and FAO website for updates
6. Ronald H. Schmidt, Gary E. Rodrick (2005) Food Safety Handbook, John Wiley & Sons Publisher (ISBN 047143227X, 9780471432272)
7. Rajesh, M., and George, J. (2005) “Food Safety Regulations, Concerns and Trade: The Developing Country Perspective”, Macmillan.
8. Naomi, R., and Watson, D. (2007) “International Standards for Food Safety”, Aspen Publication.
9. Newslow, D.L. (2007) “The ISO 9000 Quality System: Applications in Food and Technology”, John Wiley & Sons.
10. Hubbard, Merton R. (2003) “Statistical Quality Control for the Food Industry”, 3rd Edition, Springer,

PS 596.4: Food Hygiene and Sanitation 39 Hours

Unit I

General principle of food hygiene, Hygiene in rural and urban areas in relation to food preparation, personal hygiene and food handling habits. Place of sanitation in food plants. Sanitary aspects of building and equipment: Plant layout and design.

Unit II

Effluent Treatment Plant Design and Layout. Food storage sanitation, transport sanitation and water sanitation Effective control of micro-organisms: micro-organisms important in food sanitation, Microorganisms as indicator of sanitary quality. Pest and Rodent control.

Unit III

Sanitary aspects of water supply: Source of water, quality of water, water supply and its uses in food industries. Purification and disinfection of water preventing contamination of potable water supply.

Unit IV

Effective detergency and cleaning practices: Importance of cleaning technology, physical and chemical factors in cleaning, classification and formulation of detergents and sanitizers, cleaning practices. Sanitary aspects of waste disposal. Establishing and maintaining sanitary practices in food plants, role of sanitation, general sanitary consideration and sanitary evaluation of food plants. Food Safety management certification (FSMS).

Recommended Books:

1. David Zachary Mc. Swane, Richard Linton, Nancy R. Rue Food Safety Fundamentals: Essentials of Food Safety and Sanitation - Second Edition, Food Marketing Institute, (2010).
2. Norman G. Marriott, Robert B. Gravani, Principles of Food Sanitation, 5th edition, Springer.
3. Lora Arduser, Douglas Robert Brown, HACCP and Sanitation in Restaurants and Food Service Operations, Atlantic publishing group INC.
4. Y. H. Hui, L. Bernard Bruinsma, J. Richard Gorham, Wai-Kit Nip, Phillip S. Tong, Phil Ventresca, Food Plant Sanitation, Marcel Dekker, Inc.
5. David Mc Swane, Richard Linton, Nancy R. Rue, Anna Graf Willliams, Retail Best Practices and Guide to Food Safety and Sanitation, Food Marketing Institute, 2004.
6. Mario Stanga, Sanitation: Cleaning and Disinfection in the Food Industry, Wiley publications.
7. David Zachary McSwane, Richard Linton, Nancy R. Rue, Food Safety Fundamentals: Essentials of Food Safety and Sanitation - Second Edition, Food Marketing Institute, (2010).
8. Krammer, A. and Twigg, B.A. Quality Control for the Food Industry. 3rdEdn. AVI, Westport, (1970).
9. Carolyn Meggitt, Heinemann, Food Hygiene and Safety: A Handbook for Care Practitioners, educational Publisher, (2003).
10. P.R. Hayes, S.J. Forsythe, Food Hygiene, Microbiology and HACCP, Springer Sciences and business media, LLC.

Practicals

PH 594.4P: Lab 6: Experiments based on Meat, Fish and Poultry processing Technology

PH 597.4P: Lab 7: Experiments based on Food Biotechnology & Food Safety and Quality Control

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