

**GANDHI INSTITUTE OF SCIENCE
(GITAM)
(Deemed to be University, Estd. u/s 3 of UGC Act 1956)
VISAKHAPATNAM *HYDERABAD *BENGALURU
Accredited by NAAC with 'A' Grade**



**REGULATIONS & SYLLABUS
of**

**Master of Science
in
(Food Science and Technology)
(W.e.f 2015-16 admitted batch)**

Website: www.gitam.edu

M.Sc. (Food Science and Technology)
REGULATIONS
(W.e.f. 2015-16 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. ELIGIBILITY CRITERIA

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 CREDIT SYSTEM

Choice Based Credit System (CBCS) is introduced with effect from the admitted batch of 2015-16 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 THE PROGRAM

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.
- Two credits for three (or more) hours of practicals per week
- Three credits for nine hours of practicals
- 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 OF INSTRUCTION**

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. **ATTENDANCE REQUIREMENTS**

7.1 A student is required to have a minimum of 75% attendance in all the courses put together in any semester, failing which he/she will not be permitted to attend the end - 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 (60 marks).

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 Table 1.

Table 1: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination Shall be for a maximum of 60 marks.
	Total	100		
2	Practical	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		
3	Project work (IV semester)	200	Project evaluation	(i) 150 marks for evaluation of the project work dissertation submitted by the candidate. (ii) 50 marks are allocated for the project Viva-Voce. (iii) The project work evaluation and the Viva-Voce shall be conducted by one external examiner outside the University and the internal project work supervisor.

9. RETOTALING & REAPPEARANC

9.1 A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent semester end examinations held for that course.

9.1.1 A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes held during summer vacation.

9.1.2 A student who has secured 'F' Grade in Project work shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10. SPECIAL EXAMINATION

A student who has completed his/her period of study and still has “F” grade in a maximum of three Theory courses is eligible to appear for Special Examination normally held during summer vacation.

11. BETTERMENT OF GRADES

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 Theory courses of any Semester of his/her choice, conducted in summer vacation along with the Special Examinations. Betterment of Grades is permitted ‘only once’ immediately after completion of the program of study.

12. GRADING SYSTEM

12.1 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 Table 2.

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	-

12.2 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.

13. GRADE POINT AVERAGE

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

$$\text{GPA} = \frac{\sum [C \times G]}{\sum C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

13.2 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.

13.3 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	$\geq 8.0^*$
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.

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

14.1 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.

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

14.3 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.

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

15. 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.

RULES

1. With regard to the conduct of the semester-end examination in any of the practical courses of the program, the Head of the Department concerned shall appoint one examiner from the department not connected with the conduct of regular laboratory work, in addition to the teacher who handled the laboratory work during the semester.
2. In respect of all theory examinations, the paper setting shall be done by an external paper setter having a minimum of three years of teaching experience. The panel of paper setters for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council. The paper setters are to be appointed by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations.
3. The theory papers of semester-end examination will be evaluated by two examiners. The examiners may be internal or external. The average of the two evaluations shall be considered for the award of grade in that course.
4. If the difference of marks awarded by the two examiners of theory course exceeds 14 marks, the paper will have to be referred to third examiner for evaluation. The average of the two nearest evaluations of the three shall be considered for the award of the grade in that course.
5. Panel of examiners of evaluation for each course is to be prepared by the Board of Studies of the department concerned and approved by the Academic Council.
6. The examiner for evaluation should possess post graduate qualification and a minimum of three years teaching experience.
7. The appointment of examiners for evaluation of theory papers will be done by the Vice Chancellor on the basis of recommendation of Director of Evaluation / Controller of Examinations from a panel of examiners approved by the Academic Council.
8. Project work shall be evaluated by two examiners at the semester-end examination. One examiner shall be internal and the other external. The Vice Chancellor can permit appointment of second examiner to be internal when an external examiner is not available.

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	SFT701	Principles of Nutrition & Biostatistics	F	4	4	-	4	3	60	40
2	SFT703	Food Chemistry	C	4	4	-	4	3	60	40
3	SFT705	Food Microbiology	C	4	4	-	4	3	60	40
4	SFT707	Technology of Plant Foods	C	4	4	-	4	3	60	40
5	SFT721	Lab-I: Analysis of Foods	C	3	-	12	12	4	--	100
6	SFT723	Lab-II: Microbial Methods	C	3	-	12	12	4	---	100
7	SFT791	Viva – Voce	C	1	-	-	-	3	--	50
		Total marks for I semester		23	16	24	40	23	240	410
II Semester										
8	SFT702	Technology of Animal Foods	C	4	4	-	4	3	60	40
9	SFT704	Food Safety, Standards and Quality control in Food Industries	C	4	4	-	4	3	60	40
10	SFT706	Principles of Food Engineering	C	4	4	-	4	3	60	40
11	SFT708	Spices, Beverages & Confectionary	C	4	4	-	4	3	60	40
12	SFT722	Lab-III: Technology of Foods	C	3	-	12	12	4	--	100
13	SFT724	Lab-IV: Food Safety, Standards and Quality Control	C	3	-	12	12	4	---	100
14	SFT792	Viva – Voce	C	1	-	-	-	3	--	50
		OPEN ELECTIVE	E	3	3	-	3	3	60	40
		Total Marks for II semester		26	19	24	43	26	300	450
III Semester										
15	SFT801	Food Product Development and commercialization	C	4	4	-	4	3	60	40

16	SFT803	Food Preservation Technology	C	4	4	-	4	3	60	40
17	SFT805	Food Packaging and Labeling	C	4	4	-	4	3	60	40
18	SFT807	Advanced Food Processing	C	4	4	-	4	3	60	40
19	SFT821	Lab-V : Food Processing and Preservation	C	3	-	12	12	4	--	100
20	SFT823	Lab-VI Product development & Evaluation Techniques	C	3	-	12	12	4	---	100
21	SFT891	Viva – Voce	C	1	-		-	3	--	50
		OPEN ELECTIVE	E	3	3	-	3	3	60	40
		Total Marks for III semester		26	19	24	43	26	300	450
IV SEMESTER										
22	SFT802	Clinical and Therapeutic Nutrition	C	4	4	-	4	3	60	40
23	SFT842	Post harvest Management of Fruits and Vegetables	E	4	4	-	4	3	60	40
24	SFT844	Fermentation Technology	E	4	4	-	4	3	60	40
25	SFT846	Research Methodology, Statistics And Computer Applications	E	4	4	-	4	3	60	40
26	SFT848	Dairy Technology	E	4	4	-	4	3	60	40
27	SFT822	Diet design and formulation of special foods	C	3	-	12	12	4	-	100
28	SFT892	Project	C	8	-	-	-	3	200	-
29	SFT894	Viva-Voce	C	1	-	-	-	-	-	50
		Total Marks for IV semester		20	8	12	20	13	320	230

Open Elective:

- 1) SOE 869: Fruit and Vegetable Processing Technology

M.Sc. (Food Science & Technology) I SEMESTER
SFT 701: PRINCIPLES OF NUTRITION AND BIostatISTICS

Hours per week: 4

End Examination: 60 Marks

Credits: 4

Sessionals: 40 Marks

UNIT - I

Physical and chemical properties of foods, food pyramid. Nutritive value of foods, nutritional requirements for different age groups, RDA and its determination. Meal planning. Proximate food constituents. Non nutritional ingredients and additives in foods.

UNIT- II

Energy – units, energy balance, energy value of foods and its measurement. Body composition, BMI, BMR.

Carbohydrate: Properties of food carbohydrates. Sources, functions, digestion and absorption. Changes in food carbohydrates during processing. Role of carbohydrates in dental caries. Dietary fibre- sources, composition and nutritional significance.

UNIT- III

Nutritional classification of amino acids. Protein–sources, functions, digestion, absorption and deficiency disorders. Lipids– sources, functions, digestion and absorption, PUFA, MUFA, excess of fat. Deficiency disorders.

UNIT-IV

Vitamins – Fat and water soluble vitamins: functions, sources, requirements and deficiency diseases. Hypervitaminosis. Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Fluorine- sources, functions, requirements and deficiency diseases.

UNIT -V

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.

Recommended Books:

1. Nutrition Science (3rd edition) by B. Srilakshmi.
2. A Text book of Nutrition (2004) by C. Vidya.
3. Essentials of Food and Nutrition (1972) by M. Swaminathan.
4. Normal and Therapeutic Nutrition (17th edition) by Robinson.
5. Text Book of Food Science, Nutrition and Dietetics (1999) by R. Begam.
6. Advanced Text Book on Food and Nutrition (2nd edition) by M. Swaminathan.
7. Biostatistics (2nd edition) by P.K. Arora and P.K. Malhal.
8. Fundamentals of Biostatistics (1994) by Khan and Khanum.
9. An introduction to biostatistics (2nd edition) by N. Gurumani.
10. Basic Concepts in Statistics (2009) by K.S. Kushwaha and R. Kumar.

M.Sc. (Food Science & Technology) I SEMESTER
SFT 703: FOOD CHEMISTRY

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

UNIT-I

Food composition-Proximate principles, analysis: moisture, fat, protein, fibre, carbohydrate, minerals, amino acid.

Water: water activity and its influence on food quality and stability - Determination of moisture content of foods. Classification of foods based on moisture content. pH, pK, acid base reactions and buffers.

UNIT -II

Carbohydrates: classification and structure, general properties of monosaccharides (glucose and fructose) disaccharides (sucrose and lactose), polysaccharides (starch and cellulose).

Lipids: Definition - classification and structure - features and occurrence of fatty acids; physical and chemical characteristics of lipids- storage changes of fats and oils and fatty foods- measurement of spoilage of lipids.

UNIT -III

Classification, structure and properties of amino acids, essential and nonessential amino acids. Protein isolation and purification. Functional diversity of proteins - Physico – chemical properties of proteins-Estimation of proteins. Chemical and biological evaluation of protein quality.

UNIT -IV

Enzymes: Nomenclature and classification. Mechanism of action of enzymes, coenzymes. Enzymes involved in food spoilage, enzymes in food processing. Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentration.

UNIT -V

Structure and function of vitamins. Effect of processing on vitamins.

Minerals: Calcium – Phosphorus – Sodium - Potassium - Zinc- Iron (sources, functions in food systems, effect of processing). Trace elements: Boron- Molybdenum- Chromium-Nickel-Aluminium (Sources and physiological role).

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 *et al.*
4. Food Science (5th edition) by N. N Potter *et al.*
5. Handbook of Analysis and Quality Control for Fruit and Vegetable Products (2nd 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 Meloon.

M.Sc. (Food Science & Technology) I SEMESTER
SFT 705: FOOD MICROBIOLOGY

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

UNIT-I

Scope of food microbiology, intrinsic and extrinsic factors affecting microbial growth, microorganisms in atmosphere, soil, water, plants and animals in food contamination. Beneficial role of microorganisms in food, probiotics, prebiotics.

UNIT -II

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

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.

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.

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: *Giardia lamblia*, *Entamoebahistolytica*. Mycotoxins.

Recommended Books:

1. Food Microbiology (4th edition) by W. C Frazier.
2. Modern Food Microbiology (7th edition) by J.M. Jay .
3. Microbiology (5th edition) by M.I. Pelczar and Reid.
4. Food Microbiology (2006) by M.R. Adams.
5. Basic Food Microbiology (2004) by G.J. Banwart.
6. Food Microbiology (2007) by K.Vijaya Ramesh.
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
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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.

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.

Recommended Books:

1. Food Science (5th edition) by N. N Potter et al.
2. Snack Food Technology (3rd edition) by S.A. Matz.
3. Text book of Food science and Technology (2001) by VijayaKhader.
4. Storage of cereal grains and their product (3rdedition) by C.M. Christenson.
5. Technology of Cereals (4th edition) by Kents.
6. Principles of Cereal Science and Technology (3rdedition) by J. Delcour and R.C. Hosney.
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 et al.

M.Sc. (Food Science & Technology) I SEMESTER
SFT 721: ANALYSIS OF FOODS

Hours per week: 12
Credits: 3

End Examination: 60 Marks
Sessionals: 40 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 sodium and potassium.
13. Estimation of vitamin C in fruit juices.
14. Estimation of vitamin A.
15. 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 *et al.*
8. Food Analysis and Preservation (2012) by M. G. Kontominas .

M.Sc (Food Science & Technology) I SEMESTER
SFT 723: MICROBIAL METHODS

Hours per week: 12
Credits: 3

End Examination: 60 Marks
Sessionals: 40 Marks

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, H₂S, Catalase, coagulase, gelatin and fermentation (Acids/gas).
9. Visits to food processing units (at least two) or any other organization dealing with advanced methods in food microbiology.

Recommended Books:

1. Laboratory Experiments in Microbiology (2007) by G. Reddy *et al.*
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. Gunashekar.
6. Laboratory Manual in General Microbiology (2002) by N. Kannan.

M.Sc. (Food Science & Technology) II SEMESTER
SFT 702: TECHNOLOGY OF ANIMAL FOODS

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

UNIT -IV

Meat: Structure, muscle composition, characteristics, types of slaughtering and postmortem changes, methods of cooking, changes during cooking. Processing, preservation and their effects. Meat products. Canning of meat.

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.

Recommended Books:

1. Food Science (5th edition) by N. N Potter *et al.*
2. Food Chemistry (1996) by H. D. Belitz and W. Grosch.
3. Milk and Milk Products (2009) by S.N. Mahindru.
4. Dairy Technology (2ndedition) by P. Walstra *et al.*
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, STANDARDS AND QUALITY CONTROL IN
FOOD INDUSTRIES

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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).

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 Alimentarius Commission.

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.

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 Implementation Strategies (2015) by Andre Gordon.

M.Sc. (Food Science & Technology) II SEMESTER
SFT 706: PRINCIPLES OF FOOD ENGINEERING

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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.

UNIT-V

Food processing equipments- 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.

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 *et al.*
4. Introduction to Food Engineering (5th edition) by R. P. Singh *et al.*
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.

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M.Sc. (Food Science & Technology) II SEMESTER
SFT 708: SPICES, BEVERAGES AND CONFECTIONERY

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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*.

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.

UNIT - V

Confectionery: Sugar- Manufacturing of sugar, types of sugar, byproducts, jaggery, honey. Ingredients of chocolate-sucrose, invert sugars, corn syrup, non-nutritive sweeteners, sugar substitutes. Additional ingredients: colours, flavors, gums, pectin and gelatin, chocolate processing. Types: imitation chocolate, milk chocolate. Crystalline and non crystalline candies.

Recommended Books:

1. Text book of Food Science and Technology (2001) by Vijayakhader.
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 (3rd edition) by B.W. Minifie.
6. Sugar Confectionery Manufacture (2nd edition) by E.B. Jackson.
7. Candy Technology (2006) by J.J. Alikonis.
8. Sugar Confectionery and Chocolate Manufacture (2012) by R. Lees.

M.Sc. (Food Science & Technology) II SEMESTER
SFT 722: TECHNOLOGY OF FOODS

Hours per week: 12
Credits: 3

End Examination: 60 Marks
Sessionals: 40 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 halwaas.
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.

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 *et al.*

M.Sc. (Food Science & Technology) II SEMESTER
SFT 724: FOOD SAFETY, STANDARDS AND QUALITY CONTROL

Hours per week: 12
Credits: 3

End Examination: 60 Marks
Sessionals: 40 Marks

1. General test for the presence of common adulterants in all food products.
2. Test of water including mineral water – total dissolved solids, pH, turbidity, colour, hardness, chlorides sulphates, residual chlorine, fluoride, selenium, lead, arsenic, silver and pesticide residue analysis.
3. Cereals and cereal products- quality assessment
4. 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.
5. 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, lead dichromate estimation in turmeric.
6. Beverages : tea – moisture, total ash, water soluble ash, ash insoluble, alkalinity of soluble ash, presence of iron filings and coloring matter.
7. Coffee : Moisture, total ash, water insoluble ash, water soluble ash, ash insoluble, alkalinity of soluble ash, determination of caffeine content and presence of chicory,
 8. Instant coffee powder: Moisture and total ash.
 9. Chocolate & Confectionery: moisture, sulphated ash, acid soluble and insoluble ash, sucrose, Fat, nonfat milk solids.
 10. Spices and condiments – Added starch in spice powders, argemone seeds in mustard seeds.

Recommended Books:

1. Practical Food Microbiology and Technology (3rd edition) by H.H Weisert *et al.*
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.
5. Foods, Facts, Principles and Procedures (2009) by S.N. Manay.

M.Sc. (Food Science & Technology) III SEMESTER
SFT 801 : FOOD PRODUCT DEVELOPMENT AND
COMMERCIALIZATION

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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, financial analysis.

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.

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
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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

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.

UNIT -IV

Drying – methods of drying, pretreatments and procedures after drying. Drying rate, factors affecting drying rate. Concentration- methods, characteristics of dried and concentrated products. Effects of concentrating and drying on foods. 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, Biosensors in food-principle, design and application.

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 *et al.*
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
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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.

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.

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 *et al.*
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 807: ADVANCED FOOD PROCESSING

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

UNIT -IV

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

UNIT -V

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

Recommended Books:

1. Food Processing – Principles and Applications (2009) by Ramaswamy and Marcotte.
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 821: FOOD PROCESSING AND PRESERVATION

Hours per week: 12

Credits: 3

End Examination: 60 Marks

Sessionals: 40 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.
5. Preparation of jams, jellies, fruit juices, squashes, sauces.
6. Pickling of fruits and vegetables.
7. Freezing of fruits, vegetables and flesh foods.
8. Visits to different commercial fruit processing units, chilling and freezing units.

Recommended Books:

1. Food Science (1998) by N. N. Potter *et al.*
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 Vijayakhader.
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

End Examination: 60 Marks
Sessionals: 40 Marks

1. Cereal, millet and pulse processing: effects of different processing methods: soaking, malting, germination, fermentation and product preparation with cereals, pulses and oil seeds.
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. Visits to cereal milling, legume processing and oil seed industries.
8. Products made from fats and oils and byproducts utilization.
9. Effect of processing on quality of oils and fats.

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 *et al.*
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: CLINICAL AND THERAPEUTIC NUTRITION

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

UNIT-I

Principles of diet therapy, therapeutic modification of normal diet, nutritional care of the patient -assessment of patient needs, tube feeding, parenteral feeding. Nutrition counseling. Etiopathophysiology – clinical symptoms, functional changes, tissue changes and metabolic changes. Risk factors of different nutritional and metabolic 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).

UNIT -III

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

UNIT -IV

Diseases of cardiovascular system: atherosclerosis, 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.

UNIT -V

Diet, Nutrient and drug interaction-Effect of food nutrients on drug ingestion, digestion, absorption and metabolism. Effect of nutritional status on drug disorders.

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) 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 Dietetics and Clinical Nutrition (2011) by A. Payne and H.M. Barker.

M.Sc. (Food Science & Technology) IV SEMESTER
SFT842: POST HARVEST MANAGEMENT OF FRUITS AND
VEGETABLES

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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.

UNIT V

Physiological post harvest disorders - chilling injury and disease, 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.

Recommended Books:

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

M.Sc. (Food Science & Technology) IV SEMESTER
SPRFT 844: FERMENTATION TECHNOLOGY

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

UNIT - III

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

UNIT - IV

Industrial production: Industrial production of enzymes, proteolytic enzymes, pectinases, amylases, organic acids – acetic acid, lactic and citric acid. Production of vitamins (Vitamin B₂, Vitamin B₁₂). Immobilization of enzymes. Downstream processing, recovery and purification of microbial products.

Unit V:

Fermented foods: traditional fermented foods, - *idly, dosa*, Fermented milk products- cheese, yoghurt, butter. Fermented foods based on cereals & legumes - bread, beer, soysauce. Other fermented products --meat, fish, vegetables.

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 Ashok Pandey.
4. Industrial Microbiology (2002) by Waites.
5. Biotechnology: A Text Book of Industrial Microbiology (1991) by Cruger and Cruger.
6. Principles of Fermentation Technology (2008) by Stanbury.
7. Microbial Technology: Microbial Processes (2009) by H. J. Peppler.

M.Sc. (Food Science & Technology) IV SEMESTER
SFT 846: RESEARCH METHODOLOGY, STATISTICS AND COMPUTER
APPLICATIONS

Hours per week: 4
Credits: 4

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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 X^2 test.

UNIT- IV

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

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.

Recommended Books :

1. Foundations of Behaviouring 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 (2nd edition) by P.K. Arora and P.K. Malhal.
6. Fundamentals of Biostatistics (1994) by Khan and Khanum.
7. An introduction to biostatistics (2nd 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: DAIRY TECHNOLOGY

Hours per week:4

Credits: 4

End Examination: 60 Marks

Sessionals: 40 Marks

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.

UNIT- II

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

UNIT-III

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

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.

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.

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) IV SEMESTER
SFT 822 : DIET DESIGN AND FORMULATION OF SPECIAL FOODS

Hours per week: 12
Credits: 3

End Examination: 60 Marks
Sessionals: 40 Marks

1. Formulation of weaning foods, formulating diet for preschool going children (2-5 years).
2. Planning and preparation of balanced diets, planning and preparation of high protein diets, planning and preparation of low fat and low caloric diets.
3. Planning and preparation of high fibre diets. Planning and preparation of diets for aged people, planning and preparation of diets for athletes.
4. Diet for diabetic mellitus, diet for cardio vascular disease, diet for gastro intestinal disease, diet for anaemia.
5. Formulation of antioxidant rich foods, preparation of herbal based nutraceutical supplements, preparation of fortified foods.

Recommended Books

1. Nutritive Value of Indian Foods (1984) by C. Gopalan.
2. Handbook of Indigenous Fermented Foods (1995) by K.H. Steinkrus.
3. Dietetics (2007) by B. Srilakshmi.

OPEN ELECTIVE
SOE 869: : FRUIT AND VEGETABLE PROCESSING TECHNOLOGY
(III SEMESTER)

Hours per week: 3
Credits: 3

End Examination: 60 Marks
Sessionals: 40 Marks

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.

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.

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.

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.

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.

Recommended Books

1. Fruit and Vegetable Processing (1997) by M.E. Dauthy.
2. Preservation of Fruits and Vegetables (1998) by G. Lal *et al.*
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 *et al.*
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.