GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^+ Grade

REGULATIONS AND SYLLABUS

OF

M.Sc. Food Science and Technology

(w.e.f. 2020-21 Admitted batch)

M.Sc. (Food Science and Technology) REGULATIONS*
(W.e.f. 2020-21 admitted batch)

1. ADMISSION

1.1 Admission into M.Sc. in Food Science and Technology program of GITAM University is governed by GITAM University admission regulations.

2. ELIGIBILITYCRITERIA

2.1. A pass in B.Sc. with any two of the following subjects: Microbiology, Biochemistry, Biotechnology, Bioinformatics, Chemistry, Medical Lab. Technology, Genetics, Home science, Food and Nutrition, Zoology, Botany, Agriculture, Aqua Culture, Veterinary Sciences, Environmental Science and Mathematics, graduates of Hotel Management and B.A. Home Science with a minimum aggregate of 50% marks in degree or any other equivalent examination approved by GITAM University.

2.2. Admission into M.Sc. (Food Science and Technology) will be based on an all India GITAM Science Admission Test (GSAT) conducted by GITAM University and the rule of reservation, wherever applicable.

3. CHOICE BASED CREDITSYSTEM

Choice Based Credit System (CBCS) was introduced with effect from the admitted batch of 2020-21 based on UGC guidelines in order to promote:

- Student centered learning
- Cafeteria approach
- Inter-disciplinary learning

Learning goals/ objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4. STRUCTURE OF THEPROGRAM

4.1 The program consists of

i) Foundation Course (compulsory) which gives general exposure to a student in communication and subject related area.
ii) Core Courses(compulsory)
iii) Discipline centric electives which
    a) are supportive to the discipline
    b) expand scope of the subject
    c) provide inter disciplinary exposure
    d) Nurture the analytical skills
iv) Open electives are of general nature either related or unrelated to the discipline.
v) Practical Proficiency Courses: Laboratory and Project work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of practicals per week.
- Eight credits for project

4.4 The curriculum of the M.Sc. program is designed to have a total of 86 credits for the award of M.Sc. degree.

5. MEDIUM OFINSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute /University.

7. ATTENDANCEREQUIREMENTS

7.1 A student is required to have a minimum of 75% attendance in all the courses put togetherinanysemester,failingwhichhe/shewillnotbepermittedtoattendtheend
- semester examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

8.1. The assessment of the student's performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60marks).

8.2. A student has to secure an aggregate of 40% in the course in the two components put together, to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3. Practical/ Viva voce/ Seminar etc. are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table1.

Table 1: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Three mid semester examinations shall be conducted for 15 marks each. The performance in best two shall be taken into consideration. (ii) 5 marks are allocated for quiz. (iii) 5 marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	100	Continuous evaluation	60 marks for performance, regularity, record/ and case study. Weightage for each component shall be announced at the beginning of the semester. 40 marks (30 marks for experiment(s) and 10 marks for practical Viva-voce.) for the test conducted at the end of the Semester conducted by the concerned lab Teacher.
	Total	100		
3	Project work	200	Project evaluation	150 marks for evaluation of the project work dissertation submitted by the candidate. 50 marks are allocated for the project Viva-Voce. The project work evaluation and the Viva-Voce shall be conducted by one external examiner outside the University and the internal examiner appointed by the Head of the Department.

9. SUPPLEMENTARY EXAMINATIONS & SPECIAL EXAMINATIONS:

9.1 The odd semester supplementary examinations will be conducted on daily basis after conducting regular even semester examinations in April/May.

9.2 The even semester supplementary examinations will be conducted on daily basis after conducting regular odd semester examinations during November/December

9.3 A student who has completed his/her period of study and still has "F" grade in final semester courses is eligible to appear for Special Examination normally held during summer vacation.

10. PROMOTION TO THE NEXT YEAR OF STUDY

10.1 A student shall be promoted to the next academic year only if he/she completes the academic

requirements of 60% of the credits till the previous academic year.

10.2 Whenever there is a change in syllabus or curriculum he/she has to continue the course with new regulations after detention as per the equivalency established by the BoS to continue his/her further studies

11. BETTERMENT OF GRADES

11.1 A student who has secured only a pass or second class and desires to improve his/her class can appear for betterment examinations only in 'n' (where 'n' is no.of semesters of the program) theory courses of any semester of his/her choice, conducted in summer vacation along with the Special Examinations.

11.2 Betterment of Grades is permitted 'only once', immediately after completion of the program of study.

12. REPEAT CONTINUOUS EVALUATION:

12.1 A student who has secured 'F' grade in a theory course shall have to reappear at the subsequent examination held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

12.2 A student who has secured 'F' grade in a practical course shall have to attend Special Instruction classes held during summer.

12.3 A student who has secured 'F' grade in a combined (theory and practical) course shall have to reappear for theory component at the subsequent examination held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

12.4 The RCE will be conducted during summer vacation for both odd and even semester students. Student can register a maximum of 4 courses. Biometric attendance of these RCE classes has to be maintained. The maximum marks in RCE be limited to 50% of Continuous Evaluation marks. The RCE marks are considered for the examination held after RCE except for final semester students.

12.5 RCE for the students who completed course work can be conducted during the academic semester. The student can register a maximum of 4 courses at a time in slot of 4 weeks. Additional 4 courses can be registered in the next slot.

A student is allowed to Special Instruction Classes (RCE) 'only once' per course..

13. GRADINGSYSTEM

13.1 Based on the student performance during a given semester/trimester, a final letter grade will be awarded at the end of the trimester/semester in each course. The letter grades and the corresponding grade points are as given in Table2.

Table 2: Grades & Grade Points

S.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89

3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

13.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPA of 5 for a Pass in the semester/trimester.

14. GRADE POINT AVERAGE

14.1 A Grade Point Average (GPA) for the semester/trimester will be calculated according to the formula:

$$GPA = \frac{\Sigma [CxG]}{\Sigma C}$$

Where

C = number of credits for the course,
G = grade points obtained by the student in the course.

14.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

14.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	≥ 8.0*
First Class	≥ 6.5
Second Class	≥ 5.5
Pass Class	≥ 5.0

* In addition to the required CGPA of 8.0 or more the student must have necessarily passed all the courses of every semester in first attempt.

15. ELIGIBILITY FOR AWARD OF THE M.Sc. DEGREE

15.1 Duration of the program: A student is ordinarily expected to complete M.Sc. program of four semesters in two years. However a student may complete the program in not more than four years including study period.

15.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

15.3 A student shall be eligible for award of the M.Sc. Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.

b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.

c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc. and

d) No disciplinary action is pending against him /her.

15.4 The degree shall be awarded after approval by the Academic Council

16. Discretionary Power:

Not with standing anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

MSc Food Science and Technology:

Program Educational Objectives

PEO 1. To provide the knowledge for successful careers in food industries, and in the institutions of higher learning.

PEO 2. To provide hands-on experience in basic tools and techniques and make students competent in food sciences and allied areas.

PEO 3. To motivate the future food technologists through professional, ethical development and research in food science and technology.

PEO 4. Enable the graduates for becoming entrepreneurs

PEO 5. To introduce the students various societal needs and global food security challenges for taking up a dissertation in this direction.

Program Outcomes:

Students will be able to:

1. Acquire knowledge of food science and nutrition fundamentals, food chemistry, and source and variability of raw food materials and biochemical changes during processing and preservation.
2. Understand the properties and reactions of various food components and select the appropriate analytical method when presented with a practical problem.
3. Identify the key pathogens and spoilage microorganisms in foods and the conditions under which they will grow, and laboratory techniques to identify microorganisms in food.
4. Describe the unit operations, mass, and energy balances required in food processing to produce a given food product
5. Describe the basic principles and practices of cleaning and sanitation in food processing operations, and explain the properties and uses of various packaging materials.
6. Apply and include the principles of food science in practical, real-world situations and problems.

Program Specific Outcomes:

1. Understand the composition of food, the role of each component and their interaction, their roles in food processing.
2. Learn the detailed principles, procedures, and applications of various chromatographic and electrophoretic techniques for successfully purifying food proteins to homogeneity.
3. Will apply the knowledge of various spectrophotometric methods to quantify the desired compound in the given solutions.
4. Will be able to describe the importance of microbiology to food production and food safety and demonstrate the role and significance of microbial inactivation, adaptation, and environmental factors on the growth and response of microorganisms in various environments

5. Will be able to design food plant, identify the instruments required for processing by understanding principles followed by preservation techniques, and successful packaging method employment with good marketing skills.

Scheme of Instruction of Master of Science in Food Science and Technology

S. No.	Course Code	Name of the Course	Category	Credits	Scheme of Instruction		Total	Scheme of Examination		
					Hours per week			Duration in Hrs.	Maximum Marks	
					L/T	D/P			Sem End Exam	Con. Eval
I Semester										
1	SFT 701	Food Chemistry	PC	4	4	0	4	3	60	40
2	SFT 703	Analytical Techniques and Biostatistics	PC	4	4	0	4	3	60	40
3	SFT 705	Food Microbiology	PC	4	4	0	4	3	60	40
4	SFT 707	Technology of Plant Foods	PC	4	4	0	4	3	60	40
5	SSE 701/SSE 703	Skill Enhancement course*	SEC	2	0	3	3	3	--	100
6	SFT 721	Lab-I: Analysis of Foods	PP	3	0	9	9	3	---	100
7	SFT 723	Lab-II: Microbial Methods	PP	3	0	9	9	3	---	100
		Total		24	16	21	37	--	240	460
*** Skill Enhancement course, choose one of the following** 1. SSE 701:Basic computer concepts / 2.SSE 703: Information Technology Tools										
II Semester										
1	SFT 702	Technology of Animal Foods	PC	4	4	0	4	3	60	40
2	SFT 704	Food Safety Management	PC	4	4	0	4	3	60	40
3	SFT 706	Principles of Food Engineering	PC	4	4	0	4	3	60	40
4	SFT 708	Spices, Beverages, and Confectionery	PC	4	4	0	4	3	60	40
5	SAE 702	Professional communication skills	AEC	2	0	3	3	3	--	100
6	SFT 722	Lab-III: Technology of Foods	PP	3	-	9	9	3	---	100
7	SFT 724	Lab-IV: Food Safety, Standards and quality control	PP	3	-	9	9	3	---	100
		Total		24	16	21	37	--	240	460

III Semester										
1	SFT 801	Food Innovation Process	PC	4	4	0	4	3	60	40
2	SFT 803	Food preservation Technology	PC	4	4	0	4	3	60	40
3	SFT 805	Food packaging and Labeling	PC	4	4	0	4	3	60	40
4	SFT 841	Nutrition and Dietetics	GE-1	4	4	0	4	3	60	40
	SFT 843	Advanced Food Processing Technology								
	SFT 845	Dairy Technology								
	SFT 847	Bakery and Confectionery Technology								
5	SOE XXX	Open elective	OE	3	3	0	3	3	60	40
6	SFT 821	Lab-V: Food processing and preservation	PP	3	0	9	9	3	---	100
7	SFT 823	Lab-VI: Product development and Evaluation Techniques	PP	3	0	9	9	3	---	100
		Total		25	19	18	37	--	300	400
IV Semester										
1	SFT 802	Fermentation Technology	PC	4	4	0	4	3	60	40
2	SFT 842	Post-harvest Technology	GE - 2	4	4	0	4	3	60	40
	SFT 844	Clinical and Therapeutic nutrition								
	SFT 846	Research methodology, statistics and Computer applications								
	SFT 848	Bioethics and Biosafety								
3	SFT 822	Lab-VII: Diet Design, and formulation of special foods	PP	3	0	9	9	3	---	100
4	SFT 892	Project Work	PP	8	0	0	0	3	--	200
		Total		19	8	9	17	12	120	380

Open Elective Course

1. SOE 883- Fruit and Vegetable Processing Technology

M.Sc. (Food Science & Technology) I SEMESTER
SFT 701: FOOD CHEMISTRY

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble:

Food chemistry deals with the chemical processes and interactions of all biological and non-biological components of foods. The biological substances comprise items like poultry, lettuce, meat, milk and beer. It is parallel to biochemistry in its main components including water, carbohydrates, lipids, proteins and enzymes. Apart from this it also contains areas like vitamins, minerals, food additives, flavors, and colors. This subject also includes how products change under certain circumstances of food processing techniques and methods either to enhance or to prevent them from occurring.

Course Objectives:

- To understand the chemistry of foods - composition of food, role of each component and their interaction.
- To understand the functional aspects of food components and to study their role in food processing.

Unit-I

Water: Water activity and its influence on food quality and stability, methods to determine water activity. pH, pK, acid base reactions and buffers.

Carbohydrates: Classification, structure and properties of Food carbohydrates (Colloidal, clouding and clarifying, foaming, solubility, Viscosity, Emulsion, Gelatinization, Gelation). Sources and functions. Fibers in food processing - carbohydrate enzymes, food applications. Dietary fiber- sources, composition and nutritional significance.

Learning Outcomes:

By the end of this unit, the student will be able to

- Identify different types of water in the food and its relation to food spoilage
- Differentiate various foods based on shelf life
- Understand the types of carbohydrates in food
- Differentiate between processed foods, cereals and whole grain food

- Formulate low and high carbohydrate diet

Unit-II

Lipids: Sources, occurrence, classification, structure and functions of fatty acids. Physical and Chemical characteristics of lipids. Storage changes of fats, oils and fatty foods. Digestion and absorption.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate between various types of fats like saturated and unsaturated and essential fats
- Explain how lipids gets spoiled and how to prevent it
- Extend the concept of digestion and absorption of various types of fats and oils

Unit-III

Proteins: Classification, structure and properties of protein. Amino acids – structure and importance, physico–chemical properties of proteins, sources and functions of proteins, Digestion and absorption. Deficiency disorders. Chemical and biological evaluation of protein quality.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate the types of proteins present in plants and animals
- Compare physical and functional properties of proteins
- Illustrate different deficiency disorders caused due to lack of protein intake

Unit-IV

Minerals: Calcium, Phosphorus, Sodium, Potassium, Iron, Iodine, Flourine (sources, structure, functions, effect of processing, deficiency disorders).Vitamins: Fat soluble and water soluble vitamins (sources, occurrence, structure, functions, deficiency disorders and effect of processing).

Learning Outcomes:

By the end of this unit, the student will be able to

- Compare and contrast the water soluble and fat soluble vitamins
- Illustrate the deficiency disorder caused by lack of vitamins

- Differentiate between trace elements and essential elements in food

Unit-V

Enzymes: Nomenclature, classification, enzyme kinetics- Michaelis-Menten equation, Significance of Km and Vmax. Coenzymes. Importance of enzymes in foods -enzymes involved in food spoilage - Enzymes in food processing. Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentration.

Learning Outcomes:

By the end of this unit, the student will be able to

- Use immobilized enzymes for convenience, economy and stability of food in industries
- Understand that enzymes can be used to enhance the digestion of food and the delivery of nutrients to the blood even in a compromised digestive system
- Develop mechanisms to control the speed of chemical reactions in the food using enzymes

Course Outcomes:

By the end of this Course, the student will be able to:

- Study the chemistry of foods - composition of food, role of each component and their interaction.
- Understand the functional aspects of food components and to study their role in food processing.
- Learn that enzymes can be used to enhance the digestion of food and the delivery of nutrients to the blood even in a compromised digestive system.

Recommended Books:

1. Food Chemistry (2002) by O. R.Fennema.
2. Food Chemistry (1987) by L.H.Meyer.
3. Food Chemistry (2009) by H.D. Belitz.
4. Food Science (5^{th} edition) by N. N Potter
5. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2^{nd}edition) by S.Ranganna.
6. Foods, Facts and principles (2011) by N .S Manay and M.S.Swamy.

7. Food Chemistry (2009) by A.V.Ramani.
8. Introduction to Food Chemistry (2005) by Richard Owusu.
9. Food Analysis: Theory and Practice (3rd edition) Y. Pomeranz and C.E Meloan.

M.Sc. (Food Science & Technology) I SEMESTER

SFT 703: ANALYTICAL TECHNIQUES AND BIOSTATISTICS

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble:

This paper gives student an idea about principles and procedures in performing different chromatographic techniques like in purifying the proteins to homogeneity, testing the purity levels by different electrophoretic techniques, and quantitating the same by spectrophotometric methods. This paper also gives you brief idea about the different radioactive methods for measurement of radioactivity, electrochemical methods in determining the pH of the solution, and about importance of biosensors. This course also helps to quantitate the scientific data, importance of statistics and application of various statistical methods, importantly, standard deviation, correlation, and regression related to bioanalytical techniques.

Course Objectives:

- To understand the detailed principles, procedures and applications of various chromatographic techniques for example in learning the purification of proteins by using ion exchange and affinity chromatography, and molecular weight determination by size exclusion chromatography.
- To learn the principles, procedures and applications of various electrophoretic techniques, importantly knowing the difference between SDS and native PAGE, and isoelectric focussing.
- To study the principles, procedures and applications of various spectrophotometric methods especially in quantitation of desired compound in the given solutions.
- To know the principles, procedures and applications of radioactive methods for measurement of radioactivity, electrochemical methods, and biosensors.
- To focus on the usage of different statistical methods learned with respect to bioanalytical techniques perspectives.

UNIT-I

Principles and applications of chromatographic techniques: paper chromatography, thin layer chromatography, gel filtration, ion-exchange chromatography, affinity chromatography, GC, GC-MS, LC-MS and HPLC.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the detailed principles, procedures and applications of various chromatographic techniques.
- Imbibe with the basics of isolation of proteins to the purification of the proteins to homogeneity, and especially with the usage of high end chromatography columns, and purification procedures.
- Proficient with the prerequisites for making recombinant protein for ease in purification of proteins with tags such as his-tag etc.
- Identify carbohydrates and amino acids by techniques like paper and thin layer chromatography

UNIT-II

Principles and concepts of electrophoretic techniques: native PAGE, SDS – PAGE, agarose gel electrophoresis, capillary electrophoresis, isoelectric focusing, two dimensional, pulse field and diagonal electrophoresis.

Learning Outcomes:

By the end of this Unit, the student will be able to:

- Understand the principles, components, and applications of various electrophoretic techniques.
- Know the difference between SDS-PAGE and native PAGE techniques with respect to proteins
- Understand the importance of agarose gel electrophoresis with respect to molecular biology techniques like PCR and molecular cloning
- Visualize the purity of proteins those are purified to homogeneity using various chromatography columns.

UNIT-III

Principles and applications of UV-visible, Raman, infrared, ORD, CD, NMR, ESR, fluorescence spectroscopy. X-ray diffraction. Principles and applications of preparative and analytical ultracentrifuges.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Know the principles, components, and applications of various spectrometry techniques.
- Apply the utilization of UV-visible spectrophotometer to know the concentrations of the different solutions.
- Understand the importance of Circular Dichroism in understanding the folding of proteins after expression and purification
- Recognize the importance of techniques such as XRD for retrieving the structure of the protein with high resolution.

UNIT-IV

Radioactive and non-radioactive tracer techniques and their applications in biological sciences. Detection and measurement of radioactivity. Principles of electrochemical techniques – operation and applications of pH, oxygen, ion-selective and gas sensing electrodes. Biosensors – principle, design and applications.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain knowledge on various radioactive and stable isotopes, tracer techniques, and about biosensors and their applications in many industries.
- Know the instruments used for measurement of radioactivity
- Understand the working of pH electrode etc.

UNIT-V

Scientific data description, tabulation and graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Types of errors and level of significance. Tests of significance - F and *t* - tests, chi-square tests, ANOVA. Simple linear regression and correlation. Nonparametric tests- Kruskal Wallis test,

Mark Whitney test, SPSS package.

Learning Outcomes:

By the end of this Unit, the student will be able to:

- Analyze the scientific data, importance of statistics and application of various statistical approaches for knowing the significance of data obtained after laboratory experiments
- Know the formulas for Standard deviation, correlation, and regression methods, and usage of these calculations and retrieved values with respect to bioanalytical techniques.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the detailed principles, procedures and applications of various chromatographic techniques, electrophoretic, spectrometric, and radioactive techniques.
- Know the basics of isolation of proteins to the purification of the proteins to homogeneity, and especially with the usage of high end chromatography columns, and purification procedures.
- Able to differentiate between SDS-PAGE and native PAGE techniques with respect to proteins and know its importance in protein purification.
- Importance of agarose gel electrophoresis with respect to molecular biology techniques like PCR and molecular cloning
- Know the usage of UV-visible for obtaining the concentrations of the solutions, circular dichroism in understanding the folding of proteins after expression and purification, and XRD in retrieving the structure of proteins.
- Gain knowledge on various radioactive and stable isotopes, tracer techniques, and about biosensors and their applications in many industries.
- Analyze the scientific data, importance of statistics and application of various statistical approaches for knowing the significance of data obtained after laboratory experiments

RECOMMENDED BOOKS:

1. Principles and Techniques of Biochemistry and Molecular Biology (7^{th} edition) by K. Wilson and J. Walker.
2. A Biologists guide to Principles and Techniques of Practical Biochemistry (3^{rd} edition)

by.B.D.Williams.

3. Biophysical Chemistry: Principles and Techniques (2010) by Upadhyay, Upadhyay and Nath.
4. Biostatistics (2^{nd} edition) by P.K. Arora and P.K. Malhal
5. Fundamentals of Biostatistics (1994) by Khan and Khanum.
6. Fundamentals of Applied Statistics (10^{th} edition) by S.C.Gupta and V.K. Kapoor.
7. Physical Chemistry (9^{th} edition) by P.W. Atkins and W.H. Freeman.
8. An introduction to biostatistics (2^{nd} edition) by N. Gurumani.
9. Basic Concepts in Statistics (2009) by K.S. Kushwaha and R. Kumar.

M.Sc. (Food Science & Technology) I SEMESTER

SFT 705: FOOD MICROBIOLOGY

Hours per week: 4 End Examination: 60Marks

Credits:4 Sessionals: 40Marks

Preamble:

Microbiology being a critical component of the food industry is central to all aspects of food production. Food microbiology is the scientific study of microorganisms that inhabitat, create, or contaminate food, including the study of microorganisms causing food spoilage. All food should be safe and free from contamination and thereby spoilage in all points of its journey from its source until it reaches the consumers plate.

UNIT-I

Microorganisms in atmosphere, soil, water, plants and animals. Gut microbiome. Microbial interactions. intrinsic and extrinsic factors for microbial growth. Food contamination. Beneficial role of microorganisms in food, probiotics, prebiotics, synbiotics.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Describe the importance of microbiology to food production and food safety.
- Understand the scope of food microbiology
- Know the role and significance of microbial inactivation, adaptation and environmental factors (i.e., aW, pH, temperature) on growth and response of microorganisms in various environments.

UNIT -II

Bacteria, molds and viruses: General characteristics- structure, morphological characteristics, growth, cultural characteristics. Bacteria, molds and yeasts of industrial importance.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Identify the important pathogens and spoilage microorganisms in foods.
- List and describe the general and cultural characteristics of microorganisms that cause food spoilage.
- know about industrially important microorganisms

UNIT -III

Microscopy-light and electron microscopy, staining techniques, nutritional requirements of microorganisms, culture media- types, Sterilization methods - Physical and chemical. Pure culture methods, microbial growth and measurement, preservation and maintenance of microbial cultures.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain Knowledge on the concept of microscopy
- Know various laboratory techniques in isolating, identifying, enumerating microorganisms
- Understand various methods for preservation and maintenance of microorganisms
- Understand the concepts of Sterilization methods

UNIT- IV

Food spoilage: Factors affecting food spoilage, spoilage of different groups of foods: perishable and non-perishable foods (cereals and cereal products, vegetables and fruits, meat, egg and poultry, fish, milk and milk products), canned foods.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Know about various species of organisms involved in spoilage of different groups
- Know the principles involving in food spoilage
- Identify the conditions under which the important pathogens can be inactivated, killed or made harmless in foods.

UNIT -V

Food poisoning and intoxication.Food and water borne diseases by *Salmonella, Staphylococcus, Clostridium, Listeria, Shigella, E. coli, Bacillus, Campylobacter, Vibrio*. Food borne viruses and diseases – Polio, Hepatitis, Gastroenteritis. Food borne animal parasites: Helminthes and Nematodes:Tapeworms, Round worms, Protozoa: *Giardialamblia, Entamoebahistolytica*. Mycotoxins.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Differentiate between Food poisoning and intoxication
- Gain knowledge on various bacterial and viral Food borne diseases
- Understand various concepts of mycotoxins

Course Outcomes:

By the end of this Course, the student will be able to:

- Describe the importance and scope of microbiology in food production and food safety.
- Identify the growth requirements of microorganisms
- Differentiate pathogens and spoilage microorganisms in foods.
- Discriminate between prebiotics and probiotics
- Develop theoretical as well as practical based knowledge

Recommended Books:

1. Food Microbiology (4th edition) by W. CFrazier.
2. Modern Food Microbiology (7th edition) by J.M. Jay .
3. Microbiology (5th edition) by M.I. Pelczar andReid.
4. Food Microbiology (2006) by M.R.Adams.
5. Basic Food Microbiology (2004) by G.J.Banwart.
6. Food Microbiology (2007) by K.VijayaRamesh.
7. Fundamentals of Food Microbiology (5thEdition) by B. Ray and A.Bhunia.
8. Biology of Microorganisms (2012) by T. D.Brock.

M.Sc. (Food Science & Technology) I SEMESTER

SFT 707: TECHNOLOGY OF PLANT FOODS

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble

In order to prevent huge quantitative as well as qualitative losses of cereals, pulses, spices, and plantation crops, all steps of improved postharvest technology (PHT) must be carefully designed and implemented, beginning with harvesting and ending with consumption and utilization of their products and by-products. To derive optimal benefit from production techniques, the engineering principles and practice of harvesting and threshing and their effects on grain yield have been outlined in this paper.

Course Objectives:

- To teach technology of milling of various cereals
- To impart technical knowledge of pulses and oilseeds refining

UNIT-I

Cereal grains and millets: properties and nutritional attributes of rice, wheat, maize, jowar, bajra, ragi and Italian millet. Post-harvest losses, post- harvest technology: handling, storage, transport, Fumigation, prevention of insect infestation.

Learning Outcomes:

By the end of this unit, the student will be able to:

- The various processing steps of major cereals after harvesting.
- The production of different processed products and by-products.

UNIT-II

Milling technology : large scale and small scale milling, turbo milling, conventional wet and dry milling –flouring, enrichment, fortification of products, factors affecting milling quality and degree of milling – products and byproducts. Flours, flakes and grits.

Baking technology: production of cake, muffins, bread, biscuits, pizza.

Learning Outcomes:

By the end of this unit, the student will be able to

- Different milling technologies

- Importance of baking technology in making of bakery products

UNIT–III

Legumes and pulses: composition, structure, processing of commonly used legumes, bengal gram, red gram, green gram, black gram, horse gram – soaking, germination, fermentation, elimination of toxic factors, processed soyabean products.

Learning Outcomes:

By the end of this unit, the student will be able to

- The various processing steps of major pulses after harvesting.
- The toxic constituents of pulses.
- The various processing steps and methods of major legumes after harvesting.
- The production of different processed products and fermented products.

UNIT–IV

Nuts and oil seeds: types, chemical composition, properties and uses. Processing: extraction of oils, expelling (peanuts, coconut, sunflower, palm oil, gingelly), solvent extraction, refining, hydrogenation and inter esterification.

Plasticizing and tempering products– butter, margarine, shortening agents, mayonnaise.

Learning Outcomes:

By the end of this unit, the student will be able to

- The various processing steps of major oil seeds after harvesting.
- The production of different methods of old refining and protein products.

UNIT–V

Fruits and vegetables: classification – composition - physiological and biochemical changes during ripening - handling and storage. Post-harvest practices. Fruits and vegetable products: juices, squashes, pickles, jams, jellies and marmalades. Byproduct utilization.

Foods for future -organic foods, food fortification, GM foods.

Learning Outcomes:

By the end of this unit, the student will be able to

- Different methods for the preservation fruits and vegetables.
- The detailed account on canning process and bottling.
- To understand the processing of fruits and vegetables in making different products like juices,

jam and jellies and marmalade.

- The product technologies and the defects in the production of the products.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand various processing steps of major cereals, pulses, and legumes after harvesting
- The production of different processed products and fermented products.
- To understand the processing of fruits and vegetables in making different products like juices, jam and jellies and marmalade

Recommended Books:

1. Food Science (5th edition) by N. N Potter
2. Snack Food Technology (3rd edition) by S. A. Matz.
3. Text book of Food science and Technology (2001) by Vijaya Khader
4. Storage of cereal grains and their product (3rd edition) by C.M.Chriestenson.
5. Technology of Cereals (4th edition) by Kents
6. Principles of Cereal Science and Technology (3rd edition) by J. Delcour and R.C. Hoseney.
7. Hand book of Post harvest Technology, Cereals, Fruits, Vegetables, Tea and Spices (2003) by A. Chakraverty and A. S.Mujumdar.
8. Snack Food Technology (2013) by S. A.Matz
9. Wheat Flour Milling (2004) by S. Elieser

M.Sc. (Food Science & Technology) I SEMESTER

SSE 701: BASIC COMPUTER CONCEPTS

Hours per week: 3 Sessionals: 100 Marks

Credits: 2

Preamble:

The course gives an understanding about the characteristics and classification of computers, various components of computer along with different operating systems that are available. It gives hands on training on the packages MS-Word, MS-Power Point and MS-Excel. The course also comprehends AI tools.

Basics of Computers: Definition of a Computer - Characteristics and Applications of Computers – Block Diagram of a Digital Computer – Classification of Computers based on size and working – Central Processing Unit – I/O Devices, Primary, Auxiliary and Cache Memory – Memory Devices. Software, Hardware, Firmware and People ware – Definition and Types of Operating System – Functions of an Operating System – MS-DOS –MS Windows, UNIX. Introduction to AI tools.

MS-Word

Features of MS-Word – MS-Word Window Components – Creating, Editing, ormatting and Printing of Documents – Headers and Footers – Insert/Draw Tables, Table Auto format – Page Borders and Shading – Inserting Symbols, Shapes, Word Art, Page Numbers, Equations – Spelling and Grammar – Thesaurus – Mail Merge.

MS-PowerPoint

Features of PowerPoint – Creating a Blank Presentation - Creating a Presentation using a Template - Inserting and Deleting Slides in a Presentation – Adding Clip Art/Pictures -Inserting Other Objects, Audio, Video- Resizing and Scaling of an Object –Slide Transition – Custom Animation.

MS-Excel

Overview of Excel features – Creating a new worksheet, Selecting cells, Entering and editing Text, Numbers, Formulae, Referencing cells – Inserting Rows/Columns –Changing column widths and row heights, auto format, changing font sizes, colors, shading.

Reference Books:

1. Fundamentals of Computers by V.RajaRaman, PHI Learning Pvt. Ltd, 2010.
2. Microsoft Office 2010 Bible by John Walkenbach, Herb Tyson, Michael R. Groh andFaithe Wempen, Wiley Publications, 2010.

Learning Outcomes:

- Able to understand fundamental hardware components that make up a computer's hardware and the role of each of these components
- Understand the difference between an operating system and an application program, and what each is used for in a computer.
- Acquire knowledge about AI tools.
- Create a document in Microsoft Word with formatting that complies with the APA guidelines.
- Write functions in Microsoft Excel to perform basic calculations and to convert number to text and text to number.
- Create a presentation in Microsoft PowerPoint that is interactive and legible content.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand fundamental hardware components and the role of each of these components
- Acquire knowledge abut MS Word, Excel, and PowerPoint

M.Sc. (Food Science & Technology) I SEMESTER

SSE 703: INFORMATION TECHNOLOGY TOOLS

Hours per week: 3 Sessionals: 100 Marks

Credits: 2

Preamble:

The course enables the student to understand networking concepts related to Internet and introduce the social Networking sites and working of Email. It gives orientation of Block Chain technology. It give hands on training in SPSS, R Programming and creation of simple HTML documents.

Introduction to Internet: Networking Concepts, Data Communication –Types of Networking, Internet and its Services, Internet Addressing –Internet Applications–Computer Viruses and its types – Browser –Types of Browsers.

Internet applications: Using Internet Explorer, Standard Internet Explorer Buttons, Entering a Web Site Address, Searching the Internet– Introduction to Social Networking: twitter, tumblr, Linkedin, facebook, flickr, skype, yahoo!, google+, youtube, WhatsApp, etc.

E-mail : Definition of E-mail, Advantages and Disadvantages,User Ids, Passwords, Email Addresses, Domain Names, Mailers, Message Components, Message Composition, Mail Management, Email Inner Workings.

WWW-Web Applications, Web Terminologies, Web Browsers ,URL–Components of URL, Searching WWW –Search Engines and Examples.

Block Chain technology: What is Block Chain, Blockchain Architecture, How Block chain Transaction Works? Why do we need Blockchain? Block chain versions, Block chain Variants, Block chain Use Cases, Important Real-Life Use Cases of Block chain Bitcoin cryptocurrency: Most Popular Application of Block chain, Block chain vs. Shared Database, Myths about Block chain, Limitations of Block chain technology.

SPSS : SPSS Commands, Descriptive Statistics, Hypothesis Testing, Test of Difference, Analysis of Variance- One Way ANOVA, Non Parametric Tests, Correlation Analysis, Regression Analysis.

R Programming: Becoming familiar with R, Working with Objects, Introduction to Graphical Analysis.

HTML: WEB Terminology, Structure of HTML Document, HTML – Head and Body tags, Semantic tags- HR- Heading, Font, Image & Anchor tags, Different Types of Lists using Tags, Table Tags, Image Formats – Creation of Simple HTML Documents.

Reference Books:

- In-line/On-line : Fundamentals of the Internet and the World Wide Web by Raymond Greenlaw and Ellen Hepp, 2nd Edition, TMH.
- Microsoft Office 2010 Bible by John Walkenbach, Herb Tyson, Michael R. Groh and Faithe Wempen, WileyPublications.

Learning Outcomes:

- Enable to understand the basic networking concepts, types of networks, Internet Explorer and www.
- Outline the Block chain architecture, Bitcoin Crypto currency and Limitations of Block Chain.
- Choose different statistical tests to be performed on the data sets.
- Demonstrate the R programming with simple graphs.
- To make use of commands to structure HTML document.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the basic networking concepts, types of networks, Internet Explorer and www.
- Learn R programming and HTML concepts

M.Sc. (Food Science & Technology) I SEMESTER

SFT 721: ANALYSIS OF FOODS

Hours per week: 8

Credits:3 Sessionals:100 Marks

1. Preparation of percent, normal, molar and molal solutions.
2. Determination of moisture content in foods.
3. Qualitative and quantitative tests for carbohydrates, proteins and lipids in foods.
4. Estimation of starch.
5. Estimation of invert sugar in honey.
6. Determination of fat content in foods.
7. Activity of food enzymes.
8. Determination of total ash in foods.
9. Estimation of calcium in dairy products.
10. Estimation of phosphorus.
11. Estimation of iron.
12. Estimation of vitamin C in fruit juices.
13. Estimation of vitamin A.
14. Estimation of total carotenoids.

Recommended Books:

1. Food Chemistry and Analysis-Theory and Practice (2007) by N.Prasad.
2. A Manual of Laboratory Techniques (2003) NIN,ICMR.
3. Techniques of Food Analysis (2001) by A.L. Winton and K.Winton.
4. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products (2nd edition) by S.Ranganna.
5. Chemical Analysis of Food and Food products (3rd edition) by B. J.Morris.
6. Food Analysis Laboratory Manual (4th edition) by S.Nielsen
7. Food Analysis (2013) by N. Khetarpaul
8. Food Analysis and Preservation (2012) by M. G. Kontominas

Course Outcomes:

After the completion of the above experiments the students will be able to

- Prepare percentage, molarity and normality of different reagents used in laboratory
- Learn to identify different carbohydrates, amino acids, and lipids
- Quantify the sugar, protein, and lipid concentrations by variety of methods
- Estimate iron, phosphorus, calcium, ascorbic acid and carotenoids in a variety of foods.

M.Sc. (Food Science & Technology) I SEMESTER

SFT 723: MICROBIAL METHODS

Hours per week: 8

Credits:3 Sessionals:100Marks

1. Preparation of common laboratory media and special media for cultivation of bacteria, yeast and molds.
2. Staining of Bacteria: Gram's staining, acid-fast, spore, capsule, motility of bacteria, staining of yeast and molds.
3. Cultivation and identification of important molds and yeast
4. Study of work area as source of microorganisms in food. Swab and rinse techniques.
5. Isolation of microorganisms: Pour, streak, spread plate techniques and maintenance of cultures of microorganisms.
6. Bacteriological analysis of foods: Processed and unprocessed
7. Bacteriological analysis of water and milk, total count, Most Probable Number (MPN), coliform (count) and Methylene Blue dye Reduction Test (MBRT), Indole, Methyl red, Voges-Proskauer, and Citrate utilization test(IMVIC).
8. Biochemical tests used in identification of bacteria in foods: urease, amylase, H_2S, Catalase, coagulase, gelatin and fermentation(Acids/gas).

Recommended Books:

1. Laboratory Experiments in Microbiology (2007) by G. Reddy
2. Laboratory Manual of Microbiology and Biotechnology (2014) by K.R.Aneja.
3. Microbiology - Practical Manual (3rd edition) by S.M. Reddy and S.R.Reddy.
4. Microbiology – A Laboratory Manual (10th edition) by J.G. Cappuccino and N. Sherman.
5. Laboratory Manual in Microbiology (2007) by P.Gunashekaran.
6. Laboratory Manual in General Microbiology (2002) by N.Kannan.

Course Outcomes:

After the completion of the above experiments the students will be able to

- Isolate various microorganisms (bacteria, fungi) from different sources (water, soil, food)
- Identify physiological characteristics such as gram, capsule, spore and flagella by microscopic techniques

- Find the biochemical characteristics of the bacteria
- Preparation of various types of media for culturing of microorganism
- Perform microbial quality of water and milk

M.Sc. (Food Science & Technology) II SEMESTER

SFT 702: TECHNOLOGY OF ANIMAL FOODS

Hours per week: 4 End Examination: 60 Marks

Credits: 4 Sessionals: 40 Marks

Preamble:

The principle interests of the paper are in the areas of dairy, processing of milk and milk product. This study involves processing, storage, packaging, distribution and transportation of dairy products by entailing the science of bacteriology, nutrition and biochemistry. Additionally, this study involves total utilization of flesh foods, particularly poultry and fish, animal welfare, and the sustainability of animal agriculture. Issues of animal welfare are also presented to challenge simplistic, often anthropomorphic assumptions, especially with respect to egg layers.

Course Objectives:

- To know the need and importance of dairy and fishery industry
- To know the compositional and technological aspects of milk and fish.
- To study processed milk and fish products

UNIT-I

Milk**:** Composition, physical and functional properties. Processed milk - toned, homogenized, fortified, reconstituted, filled and flavored milk. Dairy products - processing and storage of cultured milk, yoghurt, butter, whey, cheese, concentrated and dried products, frozen desserts, dairy product substitutes. Byproduct utilization.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the composition milk, its properties both physical and functional and composition.
- Amend the processing of milk and milk products.
- Know different milk products and its production.
- Appreciate the concepts of Dairy sanitization and storage.

UNIT -II

Egg: structure, composition, functional properties, grading and measure of quality of eggs. Changes during storage, preservation of eggs, egg processing. Low cholesterol egg substitute-lecithin.

Learning Outcomes:

By the end of this unit, the student will be able to

- Egg structure, composition, nutritive value and quality characteristics.
- Evaluation of quality and grading of eggs;
- Preservation of shell eggs and experiments in by-products utilization.

UNIT -III

Poultry: Classification, composition and nutritive value, processing plant operations (slaughter, grading, scalding, defeathering, eviscerating, chilling, packaging), preservation methods and storage. Poultry meat products and preservation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the sources and developments of poultry industries in India.
- Learn importance of classification, composition, nutritive values of poultry

UNIT -IV

Meat**:** Structure, muscle composition, characteristics, quality. Types of slaughtering and postmortem changes. Methods of cooking, changes during cooking. Processing, preservation and their effects. Meat products. Canning of meat.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about the muscle structure, chemical composition of meat muscle.
- Appreciate the pre-slaughter operations of meat animals and poultry birds.
- Understand the importance of slaughtering and dressing of meat animals and their post-mortem changes.
- Understand the preservation of meat by different methods
- Understand the processing, preparation of meat and poultry products.

UNIT -V

Fish and marine foods: Texture of fish, types, composition, post-harvest changes and storage. Selection and cooking, spoilage of fish, changes during processing, byproducts and new products, assessment of microbial quality of fish. Preservation of fish- curing and irradiation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the processing of fish by curing agents, drying and salting.
- Amend other processing options of preserving fish by smoking.
- Gain knowledge of processing of fish by canning of different variety fishes.
- Fish by products processing and potential benefits.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the composition of milk and functionality of dairy industry
- Gain knowledge on processing of poultry, meat, and fish
- Learn efficient preservation methods of meat

Recommended Books:

1. Food Science (5th edition) by N. N Potter
2. Food Chemistry (1996) by H. D. Belitz and W.Grosch.
3. Milk and Milk Products (2009) by S.N.Mahindru.
4. Dairy Technology (2nd edition) by P. Walstra
5. Protein Functionality in Foods (1981) by J.P.Cherry.
6. Principles of Dairy Processing (2007) by J. N.Warner.
7. Fish Processing Technology (1995) by T.K.Govindan.
8. Milk and Milk Products Technology, Chemistry and Microbiology (2001) by A. H.Varnam.
9. Meat Science (2nd edition) R.A.Lawrie.
10. Outlines of Dairy Technology (2008) by S.De.

M.Sc. (Food Science & Technology) II SEMESTER

SFT 704: FOOD SAFETY MANAGEMENT

Hours per week: 4 End Examination: 60 Marks

Credits: 4 Sessionals: 40 Marks

Preamble:

Food quality is the quality characteristics of food that is acceptable to consumers. This includes external factors as appearance (size, shape, colour, gloss, and consistency), texture, and flavor; factors such as federal grade standards and internal (chemical, physical, microbial). Food safety/hygiene are the conditions and measures necessary to ensure the safety of food from production to consumption. Food can become contaminated at any point during slaughtering or harvesting, processing, storage, distribution, transportation and preparation. Food hygiene and safety issues are not separate from human health concerns or from community health issues. Good food hygiene practices can protect the community from foodborne illness.

Course Objectives:

- To describe the public health importance and aims of food hygiene.
- To define the essential functions of food
- To outline the principle aspects of a food control system and explain why food control is important.

UNIT- I

Food safety: food adulteration and contaminants, sources of food contamination, personal hygiene, health of staff, sanitary practices. Safety at the work place. Cleaning and sanitization of equipment; Pest control and disposal of waste.

Learning Outcomes:

By the end of this unit, the student will be able to

- Prevent food spoilage, i.e. changes that make food unfit for consumption due to microbial or chemical contamination.
- Inform and educate people about simple and practical methods of keeping food safe to protect themselves against foodborne diseases.
- Protect food from adulteration (intentional contamination).

- Differentiate unsafe food, misbranded food, adulterated food, wholesome food and uncontaminated food
- Learn how to dispose the waste safely and make money out of waste

UNIT- II

Toxicology: introduction, classification of toxicants, factors influencing toxicity, naturally occurring toxins in foods, metallic and nonmetallic toxins. Microbial toxins: bacterial, fungal and algal. Insecticide and pesticide residues.

Learning Outcomes:

By the end of this unit, the student will be able to

- Identify different types of toxins present in food
- Differentiate between fungal, algal, microbial and other toxins
- Illustrate the safety limits of pesticides and insecticides in food

UNIT- III

Concept of quality, quality attributes physical, chemical, nutritional, microbial, and sensory. Quality control in food industry: objectives, importance, total quality management (GMP, GHP, GLP, GAP).

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept of quality control ensuring the production of good quality products which helps in attracting more customers to the product thereby increasing sales.
- Develop measures to prevent defects in the production of food products

UNIT- IV

Quality management systems in India, Food inspection agency -Sampling procedures and plans. Domestic regulations, organizations for inspection and certification (FSSAI 2006, BIS), Global food safety initiative, International food standards- ISO 9001 & 14001 -Codex Alimentarious Commission.

Learning Outcomes:

By the end of this unit, the student will be able to

- Apprehend about quality management system to control an organization in order to continually improve the effectiveness and efficiency of it performance
- Appreciate the importance of national and international food standards which should be maintained in the food industries

UNIT-V

Hazard analysis and critical control points in processing of foods. Food additives and food colour determination, safety aspects. Water and carbonated beverages quality determination and safety aspects. Quality assurance, quality documentation and audits, record maintenance. Export import policy and export documentation. Export promotion agencies: APEDA, ECI. World Trade Organization: TBT Agreement, SPS and STDF. Food testing laboratory, quality procedures and assessment of laboratory NABL.

Learning Outcomes:

By the end of this unit, the student will be able to

- Illustrate important safety tools like HACCP that will help food industries to handle, store, and sell safe food to customers while ensuring compliance with the necessary standards
- Understand practices and procedures to actively control risks and hazards throughout the food process and ensure regulatory compliance. Appreciate the rules and regulations for importing and exporting food products.
- Gain knowledge on various national and international food testing laboratories.

Course Outcomes:

By the end of this Course, the student will be able to:

- Inform and educate people about simple and practical methods of keeping food safe to protect themselves against foodborne diseases.
- Illustrate important safety tools like HACCP
- Develop measures to prevent defects in the production of food products
- Learn how to dispose the waste safely and make money out of waste

Recommended Books:

1. Guide to Quality Management Systems for the Food Industry (1995) by R.Early.
2. Total Quality Assurance for the Food Industries (3rd edition) by W.A. Gould and R.W. Gould.
3. Food Analysis: Theory and Practice (2002) by Y. Pomeranz and C.E. Meloan.
4. ISO 22000 Standard Procedures for Food Safety Management Systems (2008) by Bizmanualz
5. Principles of Food Toxicology (2008) by T.Pussa.
6. Essentials of Toxicology (2011) by V. K.Matham.
7. Toxicology (2009) by Y.K.Lahir.
8. Food Safety and Quality Systems in Developing Countries: Export Challenges and

M.Sc. (Food Science & Technology) II SEMESTER

SFT 706: PRINCIPLES OF FOOD ENGINEERING

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals: 40 Marks

Preamble:

The amalgamation of food technology with engineering operations has given birth to the discipline of food engineering. This course covers the basic principles, materials and energy balance concepts that prepare a solid ground for easy comprehension of the technology involved. This course also emphasizes about unit operations in food processing, distillation, and several other mechanical operations. The student also learns about food industry management, and the peripheral and integrated food engineering operations.

Course Objectives:

- To understand the principle of Unit operation
- To acquaint with fundamentals of food engineering and its process
- To understand the basics of designing of food plant and systems

UNIT-I

Unit operations in food engineering: Units, dimensions, conversions, common terms, definitions - mass & energy balance, fluid flow, fluid statics, fluid dynamics, fluid flow applications. Rheological properties.

Learning Outcomes:

By the end of this unit, the student will be able to:

- Learn about unit operations, mass energy balance
- Understand fluid flow, and rheological properties and know about the importance of study of viscosity

UNIT -II

Heat transfer, radiation, conduction- steady state conduction, convection – steady state convection, natural convection and forced convection. Heat exchangers and their design. Evaporation- general principles and applications, evaporators.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about conductive and convective heat transfer methods, and heat exchangers.
- Understand the principle of heat exchangers and evaporation designs used in food industry

UNIT-III

Plant location, design and functionality of food plant, fabrication of equipment, hygienic design of food processing equipment, operational characteristics. Plant layout. Cost benefit analysis.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about the food plants designs, and layout types.
- Understand the importance of hygienic design of food processing equipment

UNIT -IV

Refrigeration, refrigerants, cold storage – requirement, applications of refrigeration in plant and animal food processing. Food freezing: Thermo physical properties of food freezing – freezing process, freezing methods, quality and stability of frozen foods.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about vapour-compression-refrigeration cycle
- Know about importance of selection of refrigerants.
- Perform freezing time calculations, methods of frozen food storage.

UNIT-V

Food processing equipment- cleaners, graders, distillers, evaporators, blenders, palletizers, freeze driers, pasteurizers, cream separators in food industries. Driers- Fluidized bed driers, drum driers, spray driers, vacuum driers and foam mat drier.

Learning Outcomes:

By the end of this unit, the student will be able to:

- Understand principles of different equipments used in food industry
- Study about designs and types of various cleaners, graders, distillers, driers used in food industry

Course Outcomes:

By the end of this Course, the student will be able to:

- Learn about the design of food plant with the learned layout and hygiene concepts.
- Demonstrate the working of various equipments used in food industry
- Understand about the importance of refrigeration, and principles and applications of conduction, convection, and radiation.

Recommended Books:

1. Hand Book of Food Engineering, (1992) by D.R. Heldman and D.B. Lund
2. Fundamentals of Food Engineering (2010) by D.G.Rao.
3. Hand Book of Food Processing Equipment (2006) by G. D. Saravacos*etal*.
4. Introduction to Food Engineering (5^{th} edition) by R. P. Singh *etal*.
5. Food Processing Operations Analysis (2005) by H. Das.
6. Food Process Engineering Operations (2011)by G. D. Saravacos and Z. B. Maroulis
7. Elements of Food Engineering (1998) by E.L. Watson and J.C. Harper
8. Fundamentals of Food Process Engineering (2007) by Toledo and Romeo.

M.Sc. (Food Science & Technology) II SEMESTER

SFT 708: SPICES, BEVERAGES AND CONFECTIONERY

Hours per week: 4 End Examination: 60 Marks

Credits: 4 Sessionals: 40 Marks

Preamble:

Spices are woven into the history of nations. Most of the spices are native of our country and hence India is known as the Land of Spices. Beverages including alcoholic and nonalcoholic beverages are diverse group of commodities which range from the most innocuous and essential drink. The market for these products continues to show a remarkable potential for growth.

Course Objectives:

- To introduce students to the world of plants and their products with an emphasis on the creative use of spices in enhancing the aroma and taste of many dishes.
- To study the processing of cocoa pods and manufacturing of chocolate.
- To provide students with the knowledge on basic raw materials and additives in beverage and confectionery production
- To familiarize the students with technological phases of alcoholic and nonalcoholic beverages.
- To introduce the fundamentals of the science of sugar study

UNIT –I

Spices and condiments: Major and minor spices of India, classification, composition, active principles. Spice production, processing. Packaging, storage and quality control. Value added products of spices. Technology of manufacturing oleoresins and spice oils, applications**.**

Learning Outcomes:

By the end of the course, the student will be able to

- Understand the classification and composition of spices
- Describe various methods for manufacturing spice extracts
- Discuss on value added products of spices
- Understand the concepts of spices processing

UNIT -II

Water – Laboratory standards of water, water treatments (reverse osmosis, membrane filtration, deionization, ozonation, irradiation). Beverages: Classification. Carbonated non – alcoholic soft drinks-

ingredients and manufacturing. Non-nutritive and fruit based beverages.

Learning Outcomes:

By the end of the course, the student will be able to

- Describe the laboratory standards of water
- Compare and contrast various water treatments
- Classify beverages
- Understand the technologies involved in making carbonated beverages and fruit beverages

UNIT - III

Alcoholic beverages: beer- types, raw materials, production- malting, brewing and fermentation. Storage, finishing and packaging. Wine, types of wine-White wines, Red wines, Dry wine and Sweet wine, Champagne and sparkling wines. Distilled spirits- whisky, rum, gin and brandy. Traditional alcoholic beverages: toddy, *chang, kaomak, takju, feni* and *madhuka.*

Learning Outcomes:

By the end of the course, the student will be able to

- Understand the concepts of wine and beer making
- Summarize different types traditional alcoholic beverages
- Gain Knowledge on distilled spirits
- Classify wines

UNIT -IV

Coffee: varieties, processing- bean processing, blending, roasting, grinding, brewing. Decaffeinated coffee: methods of decaffeination, Instant coffee processing. Tea- types of tea, chemical constituents, harvesting, processing and packaging. Instant tea processing. Cocoa- Production, composition, processing, grading, cocoa products.

Learning Outcomes:

By the end of the course, the student will be able to

- Gain Knowledge on coffee and tea manufacturing
- Compare different types of tea
- Describe instant tea and instant coffee processing
- Discuss cocoa composition, processing

UNIT - V

Confectionery: Sugar- Manufacturing of sugar, types of sugar, byproducts, jaggery, honey. Chocolates: Ingredients- sucrose, invert sugars, corn syrup, non-nutritive sweeteners, sugar substitutes; Additional ingredients; Processing. Types of chocolates. Crystalline and non-crystalline candies.

Learning Outcomes:

By the end of the course, the student will be able to

- Describe the properties and functions of various ingredients used in the production of chocolates
- Gain knowledge on manufacturing of sugar
- Differentiate between jaggery and sugar manufacturing
- Describe honey processing

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the classification and composition of spices
- Describe the laboratory standards of water
- Learn the properties and functions of various ingredients used in the production of chocolates

Recommended Books:

1. Text book of Food Science and Technology (2001) byVijayakhader.
2. Spices and Condiments (2011) by J.S.Pruthi
3. Handbook on Spices and Condiments (Cultivation, Processing and Extraction) (2010) by H.Panda
4. Chemistry and Technology of Soft Drinks and Fruit Juices(2nd Edition) by P. R. Ashurst
5. Chocolate, Cocoa and Confectionery Science and Technology(3rdedition) by B.W. Minifie.
6. Sugar Confectionery Manufacture(2nd edition) byE.B. Jackson.

M.Sc. (Food Science & Technology) II SEMESTER

SAE 702: PROFESSIONAL COMMUNICATION SKILLS

Hours per week: 3 Sessionals: 100 Marks

Credits: 2

Preamble:

This course is designed to expose students to the basics of academic and professional communication in order to develop professionals who can effectively apply communication skills, theories and best practices to meet their academic, professional and career communication needs.

Course Objectives:

- To acquaint themselves with basic English grammar
- To acquire presentation skills
- To develop formal writing skills
- To develop creative writing skills
- To keep themselves abreast with employment-readiness skills

UNIT - I

BACK TO BASICS: Tenses, Concord – Subject Verb Agreement, Correction of Sentences-Error Analysis, Vocabulary building.

Learning Outcomes:

At the end of the unit, the student will be able to

- Use structures and tenses accurately (L3)
- Apply the right verb to the right subject in a sentence (L3)
- Detect incorrect sentences in English and write their correct form (L1)
- Acquire new vocabulary and use in speaking and writing (L3)

UNIT - II

ORAL PRESENTATION: What is a Presentation? Types of Presentations, Technical Presentation – Paper Presentation, Effective Public Speaking, Video Conferencing.

Learning Outcomes:

At the end of the unit, the student will be able to

- Overcome speaking anxiety prior to presentation (L3)

- Plan and structure effective presentations that deliver persuasive messages (L6)
- Prepare slides that can catch the attention of the audience (L6)
- Engage the audience (L3)
- Demonstrate skills in organizing, phrasing, and expressing the ideas, opinions and knowledge. (L3)
- Facilitate and participate in a video conference effectively (L3)

UNIT III

DOCUMENTATION : Letter –Writing, E-mail Writing & Business Correspondence, Project Proposals, Report Writing, Memos, Agenda, Minutes, Circulars, Notices, Note Making.

Learning Outcomes:

At the end of the unit, the student will be able to

- Write a business letter, which includes appropriate greetings, heading, closing and body and use of professional tone. (L6)
- Draft crisp and compelling emails (L6)
- Draft project proposals, reports and memos (L6)
- Prepare agenda and draft minutes (L6)
- Prepare circulars, notices and make notes.(L6)

UNIT IV

CREATIVE WRITING: Paragraph Writing, Essay writing, Dialogue Writing, Précis Writing, Expansion of Hints, Story Writing.

Learning Outcomes:

At the end of the unit, the student will be able to

- Write paragraphs on familiar and academic topics using a topic sentence, supporting detail sentences and a conclusion sentence. (L6)
- Learn the structure of a five-paragraph essay and write essays that demonstrate unity, coherence and completeness (L1)
- Structure natural, lucid and spontaneous dialogues (L6)
- Draft clear, compact logical summary of a passage (L6)
- Recognize the elements of a short story and develop their functional writing skills.(L1)

UNIT V

PLACEMENT ORIENTATION: Resume preparation, group discussion – leadership skills, analytical skills, interviews –Types of Interviews, Preparation for the Interview, Interview Process.

Learning Outcomes:

At the end of the unit, the student will be able to

- Write a professional resume that highlights skills, specific to the student's career field (L6)
- Demonstrate the personality traits and skills required to effectively participate in a G.D (L3)
- Understand the purpose of interviews (L2)
- Be aware of the processes involved in different types of interviews (L2)
- Plan how to prepare for an interview (L6)
- Prepare how to answer common interview questions(L6)

Course Outcomes:

By the end of this Course, the student will be able to:

- Write good English with correct Grammar
- Understand the basic ethics of mail, paragraph writing
- Prepare for placement interviews

Recommended Books :

1. Essentials of Business Communication by Rajendra Pal and J S KorlahaHi, Sultan Chand & Sons.
2. Advanced Communication Skills by V. Prasad, Atma Ram Publications.
3. Effective Communication by Ashraf Rizvi, McGraw Hill Education; 1st Edition , 2005.
4. Interviews and Group Discussions How to face them by T.S.Jain, Gupta,1st Edition, Upkar Prakashan,2010.
5. High School English Grammar and Composition by P.C.Wren & Martin, N.D.V.Prasada Rao S.Chand.

M.Sc. (Food Science & Technology) II SEMESTER

SFT 722: TECHNOLOGY OF FOODS

Hours per week: 8

Credits:3 Sessionals: 100 Marks

1. Sensory evaluation of foods.
2. Cereal cookery, starch, factors affecting gelatinization of different types of starch.
3. Pulse cooking – effect of different processing and cooking methods.
4. Vegetable cookery – different cooking methods, enzymatic browning.
5. Fruit preparations: processing – effect of browning and cooking on pigments – pectin- Jams and Jellies.
6. Sugar cookery : Factors affecting crystallization in candies and fondant, inhibition of crystallization in Indian Sweets like burfees, toffees and halwas.
7. Fats and Oils–Smoke points, oil absorption and stability of emulsion – Mayonnaise.
8. Milk cooking : preparation of milk products
9. Egg cookery: Egg white foams: preparation of the eggs acting as binding, emulsifying and thickening agent.
10. Meat cookery: Effect of different cooking methods
11. Fish cookery, and other marine foods.

Course Outcomes:

After the completion of the above experiments the students will be able to:

- Know about importance and performing sensory evaluation of foods
- Understand cereal, pulse, sugar, vegetable, milk, egg, meat, and fish cookeries
- Perform critical analysis of foods by studying the processing of foods undergoing while cooking
- Preparation of variety of food items using each cookery ingredients.

Recommended Books:

1. Food Theory and Application (1972) by P.C. Paul and A.H.Palmer.
2. Food Science and Experimental Foods (1995) by M.Swaminathan.
3. Foods, Facts, Principles and Procedures (2009) by S.N.Manay
4. Food science (2nd edition) by B. SriLakshmi.

5. Food Processing and Preservation (2006) by G. Subbalakshmi

M.Sc. (Food Science & Technology) II SEMESTER

SFT 724: FOOD SAFETY, STANDARDS AND QUALITY CONTROL

Hours per week: 8

Credits:3 Sessionals:100 Marks

1. Introduction to Food Adulteration- Tests for common adulterants in food. Permissible limits for food colours, food Additives and artificial sweeteners.
2. Test of water including mineral water – total dissolved solids, pH, turbidity, colour, hardness, Chlorides, sulphates, residual chlorine.
3. Cereals and cereal products- quality assessment ,Wheat and wheat products – pH value, moisture, total ash, acid insoluble ash, bleach value, total solid contents of wheat, bread and biscuits, fat and acidity of extracted fat from wheat products.
4. Fats and oils : Specific gravity, refractive index, color, moisture, acid value, iodine value, RM value, peroxide value, presence of non – edible and inedible oils in edible oils. Saponification value
5. Beverages: Tea – moisture, total ash, water soluble ash, ash insoluble, alkalinity of soluble ash, presence of iron filings and coloring matter.
6. Coffee **:** Moisture, total ash, water insoluble ash, water soluble ash, ash insoluble, alkalinity of soluble ash, determination of caffeine content and presence of chicory, Instant coffee powder: Moisture and total ash.
7. Chocolate & Confectionery: moisture, sulphated ash, acid soluble and insoluble ash, sucrose, Fat, nonfat milk solids.
8. Spices and condiments – Added starch in spice powders, argemone seeds in mustard seeds. Lead dichromate estimation in turmeric.

Course Outcomes:

After the completion of the above experiments the students will be able to

- Identify different types of adulterations in food items
- Test the hardness of water and assess it portability
- Assess the quality of cereals, fats, oils, tea, coffee, chocolates, spices and condiments

Recommended Books:

1. Practical Food Microbiology and Technology (3rd edition) by H.H. Weisert
2. Biochemistry of Industrial Microorganisms (2007) by C Rainbow and A.H.Rose.
3. Food Microbiology (4th edition) by W. C.Frazier.
4. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd edition) by S.Ranganna.
4. Foods, Facts, Principles and Procedures (2009) by S.N.Manay.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 801: FOOD INNOVATION PROCESS

Hours per week: 4 End Examination: 60Marks

Credits: 4 Sessionals: 40Marks

Preamble:

This course provides overview about the commercialization of innovation and new products in fast-paced, high-tech markets and matching technological innovation to market opportunities. This paper deals about how to integrate business, market, technology and resource strategies for optimal product development decisions and global commercialization success. It demonstrates food product development from a number of perspectives: the process itself; health research that may provide opportunities; idea creation; regulation; and processes and ingredients.

Course Objectives:

- To study innovations in product development and factors effecting product development
- To learn the importance of product development process, product design
- To learn about different phases of food product development and product commercialization
- To provide knowledge about entrepreneurship development-basic principles, important parameters in selecting plant location, and getting funds for startup.

UNIT–I

Innovations in product development, need, classification, characterization, factors shaping new product development – social concerns, health concerns, impact of technology, market influence, market sector perspective and market research.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn innovations in product development
- Learn factors effecting product development

UNIT -II

Product development process: techniques and resources, product design specifications, technical development – recipe development, standardization and testing for quality, sensory evaluation, acceptability studies and scale up. Test marketing – evaluating results and analysis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the importance of product development process, product design
- Value the importance of recipe generation, quality testing and significantly sensory evaluation

UNIT -III

Phases of food product development- introductory phase, growth phase, maturity phase and decline phase. Product strategy development- idea generation and screening, product concept, product profile, product engineering, product launch – pre and post launch evaluation- case studies.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about different phases of food product development
- Learn about product strategy development-importance in idea generation, and implementation to product launch

UNIT -IV

Product commercialization – requirements for market plan – marketing information, market channel and distribution, pricing, promotion and sales – pre launch trial, consumer expectations from the food industry, overall operational plan, and financial analysis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand importance of product commercialization
- Learn the value of importance of market plan ahead, distribution, pricing, promotions, product trials etc. before commercialization.

UNIT –V

Entrepreneurship development- principles, planning, implementation, plant location, investment, financing the project. Participation, coordination and training for rural development ,community development, agricultural and industrial development programs.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about entrepreneurship development-basic principles, important parameters in selecting plant location, and getting funds to startup etc.

- Understand and learn to organize society, agricultural, and industrial development programs.

Course Outcomes:

By the end of this Course, the student will be able to:

- Learn the importance of product development process, product design
- Learn about different phases of food product development
- Understand and learn to organize society, agricultural, and industrial development programs.
- Understand importance of product commercialization

Recommended Books:

1. New Food Product Development: From Concept to Market Place (1994) by G.W.Fuller.
2. Food Product Development from Concept to the Market Place (1991) by Graf & Saguay.
3. Shelf Life Evaluation of Foods (1994) by C.M.D. Man and A.A. Jones.
4. Principles and Practices for the Safe Processing of Foods (1991) by D.A. Shapton, and N.F. Shapton.
5. New Product Development and Value Addition (1990) by J.G.Oickle.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 803: FOOD PRESERVATION TECHNOLOGY

Hours per week: 4 End Examination: 60Marks

Credits:4 Sessionals:40Marks

Preamble:

Food Preservation is defined as a method of maintaining foods at a desired level of properties for their maximum benefit for as long as possible. The subject lies in the core of food science and technology and it is the main purpose of food processing. Food preservation uses many techniques that range from too simple to highly sophisticated technologies.

Course Objectives:

- To study the importance and need of food preservation
- To introduce the basics of various food processing and preservation technologies.
- To introduce the concepts of novel food preservation methods
- To familiarize the pros and cons of various food preservation techniques

UNIT -I

Food preservation: principles of food preservation, food deterioration and spoilage - factors affecting food spoilage. Traditional methods of food preservation. Food preservatives, food additives- types and functions, effects on health.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Identify the important pathogens and spoilage microorganisms in foods
- Classify the conditions under which important pathogens are commonly inactivated, killed or made harmless in foods.
- Know the principles involving in food preservation via various processes
- Understand the types and effect of food additives

UNIT -II

High temperature preservation: heat transfer. Heat resistance of microorganisms, and their spores, factors affecting heat resistance. Thermal death time (TDT), Decimal reduction time. Heat penetration. Pasteurization, blanching, canning. High pressure processing – Pascalization

Learning Outcomes:

By the end of this Unit, the student will be able to

- Classify various thermal treatments based on temperature
- Discuss the Pros and cons of high temperature preservation
- Suggest the best thermal treatment for processing different foods
- Describe the mode of action of Pascalization

UNIT -III

Low temperature: growth of microorganisms at low temperatures, preservation methods and their effects - freezing, refrigeration and cold storage. Dehydro- freezing, accelerated freeze drying. Controlled and modified atmosphere.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Differentiate Freezing from Refrigeration
- Discuss the role of various gases on the storage stability of foods
- Describe the advantages of de-hydrofreezing
- Compare and contrast freeze drying and accelerated freeze drying

UNIT -IV

Drying – methods of drying, pretreatments and procedures after drying. Drying rate, factors affecting drying rate. Novel drying methods. Concentration- methods, characteristics of dried and concentrated products. Effects of concentrating and drying on foods. Intermediate moisture foods.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Compare and contrast Drying and Dehydration
- Apply the concept of heat and mass transfer in various dehydration methods
- Discuss various factors affecting concentration and dehydration
- Describe the advantages of Intermediate moisture foods

UNIT – V

Advanced food preservation methods – food irradiation - safety and quality of irradiated foods. Microwave and Ohmic processing of foods- principles, procedure and applications. Application of nanotechnology in food preservation.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Analyze the Quality and safety of irradiated foods
- Know the principle and procedure of Microwave and Ohmic processing
- Categorize different kinds of ionizing radiations used in food irradiation
- Discuss the applications of nanotechnology in food preservation.

Course Outcomes:

- List out various food preservation methods
- Know the principles involving in food preservation
- Compare conventional methods of food preservation with novel methods of food preservation
- Evaluate the effect of processing upon the nutritional properties of foodstuffs

Recommended Books:

1. Introduction to Food, Nutrition and Food Processing (1998) by M.Vashisht.
2. Text Book on Food Storage and Preservation (2004) by Vijayakhader.
3. Food Science (2002) by B.Srilakshmi.
4. Food Processing and Preservation (2010) by B.SivaShakar.
5. Food Processing and Preservation (2007) by G. Subbalakshmi
6. Modern Technology on Food Preservation and Agro Based Industries (2003) National Institute of Industrial Research.
7. Hand Book of Fruit Science and Technology: Production, Composition, Storage and Processing (1995) by D.K. Salunkhe and S.S.Kadam.
8. Food packaging (1993) by G.L.Robertson.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 805: FOOD PACKAGING AND LABELING

Hours per week: 4 End Examination: 60Marks

Credits: 4 Sessionals:40 Marks

Preamble:

This course informs the student brief idea about food preservation processes and techniques, product quality and shelf life, and the in-depth knowledge about logistical packaging, packaging materials, machinery and processes, necessary for a wide range of packaging presentations. The course also teaches food packaging innovation have a thorough technical understanding of the requirements of a product for protection and preservation, together with a broad appreciation of the multi-dimensional role of packaging.

Course Objectives:

- To impart comprehensive overview of the scientific and technical aspects of food packaging.
- To instill knowledge on packaging machinery, systems, testing and regulations of packaging.

UNIT-I

Introduction to packaging. Packaging operations, package-functions and design. Principles of protective packaging. Deteriorative changes in foodstuff. Shelf life of packaged foodstuff, packaging methods to extend shelf-life. Packaging materials: origin, types, chemistry, morphology and physical characteristics, advantages, defects and risks.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Get an idea about food packaging and learn about packaging operations
- Understand various food packaging materials such as metal, glass, plastic, paper and their importance

UNIT -II

Food containers: Rigid containers, corrosion of containers (tin plate). Flexible packaging materials and their properties. Food packages-bags, pouches, wrappers, carton and other traditional packages. Containers-wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about food containers, rigid and flexible containers
- Gain knowledge about Wooden boxes, crates etc. in food packaging

UNIT -III

Challenges in food packaging, considerations in the packaging of perishable and processed foods. Evaluation of packaging material and package performance, WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test, puncture test, impact test. Packaging equipment, package standards and regulation.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand testing (variety of methods to know the quality of packaging material) and regulatory aspects of food packaging.
- Know about food packaging laws and regulations
- Understand the principle and working of different packaging machinery and systems

UNIT -IV

Shrink packaging. Bar coding, aseptic and retortable pouches. Flexible and laminated pouches, Aluminum as packaging material. Biodegradable packaging. Active packaging, smart packaging and intelligent packaging.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn the importance of biodegradable packaging and its essentiality nowadays
- Know the importance of barcoding
- Understand the importance of smart packaging that deals active and intelligent packaging systems

UNIT -V

FSSAI regulations of food labeling - CAC guidelines for food labeling. FOSHU- Nutritional labeling and education act 1990- mandatory nutritional labeling, nutrient content claims, health claims, national uniformity for food act, 2005.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn the labelling and related Laws, importance of labelling of nutrient information
- Know the importance of FOSHU, NLEA etc.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand various food packaging materials such as metal, glass, plastic, paper and their importance
- Learn the importance of biodegradable packaging and its essentiality nowadays
- Learn the labelling and related Laws, importance of labelling of nutrient information

Recommended Books:

1. A Handbook of Food Packaging (1992) by F.A. Painy and H.Y.Painy.
2. Food Packaging Science and Technology (2008) by D. S. Lee and K. L.Yam.
3. Food Science (1996) by N. N. Potter
4. Food Packaging: Principles and Practice (2009) by L. Gordon and Robertson.
5. Food Packaging Technology (2004) National Institute of Industrial Research, Asia Pacific Business Press, New Delhi.

M. Sc. (Food Science & Technology) III SEMESTER

SFT 841: NUTRITION AND DIETETICS

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals: 40 Marks

Preamble:

Food is the basic necessity of man. It is a mixture of different nutrients such as carbohydrate, protein, fat, vitamins and minerals. These nutrients are essential for growth, development and maintenance of good health throughout life. They also play a vital role in meeting the special needs of pregnant and lactating women and patients recovering from illness.

Course Objectives:

- To discuss basic nutrients and their role in growth, development and health maintenance
- To categorize the nutritional requirements for different age groups
- To identify appropriate dietary guidelines across the lifespan to include pregnancy, lactation, and older aged clients.
- To understand the advantages of breast feeding

UNIT I:

Functions of food- physiological, psychological and social, food groups- major nutrients, recommended daily allowances for nutrients, factors affecting RDA, uses of RDA, BMI and Nutritional Status, Food Pyramid, food exchange list, basal metabolism, factors affecting BMR, malnutrition, balanced diet, guidelines for good health.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand various functions of food
- Explain the role of nutrition in health
- Gain Knowledge on various food groups, RDA, BMI, BMR, balanced diet
- Understand the significance of food Pyramid, food exchange list

UNIT II

Nutrition and food requirements of expectant mother, recommended daily allowance, dietary modification, general dietary problems, physiological changes in pregnancy, common complications

during pregnancy. Nutrition and food requirements of lactating women, recommended daily allowance.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the nutritional requirements of expectant mother
- Discuss the general dietary problems during pregnancy
- Describe common complications associated with pregnancy
- Gain knowledge on the nutritional requirements of expectant mother

UNIT III

Nutritional requirements of preschool, recommended daily allowance, nutrition related problems. Nutritional requirements of school children, planning packed lunch, school lunch programs in India. Nutritional requirements during adolescence, dietary habits, nutritional problems, recommended daily allowance.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Discuss the nutritional requirements of preschool and school children
- Identify various nutrition related problems of preschool child and plan packed lunch for school children
- Gain knowledge on the dietary habits and RDA of adolescence

UNIT IV

Nutrition and food requirements during infancy, Growth and development during infancy, recommended daily allowance for infants, nutritional assessment, breast feeding – composition of colostrum, nutritional and immunological factors of breast feeding, advantages of breast feeding, artificial feeding, weaning foods –DHA.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Discuss the nutrition and food requirements of an infant
- Deliberate the immunological factors in breast feeding
- Describe the advantages of breast feeding over artificial feeding
- Understand the importance of weaning foods

UNIT V

Nutritional requirements for adults, nutritional importance during adulthood, classification of activities, recommended daily allowances for adult man and woman. Nutritional requirements during old age, dietary modifications, Nutritional problems of old age, common complaints, effect of drugs on food intake.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Assess the Nutritional needs of adults and old people
- Classify various physical activities
- Discuss common complaints and problems associated with old age
- Gain knowledge on the effect of drugs on food intake

Course Outcomes:

By the end of this Course, the student will be able to:

- Gain Knowledge on various food groups, RDA, BMI, BMR, balanced diet
- Explain the nutritional requirements of expectant mother, lactating mother, new born, and for the old age.

Recommended Books:

1. Nutrition in Health and Disease (1982) by Dibble.
2. Nutrition: Principles and Clinical Practice (1980) by S.M.Hun.
3. Dietetics (2007) by B.Srilakshmi
4. Nutrition and Diet Therapy (2005) by S.R.Williams
5. Text Book of Human Nutrition (2010) by Bamji
6. Essentials of Human Nutrition (2007) by A.S.Truswell
7. Advancing Dietitics and Clinical Nutrition (2011) by A. Payne and H.M.Barker

M.Sc. (Food Science & Technology) III SEMESTER

SFT 843: ADVANCED FOOD PROCESSING TECHNOLOGY

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40Marks

Preamble:

Food processing technologies are an essential link in the food chain. These technologies are many and changing in popularity with changing consumption patterns and product popularity. Advanced processing technologies are evolved to provide the added advantages. Conventional and Advanced Food Processing Technologies fuses the practical, theoretical and recent trends, making it ideal for industrial use.

Course Objectives:

- To impart basic knowledge of Cold Preservation and freezers
- To understand the concept of Dehydration and Irradiation
- To impart basic knowledge of Food Packaging
- List the pros and cons of Thermal Processing

UNIT-I

Thermophysical properties of foods, heat transfer, fluid flow, effects of processing on sensory characteristics of foods – Effect of processing on nutritional properties. Processing control- automatic control, computer based systems.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the impact of processing on sensory characteristics of foods
- Understand the thermo physical properties of foods
- Gain knowledge on computer based systems in food processing

UNIT -II

Role of primary, secondary and tertiary processing of foods-RTE Foods, RTC Foods, RTS Foods, Instant Foods. Thermal processing: Introduction, principles of thermal processing, classification. Thermal process equipment- commercial retorts, quality improvement in thermally processed foods.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the role of primary, secondary and tertiary processing of foods
- Classify thermal process equipment
- Describe the equipment used for thermal processing
- Understand the concepts of RTE, RTC, and RTS Foods
- Discuss methods to improve quality of thermally processed foods.

UNIT -III

Novel thermal processing techniques.Extrusion method of food processing.Pulsed electric field processing.Ultrasonic food processing.Food dehydration, dehydration fundamentals, effect of product characteristics on drying, common drying systems, novel drying techniques, quality and storage stability of dehydrated foods.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain knowledge on novel thermal processing techniques
- Summarize various dehydration methods
- Discuss the quality and storage stability of dehydrated foods.
- Compare and contrast conventional and novel drying methods

UNIT -IV

Separation and concentration, evaporation, membrane processing, membrane materials, configurations and performance, freeze concentration, extraction, super critical fluid extraction, osmotic dehydration. Applications in foodindustry.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the concept of osmotic dehydration
- Discuss the applications of separation and concentration in food industry
- Summarize various membrane materials
- Gain knowledge on extraction methods

UNIT -V

Post processing operations, coating or enrobing-coating materials, enrobers, dusting or breading, pan coating, storage and distribution.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain knowledge on post processing operations
- Summarize coating materials
- Understand the concepts in material handling
- Discuss the applications of dusting in food processing

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the impact of processing on sensory characteristics of foods
- Explain the role of primary, secondary and tertiary processing of foods
- Gain knowledge on post processing operations

Recommended Books:

1. Food Processing – Principles and Applications (2009) by Ramaswamy andMarcotte.
2. Food Processing Technology – Principles and Practice (2000) by P.J.Fellows.
3. Modern Technology of Food Processing and Agro based Industries (2003) National Institute of Industrial Research.
4. New Methods of Food Preservation (1995) by G.W.Gould.
5. Food Processing and Industrial Powerhouse in Transition (1997) by J.M. Connor and W.A.Schick.
6. Fruit Processing (1996) by D. Arthy and P.R.Ashurst.
7. Bakery Technology and Engineering (1996) by S.A.Matz.
8. Candy Technology (2000) by J.J.Alikonis.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 845: DAIRY TECHNOLOGY

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble:

Dairy Technology deals with processing of milk and milk product. Dairy technology study involves processing, storage, packaging, distribution and transportation of dairy products by entailing the science of bacteriology, nutrition and biochemistry.

Course Objectives:

- To know the need and importance of dairy industry
- To know the compositional and technological aspects of milk
- To study processed milk and milk products

UNIT- I

Introduction, milk - composition, food and nutritive value, physico-chemical properties. Buying and collection of milk, transportation of milk, milk reception in dairies, quality and quantity tests at reception. Microbiological quality of milk and its spoilage.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the composition of Milk, its properties nutritive value, physico-chemical properties
- Gain knowledge on purchase and collection of milk, perform quality analysis at the reception desk.

UNIT- II

Filtration / clarification, storage of milk, standardization, types of milk- low fat milk, full fat milk, SNF. Homogenization, pasteurization – types of pasteurization process. Equipment used in each process - cream separating centrifuges, pasteurizers (heat exchangers), homogenizers, bottle and pouch fillers, milk chillers.

Learning Outcomes:

By the end of this unit, the student will be able to

- Know the processing stages of milk and milk products.

- Understand variety of equipments used in various stages of processing

UNIT-III

Manufacture of cream, butter, ghee, milk powder, cheese – types and defects in cheese. Chemical and microbiological quality. Dairy equipment- butter churn, ghee boiler, spray and drum dryers.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn manufacturing of cream, butter, ghee, milk powder, and cheese
- Learn dairy equipment related to the the above products manufacturing

UNIT-IV

Manufacture of ice cream – chemistry and technology – microbiology of ice cream
– quality aspects. Manufacture of paneer, toned milk, sweetened condensed milk, khoa. Extraction of casein from milk – properties, composition and industrial uses. Production of lactose and whey.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about ice cream manufacturing, manufacturing to quality aspects
- Understand the concepts of preparation of paneer, khoa, whey etc.

UNIT-V

Fermented products – yoghurt, curd, acidophilus milk, butter milk. Dairy plant sanitization – cleaning in place – bottle and can washing, cleaning of tankers and silos – detergents and sanitizers.

Learning Outcomes:

By the end of this unit, the student will be able to

- Study of different milk products and its production.
- Understand the importance of dairy sanitization.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the composition of Milk, its properties nutritive value, physico-chemical properties
- Know the processing stages of milk and milk products.
- Learn the importance of sanitization in dairy industry.

Recommended Books

1. Outlines of Dairy Technology (2008) by S.De.
2. Modern Technology of Milk Processing and Dairy Products(2004) NIIR Publications.
3. Milk Products (1999) by W.M.C. Harvey and H.Hill.
4. Milk and Dairy Product Technology (2005) by E.Spreer.
5. Food Engineering and Dairy Technology (1981) by H.G.Kessler.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 847: BAKERY AND CONFECTIONARY TECHNOLOGY

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble:

Baking is both an art and a science, and mastery in baking allows the baker to be creative in exploring new and quality products from inconsistent ingredients and process conditions. The course gives a wealth of information about making of various yeast-made products—bread, cakes, biscuits, desserts and pizza—their ingredients in bakery production. The course also allows us to understand the use of modern technology machines in bakery production, icings, decoration, bakery organization, and many other aspects.

Course Objectives:

- To understand the fundamentals of baking
- To learn the technologies behind bakery products
- To understand industry trends

Unit I

Bakery industry: Introduction to bakery and bakery layout. Product types, nutritional quality and safety of products, pertinent standards & regulations. Bread, buns and pizza base: Ingredients & processes for breads, buns, pizza base, equipment used, product quality characteristics, faults and corrective measures. Cakes: Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and corrective measures. Different types of icings.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the nutritional quality and safety of bakery products
- Explain the ingredients and making process of bread, buns and pizza base, cakes

Unit II

Biscuits, cookies & crackers: Ingredients & processes, Equipments used, product quality characteristics, faults and corrective measures. Modified bakery products: Modification of bakery products for people with special nutritional requirements e.g. High fibre, low sugar, low fat, gluten free bakery products. Breakfast cereals, macaroni products and malt: Production and quality of breakfast

cereals, macaroni products and malt.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Discuss the ingredients and process of preparation of biscuits, cookies & crackers
- Discuss the ingredients and process of preparation of breakfast cereals, macaroni products and malt

Unit III

Chocolate processing - Different steps involved in chocolate processing - Ingredients, mixing, refining. General technical aspects of Industrial sugar confectionery, composition effects, changes, change of state.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Understand the process of chocolate making and its ingredients
- Gain knowledge on the process of making confectionery

Unit IV

Boiled sweets - classification - Ingredients used in the preparation - Caramel, toffee and fudge – Processing. Processing of liquorice paste, cream paste and aerated confectionery products - Ingredients- their function - Ingredients and Processing. Tablets, Lozenges, Sugar panning tablets, Granulated confectionery, medicated confectionery - Ingredients and Processing.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain knowledge on the process of making boiled sweets
- Understand the ingredients and making process of Granulated and medicated confectionery

Unit V

Chewing gums, fondants, Marzipan - Ingredients & Processing. Crystallized confectionery - Processing - Ingredients and their functions. Quality and standards/regulations to be followed in the confectionery Industry and packaging requirements

Learning Outcomes:

By the end of this Unit, the student will be able to

- Explain the ingredients and making process of Chewing gums, fondants, Marzipan
- Understand the quality and standards/regulations to be followed in the confectionery Industry and packaging requirements.

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the nutritional quality and safety of bakery products
- Discuss the ingredients and process of preparation of biscuits, cookies & crackers
- Understand the quality and standards/regulations to be followed in the confectionery Industry and packaging requirements.

Recommended Books:

1 Basic Baking 5th Ed. Dubey, S.C. (2007). Chanakya Mudrak Pvt. Ltd.

2 Industrial Chocolate Manufacture. Beckette S.T. (2009)., Blackwell Publishing Ltd.

3 Chocolate, Cocoa and Confectionary, Minifie B.W. (1999). Aspen Publication.

4 Text book of Food Science and Technology. Vijaya Khader.. ICAR

5 Bakery Technology and Engineering. Samuel A. Matz (1999)., PAN-TECH International Incorporated.

M.Sc. (Food Science & Technology) III SEMESTER

SFT 821: FOOD PROCESSING AND PRESERVATION

Hours per week: 12

Credits: 3 Sessionals: 100 Marks

1. Survey of preserved foods available in the local markets to study methods of preservation, preservatives used, shelf life, cost and form of availability.
2. Preservation of food by traditional methods.
3. Preservation of food by preservatives.
4. Drying of cereals and pulses –product preparation.
5. Drying and dehydration of vegetables, fruits, flesh food.
6. Preparation of jams, jellies, fruit juices, squashes, sauces.
7. Pickling of fruits and vegetables.
8. Freezing of fruits and vegetables
9. Freezing of flesh foods.

Course Outcomes:

After the completion of the above experiments the students will be able to

1. Understand various preservative techniques used in food industry
2. Differentiate between traditional and chemical preservatives
3. Demonstrate the concepts of drying and freezing

Recommended Books:

1. Food Science (1998) by N. N. Potter
2. Introduction to Food, Nutrition and Food Processing (1998) by M.Vashisht
3. Wiser– Practical Food Microbiology and Technology (2009) by M.Vashisht
4. Text Book on Food Storage and Preservation (2004) by Vijaya Khader
5. Food Science (2003) by B.Srilakshmi

M.Sc. (Food Science & Technology) III SEMESTER

SFT 823: FOOD PRODUCT DEVELOPMENT AND EVALUATION TECHNIQUES

Hours per week: 12

Credits: 3 Sessionals: 100 Marks

1. Cereal, millet and pulse processing: effects of different processing methods: soaking, malting, germination, fermentation and product preparation with cereals, pulses and oilseeds.
2. Preparation of baked products – effect of baking powders on bakery products.
3. Preparation of breakfast cereals.
4. Nutritional evaluation of "ready to eat foods".
5. Nutritional evaluation of "ready to cook foods".
6. Tests for fats and oils – chemical and physical tests, solid fat index, fat absorption tests for vegetable and animal fats and oils.
7. Products made from fats and oils and by products utilization.
8. Effect of processing on quality of oils and fats.

Course Outcomes:

After the completion of the above experiments the students will be able to:

- Understand different processing methods
- Prepare baked products and breakfast cereals
- Evaluate nutritional values of ready to eat and ready to cook foods

Recommended Books:

1. Snack Food Technology (1993) by S.A.Matz.
2. Principles of Cereal Science and Technology (1986) by R.C.Horseny.
3. Food Science (1998) by N. N. Potter.
4. Breakfast Cereals and How They are Made (1990) by R.B. Fast and E.F.Caldwell.

M.Sc. (Food Science & Technology) IV SEMESTER
SFT 802: FERMENTATION TECHNOLOGY

Hours per week: 4 End Examination: 60Marks

Credits: 4 Sessionals:40 Marks

Preamble:

Fermentation is a metabolic process that produces chemical changes in organic substrates through the action of enzymes. Industrial fermentation is the intentional use of fermentation by microorganisms such as bacteria and fungi to make products useful to humans. Fermentation technology is a valuable tool for future economic development. Fermented products have applications as food as well as in general industry.

Course Objectives:

- Understand and explain the science underlying the fermentation mechanism
- Develop an understanding of process control and downstream process
- Acquire experimental knowledge of microbial production of various industrial products
- Get acquainted with the industrial aspect of the field of Microbiology
- Learn about growth pattern of microbes in different industrial systems.

UNIT – I

Introduction to fermentation processes, microorganisms used in food fermentation. Probiotics and prebiotics- LAB, yeast; isolation, primary and secondary screening methods, preservation and strain improvement. Effect of fermentation process on nutrient constituents in food.

Learning Outcomes:

By the end of this Unit, the student will be able to

- List microorganisms used in food fermentation
- Compare and contrast probiotics and prebiotics
- Summarize various screening methods
- Understand strain improvement methods

UNIT - II

Industrial media formulation; substrates for fermentation – carbon & nitrogen sources; antifoams; sterilization; inoculum, media; microbial growth kinetics-batch culture, continuous culture, fed batch culture and dual or multiple fermentations. Solid state, surface, submerged fermentations, scale up,

inoculum development.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Formulate media using carbon, nitrogen and mineral sources etc.
- Summarize different types of fermentations
- Develop inoculum to carry fermentation
- Understand the role of sterilization

UNIT – III

Design of fermenter, types of fermenters: maintenance of aseptic conditions, instrumentation control, physical and chemical environment sensors, control of various physical parameters; computer applications in fermentation technology, fermentation economics.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Describe the design of fermenter
- Evaluate the importance of aseptic conditions during fermentation
- Gain knowledge on fermentation economics
- Summarize the types of fermenters

UNIT - IV

Industrial production: Industrial production of enzymes, proteolytic enzymes, pectinases, amylases, organic acids – acetic acid, lactic and citric acid. Production of vitamins (Vitamin B_2, Vitamin B_{12}).

Learning Outcomes:

By the end of this Unit, the student will be able to

- Gain knowledge on industrial production of enzymes
- Gain knowledge on industrial production of vitamins
- Gain knowledge on industrial production of organic acids

Unit V

Downstream processing-recovery and purification of microbial products. Immobilization of enzymes-adsorption, covalent binding, entrapment, membrane confinement. Fermented foods: traditional fermented foods, Fermented foods based on cereals & legumes -bread, soysauce. Other fermented products -- meat, fish, vegetables.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Illustrate the immobilization technology
- Gain knowledge on product recovery
- Summarize downstream processing and purification techniques
- Describe the process of making various fermented products

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand strain improvement methods
- Summarize downstream processing and purification techniques
- Describe the process of making various fermented products
- Gain knowledge on industrial production of enzymes, vitamins, and organic acids

Recommended Books:

1. Industrial Microbiology (1984) by A.H.Patel.
2. Prescott and Dunn's Industrial Microbiology (2004) by G.Reed.
3. Solid State Fermentation in Biotechnology (2009) by AshokPandey
4. Industrial Microbiology (2002) byWaites.
5. Biotechnology: A Text Book of Industrial Microbiology (1991) by Cruger andCruger.
6. Principles of Fermentation Technology (2008) byStanbury.
7. Microbial Technology: Microbial Processes (2009) by H. J.Peppler

M.Sc. (Food Science & Technology) IV SEMESTER

SFT 842: POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Hours per week: End Examination: 60 Marks

Credits:4 Sessionals:40 Marks

Preamble:

Fruits and vegetable (FV) production is an emerging horticulture sub-sector nowadays. Lack of postharvest management skills and technology such as temperature control to maintain the cold chain, value addition, and packaging have caused several economic and food security setbacks. Hence in this paper, the student will study about several postharvest technologies such as controlled ripening, edible coating, temperature management, chemical treatment methods etc.

Course Objectives:

- To provide an overview on scope of post-harvest management of fruits and vegetables
- To study Structure and composition of fruits and vegetables
- To learn about harvesting and handling of fruits and vegetables
- To give understanding about different storage practices
- To know the importance of chilling injuries and related diseases of post harvesting methods to fruits and vegetables

UNIT I

Scope of post-harvest management of fruits and vegetables in Indian economy. Farm to fork concept of food production- food chain and good practices, GMP, GHP, GLP, GAP, GPHM. Packaging house operations, transport operations. Post harvest losses during transportation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn importance of post-harvest management of fruits and vegetables
- Learn about food chain and good practices
- Understand the importance of packaging and careful transport operations.

UNIT II

Structure and composition of fruits and vegetables, methods of maturity determinations- maturity indices and standards for selected fruits and vegetables viz. citrus, mango, banana, pomegranate, tomato, papaya and carrot.

Learning Outcomes:

By the end of this unit, the student will be able to:

- Learn about structure and composition of fruits and vegetables
- Understand about several maturity determination methods.

UNIT III

Harvesting and handling of important fruits and vegetables, harvesting tools and their design. Primary processing for sorting and grading at farm and cluster level, factors affecting post harvest losses, standards and specifications for fresh fruits and vegetables.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about harvesting and handling of important fruits and vegetables
- Learn about different methods of sorting and grading, and prominently learn high end methods for sorting

UNIT IV

Post-harvest physiological and biochemical changes in fruits and vegetables, ripening of climacteric and non-climacteric fruits: regulations, methods. Storage practices: CA and MA, hypobaric storage, pre-cooling and cold storage, zero energy cool chambers. Commodity pretreatments - chemicals, wax coating, prepackaging, VHT and irradiation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about Physiological and biochemical changes
- Understand about different storage practices
- Know about several pretreatments

UNIT V

Chilling injury and prevention of post harvest diseases and infestation, handling and packaging of fruits and vegetables, post harvest handling system for fruits and vegetables of regional importance such as citrus, mango, banana, pomegranate, tomato, papaya and carrot.

Learning Outcomes:

By the end of this unit, the student will be able to

- Learn about chilling injuries and eradication of post-harvest diseases

- Understand about handling and packaging of fruits and vegetables, and importantly regional importance

Course Outcomes:

By the end of this Course, the student will be able to:

- Learn importance of post-harvest management of fruits and vegetables
- Acquire knowledge about different methods of sorting and grading, and prominently learn high end methods for sorting
- Understand about problems associated with chilling injuries and eradication of post-harvest diseases

Recommended Books:

2. Post-harvest Technology of Horticultural Crops (2002) by A.A.Kadar.
3. Preservation of Fruits and Vegetables (1998) by G. Lal.
4. Post-harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables (1991) by D.K. Salunkhe.
5. Storage, Processing and Nutritional Quality of Fruits and Vegetables (1991) by B. Pantastico.
6. Post Harvest Technology of Fruits and Vegetables (1995) by A.K. Thompson.
7. Post-harvest Technology of Fruits and Vegetables (2000) by V.K.Joshi.

M.SC. (Food Science & Technology) IV SEMESTER

SFT 844: CLINICAL AND THERAPEUTIC NUTRITION

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals:40Marks

Preamble:

Food is the basic necessity of life. Nutrition is the scientific study of food and its relation to health. Therapeutic nutrition refers to the use of food and the nutrients it contains to prevent or treat a disease or condition. Therapeutic nutrition brings awareness about the main etiological factors responsible for various ailments of the present day generation.

Course Objectives:

- To provide an overview of fundamental knowledge in food and nutrition.
- To introduce students to clinical dietary and nutritional principles
- Translate basic concepts of medical nutrition therapy for the different diseases into practical menu planning application
- To familiarize the concept of lifestyle changes

UNIT-I

Nutritional requirements for different age groups, RDA and its determination. Meal planning. Principles of diet therapy, therapeutic modification of normal diet, nutritional care of the patient - assessment of patient needs, tube feeding, parenteral feeding. Nutrition counseling. Risk factors of different nutritional and metabolic disorders.

Learning Outcomes:

By the end of this unit, the student will be able to

- Describe the nutritional requirements for different age groups
- Determine RDA for different age groups
- Assess patient needs and plan meal
- Differentiate tube feeding and parenteral feeding
- Discuss the risk factors of different disorders

UNIT -II

Dietary management in metabolic disorders. Diabetes mellitus – etiology, diagnosis, insulin, oral

hypoglycemic drugs and complications. Obesity, gout, cancer and oxidative stress. Nutrition management during immuno deficiency diseases (HIV-AIDS).

Learning Outcomes:

By the end of this Unit, the student will be able to

- Discuss the etiology and plan a diet for diabetes, gout, cancer, AIDS, obesity, oxidative stress
- Outline different types of oral hypoglycemic drugs
- Describe the role of insulin in treating diabetics
- Discuss the complications associated with oral hypoglycemic drugs

UNIT -III

Dietary management in gastro intestinal disorders – dyspepsia, gastritis, ulcers malabsorption syndrome and diverticulitis. Liver disorders - hepatitis, cirrhosis and hepatic coma. Bilary tract – cholecystitis, cholelithiasis, pancreatitis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Suggest dietary changes in gastro intestinal disorders
- Discuss the etiology and plan a diet for Liver disorders
- Suggest dietary changes in pancreas related disorders
- Discuss the role of diet in cholecystitis, cholelithiasis

UNIT -IV

Diseases of cardiovascular system: atheroscelerosis, coronary heart disease, hypertension, myocardial infarction, congestive heart failure, dietary management (prophylactic role of diet). Diseases of kidneys and urinary tract: Nephritis, nephrotic syndrome, acute chronic uremia, renal calculi – dietary management.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Discuss the prophylactic role of diet in treating heart diseases
- Discuss the etiology and life style changes of renal calculi
- Differentiate nephritis and nephrotic syndrome
- Suggest dietary changes in acute chronic uremia

UNIT -V

Effect of food nutrients on drug ingestion, digestion, absorption and metabolism.

Anaemia, Inborn errors of metabolism, phenylketonuria, galactosemia, childhood related disorders.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Describe various childhood related disorders.
- Discuss the effect of food nutrients on drug metabolism
- Understand the etiology of anaemia
- Suggest dietary changes in Inborn errors of metabolism

Course Outcomes:

- Describe different methods of feeding in relation to the health status
- Identify risk factors associated with various illnesses
- Develop a day diet plan that addresses client's disease incorporating the client's cultural preferences
- Describe the current prevalence of various diseases
- Understand the physiological role physical activity plays in the various diseases

Recommended Books:

1. Nutrition in Health and Disease (1982) by Dibble.

2. Nutrition: Principles and Clinical Practice (1980) by S.M.Hunt.

3.Dietetics (2007) by B.Srilakshmi.

4.Nutrition and Diet Therapy (2005) byS.R.Williams.

5.Text Book of Human Nutrition (2010) byBamji

6.Essentials of Human Nutrition (2007) byA.S.Truswell.

7.AdvancingDietitics and Clinical Nutrition (2011) by A. Payne andH.M.Barker.

M.Sc. (Food Science & Technology) IV SEMESTER

SFT 846: RESEARCH METHODOLOGY, STATISTICS AND COMPUTER APPLICATIONS

Hours per week: 4 End Examination: 60 Marks

Credits:4 Sessionals: 40 Marks

Preamble:

This paper consistently integrates methods, statistics, and computer applications to prepare students for both graduate work and critical analysis of research as professionals. In brief they learn about research significance, importance of probability and statistics in research environments, and about several computer tools.

Course Objectives:

- To learn about significance of research and understanding the research problem
- To learn necessary guidelines to be taken while writing research reports and proposals
- To know the importance of testing levels of significance to determine the research result to be significant or not.
- To learn about exploitation of computer tools in performing the statistical calculations and other tools

UNIT-I

Research: significance, conceptualization of problem – hypothesis, Types of research – Research designs, fundamental, applied – action, exploratory, discipline, experimental, survey, case study and ex post facto. Longitudinal, cross sectional and correlational research.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about significance of research and understanding the research problem
- Understand about the types of research

UNIT-II

Theory of probability – population sample. Sampling techniques: Research methods – Interview schedule, important methods and data collection, interpretation of results, observation, social mapping, participatory rapid assessment. Writing up research reports and proposal.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Know the importance of theory of probability.
- Understand necessary guidelines to be taken while writing research reports and proposals
- Analyze the scientific data, importance of statistics and application of various statistical approaches for knowing the significance of data obtained after laboratory experiments.

UNIT– III

Statistics – meaning, role of statistics in research- descriptive research – classification, tabulation of data – graphic and diagrammatic representation of data. Measurement of central tendency , variation, dispersion, normal distribution

– Mean, median, testing levels of significance – "T" test, F test, and χ^2 test.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Know the formulas for central tendency and do necessary calculations
- Know the importance of testing levels of significance to determine the result to be significant or not.

UNIT– IV

Correlation, coefficient of correlation – rank correlation, analysis of variance, types, regression and forecasting–Fitting regression curves, discrimination analysis.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Know the formulas for Standard deviation, correlation, and regression methods, and usage of these calculations and retrieved values with respect to food technology values.

UNIT - V

Computer applications: MS office-word, excel, power point, internet, photoshop. Statistical software packages used in research. Software controlled food processing operations, application part in food industry. Software applications for quality control.

Learning Outcomes:

By the end of this Unit, the student will be able to

- Learn about exploitation of computer tools in performing the statistical calculations and other tools
- Learn about software controlled food processing operations.

Course Outcomes:
By the end of this Course, the student will be able to:

- Learn about significance of research and understanding the research problem
- Understand necessary guidelines to be taken while writing research reports and proposals
- Learn about exploitation of computer tools in performing the statistical calculations and other tools

Recommended Books:

1. Foundations of Behavouring Research (1983) by F.N.Kerlinger
2. Research Methodology: Methods and Techniques (2004) by C.R.Kothari
3. Methodology and Techniques of Social Research (2000) by P.L. Bandarkar and T.S.Wilkinson.
4. Research Methodology for Biological Sciences (2006) by N.Gurumani
5. Biostatistics (2^{nd} edition) by P.K. Arora and P.K.Malhal.
6. Fundamentals of Biostatistics (1994) by Khan and Khanum
7. An introduction to biostatistics (2^{nd} edition) by N.Gurumani.
8. Basic Concepts in Statistics (2009) by K.S. Kushwaha and R.Kumar

M.Sc. (Food Science & Technology) IV SEMESTER

SFT 848: BIOETHICS AND IPR

Hours per week:4 End Examination: 60 Marks

Credits:4 Sessionals: 40Marks

Preamble:

Bioethics is the study of the ethical issues emerging from advances in biology and medicine. Bioethics are concerned with the ethical questions that arise in the relationships among life sciences, biotechnology, medicine and medical ethics, politics, law, and philosophy. Intellectual property refers to creations of the mind: inventions; literary and artistic works; and symbols, names and images used. Intellectual property is divided into two categories: Industrial Property includes patents for inventions, trademarks, industrial designs and geographical indications.

Course Objectives:

- To create a stable research environment to encourage investigation, analysis and studying the bioethical principles, values, concepts, social and juridical implications.
- To gain knowledge on the human rights contained in the Universal Declaration on Bioethics
- To create awareness on protection of the rights of IP owners to enable them to reap the rewards of their creativity.

UNIT-I

Bioethics, ethical issues in genetic engineering, patenting human genes, cloning, genetic testing & screening. Stem cell research. Biotechnology & social responsibility; Public acceptance issue in Biotechnology.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concepts of genetic engineering, patenting, cloning etc.
- Gain awareness on social responsibilities and public acceptance
- Apprehend latest research in biotechnology and stem cell research

UNIT-II

Biosafety and risk assessment, framework of biosafety regulation in India; DBT guidelines on biosafety in conducting research in biology / biotechnology. GM foods. Regulations of Genetically modified Organisms in India. Cartagena Protocol on biosafety; Bioterrorism.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concept of Bioterrorism and its global impacts
- Grasp the biosafety regulations to be followed in India
- Apprehend the guidelines to be followed for conducting research in biology

UNIT-III

Hazard assessment, release of genetically modified organisms in environment; biosafety in laboratory, laboratory associated infections and other hazards; level of biosafety, prudent biosafety practices in laboratory.

Learning Outcomes:

By the end of this unit, the student will be able to

- Assess the hazards and biosafety in labs
- Illustrate the type and level of biosafety to be followed by different labs
- Understand the consequences of releasing the GM organisms into surroundings

UNIT-IV

Concept of intellectual property rights (IPR) and protection (IPP). Biotechnology and IPR-rationale of patent in research and scientific innovations, requirements for patentability-patentable subject matter, novelty, invention in biotechnological research, industrial applicability, patent documentation.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate IPR and IPP
- Understand the importance of patenting in research and scientific innovations
- Apprehend the procedures for patent documentation

UNIT-V

Categories of biotechnological patents, examples of patents granted. Concerns over biotechnology patents, International conventions; patenting living organisms; biodiversity & farmer's rights; patent owners rights and duties.

Learning Outcomes:

By the end of this unit, the student will be able to

- Differentiate between the types of patent available
- Understand the pros and cons of patents in biotechnology
- Illustrate the rights and duties of patent owners and farmers rights

Course Outcomes:

By the end of this Course, the student will be able to:

- Understand the concepts of genetic engineering, patenting, cloning etc.
- Understand the importance of patenting in research and scientific innovations
- Apprehend the guidelines to be followed for conducting research in fields of food technology

Recommended Books:

1. Principles of cloning (2002) J. Cibelliet.al.
2. Ethics In Engineering (2004), M.W. Martin and R.Schinzinger
3. Biosafety Issues Related To Transgenic Crops, DBT Guidelines, Biotech Consortium India Limited, New Delhi.
4. Biotechnology and Intellectual Property Rights: Legal and Social Implications (2015) by K. K.Singh
5. Bioethics and Biosafety In Biotechnology (2007) by V.Sreekrishna
6. Bioethics and Biosafety (2008) by M. K.Sateesh

M.Sc. (Food Science & Technology) IV SEMESTER

SFT 822: FERMENTATION TECHNOLOGY

Hours per week: 8

Credits: 3 Sessionals: 100 Marks

1. Screening for amylase production.
2. Screening for organic acid production by crowded plate technique
3. Screening of antibiotic producing microorganisms.
4. Production of antibiotics by fermentation.
5. Production of citric acid by A*spergillus niger*.
6. Production of glutamic acid by fermentation.
7. Isolation of yeasts from grapes.
8. Production of Wine
9. Production & Estimation of Ethanol
10. Isolation of air-borne micro flora.
11. Isolation of *Rhizobium, Azotobacter* from soil.
12. Microbiological assay and determination of MIC of antibiotics.

RECOMMENDED BOOKS:

1. Manual of Industrial Microbiology and Biotechnology (2010) by R. H. Baltz, *et. al.*
2. Experiments In Microbiology, Plant Pathology, Tissue Culture & Mushroom Production Technology by Aneja.
3. Manual Of Environmental Microbiology (3^{rd} edition) by C. J. Hurst.
4. Practical manual on Fermentation Technology (2012) by S. Kulandaivelu and S. Janardanan.
5. Environmental Microbiology: A Laboratory manual (2005) by Peppler *et. al.*

Course Outcomes:

After the completion of the above experiments the students will be able to:

- Screening techniques for amylase enzyme, organic acid and antibiotic producing microorganism
- Production of citric acid, glutamic acid wine and ethanol
- Isolation of *Rhizobium, Azotobacter*
- Microbial assay of MIC of antibiotics against pathogens

OPEN ELECTIVE (III SEMESTER)

SOE 883: FRUIT AND VEGETABLE PROCESSING TECHNOLOGY

Hours per week: 3 End Examination: 60Marks

Credits:3 Sessionals:40Marks

Preamble:

Processing of fruits and vegetables is very important to produce products for direct consumption and as food ingredients. During processing, the main objectives are to preserve the color, flavor, texture, and nutrition while prolonging the shelf life of perishable fruits and vegetables.

Course Objectives:

- To understand the chemistry of fruits and vegetables- composition and role of each component
- To impart knowledge of different methods of fruits and vegetable processing.
- To understand the concept of development and preparation of fruit and vegetable products.

UNIT-I

Production of fruits and vegetables in India, composition of fruits- mangoes, pineapple, guava, papaya, grapes. Composition of vegetables- beans, carrot, tomatoes, potato, onion, brinjal. Post harvest loss of fruits and vegetables, general methods of preservation of fruits and vegetables.

Learning Outcomes:

By the end of this unit, the student will be able to

- Stimulate agricultural production by obtaining marketable products
- Gain knowledge on composition of fruits and vegetables
- Reduce fruit and vegetable losses;

UNIT-II

Collection, sorting and storage operations for fruit and vegetables. Preparation of fruits and vegetables for canning. Common machinery for operations like peeling, slicing/dicing, pulping, grating and canning. Blanching - importance of blanching operations, batch and continuous blanching, hot water and steam blanching. Canning operations – precautions in canning operations, Spoilage of canned foods.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concepts of storage of fruits and vegetables
- Illustrate the pros and cons of canning
- Cognize different types of blanching and its uses

UNIT-III

Juice and pulp extraction – different methods, clarification. Preparation of products like jams, jellies, marmalades, squashes, pickles, puree, ketchup, sauce, fruit bars, fruit preserve, fruit juice concentrates, fruit juice powders. Fruit juice aroma recovery and its importance.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the defects in the preparation of value added products like jams, jellies, marmalade, pickles
- Elucidate different methods for the extraction of pulp and fruit juices
- Apprehend the importance of aroma recovery from fruits

UNIT-IV

Dehydration principles - Preparation of fruits and vegetables for dehydration. Equipment used for drying- cross flow shelf dryers, vacuum shelf dryers, tunnel dryers, foam mat dryers, freeze dryers, fluidized bed dryers, infra red dryers, solar dryers. Packaging of dried slices, dices and powder.

Learning Outcomes:

By the end of this unit, the student will be able to

- Illustrate different types of dehydration equipment
- Learn how to pack the finished product for extended shelf life

UNIT-V

Aseptic processing and bulk packing of fruit juice concentrates, pulps and puree. Tetra pack for small quantities. Storage of aseptically packed products. Minimal processing and packaging of vegetables, hurdle technology.

Learning Outcomes:

By the end of this unit, the student will be able to

- Understand the concepts of various packaging materials
- Learn the methods to eliminate or control pathogens in food products
- Store the finished products for longer duration

Course Outcomes:

By the end of this Course, the student will be able to:

- Gain knowledge to stimulate agricultural production by obtaining marketable products
- Understand the concepts of various packaging materials
- Learn Illustrate the pros and cons of canning

Recommended Books

1. Fruit and Vegetable Processing (1997) by M.E.Dauthy.
2. Preservation of Fruits and Vegetables (1998) by G. Lal
3. Fruit and Vegetable Preservation, Principles and Practices (1998) by R.P. Srivastava and Sanjeev Kumar.
4. Food Preservation and Processing (1996) by M. Kalia and S.Sood.
5. Hand Book of Vegetable Preservation and Processing (2004) by Y.H.Hui.
6. Handbook of Fruit Science and Technology: Production, Composition and Processing (1995) by Salunkhe.
7. Handbook of Vegetable Science and Technology: Production, Composition, Storage and processing (1995) by D.K. Salunkhe and S.S.Kadam.
8. Handbook of Post-harvest Technology (2001) by A.Chakraverty.