ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
MANGALORE UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR.35/B.Sc(FT)/2015-16/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199

ದಿನಾಂಕ/Date: 21.07.2017

NOTIFICATION

Sub: Regulation and Syllabus governing B.Sc. (Food Technology) degree programme.

Ref: 1) Decision of the Academic Council meeting held on 3.02.2017
2) Government letter No. ED 11 UDS 2017, dated 29.06.2017

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The Regulation governing B.Sc.(Food Technology) degree programme assented to by the Honorable Chancellor on 14.06.2017 as communicated in Government letter referred to (2) above and the Syllabus thereon approved by the Academic council at its meeting held on 3.02.2017 are hereby notified for implementation with effect from the academic year 2017-18 and onwards.

REGISTRAR.

To:

1) The Principals of the Colleges concerned.
2) The Registrar (Evaluation), Mangalore University.
3) The Chairman, Ad-hoc BOS in Food Technology.
4) The Dean, Faculty of Science, Mangalore University.
5) The Assistant Registrar (ACC), Mangalore University.
6) The Superintendent (ACC), O/o the Registrar, Mangalore University.
7) A6/ A7 Case Worker (ACC), O/o the Registrar, Mangalore University.
8) Guard File.
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MANGALORE UNIVERSITY

REVISED REGULATIONS GOVERNING CREDIT BASED SEMESTER SCHEME FOR BACHELOR OF SCIENCE IN FOOD TECHNOLOGY{B.Sc.(Food Technology)}

(Framed under Section 44 (1) (c) of the KSU Act 2000)

Preamble:

The Bachelor of Science Degree in Food Technology is proposed with the objective of developing a job-oriented programme for placement in the Food Industry or to enable startups in the emerging field of Food Technology. The course content has been prepared keeping in view, the unique requirements of B.Sc. Food Technology students.

The objectives of the programme are as follows:

- To impart knowledge of various areas related to Food technology
- To enable students to understand composition of food and its physico-chemical, nutritional, microbiological and sensory/quality aspects
- To familiarize students about processing and preservation techniques of fruits, vegetables, pulses, oilseeds, spices, meat, fish, poultry, milk & milk products
- To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

The Salient Features of the Credit Based Semester Scheme:

Each course shall carry certain number of credits, which normally represent the weightage of a course and are a function of teaching, learning and evaluation strategies such as number contact hours, the course content, teaching methodology, learning expectations, maximum marks, etc. In the proposed programmes, the credit shall be based on the number of instructional hours per week, generally one credit for two hours of instruction per week in theory papers and one credit for three hours of practicals per week. On these bases, a three-year degree programme will have around of 94 credits.

The salient features of the course content are as follows:

- The programme consists of three theory and three practical modules in the first four semesters in addition to Languages and Compulsory papers.
- The fifth and sixth semester offer six specialized theory and three practical modules.
- This course also offers professional edge to the students by providing hands on training through project work in the sixth semester.
- The contents have been drawn-up to accommodate the widening horizons of the discipline of Food Technology and facilitate placement and start-ups in the emerging industrial market of food processing.
- It is in keeping with the current needs of the food industry, with due emphasis being given for emerging technologies in food processing, waste management and IPR.
- Fundamental subjects such as food biochemistry, food microbiology, quality control, and food products have been given due importance.

1. TITLE AND COMMENCEMENT:

i) These regulations shall be called "The Regulations governing Credit Based Semester Scheme for Bachelor Degree Programmes in the Faculties of Arts, Science and Commerce"

ii) These regulations shall come into force from the date of assent of the Chancellor.

2. DURATION OF THE PROGRAMMES:

The duration of Bachelor Degree Programmes shall extend over six semesters (three academic years) of a minimum of 16 weeks each to ensure 90 actual working days in a semester. Each semester shall consist of 16 weeks of study (excluding the time spent for the conduct of final examination of each semester).

3. ELIGIBILITY FOR ADMISSION:

A candidate who has passed the two years Pre-University Examination conducted by the Pre-University Education Board in the State of Karnataka or of any State Government or any other examination considered as equivalent thereto by Mangalore University is eligible for admission to this programmes.

4. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMMES:

The candidate shall complete the programme within six years from the date of admission to the programme.

5. MEDIUM OF INSTRUCTION:

The medium of instruction and examination shall be English/Kannada.

6. SUBJECTS OF STUDY:

a) Subjects of study shall comprise of Food and Nutrition, Principles of Food Sciences, Food Microbiology and Chemistry, Food Preservation, Fundamentals of Food Processing, Technology of Plant and Animal Products, Brewing and Fermentation Technology, Bakery, Confectionary and Extruded Products, Technology in Fat and Oil Products, Food Biotechnology, Food Engineering, Food Packaging and Storage Technology, Techniques in Food Analysis, Quality Control in Food Processing Industries, Emerging Technologies in Food Processing, Waste management of Food Industries, Nutraceuticals and Functional Foods, Utilization of Food Industry Wastes, Enzyme Technology, food Plant Sanitation, Bioethics, Biosafety and Intellectual Property Rights and other subjects introduced from time to time.

b) Lab or Practical component relevant to each of the theory papers will be conducted throughout the course.

c) Constitution of India, Human Rights, Gender and Environmental studies shall be compulsory subjects in the first / second semesters.

d) Co-and Extra Curricular Activities: A student shall opt for any one of the following activities in the first four semesters offered in the college

A) N.S.S. / N.C.C / Rovers and Rangers
B) Sports and Games
C) Other Co-and Extra-Curricular Activities as prescribed by the university

Evaluation of Co-and Extra Curricular Activities is as per the procedure evolved by the university from time to time

7. ATTENDANCE AND CHANGE OF SUBJECTS:

7.1 A candidate shall be considered to have satisfied the requirement of attendance for a semester if he/she attends not less than 75% of the number of classes actually held up to the end of the semester in each of the subjects. There shall be 50% attendance requirement for the Co- and Extra-Curricular activities opted by the candidate.

7.2 A candidate who does not satisfy the requirement of attendance even in one subject shall not be permitted to take the whole University examination of that semester and he/she shall seek re-admission to that Semester in a subsequent year.

7.3 Option to change a language/subject after admission is exercisable only once within four weeks from the date of commencement of the I Semester on payment of fee prescribed by the University.

7.4 Whenever a change in a subject is permitted the attendance in the changed subject shall be calculated by taking into consideration the attendance in the previous subject studied by the candidate.

7.5 If a candidate represents his/her institution/University/ Karnataka State/ Nation in Sports/ NCC/ NSS/ Cultural or any officially sponsored activities he/she may be permitted to claim attendance for actual number of days required for participation, based on the recommendation of the Head of the Institution concerned. If a candidate is selected to participate in national level events such as Republic Day Parade etc., he/she may be permitted to claim attendance based on the recommendation of the head of the Institution concerned.

8. COURSE PATTERNS AND SCHEMES OF EXAMINATIONS

The details of Course Patterns (hours of instructions per week) and the Schemes of Examinations is as per appendix "A". The Syllabi of the courses shall be as prescribed by the University.

9. INTERNAL ASSESSMENT:

9.1 The internal assessment marks shall be based on at least two tests of a minimum of one hour duration each (the average of the best two tests shall be taken - 20 marks) and seminar / viva/ Project work (10 marks).

9.2 The marks of the internal assessment shall be published on the notice board of the college for information of the students.

9.3 The Internal assessment marks shall be communicated to the Registrar (Evaluation) at least 15 days before the commencement of the University examinations and the Registrar (Evaluation) shall have access to the records of such periodical assessments.

9.4 There shall be no minimum in respect of internal assessment marks.

9.5 Internal assessment marks shall be shown separately in the marks card. A candidate who has failed or rejected the result, shall retain the internal assessment marks.

9.6 Internship/Industrial Practicum/Project work in the degree programmes if any shall be as prescribed for the course.

10. REGISTRATION FOR EXAMINATIONS:

A candidate shall register for all the papers of a semester when he/she appears for the examination of that semester for the first time.

11. CONDUCT OF EXAMINATIONS:

11.1 There shall be Theory and Practical examinations at the end of each semester, ordinarily during October/November for odd semesters and during April/May for even semesters, as prescribed in the Scheme of Examinations.

11.2 Unless otherwise stated in the schemes of examination, Practical examinations shall be conducted at the end of each semester. The statement of marks sheet and the answer books of practical examinations shall be sent to the Registrar (Evaluation) by the Chief Superintendent of the respective Colleges immediately after the practical examinations.

11.3 The candidate shall submit the record book for practical examination duly certified by the course teacher and the H.O.D/staff in-charge. It shall be evaluated at the end of the Semester at the practical examination.

12. MINIMUM FOR A PASS:

12.1 A candidate shall be declared to have passed the program if he/she secures at least a CGPA of 4.0 (Course Alpha-Sign Grade C) in the aggregate of both internal assessment and semester end examination marks put together in each unit such as theory papers/ practicals / project work / dissertation / viva-voce under Group I / Group II / Group III (except in Co. and Extra curricular activities)

12.2 The candidates who pass all the semester examinations in the first attempts in three years are eligible for ranks provided they secure at least CGPA of 6.0 (at least Alpha-Sign Grade A).

12.3 The results of the candidates who have passed the sixth semester examination but not passed the lower semester examinations shall be declared as NCL (Not Completed Lower semester examinations). Such candidates shall be eligible for the degree only after completion of all the lower semester examinations.

12.4 A candidate who passes the semester examinations in parts is eligible for only CGPA and Alpha-Sign Grade but not for ranking.

12.5 There shall be no minimum in respect of internal assessment and viva-voce.

12.6 A Candidate who fails in any of the subject/paper/project work/Project Report/ dissertation shall reappear in that unit and pass the examination subsequently.

13. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

The results of successful candidates at the end of each semester shall be declared in terms of Grade Point Average (GPA) and alpha – sign grade. The results at the end of the sixth semester shall be classified on the basis of the Cumulative Grade Point Average (CGPA) obtained in all the six semesters and the corresponding overall alpha – sign grade. An eight-point grading system, alpha – sign grade as described below shall be adopted.

Eight Point Alpha – Sign Grading Scale:

Grade Point Average	<4	4-<5	5-<5.5	5.5-<6	6-<7	7-<8	8-<9	9-10
Alpha-Sign Grade:	D	C	B	B+	A	A+	A++	O (Outstanding)

The Grade Point Average (GPA) in a Semester and the Cumulative Grade Point Average (CGPA) at the end of sixth semester shall be computed as follows;

Computation of Grade Point Average **(GPA):** The grade points (GP) in a course shall be assigned based on the actual marks scored in that course as per the table below:

% Marks	35-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100
Grade Points	4	4.5	5.0	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10

The Grade Point Weights (GPW) shall then be calculated as the product of the grade points earned in the course and the credits for the course. The total GPW for a semester is obtained by adding the GPW of all the courses of the semester. The GPA shall then be computed by dividing the total GPW of all the courses of study by the total credits for the semester.

The sample illustrations of computing semester grade point averages and cumulative grade point average and the alpha – sign grades assigned are as per Appendix B.

14. CARRY OVER:

A candidate who fails in a lower semester examination may go to the higher semester and take the examinations.

15. REJECTION OF RESULTS:

15.1 A candidate may be permitted to reject the result of the whole examination of any semester. Rejection of result paper-wise/subject-wise shall not be permitted. A candidate who has rejected the result shall appear for the immediately following regular examination.

15.2 The rejection shall be exercised only once in each semester and the rejection once exercised cannot be revoked.

15.3 Application for rejection along with the payment of the prescribed fee shall be submitted to the Registrar (Evaluation) through the College of study together with the original statement of marks within 30 days from the date of publication of the result.

15.4 A candidate who rejects the result is eligible for only class and not for ranking.

16. Transfer of Admission

Transfer of admissions is permissible either within the University or from other Universities within one month from the date of commencement of even/odd semester classes.

16.1 Conditions for transfer of admission of students within the University.

i) His/her transfer admission shall be within the intake permitted to the college.

ii) Availability of same combination of subjects studied in the previous college.

iii) He/She shall fulfill the attendance requirements as per the Mangalore University Regulation.

iv) He/She shall complete the programme as per the regulation governing the maximum duration of completing the programme as per clause 6 of this regulation.

16.2 Conditions for transfer admission of students of other Universities.

i) A Candidate migrating from any other University may be permitted to join odd/even semester of the degree programme provided he/she has passed all the subjects of previous semesters/years, as the case may be. Such candidates must satisfy all other conditions of eligibility stipulated in the regulations of Mangalore University.
ii) His/her transfer admission shall be within the intake permitted to the college.
iii) He/she shall fulfill the attendance requirements as per the Mangalore University Regulation.
iv) The candidate who is migrating from other Universities is eligible for overall class and not for ranking.
v) He/She shall complete the programme as per the regulation governing the maximum duration of completing the programme as per clause 6 of this regulation.

Appendix A

COURSE PATTERN AND SCHEME OF EXAMINATION

B.Sc. Food Technology

T- Theory **P-** Practical
CC- Co-Curricular **EC-** Extra-Curricular

I / II Semester

	Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
					IA	Exam	Total	
Group 1	2 Languages	2L	2 x 4	2 x 2	2 x 20	2 x 80	2 x 100	2 x 2
Group 2	3 Food Technology Subjects with 3 Practicals	3T	3x 4	3 x 3	3 x 20	3 x 80	3 x 100	3 x 2
		3P	3 x 3	3 x 3	3 x 10	3 x 40	3 x 50	3 x 1
Group 3	Constitution of India, Human Rights, Gender and Environmental studies	1T	1 x 4	1 x 3	1x20	1 x 80	1 x 100	2
	CC & EC	-	-	-	1 x 50	-	1 x 50	1
							Semester Total	16

III Semester

	Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
					IA	Exam	Total	
Group 1	2 Languages	2L	2 x 4	2 x 2	2 x 20	2 x 80	2 x 100	2 x 2
Group 2	3 Food Technology subjects with 3 Practicals	3T	3 x 4	3 x 3	3 x 20	3 x 80	2 x 100	3 x 2
		3P	3 x 3	3 x 3	3 x 10	3 x 40	3 x 50	3 x 1
	CC & EC	-	-	-	1 x 50	-	1 x 50	1
							Semester Total	14

IV Semester

	Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
					IA	Exam	Total	
Group 1	2 Languages	2L	2 x 4	2 x 2	2 x 20	2 x 80	2 x 100	2 x 2
Group 2	3 Food Technology subjects with 3 Practicals	3T	3 x 4	3 x 3	3 x 20	3x 80	2 x 100	3 x 2
		3P	3 x 3	3 x 3	3 x 10	3 x 40	3 x 50	3 x 1
	CC & EC	-	-	-	1 x 50	-	1 x 50	1
							SemesterTotal	14

V Semester

	Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
					IA	Exam	Total	
Group 2	6 Food Technology Subjects and 3 Practicals	6T	6 x 4	6 x 3	6 x 20	6 x 80	6 x 100	6 x 2
		3P	3 x 3	3 x 3	3 x 10	3 x 40	3 x 50	3 x 2
							Semester Total	18

VI Semesters

	Subjects	Paper	Instruction hrs/week	Duration of Exam(hrs)	Marks			Credits
					IA	Exam	Total	
Group 2	5 Food Technology Subjects and 2 Practicals	5T	5 x 4	5 x 3	5 x 20	5 x 80	5 x 100	5 x 2
		2P	2 x 3	3 x 3	2 x 10	2 x 40	2 x 50	2 x 2
Group 2	Project work	Disser-tation	15	-	10	40	50	2
							Semester Total	16
							Grand Total	94

(Assented to by the Chancellor on 14.06.2017 as communicated in Government letter No.ED 11 UDS 2017 dated 29.06.2017)

Sd/-
REGISTRAR

Scheme and Syllabus for B.Sc.(Food Technology)

SEMESTER - 1								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
	English	4	48	3	20	80	100	2
	Kannada/Hindi/Malayalam	4	48	3	20	80	100	2
BFT101	Food and Nutrition	4	48	3	20	80	100	2
BFT102	Principles of Food Science	4	48	3	20	80	100	2
BFT103	Food Microbiology	4	48	3	20	80	100	2
BFT104	Food and Nutrition Practical-1	3	36	3	10	40	50	1
BFT105	Principles of Food Science Practical-2	3	36	3	10	40	50	1
BFT106	Food Microbiology Practical-3	3	36	3	10	40	50	1
	Constitution of India, Human Rights, Gender and Environmental studies	4	48	3	20	80	100	2
	CC & EC				50		50	1
Total		**33**	**396**				**800**	**16**

SEMESTER - 2								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
	English	4	48	3	20	80	100	2
	Kannada/Hindi/Malayalam	4	48	3	20	80	100	2
BFT151	Food Chemistry	4	48	3	20	80	100	2
BFT152	Food Preservation	4	48	3	20	80	100	2
BFT153	Fundamentals of food Processing	4	48	3	20	80	100	2
BFT154	Food Chemistry Practical-4	3	36	3	10	40	50	1
BFT155	Food Preservation Practical-5	3	36	3	10	40	50	1
BFT156	Fundamentals of food Processing Practical-6	3	36	3	10	40	50	1
	Constitution of India, Human Rights, Gender and Environmental studies	4	48	3	20	80	100	2
	CC & EC				50		50	1
Total		**33**	**348**				**800**	**16**

SEMESTER - 3								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
	English	4	48	3	20	80	100	2
	Kannada/Hindi/Malayalam	4	48	3	20	80	100	2
BFT201	Technology of Plant Products	4	48	3	20	80	100	2
BFT202	Technology of Animal Products	4	48	3	20	80	100	2
BFT203	Brewing and Fermentation Technology	4	48	3	20	80	100	2
BFT204	Technology Plant Products Practical-7	3	36	3	10	40	50	1
BFT205	Technology of Animal Products Practical-8	3	36	3	10	40	50	1
BFT206	Fermentation Technology Practical-9	3	36	3	10	40	50	1
	CC & EC				50		50	1
Total		**29**	**348**				**700**	**14**

SEMESTER - 4								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
	English	4	48	3	20	80	100	2
	Kannada/Hindi/Malayalam	4	48	3	20	80	100	2
BFT251	Bakery, Confectionary and Extruded Foods	4	48	3	20	80	100	2
BFT252	Technology of Fat and Oil Products	4	48	3	20	80	100	2
BFT253	Food Biotechnology	4	48	3	20	80	100	2
BFT254	Bakery, Confectionary and Extruded Foods Practical-10	3	36	3	10	40	50	1
BFT255	Technology of Fat and Oil products Practical-11	3	36	3	10	40	50	1
BFT256	Food Biotechnology Practical-12	3	36	3	10	40	50	1
	CC & EC				50		50	1
Total		**29**	**348**				**700**	**14**

SEMESTER - 5								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
BFT301	Food Engineering	4	48	3	20	80	100	2
BFT302	Food Packaging and Storage Technology	4	48	3	20	80	100	2
BFT303	Techniques of Food Analysis	4	48	3	20	80	100	2
BFT304	Quality Control in Food Processing Industries	4	48	3	20	80	100	2
BFT305	Emerging Technologies in Food Processing	4	48	3	20	80	100	2
BFT306	Waste Management of Food Industries	4	48	3	20	80	100	2
BFT307	Food Engineering and Packaging Technology Practical-13	4	48	3	10	40	50	2
BFT308	Food Analysis and Quality Control Practical-14	4	48	3	10	40	50	2
BFT309	Emerging Technologies and Waste Management Practical-15	4	48	3	10	40	50	2
Total		**36**	**432**				**750**	**18**

SEMESTER - 6								
Paper Code	Title of Paper	Instruction / week Hours	Hours / semester	Duration of Examination Hours	Marks			Credits
					IA	Exam	Total	
BFT351	Nutraceuticals and Functional Foods	4	48	3	20	80	100	2
BFT352	Utilization of Food Industry Wastes	4	48	3	20	80	100	2
BFT353	Enzyme Technology	4	48	3	20	80	100	2
BFT354	Food Plant Sanitation	4	48	3	20	80	100	2
BFT355	Bioethics, Biosafety and IPR	4	48	3	20	80	100	2
BFT356	Nutraceuticals, Functional Foods, Food Waste Utilization Practical- 16	4	48	4	10	40	50	2
BFT357	Enzyme Technology and Sanitation Practical -17	4	48	4	10	40	50	2
BFT358	Project work	15	180		10	40	50	2
Total		**43**	**516**				**650**	**16**

SEMESTER-1

B.Sc.-FOOD TECHNOLOGY-SEMESTER SYLLABUS

BFT 101 Food and Nutrition (Theory)

UNIT 1

1. **Introduction** **(5 hours)**
   Basic terms used in study of food and nutrition, Body Mass Index (BMI) and Nutritional Status, Understanding Relationship between food, nutrition and health. Definition of calorie & Joule, Measurement of basic nutrients.
2. **Balanced Diet** **(5 hours)**
   Functions of food-physiological, psychological and social, Concept of Balanced Diet, Malnutrition – over and under. Basic Food Groups, Food Pyramid.
3. **Concepts of Meal Planning** **(2 hours)**
   Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

UNIT 2

4. **Carbohydrates** **(4 hours)**
   Classification, digestion, functions, dietary sources, requirement, Clinical manifestations of deficiency and excess and factors affecting absorption of carbohydrates.
5. **Proteins** **(4 hours)**
   Classification, digestion, functions, dietary sources, requirement, evaluation of protein quality, Clinical manifestations of deficiency and excess and factors affecting absorption of proteins
6. **Lipids** **(4 hours)**
   Classification, digestion, functions, dietary sources, requirement, essential fatty acids, PUFA, Cholesterol, Clinical manifestations of deficiency and excess and factors affecting absorption of Lipids.

UNIT 3

7. **Vitamins** **(4 hours)**
   Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Vitamin A, D, K).
8. **Minerals** **(4 hours)**
   Classification, digestion, functions, dietary sources, requirement, effects of deficiency (Iodine, Sodium and Potassium).
9. **Pigments and colloids** **(4 hours)**
   Chlorophyll, Flavanoids, Anthocyanins, Anthoxanthins, Colloidal chemistry, Properties of solutions, Sols & Suspensions, Food colloids.

UNIT 4

10. **Enzymes** **(5 hours)**
    Classification of enzymes, Source of enzymes in food, Use of enzymes in food, Enzymatic and non-enzymatic reactions during storage.
11. **Methods of Cooking** **(5 hours)**
    Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various
    methods of cooking on foods, Changes in food during cooking using dry heat, moist heat, heated oil and microwave.
12. **Nutritional Labeling** **(2 hours)**
    Importance, global trends, codex guidelines, nutritional labeling in India, FSSAI guidelines.

Recommended Readings

1. Bamji MS, Krishnaswamy K, Brahmam GNV. Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd. 2009
2. Srilakshmi. Food Science, 4th Edition. New Age International Ltd, 2007.
3. Srilakshmi. Dietetics, Revised 5th edition. New Age International Ltd. 2005.
4. Wardlaw MG, Paul M Insel Mosby. Perspectives in Nutrition, 3rd Edition, 1996.
5. Codex Guidelines on Nutrition Labeling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C. NIN, ICMR. Nutritive Value of Indian Foods. 1990
8. Seth V, Singh K. Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd. 2005
9. Gibney et al (ed.), Introduction to Human Nutrition, Blackwell Publishers, 2005
10. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T. The Art and Science of Cooking: A Practical Manual, Revised Edition. Elite Publishing House Pvt Ltd., 2004
11. ICMR. Nutrient Requirements and Recommended Dietary Allowances for Indians, 2010.
12. Krishna Prasad Nooralabettu. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi, 2011

BFT 102 Principles of Food Science (Theory)

UNIT 1

1. **Food Chemistry** **(2 hours)**
   Introduction to different food groups and importance of food chemistry. Characteristics of protein, carbohydrates, lipids, pigments, colloids, and enzymes.
2. **Colloidal chemistry** **(5 hours)**
   Characteristics and stabilization of colloidal system, properties and formation of emulsions, formation, stability and destruction of foam, application of colloidal chemistry to food preparation.
3. **Sensory evaluation of food** **(5 hours)**
   Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duotrio test, triangle test, hedonic scale, chemical dimension of basic tastes, Amoore's classification of odorous compounds. Sherman and Sczezniak classification of food texture.

UNIT 2

4. **Growth of microorganisms in foods** **(4 hours)**
   Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure**.**
5. **Hurdle technology** **(4 hours)**
   Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.
6. **Minimal processing** **(4 hours)**
   Minimal processing of foods with thermal methods and non thermal methods-safety criteria in minimally processed foods-Minimal processing in practice-fruits and vegetables-seafood-effect on quality-Future developments

UNIT 3

7. **Ohmic heating and High Pressure processing** **(6 hours)**
   Principles, equipment and processing, effect heat and pressure on food.
8. **Water disposal** **(3 hours)**
   Waste water, hardness of water, break point chlorination, physical and chemical of impurities, BOD, COD, waste water treatment,
9. **Water disposal** **(3 hours)**
   Sanitization of food processing plants and equipments, CIP system, sanitizers used in food industry.

UNIT 4

10. **Shelf life of food material** **(3 Hours)**
    Objectives of packaging, packaging requirements of all major food groups, food contact materials,
11. **Packaging materials** **(6 Hours)**
    Properties of the following packaging materials, edible, biobased and biodegradable food packaging materials, flexible packaging, New and active packaging technologies, food packaging closures and sealing systems, as well as optical, mechanical, and barrier properties of thermoplastic polymers
12. **Packed storage** **(3 Hours)**
    Design and analysis of shelf life experiments and the shelf life estimation of foods, Factors effecting shelf life of the material during packed storage.

Recommended Readings

1. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
2. De S, Outlines of Dairy Technology, Oxford Publishers, 1980
3. Deman JM, Principles of Food Chemistry, 2nd ed. Van Nostrand Reinhold, NY 1990
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
5. Jenkins WA and Harrington JP, Packaging Foods with Plastics, Technomic Publishing Company Inc., USA, 1991
6. Manay NS and Shadaksharaswamy M, Food-Facts and Principles, New Age International (P) Ltd. Publishers, New Delhi, 1987
7. Meyer LH, Food Chemistry, CBS Publication, New Delhi, 1987
8. Potter NH, Food Science, CBS Publication, New Delhi, 1998
9. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006
10. Ranganna S, Handbook of Analysis and Quality Control for Fruits and Vegetable Products, 2nd ed. TMH Education Pvt. Ltd, 1986

BFT 103 Food Microbiology (Theory)

UNIT 1

1. **Introduction to food microbiology** **(4 hours)**
   History and Development of Food Microbiology, Definition and Scope of food microbiology, Inter-relationship of microbiology with other sciences.
2. **Microscopy** **(4 hours)**
   Light microscope - Resolving power, Limits of resolution, Refractive index, Magnification. Parts of microscope. Types of microscopy - Bright field, Dark field, Electron microscope - Transmission Electron microscope, Scanning electron microscope.
3. **Characteristics of Microorganisms in Food** **(4 hours)**
   Types of microorganisms associated with food, their morphology and structure, Significance of spores in food microbiology.

UNIT 2

4. **Evolution of Microorganisms in foods** **(2 hours)**
   Theory of spontaneous generation, Germ theory of disease, Koch's postulates, Pure culture concept
5. **Microbial Growth in Food** **(4 hours)**
   Bacterial growth curve and microbial growth in food, Factors affecting the growth of microorganisms in food, Sources of Microorganisms in foods,
6. **Microbial Food Spoilage** **(6 Hours)**
   Some important food spoilage microorganisms, Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafoods, Cereal and cereal products, Fruits and vegetables and Canned products.

UNIT 3

7. **Food Fermentations** **(5 hours)**
   Fermentation –definition and types, Microorganisms used in food fermentations, Dairy Fermentations-starter cultures and their types, Fermented Foods-types, methods of manufacture for traditional fermented foods.
8. **Food borne Diseases** **(3 hours)**
   Types – food borne infections, food borne intoxications and toxic infections, Common and Recent Examples,
9. **Cultivation of Micro-organisms** **(4 hours)**
   Pure culture technique, Methods of isolation and cultivation, Enumeration of microorganisms- qualitative and quantitative.

UNIT 4

10. Concepts of microbial control **(5 hours)**
    Principles and methods of preservation, Introduction to Hurdle concept and Non Thermal methods, Probiotic concept.
11. **Control of Microorganisms in Foods** **(5 hours)**
    Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment, Irradiation, Biopreservation,
12. **Trends in Food Microbiology** **(2 hours)**
    Rapid Methods of Detection, Recent Advances

Recommended Readings

1) Frazier William C and Westhoff, Dennis C. Food Microbiology, TMH, New Delhi, 2004
2) Jay, James M. Modern Food Microbiology, CBS Publication, New Delhi, 2000
3) Garbutt, John. Essentials of Food Microbiology, Arnold, London, 1997
4) Pelczar MJ, Chan E.C.S and Krieg, Noel R. Microbiology, 5th Ed., TMH, New Delhi, 1993

BFT 104 Food and Nutrition (Practical-1)

1. Identification of food sources for various nutrients using food composition tables.
2. Record diet of self using 24 hours dietary recall.
3. Nutritional analysis of diet of self using 24 hours dietary recall.
4. Introduction to meal planning,
5. Concept of food exchange system.
6. Planning of meals for adults of different activity levels for various income groups.
7. Planning of nutritious snacks for different age and income groups.
8. Preparation of nutritious snacks using various methods of cooking.
9. Nutritional labeling of food products.
10. Estimation of BMI and other nutritional status parameters.
11. Collection of nutritional components of the various vegetables and fruits available.
12. Collection of nutritional components of fish, poultry and meat.

BFT 105 Principles of Food Science (Practical-2)

1. Sensory evaluation of seafood on 10-point hedonic scale.
2. Sensory evaluation of vegetables.
3. Sensory evaluation of fruits.
4. Total bacterial count of the food sample.
5. Total mould count of the food sample
6. Determination of Free Fatty acids.
7. Determination of Peroxide value.
8. Determination of Total Volatile Base Nitrogen.
9. Determination of TBA.
10. Estimation of total salt content in butter.
11. Estimation of total ash content of the food
12. Preparation of brix solution and checking by hand refractometer

BFT 106 Food Microbiology (Practical-3)

1. Introduction to the Basic Microbiology Laboratory Practices and Equipments
2. Functioning and use of compound microscope
3. Cleaning and sterilization of glassware
4. Preparation and sterilization of nutrient broth
5. Cultivation and sub-culturing of microbes
6. Preparation of slant, stab and plates using nutrient agar
7. Morphological study of bacteria using permanent slides
8. Morphological study of fungi using permanent slides
9. Simple staining
10. Gram's staining
11. Slide culture of the fungus
12. Motility of the bacteria using hanging drop method

SEMESTER-2

BFT 151 Food Chemistry (Theory)

UNIT 1

1. **Introduction** **(4 hours)**
   Definition, Composition of food, Definition of water in food, Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging, Water activity and shelf-life
2. **Lipids** **(4 hours)**
   Classification of lipids, Physical properties of lipids. Chemical properties of lipids. Effect of frying on fats, Changes in fats and oils and its prevention, Technology of edible fats and oils- Refining, Hydrogenation and Interesterification, Fat Mimetics
3. **Proteins** **(4 hours)**
   Protein classification and structure, Nature of food proteins (plant and animal proteins, Properties of proteins, Functional properties of proteins.

UNIT 2

4. **Carbohydrates** **(4 hours)**
   Classification of carbohydrates, Structure of important polysaccharides, Chemical reactions of carbohydrates, Modified celluloses and starches.
5. **Vitamins** **(4 hours)**
   Importance and Stability, Water soluble vitamins, Fat soluble vitamins,
6. **Flavour** **(4 hours)**
   Definition and basic tastes, Description of food flavours, Flavour enhancers

UNIT 3

7. **Minerals** **(4 hours)**
   Major and minor minerals, Metal uptake in canned foods, Toxic metals
8. **Natural Food Pigments** **(4 hours)**
   Introduction and classification, Food pigments (chlorophyll, carotenoids, anthocyanins and flavonoids, beet pigments, caramel)
9. **Browning Reactions in Food** **(4 hours)**
   Enzymatic browning, Non – Enzymatic browning, Maillard reaction, Caramelization reaction, Ascorbic acid oxidation,

UNIT 4

10. **Enzyme**s **(4 hours)**
    Introduction, General characteristics, Enzymes in food processing, Industrial Uses of Enzymes, Immobilized enzymes
11. **Changes occurring during food processing treatments** **(4 hours)**
    Drying and dehydration, Irradiation, Freezing, Canning
12. **New product development** **(4 hours)**
    Definition, Importance, Need of product development, Steps of product development- Product development tools Reasons for failure

Recommended Readings:

1. Fennema, Owen R, Food Chemistry, 3rd Ed., Marcell Dekker, New York, 1996
2. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
3. Wong, Dominic WS, Food Enzymes, Chapman and Hall, New York, 1995
4. Potter, N.N. and Hotchkiss, J.H, Food Science, 5th Ed., Chapman & Hall, 1995
5. DeMan, J.M., Principles of Food Chemistry, AVI, NewYork, 1980
6. DeMan, J.M., Principles of Food Chemistry, 3rd Ed., Springer 1999
7. Desrosier, Norman W. and Desrosier., James N., The technology of food preservation, 4th Ed., Westport, Conn.: AVI Pub. Co, 1977.

8. Fuller, Gordon W, New Product Development from Concept to Marketplace, CRC Press, 2004.
10. Whitehurst and Law, Enzymes in Food Technology, CRC Press, Canada, 2002
11. Krishna Prasad Nooralabettu. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi. 2011

BFT 152 Food Preservation (Theory)

UNIT 1

1. **Principles of Food Preservation** **(5 hours)**
   Principle, objectives and techniques of food preservation, Water activity of food and its significance in food preservation, microbial and autolytic degradation of food items, oxidative degradation.
2. **Food Microbiology** **(5 hours)**
   Microorganisms associated with foods- bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms.
3. **Types of foods** **(2 hours)**
   Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelf stable foods.

UNIT 2

4. **Freezing and Refrigeration** **(4 hours)**
   Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.
5. **Thermal Processing** **(4 hours)**
   Principle and application of heat preservation methods: Sterilization, commercial sterilization, Pasteurization, ultrahigh temperature sterilization, aseptic processing and blanching.
6. **Drying and Dehydration** **(4 hours)**
   Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry.

UNIT 3

7. **Evaporation** **(4 hours)**
   Definition and principle of evaporation, factors affecting evaporation, names of evaporators used in food industry.
8. **Food Preservation by Irradiation** **(4 hours)**
   Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry.
9. **Fermentation** **(4 hours)**
   Principles of fermentation, Types of fermentation, curing and pickling; Hurdle technology, Advantages

UNIT 4

10. **Modified atmosphere** **(4 hours)**
    History of Controlled Atmosphere Storage, Modified Atmosphere Packaging techniques, Equilibrium Modified Atmosphere Packaging techniques, gas-flushing and compensated vacuum techniques
11. **Chemical Preservatives** **(4 hours)**
    Natural Preservatives-Mode of action, Chemical preservatives- Sulphur dioxide, Benzoic acid, Sorbic acid, Antioxidants
12. **Recent Trends** **(4 hours)**
    Biopreservatives, Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology

Recommended Readings

1. Srilakshmi, B. Food science, New Age Publishers, 2002
2. Meyer, Food Chemistry, New Age, 2004
3. Bawa, A.S, Chauhan O.P. Food Science. New India Publishing agency, 2013
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
5. Krishna Prasad Nooralabettu, Downstream processing-A new horizon in biotechnology, PHI publication, New Delhi, 2010.
6. Robertson, G. L., Food Packaging: Principles and Practice, 3rd edition, 2013.

BFT 153 Fundamentals of Food Processing (Theory)

UNIT 1

1. **Introduction (2 hours)**
   Historical development of food Science and technology, Evolution of Food Processing from prehistoric times till date.
2. **Compositional, Nutritional and Technological aspects of cereals & Millets (5 hours)**
   Composition, Nutritive value and Structure of cereal grain. Toxins, Malting, Gelatinization of starch, Changes during cooking, Changes during germination.
3. **Compositional, Nutritional and Technological aspects of pulses & legumes (5 hours)**
   Composition, Nutritive value, and Structure of pulses and legumes, Antinutritional factors, Factors effecting cooking time, Changes during cooking, Changes during germination.

UNIT 2

4. **Compositional, Nutritional and Technological aspects of animal meat (4 hours)**
   Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat.
5. **Compositional, Nutritional and Technological aspects of Fish (4 hours)**
   Fish - Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical. 6.
6. **Compositional, Nutritional and Technological aspects of poultry meat (4 hours)**
   Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality.

UNIT 3

7. **Compositional, Nutritional and Technological aspects of fruits (4 hours)**
   Classification, general composition and nutritional values, Post-harvest changes in fruits– Climacteric rise, physiological changes, physical changes, chemical changes, and pathological changes during the storage of fruits.
8. **Compositional, Nutritional and Technological aspects of vegetables (4 hours)**
   Classification, general composition and nutritional values of vegetables, Post-harvest changes in vegetables–Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes.
9. **Compositional, Nutritional & Technological aspects of Milk & Milk Products (4 hours)**
   Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk and milk products.

UNIT 4

10. **Compositional, Nutritional & Technological aspects of nuts & oilseeds (6 hours)**
    Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids**.** Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.
11. **Compositional, Nutritional & Technological aspects of health foods (3 hours)**
    Functional foods, Prebiotics, Probiotics, Nutraceuticals, organic foods, GM foods
12. **Compositional, Nutritional & Technological aspects of spices (3 hours)**
    Definition, Classification, Chemical composition, use of spices

Recommended Readings

1. Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013
2. Roday, S. Food Science, Oxford publication, 2011.
3. Srilakshmi, B. Food science, New Age Publishers, 2002
4. Meyer, Food Chemistry, New Age, 2004
5. De Sukumar, Outlines of Dairy Technology, Oxford University Press, 2007
6. Manay Shakuntala N, M Shadakshara Swamy Foods: Facts and Principles -, New Age International Publishers, New Delhi 2001
7. Srilakshmi B, Food Science - New Age International Publishers, New Delhi 2005
8. Swaminathan M, Food science, Chemistry & Experimental Foods, The Bangalore Print and Publishing Company Ltd, 1995.
9. Shafiur Rahman M., Handbook of Food Preservation, CRC Press, 2007
10. Rui M. S. Cruz, Igor Khmelinskii, Margarida Vieira, Methods in Food Analysis, CRC Press, 2014
11. Picó Y, Chemical Analysis of Food: Techniques and Applications, Academic Press, 2012
12. Maynard Joslyn, Methods in Food Analysis, Elsevier Inc, 1950

BFT 154 Food Chemistry (Practical 4)

1. Estimation of total protein content of food sample.
2. Estimation of total solid content of the sample.
3. Estimation of total lipids in the food sample.
4. Estimation of saponification value.
5. Estimation of reducing sugars.
6. Estimation of non-reducing sugars.
7. Estimation of total ash.
8. Estimation of iodine value.
9. Estimation of peroxide value.
10. Determination of carotenoids.
11. Extend of non-enzymatic browning by extraction methods.
12. Estimation of non protein nitrogenous substances in the food.

BFT 155 Food Preservation (Practical-5)

1. Methods of Sampling.
2. Concept of shelf life of different foods
3. To study the concept of Asepsis and sterilization
4. Plotting drying curve.
5. Study quality characteristics of foods preserved by drying/dehydration/ freezing.
6. To perform pasteurization of fluids using different methods.
7. To perform blanching of different plant foods.
8. Pasteurization of the milk.
9. Dry salting and wet Salting of fish samples.
10. Artificial drying of vegetables.
11. Iced storage of fish samples.
12. Chilled storage of fish samples.

BFT 156 Fundamentals of Food Processing (Practical-6)

1. Estimation of total yield during the processing of vegetables.
2. Estimation of total bacterial count before and after washing of the fish samples.
3. Determination of pH of the food products using pH meter.
4. Estimation of drip loss during frozen storage.
5. Moisture change during artificial drying of vegetables.
6. Moisture change during sundrying of vegetables.
7. Moisture change during salting of fishes.
8. Changes in proteolytic bacterial in perishable food.
9. Changes in proteolytic mold count in perishable food.
10. Organoleptic characteristics of the perishable foods at room temperature.
11. Changes in lipolytic bacterial in perishable food.
12. Changes in lipolytic mold count in perishable food.

SEMESTER-3

BFT 201 Technology of Plant Products (Theory)

UNIT 1

1. **Introduction** **(2 hours)**
   Importance of fruits, vegetable, cereals and pulses, History and need of preservation, reasons of spoilage, method of preservation.
2. **Canning and bottling of Fruits and vegetable** **(5 hours)**
   Selection of fruits and vegetables, process of canning, factors affecting the process- time and temperature, containers of packing, lacquering, syrups and brines for canning, spoilage in canned foods**,** Process of bottling, factors affecting the sterilization, factors affecting the quality of the bottles foods**.**
3. **Fruits juices and tomato pulps** **(5 hours)**
   Selection of fruits, Processing of fruit juices, preservation of fruit juices. Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup**.**

UNIT 2

4. **Fruit squashes, Jams, Jellies, Marmalades and candies** **(4 hours)**
   Selection of fruits, Processing, essential constituents, types, technology and defects in Fruit squashes, Jams, Jellies, Marmalades and candies
5. **Pickles, Chutneys and Sauces** **(4 hours)**
   Processing of pickles, chutneys and squashes, Types of pickles, chutneys and squashes, Causes of spoilage in pickling**.**
6. **Drying of Foods and Vegetables** **(4 hours)**
   Sun drying and mechanical drying of Food and Vegetables, process variation for fruits and vegetables, packing and storage**.**

UNIT 3

7. **Spices** **(5 hours)**
   Processing and properties of major and minor spices, essential oils & oleoresins, adulteration**.**
8. **Tea, Coffee and Cocoa** **(5 hours)**
   Processing of Tea, Coffee and Cocoa, Variety Tea, Coffee and Cocoa and its products**.**
9. **Browning** **(2 hours)**
   Enzyme activity enzymic browning Non enzymic browning, its prevention.

UNIT 4

10. **Technology of Cereals** **(4 hours)**
    Introduction, Properties, types, milling, treatment, product and byproducts of wheat, rice
11. **Technology of Pulses** **(4 hours)**
    Milling of pulses, Dry milling, Wet milling, Improved milling method
12. **Technology of Oilseeds and alcoholic beverages** **(4 hours)**
    Introduction, Extraction of oil and refining, Sources of protein, properties and uses, protein texturization, fibre spinning, Processing of Beer, Wine, Distilled Spirits

Recommended Readings

1. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
2. Crusess W B.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India
3. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers

4. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, 2nd edition.
5. Srivastava, R.P. and Kumar, S. 2006. Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.
6. Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
7. Chakraverty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
8. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
9. Manay, S. and Sharaswamy, M. 1987. Food Facts and Principles. Wiley Eastern Limited

BFT 202 Technology of Animal Products (Theory)

UNIT 1

1. **Introduction to food microbiology** **(2 hours)**
   Status and development of fishery, meat, poultry and dairy industries in India and its need in nation's economy.
2. **Processing of meat** **(4 hours)**
   The meat processing industry, its techniques of working, general management, structure, composition. Slaughter, inspection and grading.
3. **Preservation of meat** **(6 hours)**
   Effects of feed, breed and environment on production of meat animals and their quality, quality of the meat, Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, meat curing. Sausages-processing, types and defects, byproducts.

UNIT 2

4. **Egg Industry and Egg Production Practices** **(6 hours)**
   The egg industry, its techniques of working, General management, structure, composition and
   nutritive value of egg and its products.
5. **Preservation of eggs** **(4 hours)**
   Refrigeration and freezing, thermal processing, dehydration, coating.
6. **Quality identification of shell eggs** **(2 hours)**
   Factors affecting egg quality and measures of egg quality.

UNIT 3

7. **Processing of fish** **(6 hours)**
   Post-harvest change in fish, changes during chilled storage, various techniques of fish processing and preservation: chilling, freezing, canning, irradiation, curing, smoking, fermentation, salting, brining, and drying. Quality changes due to improper handling and processing.
8. **Fishery by-products** **(4 hours)**
   Surimi- Introduction, fish muscle proteins, the surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products**.** Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysis.
9. **Fermented fish** **(2 hours)**
   Principles of fermentation of fishery products, Flowchart of Indigenous products- Fish sauce and Paste

UNIT 4

10. **Physical properties of milk** **(4 hours)**
    Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing, boiling point, specific heat, electrical conductivity. Properties and significances of lactose in dairy industry.
11. **Milk fat** **(4 hours)**
    Composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants. Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring autooxidation, prevention, measurement of auto-oxidation.
12. **Market milk industry and milk products** **(4 hours)**
    Systems of collection of milk, Reception, Platform testing, Various stages of processing, Description and working of clarifier, cream separator, homogenizer and plate heat exchanger. Butter, ghee, flavored milk, yoghurt, dahi, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, cheese (cheddar).

Recommended Readings

1) Lawrie R A, Lawrie's Meat Science, 5th Ed, Woodhead Publisher, England, 1998
2) Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997
3) Pearson & Gillet Processed Meats, 3rd Ed, CBS Publication, New Delhi, 1997
4) Shai Barbut, Poultry Products Processing, CRC Press 2005
5) Stadelman WJ, Owen, J Cotterill, Egg Science& Technology, CBSP, New Delhi, 2002
6) Sukumar D E, Outlines of Dairy Technology, Oxford University Press, Oxford.2007.
7) Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
8) Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt. Limited, 2005
9) Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London, 1994.
10) Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd Ed., CBS Publishers, New Delhi 1988

BFT 203 Brewing and Fermentation Technology (Theory)

UNIT 1

1. **Outline of Brewing** **(4 hours)**
   Introduction, Malts, Brewing liquors, Milling and Mashing, Processing of Beer, types of beer, malting.
2. **Science of Mashing** **(4 hours)**
   Introduction, Mashing schedules, Altering Mashing Conditions, Mashing Biochemistry, Mashing and Beer flavor, Spent Grains, Preparation of grists, Mashing technology.
3. **Wort Boiling** **(4 hours)**
   Introduction, Chemistry of wort boiling, Clarification, Cooling and Aeration.

UNIT 2

4. **Wort Fermentation** **(4 hours)**
   Basic principles, Bottom and top Fermentation Systems, Continuous Fermentation, Fermentation Control Systems, Beer Maturation, flavour and aroma changes,
5. **Beer Treatment** **(4 hours)**
   Stabilization against non-biological haze, Carbonation, Clarification and filtration, Special beer treatments.
6. **Chemical and Physical Properties of Beer** **(4 hours)**
   Chemical Composition, Nutritive value, Colour, Haze, Viscosity, foam Characteristics, gurting flavor, Semors analysis, Packaging.

UNIT 3

7. **Malt Whiskies** **(4 hours)**
   Raw materials and processing of Scotch Whiskey, Irish Whiskey, North American Whiskies, Japanese Whiskey, Malt whiskies,
8. **Grain Whisky** **(4 hours)**
   Raw materials, wheat-wheat breeding, Grain distillery processing, Gelatinization, Milling, Cooking Conversion, Wort Separation,
9. **Yeast and Fermentation** **(4 hours)**
   Yeast for alcohol fermentation, Yeast biochemistry, Yeast Structure, carbohydrate metabolism, Nitrogen metabolism, Fatty acid and ester production.

UNIT 4

10. **Batch and Grain Whisky Distillation** **(6 hours)**
    Design, Wash Still Operation, Sprit Still Operation, Continuous Distillation, Design and Operation of grain whisky stills,
11. **Regulations** **(3 hours)**
    Whiskies of world and their regulations, Scotch Whisky, Canadian Whisky, Marketing Scotch Whisky
12. **Whisky Analysis** **(3 hours)**
    Major Volatile Congeners, Whisky, Age- Sensory analysis, Whisky authenticity.

Recommended Readings

1. Briggs D. E., C. A. Boulton, P. A, Brookers and R. Sterens, Brewing – Science and Practice, Wood head Publishing Limited, 2004.
2. Champbell G., Fermented Foods of the world-A Dictionary & Guide, Platt, Butterworths, London, 1987.
3. Miller B.M. & W. Litsky, Industrial Microbiology by. MGH, 1976
4. Russell I, G. Stewart, C. Bamforth, Whisky- Technology, Production and Marketing, Elsevier, 2003.

5. American society of brewing chemists, U.S.A.: Methods of analysis of American Society of Brewing Chemists. (8th rev.) U.S.A. American society of brewing chemists, 1996.
6. Arntzen, C.J., ed.: Encyclopedia of agricultural science, vol. 1: - A - D. N. York, Academic Press,1994
7. Birch G.G.: Alcoholic beverages. London, Elsevier Applied Science Pub.,1985
8. Government of India.: Technical Excise Manual.
9. Hardwick, W.A., ed.: Handbook of brewing. N. York, Marcel Dekker, Inc.,1995.
10. Hough, J.S., Briggs, D.E., Stevens, R., Young, T.W.: Malting & brewing science, vol. 2: hopped wort & water. London, Champman & Hall, 1982.
11. Pollock, J.R.A., and ed.: Brewing science vol. 1. London, Academic Press, 1979

BFT 204 Technology of Plant Products (Practical-7)

1. Estimation of total soluble solids (TSS).
2. Physical characteristics of Wheat.
3. Estimation of brix: acidity ratio
4. Estimation of ascorbic acid and effect of heat treatment on it.
5. To study the steps of artificial drying of vegetables.
6. Cooking characteristics of rice.
7. Adulteration of spices.
8. Dehydration of fruits and vegetables.
9. Rehydration of fruits and vegetables.
10. Salting of vegetables.
11. Brining of vegetables.
12. Organoleptic changes during dehydration of vegetables and fruits.

BFT 205 Technology of Animal Products (Practical 8)

1. To perform acidity in milk.
2. To perform acidity COB in milk.
3. To perform acidity MBRT in milk.
4. To perform acidity specific gravity in milk.
5. To perform acidity SNF in milk.
6. To estimate milk fat by Gerber method.
7. Quality evaluation of fish/prawn.
8. Subjective evaluation of Fresh Fish.
9. Estimation of moisture content of meat.
10. Estimation of protein content of meat.
11. Estimation of lipid content of fish sample.
12. Evaluation of eggs for quality parameters (market eggs, branded eggs)

FBT 206 Brewing and Fermentation Technology (Practical 9)

1. Count the yeast in the fermentation broth using Heamocytometer.
2. Check the viability of the yeast by staining with Methylene Blue.
3. Determination of ethanol content in the given fermentation broth.
4. Determination of fermentation efficiency of yeast growing on molasses medium.
5. Preparation of wine from grapes.
6. Determination of total reducing sugar of wine production.
7. Determination of pH & total acidity of wine.
8. Determination of Volatile acidity of wine.
9. Effect of temperature of yeast growth.
10. Effect of pH on yeast growth.
11. Effect of Substrate concentration on yeast growth
12. Effect of alcohol on yeast growth

SEMESTER-3

BFT 251 Bakery, Confectionery and Extruded Foods (Theory- 4 credits)

UNIT 1

1. **Baking Industry** **(4 hours)**
   Global status of Baking industry, Introduction to baking, Bakery ingredients and their functions, traditional bakery products; Modern bakery product.
2. **Baking methods** **(4 hours)**
   Various methods of production and effect of ingredients, formulations and process parameters on quality, machinery used in baking industry.
3. **Bakery Products** **(4 hours)**
   Bread, bread rolls, sweet yeast dough products, biscuits, wafer, cookies and crackers, Multi grain bread and gluten free products,

UNIT 2

4. **Bakery Product Quality** **(3 hours)**
   Rheological testing of dough- Farinograph, mixograph, extensograph, amylograph/ rapid visco analyser, Falling number; Microbiological aspects of different bakery products – prevention of bacterial rope and mold infection
5. **Bakery plants sanitation** **(3 hours)**
   Bakery hygiene and sanitation including control of rodents and pests. Bread faults – causes and remedies; Bread staling – theory, manifestation, retardation measures
6. **Cakes** **(6 hours)**
   Cakes – flour specifications; ingredients, manufacturing process and quality evaluation; Basic methods of cake preparations, variety cakes and doughnuts, rusks, crackers, buns, muffins, pizza; Icings, glazers, creams, fondants, frostings; Cake recipe balancing, faults and remedies; Preparation of basic custards, pudding; Mousse.

UNIT 3

7. **Confectionery industry** **(4 hours)**
   Global status of confectionery industry; Raw materials, quality parameters; production, types, applications.
8. **Confectionary manufacture** **(4 hours)**
   Raw materials and processing; cocoa, sugar, special fats, dried milk products, emulsifiers; chocolate processing- compound coatings, candy bars, tempering, enrobing technology, chocolate shells.
9. **Sugar confectionery** **(4 hours)**
   General technical aspects, manufacture of boiled sweets, lollipops, lozenges, gums and jellies, chewing gums, caramel, toffee, fudge. Indian Confectionery – Types, role of sugar in preparation, other ingredients and their role in preparation

UNIT 4

10. **Extruded food product industry** **(4 hours)**
    Objectives and importance of extrusion in food product development; Advantages and disadvantages. Components, functions and classification of extruder.
11. **Extruded food product** **(4 hours)**
    Change of functional properties of food components during extrusion; Pre and post extrusion treatments; Use of extruder as bioreactor; Manufacturing process of extruded products; Application of extrusion technologies in food industries.
12. **Cost consideration** **(4 hours)**
    Costing economics & Marketing of processes and products, including energy required and auditing; Project Preparation for Baking Unit and Layout; Bakery management and marketing

Recommended Readings

1. Matz, Samuel A, Bakery Technology and Engineering, 3rd Ed, CBS Publishers, 2008.
2. Stanley Cauvain and Linda Young, Baked Products- Science, Technology and practice, Blackwell Publishing, 2006.
3. Amendola, Joseph and Nicole Rees, The Baker's Manual, 5th Ed, Wiley, 2003.
4. Hamed Faridi and Jon M. Faubion, Dough Rheology and Baked Product Texture, CBS Publishers, 1997.
5. Duncan, Manley. Biscuit, Cookie and Cracker Manufacturing Manuals. Vol.1-6. Woodhead Publishing Harper JM. Extrusion of Food, Vol 2, CRC Press1981.
6. Matz SA. Bakery Technology & Engineering. AVI Pub. 1960.
7. Fance WJ and Wrogg BH. Up to-date Bread Making; Maclasen & Sons Ltd. 1968,
8. Kent-Jones DW and Amos AJ, Modern Cereal Chemistry, Food Trade Press Ltd. 1967
9. NIIR Board of Consultants & Engineers, The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production) 3rd Ed., 2014
10. Ashokkumar Y, Textbook of Bakery and Confectionery, PHI India Pvt. Ltd., 2012
11. Stanley Cauvain and Linda Young, Baked Products- Science, Technology and practice, Blackwell Publishing, 2006.
12. Amendola, Joseph and Nicole Rees, The Baker's Manual, 5th Edition, Wiley, 2003.
13. Hamed Faridi and Jon M. Faubion, Dough Rheology and Baked Product Texture, CBS Publishers, 1997.

BFT 252 Technology of Fat and Oil Products (Theory)

UNIT 1

1. **Edible fats and oil processing industry** **(4 hours)**
   Global status of edible fat and oil industry, Introduction to edible fat and oil production, , traditional edible fat and oil products; Modern fat and oil products.
2. **Properties of fat and oil products** **(4 hours)**
   Chemical, physical and functional properties of fats and oils, Importance of fats and oils in human nutrition Commercial oil resources,
3. **Edible fats and oil products** **(4 hours)**
   Importance of fats and oils in foods; Sources, composition and properties of fats and oils of plant and animal origin; Reversion and rancidity of fats and oils.

UNIT 2

4. **Extraction of fats and oils** **(4 hours)**
   Rendering, pressing, solvent extraction, supercritical fluid extraction, enzyme-derived oil extraction.
5. **Processing of fats and oils** **(4 hours)**
   Basic processing of fats and oils - oil extraction, degumming, refining, bleaching, hydrogenation, fractional crystallization, interesterification, glycerolysis, molecular distillation, plasticizing and tempering
6. **Modification of fats and oils** **(4 hours)**
   Breeding, Hydrogenation, Fractionation, Emulsification, Interesterification, Crystallization, Blending and Calculation

UNIT 3

7. **Plastic fats** **(4 hours)**
   Application of plastic fat in bakery, confectionary and cocoa butter replacers, shortenings,
8. **By-products of fat and oil processing industry** **(4 hours)**
   Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidants and its mechanism of application.
9. **Chemical adjuncts** **(4 hours)**
   Chemical adjuncts-lecithins, monoglycerides and derivatives, propylene glycol esters, polyglycoesters.

UNIT 4

10. **Shortening** **(4 hours)**
    Introduction into shortening, manufacturing and uses of shortening, types of shortening.
11. **Value added products** **(4 hours)**
    Margarine-manufacturing process and its uses. Mayonnaise and salad dressings. Confectionery coatings. Imitation dairy products - peanut butter and vegetable ghee.
12. **Packaging of fat and oil products** **(4 hours)**
    Packing, storage and transportation of fats and oils, cocoa butter, fat substitutes.

Recommended Readings

1. Swern D, Bailey's Industrial Oil and Fat Products, Vol 1 & 2; 4th ed, John Wiley & Sons, 1982.
2. Devine J & Williams PN, The Chemistry & Technology of Edible Oils and Fats, Pergamon Press, 1961.
3. Weiss TJ. Food Oils and their Uses. AVI,1983,
4. Torrey S, Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); NDC, 1983.
5. Hamilton RJ and Bharti A, Fats and Oils: Chemistry and Technology, Applied Science, London, 1980.

6. Salunkhe OK, Chavan JK, Adsule RN and Kadam SS, World Oilseeds: chemistry, Technology and Utilization, VNR, New York, 1992.
7. Wolf IA, Handbook of Processing and Utilization in Agriculture, (2 vol. set), CRC Press, Florida, 1983.

BFT 253 Food Biotechnology (Theory)

UNIT 1

1. **Scope of Food Biotechnology** **(4 hours)**
   Scope of Food biotechnology, Difference between the modern biotechnology and the traditional biotechnology, Difference between Food technology and Food biotechnology.
2. **Tools of the trade** **(4 hours)**
   Foods produced through indigenous and modern biotechnical tools. Future prospects of such foods, merits and demerits of genetically modified foods, Use of Genetic Engineering, nucleotide sequencing, DNA hybridization, gene cloning and PCR in food industry.
3. **Recombinant proteins** **(4 hours)**
   Introduction of gene expression and protein production, Manipulation of gene expression in prokaryotic system and prokaryotic system, Large-scale production of proteins from recombinant microorganisms, Application of recombinant proteins.

UNIT 2

4. **Microbial Biotechnology in foods** **(4 hours)**
   Isolating DNA from one organism, Using restriction enzymes to cut the DNA into fragments, Joining a cloning vector with DNA ligase, Incorporation into a host, Detection and purification of the desired clone, Production of large numbers of cells, making a gene product, importance of gene cloning in food production,
5. **Algal technologies in food** **(4 hours)**
   Identification and mass production of Blue-green algae and Azolla for food and feed, Mycorrhizae **-** importance in agriculture and forestry. Algae as a source of food, feed, single cell protein, Mass cultivation of commercially valuable marine macroalgae for alginates.
6. **Plant biotechnology in foods** **(4 hours)**
   Introduction to cell and tissue culture, induction to Plant Genetic Engineering, Generation and maintenance of transgenic plants, Production of fermented cereal food products.

UNIT 3

7. **Animal biotechnology in foods** **(4 hours)**
   Concepts of tissue culture and engineering, Chromosome manipulation in Aquaculture, Genetic engineering of animals and birds meant for food: DNA cloning, protoplast fusion & cell culture methods for trait improvement.
8. **Diagnostic systems** **(4 hours)**
   Molecular tools for the identification of diseases in aquatic species. Tools for disease diagnosis in cultivable organisms, Enzyme immuno assays, Dot immunobinding assay, Western blotting, Latex agglutination test, Monoclonal antibodies, DNA based diagnosis.
9. **Cell culture and food-Brewing, dairy Biotechnology and additives** **(4 hours)**
   Genetic engineering of bacteria and animals intended for dairy-based products, Enzymes in dairy industry & production by whole cell immobilization. Biotechnology of dairy effluent treatment **UNIT 4**
10. **Industrial cell culture** **(4 hours)**
    Nutraceuticals, flavonoids, antioxidants, vitamins, enzymes in food industry, enzyme generation of flavor and aroma compounds, use of genetically modified microorganisms to produce organic acids, single cell proteins
11. **Ethics and safety of food biotechnology products** **(4 hours)**
    Ethical issues relating to genetic modification of dairy, microbes and milk-yielding, Food safety assessment procedures for food derived from genetically modified plants- Description of the rDNA plant, Description of the host plant and its use as food, Description of the donor organism, Description of the genetic modifications, and Characteristics of the genetic modification.

12. Regulations of Genetically modified foods and issues

Regulatory agencies at national and international level- FDA, USDA, EPA, FSIS, EEC, BRAI, responsibilities of regulatory agencies, Issues of Genetically modified foods –public health concern, labeling, religious practice, environmental issues, liabilities, International trade issues,

Recommended reading

1. Anthony Pometto, Kalidas Shetty, Gopinadhan Paliyath, Robert E. Levin, Food Biotechnology, CRC Press, 2005.
2. Byong H. Lee, Fundamentals of Food Biotechnology, Wiley-Blackwell, 2014.
3. Hui Y H, George G., Food Biotechnology: Microorganisms, Wiley-VCH, 1995.
4. Joshi VK and Singh RS, Food Biotechnology-Principles and Practice, 2012
5. Aneja K R, Laboratory Manual of Microbiology and Biotechnology, MEDTECH, 2014.
6. Lisa A S, Cynthia JM, Basic Laboratory Methods for Biotechnology (2nd Ed.),

BFT 254 Bakery, Confectionery, and Extruded Foods (Practical 10)

1. Introduction to bakery equipments
2. Determination of ash content of the given sample of white wheat flour
3. Estimation of water absorption power and gluten content of the given flour.
4. Determination of alcoholic acidity of the given sample of wheat flour.
5. Determination of sedimentation value of white wheat flour
6. Determination of yeast quality by its dough rising capacity
7. Preparation of plain biscuit in laboratory
8. Preparation of egg less cake.
9. Preparation of bread by straight dough method.
10. Microbial flora of aging bakery items.
11. Sensory characteristics of the baked products.
12. Objective characteristics of biscuits.

BFT 255 Technology of Fat and Oil Products (Practical 11)

1. Determination of physical characteristics of fats, and oils.
2. Chemical analysis of fats, oils and fatty acids.
3. Extraction of oil from different sources using different techniques.
4. Debumming of oil sample.
5. Refining of oil sample.
6. Bleaching of oil sample,
7. Hydrogenation of oils sample.
8. Interesterification of oil sample.
9. Tempering of oil sample.
10. Preparation of peanut butter.
11. Objective parameters of fat and oils
12. Subjective characteristics of fats and oil.

BFT 256 Food Biotechnology (Practical 12)

1. Microscopic examination of various plant and animal cells
2. Production of cheese
3. Production of curd.
4. Production of food indigenous condiment using rice.
5. Production of food indigenous condiment using wheat.
6. Production of food indigenous condiment using rice.
7. Production of food indigenous condiment using pulses.
8. Production of food indigenous condiments using fruits
9. Food pathogens related -genes, marker and single nucleotide polymorphism (SNP) analysis using online tools
10. Genomic DNA isolation and purification from food samples.
11. Spectrophotometric Determination (DNA quantification and purity)
12. Agarose gel electrophoresis of DNA.

SEMESTER -5

BFT 301 Food Engineering (Theory)

UNIT 1

1. **Introduction** **(2 hours)**
   Concept of Unit operation, Units and dimensions, Unit conversions, dimensional analysis, Mass and Energy Balance. Related numericals.
2. **Design of food plant** **(6 hours)**
   Design considerations of food plants, Types of layout, Installation of cold storage, evaporators, dryers, freezers, Seaming machine; Sterilizers & other accessories used in canning industries; Engineering aspects of pasteurizer; homogenizer, evaporators and concentrators.
3. **Grinding and mixing** **(4 hours)**
   Principle of grinding and mixing, Different types of grinders and mixers used in food industry, application of grinders and mixers in food industry

UNIT 2

4. **Fluid Flow in food Processing** **(5 hours)**
   Liquid Transport systems, Properties of Liquids, Newton's Law of Viscosity, Principle of Capillary tube and rotational viscometer, Properties of Non-Newtonian fluids, Flow characteristics, Reynolds Number, Bernoulli's Equation, Concept of Flow Measurement devices.
5. **Refrigeration and Freezing** **(5 hours)**
   Concept and selection of a refrigerant, Description of a Refrigeration cycle, Pressure Enthalpy charts and Tables, Mathematical expressions useful in analysis of vapour compression refrigeration cycle, Numericals based on VCR system, Freon 12 and R-717, superheating and sub cooling, Freezing time calculation using Plank's Equation, Frozen food storage, Related basic numericals.
6. **Cold Storages** **(2 hours)**
   Construction of cold storages, types of cold storages, requirement of cold storages, machineries and utensils in cold storages.

UNIT 3

7. **Heat and Mass Transfer** **(5 hours)**
   Systems for heating and cooling food products, Thermal Properties of Food, Modes of heat transfer, Application of steady state heat transfer- estimation of conductive heat transfer coefficient, convective heat transfer coefficient, overall heat transfer coefficient and, design of tubular heat exchanger. Related basic numerical, Fick's Law of Diffusion,
8. **Membrane separation systems** **(5 hours)**
   Electrodialysis system, Reverse Osmosis, Membrane System, and Ultrafiltration Membrane System, Membrane devices used for RO and UF: Plate and Frame, Tubular, Spiral wound and hollow fiber devices.
9. **Psychrometrics** **(2 hours)**
   Properties of Dry Air Properties of Water Vapour, Properties of air Vapour mixture, Psychrometric Chart, Related basic numerical.

UNIT 4

10. **Steam** **(4 hours)**
    Generation of steam, Construction and functions of fire tube and water tube boilers, Thermodynamics of Phase change, Steam tables, Boiling point elevation, Related basic numerical
11. **Evaporation** **(4 hours)**
    Principle of evaporation, Types of evaporations, Design of single effect evaporators, Related basic numerical

12. Dehydration **(4 hours)**

Basic Drying Process, Moisture content on wet basis and dry basis, Dehydration systems, Dehydration system Design. Related basic numerical.

Recommended Readings

1) Rao DG. Fundamentals of food engineering. PHI learning Private Ltd. 2010.
2) Singh RP and Heldman DR. Introduction to food engineering. Academic press 4th edition, 2009
3) Rao C G, Essentials of food process engineering. B S Publications, 2006
4) Fellow P. Food processing technology, 1988

BFT 302 Food Packaging and Storage Technology (Theory)

UNIT 1

1. **Introduction** **(3 hours)**
   Introduction to packaging: definition, importance and scope of packaging of foods, Protective role of packaging; Principle in the development of protective packaging,
2. **Packaging material** **(6 hours)**
   Origin, types, chemistry, morphology and physical characteristics, advantages, defects and risks
   Forms of packaging-wooden boxes, crates, plywood, wire bound boxes, corrugated and fiber board boxes, bottle, tetra, retortable, flexible and laminated pouches, shrink, vacuum, gas, CAP, MAP, wrappers, textile bags, aseptic etc;
3. **Characteristics of packaging materials** **(3 hours)**
   Introduction to WVTR, GTR, bursting strength, tensile strength, tearing strength, drop test, puncture test, impact test, etc.

UNIT 2

4. **Effect of food stuff on packaging material** **(2 hours)**
   Characteristics of food stuffs that influence packaging selection: physical chemical and biological.
5. **Packaging requirement** **(5 hours)**
   Packaging requirements and their selection for raw and processed foods; meat, fish, poultry and egg, milk and dairy products, fruits and vegetables, cereal grains and cereal products, baked products, beverages, ready to eat snacks.
6. **Packaging machinery** **(5 hours)**
   Bottling, canned former, form fill and sealed machine, bags- their manufacturing and closing, vacuum pack units, shrink pack units, tetra pack units, temper evident and child resistant packaging and box coding.

UNIT 3

7. **Packaging techniques** **(4 hours)**
   Packaging and temperature changes: intelligent packaging; Packaging for microwave heating; Printing techniques; Package labeling: functions and regulations; Environmental aspect of food packaging, ecobalances.
8. **Cold Storage design and construction** **(4 hours)**
   Small and large commercial storages, cold room temperatures, insulation, properties of insulating materials, air diffusion equipment, doors and other openings.
9. **Refrigeration** **(4 hours)**
   Refrigeration cycles, vapour compression and vapor absorption cycles, refrigerants, characteristics of different refrigerants. Ton of refrigeration, components of refrigeration system.

UNIT 4

10. **Storage of food products** **(4 hours)**
    Cold load estimation; prefabricated systems, walk-in coolers, and refrigerated container trucks; Freezer storages, freezer room temperatures, insulation of freezer rooms. Pre-cooling and pre freezing. Stacking and handling of material in and around cold rooms.
11. **Changes during storage** **(4 hours)**
    Storage of grains - biochemical changes during storage - production, distribution and storage capacity estimate models, factors affecting losses, storage requirements, preventive method.
12. **Controlled and modified atmospheric storages** **(4 hours)**
    Principles and basics of their construction, operation and maintenance, cleanliness, defrosting practices, preventive and safety measures. Optimum temperatures of storage for

different food materials: meat and poultry products, marine products, fruits and vegetables, spices and food grains.

Recommended Readings

1. Coles R, McDowell D and Kirwan MJ, Food Packaging Technology, CRC Press, 2003
2. Ahvenainen R., Novel Food Packaging Techniques, Woodhead Publishing, 2003
3. Robertson GL, Food Packaging: Principles and Practices,2nd ed, CRC, 2005
4. Yam KL, Lee DS and Piergiovanni L, Hand Book of Food Packaging, CRC Press, 2006
5. Gosling CT, Applied Air conditioning and refrigeration. Applied Science Publishers Ltd. London. 1980.
6. Holowell ER, Cold Storage and Freezer Storage Manual, AVI Pub. Co. 1980.
7. Ciobanu A, and Lasku G, Bersescu V, Cooling Technology in the Food Industry, Abacus Press, 1976
8. Koelet PC, Industrial refrigeration, Principles, Design and Applications.CRC, 1992
9. Mascheroni RH. Operations in Food Refrigeration, CRC, 2009.
10. Stoecker WF, Industrial Refrigeration Handbook, McGraw Hill Professional, 1998.
11. Arvanitoyannis I, Modified Atmosphere and Active Packaging Technologies. CRC, 2009.

BFT 303 Techniques of Food Analysis (Theory)

UNIT 1

1. **Acceptance Sampling** **(4 hours)**
   Various methods of sampling, operational characteristics, risks, attribute sampling plans, administration of attribute sampling plans, sampling error.
2. **Food Analysis** **(4 hours)**
   Role of analysis, analysis of results. Techniques of analysis: gravimetric, titrimetric, colorimetric, spectrophotometric, fluorimetric, chromatographic.
3. **Physio-chemical basis of identification** **(4 hours)**
   Physical, chemical and rheological properties of food; Principles of analysis of various food constituents and subsequent changes on packaging.

UNIT 2

4. **Sensory Attributes** **(4 hours)**
   Sensory attributes of foods: mechanisms of sensation and perception of colour, taste, odour, and flavour;
5. **Sensory evaluation methods** **(4 hours)**
   Importance and use of sensory evaluation methods; facilities required for sensory evaluation; selection of trained panelists.
6. **Affective and analytical methods** **(4 hours)**
   discrimination methods, preference and ranking; rating with use of scales, magnitude determination, sensory profiling, flavour profile.

UNIT 3

7. **Descriptive methods** **(4 hours)**
   Quantitative Descriptive Analysis and Spectrum techniques; texture profile.
8. **Selection of trained panelist** **(4 hours)**
   Selection of trained panelists: type of panelists suitable for different tasks and methods; conditions for sensory analysis: room, serving and preparation of samples.
9. **Consumer tests** **(4 hours)**
   Application of consumer tests; control of factors affecting accuracy and precision of sensory data.

UNIT 4

10. **Advanced techniques of food analysis** **(7 hours)**
    Principles and application of flame photometry, atomic absorption, X-ray analysis, electrophoresis-applications, Mass spectroscopy, Nuclear magnetic resonance (NMR), chromatography, refractometry.
11. **Rheological measurements** **(3 hours)**
    Rheology measurements. Enzymatic methods DSC, SEM, rapid methods of microbial analysis, immunoassays, ESR, (electron spin resonance).
12. **Analysis of sensory data** **(2 hours)**
    Statistical testing; correlating instrumental and sensory measurements.

Recommended Readings

1. Sathe AV, A First Course in Food Analysis, New Age International Pvt. Ltd. 1999.
2. Nielsen SS, Food Analysis, 3rd ed., Kluwer Academic Publishers, 2003
3. Wood R, Foster L, Damant A and Key P, Analytical Methods for Food Additives, Woodhead Publishing, 2004
4. Pomeranz Y. and Meloan CE, Food Analysis: Theory and Practice, 3rd ed Chapman & Hall, 1994
5. AOAC, Official Methods of Analysis and AOAC International, 2005
6. Wrolstad RE, Acree TE, Decker EA Penner MH and Reid DS, Handbook of Food Analytical Chemistry, John Wiley & Sons, 2004

BFT 304 Quality Control in Food Processing Industries (Theory)

UNIT 1

1. **Overview** **(4 hours)**
   Organization and management; quality, quality assurance, quality control, total quality management
2. **Current Food Good Manufacturing Practices** **(4 hours)**
   Basic principles, Provisions- General Provisions, Buildings and Facilities, Equipment, Production and Process Controls, Defect Action Levels, cGMP for Dietary fibers
3. **Hazard Analysis Critical Control Point** **(4 hours)**
   Principles of HACCP-Conduct a Hazard Analysis, Identify the Critical Control Points, Establish a maximum or minimum limit, Establish Critical Limits, Establish Monitoring Procedures, Establish Corrective Actions, Establish Record Keeping Procedures, and Establish Verification Procedures.

UNIT 2

4. **Hazard in food** **(4 hours)**
   Overview of biological, chemical and physical hazard in foods, designing safety into food and processes; grades and standard of identity, Codex Alimentarius, safety, hazards, risk.
5. **Quality standards** **(4 hours)**
   ISO:9000 series and ISO:14000 series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, Food Safety Act.
6. **Quality Testing** **(4 hours)**
   Objective analysis, sensory assessment, rapid microbiological techniques; acceptance sampling; operational characteristics, risks, attributes, sampling plan, variables sampling plan, administration of acceptance sampling.

UNIT 3

7. **Adulteration of food** **(4 hours)**
   Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits.
8. **Sanitation in food processing facilities** **(4 hours)**
   Definition, important and application; laws and regulation governing sanitation; establishment of SOPs; sanitization methods; waste disposal; solid and liquid; waste control.
9. **Personal hygiene and hygienic food handling** **(4 hours)**
   Personal hygiene and hygienic food handlings, employee health, cleaning compounds; choosing of cleaning compounds, handling and storing of cleaning compounds.

UNIT 4

10. **Quality Control** **(3 hours)**
    Quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.
11. **Statistical analysis** **(6 hours)**
    Introduction, Types of data; variation, series data, randomness, definition of probability, sampling, summary statistics. Frequency distributions; histogram, normal distribution curve, probability plots, capability indices. Basic rules of probability, binomial & poisson distributions.
12. **Quality standards** **(3 hours)**
    Relationship between standards and measurement in a quality process, Identification of quality characteristics of a product or service, effect of instrument characteristics on measurement results.

Recommended Readings

1. Sathe AV, A First Course in Food Analysis, New Age International Pvt. Ltd. 1999
2. Nielsen SS, Food Analysis, 3rd ed., Kluwer Academic Publishers, 2003
3. Wrolstad RE, Acree TE, Decker EA, Penner MH and Reid DS, Handbook of Food Analytical Chemistry, John Wiley & Sons, 2004
4. Ali I, Food Quality Assurance: Principles and Practices, CRC Press, 2003
5. Vasconcellos JA, Quality Assurance in Food Industry: a Practical Approach, CRC Press, 2003
6. Hubbard MR, Statistical Quality Control for the Food Industry, Kluwer Academic/ Plenum Publishers, 2003
7. Pearson AM and Dutson TR, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Press Publishers, 1995
8. D'Mello J P F, Food Safety Contaminants and Toxins, Oxford University Press, 2003
9. Shasidi F, Spanier AM, Chi-Tang Ho and Braggins T, Quality of Fresh and Processed Foods, Kluwer Academics/ Plenum Publishing, 2004
10. Jotbill I, Rapid and On-line Instrumentation for Food Quality Assurance, Woodhead Publishing, 2003
11. Nielsen SS, Food Analysis Laboratory Manual, Kluwer Academic Publishers, 2003

BFT 305 Emerging Technologies in Food Processing (Theory)

UNIT 1

1. **High Pressure Processing** **(4 hours)**
   Principles of high pressure processing(HPP), use of high pressure to improve food safety and stability. Effects of high pressure on food quality.
2. **Modeling High Pressure Processing** **(4 hours)**
   Pressure effects on microorganisms, enzyme, texture and nutrients of food. Modeling HP processes.
3. **Pulsed electric fields processing** **(4 hours)**
   Historical background, PEF treatment systems, main processing parameters. PEF for processing of liquid foods and beverages, PEF Processing for solid foods.

UNIT 2

4. **Food Safety aspects** **(4 hours)**
   Mechanisms of microbial and enzyme inactivation by HPP and PEF, Food safety aspects of pulsed electric fields, and high pressure processing.
5. **Osmotic dehydration** **(4 hours)**
   Mechanism of osmotic dehydration, effect of process parameters on mass transfer, determination of moisture and solid diffusion coefficient, application of osmotic dehydration.
6. **Athermal membrane concentration** **(4 hours)**
   Athermal membrane concentration of liquid foods and colours: osmotic membrane distillation, direct osmosis, membrane modules, Applications of membrane concentration.

UNIT 3

7. **Radio frequency electric fields** **(4 hours)**
   Processing by radio frequency electric fields s equipments, RFEF non-thermal inactivation of yeasts, bacteria and spores, electrical costs.
8. **Ultrasound processing** **(4 hours)**
   Fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties.
9. **Alternate thermal processing:** **(4 hours)**
   Microwave heating: dielectric properties of foods, heat and mass transfer in microwave processing, application of microwave processing for foods;

UNIT 4

10. **Radio frequency electric fields** **(3 hours)**
    Dielectric heating, material properties, radio-frequency heating and drying applications;
11. **Ohmic heating** **(3 hours)**
    Fundamentals of ohmic heating, electrical conductivity, modeling, treatment of products.
12. **Hybrid drying technologies** **(6 hours)**
    Combined microwave vacuum drying, combining microwave vacuum drying with other processes, equipment for microwave vacuum drying, product quality degradation during dehydration.

Recommended Readings

1. Sun, Da-Wen, Emerging Technologies for Food Processing, Academic Press, 2005
2. Barbosa-Canovas, Tapia and Cano, Novel Food Processing Technologies, CRC Press, 2004

3. Ohlsson, Minimal Processing technologies in the food industry, Woodhead Publishing Limited, 2002
4. Rao E. S. Food Quality Evaluation. Variety Books. 2013.
5. Pomeranz Y and Meloan CE. Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi. 2002.
6. Meilgard, Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.
7. Amerine, Pangborn & Roessler, Principles of Sensory Evaluation of food, Academic Press, London, 1965.

BFT 306 Waste Management of Food Industries (Theory)

UNIT 1

1. **Introduction** **(4 hours)**
   Classification of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry
2. **Characteristics of industrial waste** **(4 hours)**
   Physico-chemical characteristics of wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry
3. **Physical, Chemical & Biological aspects** **(4 hours)**
   Physical, Chemical & Biological aspects of waste from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar and Dairy industry

UNIT 2

4. **Economic aspects** **(4 hours)**
   Waste treatment economics in Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry
5. **Effluent treatment methods** **(4 hours)**
   Treatment methods for liquid wastes from Fruit and Vegetable processing industry, Beverage industry, Fish, Meat & Poultry industry, Sugar industry and Dairy industry;
6. **Waste treatment plant design** **(4 hours)**
   Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

UNIT 3

7. **Treatment methods of solid wastes** **(4 hours)**
   Treatment methods of solid wastes from meat, fish, vegetable, sugar industry- Biological composting, drying and incineration;
8. **Design of Solid Waste Management System** **(4 hours)**
   Design of Solid Waste Management System such as Landfill Digester, Vermicomposting Pit.
9. **Biofilters and Bioclarifiers** **(4 hours)**
   Examples of Biofilters and Bioclarifiers, treatment methods- solid phase, liquid phase and gaseous phase, types of filter media, advantages and disadvantages

UNIT 4

10. **Treatment of waste water** **(4 hours)**
    Ion exchange treatment of waste water, Recovery of useful materials from effluents by different methods.
11. **Waste regulations** **(4 hours)**
    Waste regulations- national and international scenario, Solid waste policy in India, Municipal Solid waste rules,
12. **Environmental protection acts** **(4 hours)**
    Salient features and provisions of Environmental protection act (1986), The Ozone Depleting Substances (Regulation and Control) Rules, 2000

Recommended Readings

1. Herzka A & Booth RG, Food Industry Wastes: Disposal and Recovery, Applied Science Pub Ltd. 1981.
2. Fair GM, Geyer JC and Okun DA, Water & Wastewater Engineering, John Wiley & Sons, Inc. 1986

3. Inglett GE, Symposium: Processing Agricultural & Municipal Wastes, AVI. 1973.
4. Green JH and Kramer A, Food Processing Waste Management, AVI, 1979.
5. Rittmann BE and McCarty PL, Environmental Biotechnology: Principles and Applications, Mc-Graw-Hill International editions, 2001.
6. Bhattacharyya BC and Banerjee R, Environmental Biotechnology, Oxford University Press, 2007.

BFT 307 Food Engineering and Packaging Technology (Practical-13)

1. Plant layout design
2. Determination of drying characteristics
3. Study of effect of temperature on viscosity
4. Study of evaporation process.
5. Study of dehydration process.
6. Study of distillation process.
7. Study of solvent extraction process
8. Freezing time calculation
9. Identification of different types of packaging.
10. Measurement of thickness of packaging materials.
11. Testing of chemical resistance of packaging materials.
12. Visit to cold storages.

BFT 308 Food Analysis and Quality Control (Practical-13)

1. Sample preparation.
2. Study of emulsion stability
3. Determination of specific gravity of oils.
4. Hydration capacity of dehydrated foods.
5. Study of effect of meat tenderizers,
6. Effect of processing on colour of meat, vegetables
7. Determination of available lysine in processed meat
8. Determination of starch and pectins;
9. Organoleptic evaluation of food.
10. Analysis of rancidity in food.
11. Simple food adulterant tests.
12. Food pathogen tests.

BFT 309 Emerging Technologies and Waste Management (Practical-13)

1. Dehydration of the vegetables in microwave oven.
2. Recognition tests for various food flavors.
3. Osmotic dehydration.
4. Texture evaluation of various baked foods.
5. Texture evaluation of various fish products.
6. Texture evaluation of various blanched foods.
7. Textural measurement of various food products using Texture Analyzer.
8. Measuring the BOD level of the waste water.
9. Measuring the COD level of the waste water.
10. Measuring solid waste and liquid waste from the waste water.
11. Measuring the microbial flora in industrial waste water.
12. Enzyme activity in waste products.

SEMESTER 6

BFT 351 Nutraceuticals and Functional Foods (Theory)

UNIT 1

1. **Introduction** **(2 hours)**
   Classification of nutraceuticals, Scope involved in the industry, Indian and global scenario
2. **Concept, Biochemistry of nutrition and dietetics** **(5 hours)**
   Introduction of Balanced Diet, Basic Five Food Groups, Food Pyramid, Classification of Nutrients, Dietary Fibre, Components, physiological effects, potential health benefits.
3. **Nutrition related diseases and disorders** **(5 hours)**
   Diseases and disorders related to Excess and deficiency of Carbohydrates, Protein, Fat Metabolic disorders, Metabolic disorders, Concept of antioxidants, Role of nutraceuticals in the prevention and treatment of disease and disorders.

UNIT 2

4. **Nutraceuticals of plant and animal origin** **(4 hours)**
   Classification, recover and application of alkaloids, phenols, terpenoids with special reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants.
5. **Concept of cosmoceuticals and aquaceuticals.** **(4 hours)**
   Sources, extraction and application of chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin
6. **Microbial and algal nutraceuticals** **(4 hours)**
   Concept of prebiotics and probiotics -principle, mechanism, production and technology involved, applications-examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora-extraction from plant sources.

UNIT 3

7. **Synbiotics for maintaining good health.** **(2 hours)**
   Algae as source of omega-3 fatty acids, antioxidants and minerals-extraction and enrichment.
8. **Phytonutraceutical biotechnology** **(6 hours)**
   Role of medicinal and aromatic plants in nutraceutical industry–propagation-conventional and tissue culture, cultivation, post-harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement.
9. **Product development and clinical trials** **(4 hours)**
   Activity screening, formulations, toxicology, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials involved.

UNIT 4

10. **Functional Foods** **(4 hours)**
    Cereal and cereal products, Milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages such as tea and wine.
11. **Fermented foods as functional foods** **(4 hours)**
    Health benefits and role of fermented foods in conditions like cardiovascular diseases, hypertension, diabetes etc.
12. **Scope of functional foods and nutraceuticals** **(4 hours)**
    Future prospects of functional foods and nutraceuticals and their potential for use in improving health. Development in processing of functional foods. Formulation and fabrication of functional foods.

Recommended Readings

1. Wildman REC, Handbook of Nutraceutical and Functional Foods, CRC Press 2001.
2. Ghosh D et al, Innovations in Healthy and Functional Foods, CRC Press 2012.
3. Pathak YV, Handbook of nutraceuticals Volume 2, CRC Press 2011.
4. Hotchkiss JH, Potter NN, Food Science (5th Ed.), CBS Publishers & Distributors, 2007.
5. Fellows PJ, Food process Technology by Woodhead Publishing Ltd, 2009.

BFT 352 Utilization of Food Industry Wastes (Theory)

UNIT 1

1. **Introduction** **(3 hours)**
   Food industry wastes, economics of food waste treatment, necessity of food waste utilization, environmental best- practice technologies for waste minimization.
2. **Characteristics of industrial wastes** **(4 hours)**
   Moisture content, ferment ability, nutrient status, inert contaminants such as stones, plastics, salt content, organic materials such as proteins, carbohydrates and lipids, suspended solids, biochemical oxygen demand.
3. **By product utilization from fruit juice processing waste** **(5 hours)**
   Production of pectin, vitamins, ethanol, natural gas, citric acid, activated charcoal, fibre extract from apple pomace, Production of citrus oil from peels of citrus fruits, Manufacture of candied peel and pectin from albedo of citrus fruits.

UNIT 2

4. **By product utilization from vegetable processing waste** **(3 hours)**
   Production of single cell protein by the use of potato wastes; Recovery of Protein from potato starch plant waste.
5. **By product utilization from Fish processing waste** **(6 hours)**
   Production of fish meal; Fish protein concentrate; Animal feed; Shell product; Glue from seafood processing waste, Texturised fish, protein concentrate, Marketable products like chitin, chitosan, fertilizer, nutritional enhancer animal feed from shells.
6. **By product utilization from meat processing waste** **(3 hours)**
   Utilization of organs and glands of animal as human food. Production of human food from animal blood and blood protein.

UNIT 3

7. **By product utilization from poultry processing waste** **(4 hours)**
   Utilization of organs and glands of animal as human food. Production of human food from animal blood and blood protein;
8. **By product utilization from starch processing waste** **(4 hours)**
   Feed for livestock from wheat and corn bran and germ. Starch, modified starch and industrial alcohol from non-usable cereals; Extraction of plolamin (Zein & katirin); Protein from sorghum; Beer spent graining.
9. **By product utilization from rice mill waste** **(2 hours)**
   Extraction of oil & wax from rice bran, Puffed cereals from broken rice; Silica from rice husk; Feed for livestock from rice bran.

UNIT 4

10. **By product utilization from dairy industrial waste** **(4 hours)**
    Fermentation products from whey, Condensed & dried, products from whey; Production of lactose and protein from whey
11. **By product utilization from coffee and tea processing waste** **(5 hours)**
    Utilization of tea waste as feed for livestock and poultry, production of plastics from coffee grounds, extraction of oil from coffee grounds, coffee ground as organic material.
12. **Composting of food processing wastes** **(3 hours)**
    Prospects and limitations of Biogas production form food processing industrial waste, Solid state bioconversion,

Recommended Readings

1. Oreopoulou V, Russ W, Utilisation of by-products and treatment of waste in the food industry, Vol, 3., Springer, 2007.
2. Waldron K. Handbook of waste management and co-product recovery in food processing. CRC, 2007.
3. Smith R, Klemes J, Kim JK, Handbook of water and energy management in food processing, CRC, 2008.
4. Yapijakis C,Wang L, Yung Tse- Hung, LO H, Waste treatment in the food processing industry, CRC, 2005.
5. Hanx W. Von Loesecke, Outlines of Food Technology - Agrabios (India) 2nd Ed, 2001

BFT 353 Enzyme Technology (Theory)

UNIT 1

1. **Enzymes – overview** **(4 hours)**
   Structure and properties of enzymes, Classification and nomenclature of enzymes, Sources of enzymes, Mechanism of enzymes action, Factors effecting enzymes action
2. **Recovery of enzymes** **(4 hours)**
   Strategies of enzyme purification, Selecting suitable homogenization method, Selecting suitable recovery method, Selecting suitable analytical method, Measuring Enzyme activity,
3. **Enzyme kinetics.** **(4 hours)**
   Bioenergetics, Initial velocity, Order of the reaction, Enzyme-substrate complex, Kinetic of enzyme catalysed reaction involving a single substrate, inhibition, Enzyme regulation, Factors responsible for rate enhancement

UNIT 2

4. **Significant features of enzymes** **(4 hours)**
   Advantages of biocatalysts over chemical catalysts, Advantages of isolated enzymes and whole cell system, Advantages of free enzymes and immobilized enzymes. Active sites of enzymes, Enzyme specificities
5. **Enzymatic Techniques.** **(4 hours)**
   Basic principles of enzyme assays, Standardization and optimization of enzyme assays, Measurement of enzyme activity-Fixed Incubation or direct method and Kinetic method.
6. **Immobilised enzymes.** **(4 hours)**
   Enzyme immobilization techniques, Design and configuration of immobilized enzyme reactors, Application of immobilized enzyme technology in food industry, Economic arguments for enzyme immobilization

UNIT 3

7. **Enzymes in Starch hydrolysis** **(4 hours)**
   Advantages of enzyme hydrolysis over acid hydrolysis, enzymatic saccharification process, different types of enzymes used in the industry, source of enzyme- α-amylase, Saccharifying α-amylase, Glucoamylase, Pullulanase, β-amylase, mechanism of action.
8. **Enzymes in Bakery** **(4 hours)**
   Different types of the enzymes- α-amylase, Xylanase, Cellulase, Oxidase, Protease, Lipase, Pentasanase, role of enzymes in the backing process, conventional methods and enzymatic methods, source of enzyme, mechanism of action
9. **Enzymes in Brewing** **(4 hours)**
   Role, source, mechanism and results of Bacterial amylase, Heat stable α-amylase, Protease, Cellulase, β-Glucanase and Pectinase in brewing and wince making process, conventional methods and enzymatic methods,

UNIT 4

10. **Enzymes in Dairy** **(4 hours)**
    Role of lipase and protease in cheese making, source of lipase and protease, mechanism of action of lipase and protease in cheese making, production of lactose free milk, processing whey
11. **Enzymes in Fruit and vegetables** **(4 hours)**
    Source, mechanism and results of use of Catalase, Glucose oxidase, Acid proteases, Glucoamylase, Polygalacturonase, Pectin esterases, Pectin lyase, Hemicellulase, Carbohydrase. Fruit and vegetable processing
12. **Enzymes in Meat** **(4 hours)**
    Use of enzymes such as Acid protease, Tyrosinases, Glutaminase, Elastase, Papain, Ficin, Bromelain, Transglutaminase, Lipases, in meat processing with their source and benefits

Recommended Readings

1. Nooralabettu KP. Enzyme Technology, Pace Maker of Biotechnology, PHI Learning Private Limited, New Delhi. 2011
2. Baily JE and Ollis K, Biochemical Engineering Fundamentals. MGH, 1990
3. Samuel Cate Prescott, Prescott & Dunn's Industrial Microbiology, A V I Publishing Company, 1987
4. Stanbury PF, Whitaker A, and Hall SJ, and Principles of Fermentation Technology, Butterworth Heinemann, 2003.
5. Cornish-Bowden A, Analysis of Enzyme Kinetic Data, Oxford University Press, Oxford, 1995.
6. Copeland RA, Enzymes: A practical introduction into structure, Mechanism and Data analysis, Wiley-VCH, New York, 1999.

BFT 354 Food Plant Sanitation (Theory)

UNIT 1

1. **Food Plant Layout and Equipment Design** **(4 hours)**
   General principles of food plant Design and layout, Importance of the food plant sanitations, Factors influencing the sanitation of the food industry.
2. **Design of food processing equipments** **(4 hours)**
   Size Reduction, mixing, separation, extraction, filtration, centrifugation, distillation and, gas absorption equipments
3. **Food hygiene and safety during procurement** **(4 hours)**
   Food hygiene and safety during then procurement of the raw materials, ingredients, chemicals and packaging materials, Physico-chemical changes and handling practices affects the conditions of the raw materials, ingredients, chemicals and packaging materials and its prevention.

UNIT 2

4. **Food hygiene and safety in water supply** **(4 hours)**
   Source of water contamination, factors contributing the water contamination, cross contamination, measures to prevent the water contamination, water treatment
5. **Food hygiene and safety of contact surface area** **(4 hours)**
   Cross contamination through food contact surface area, cleaning and sanitation of food contact surface area such as vessels, reactor, utensils tables etc. Standard sanitation operating procedures to sanitize food contact surface
6. **Food hygiene and safety in production house** **(4 hours)**
   Food hygiene and safety in during processing activity, Personnel hygiene and practices that influence the sanitation of the production unit, control measures to prevent the risks.

UNIT 3

7. **Food hygiene and safety in warehouse** **(4 hours)**
   Aerated, refrigerated and controlled atmospheric storage, Conventional & Modern control measures, storage structures for fruits, vegetables, meat and marine products, design of warehouses
8. **Food hygiene and safety during transportation** **(4 hours)**
   Cross contamination, Time and temperature effect on the sanitation of the transporting vehicle. Handling practices and Personnel hygiene effects the sanitation during transportation.
9. **Food hygiene and safety in Cold Chain** **(4 hours)**
   Physicochemical changes in stored products, Handling practices and Personnel hygiene practices that effects the sanitation during cold chain management of the raw material and the product.

UNIT 4

10. **Control measures** **(4 hours)**
    Safe food storage, transportation and display at shopping outlets: use of coolers/chillers/freezers, length of time in storage, Waste disposal, Control methods using Physical and Chemical Agents, Pest and Rodent, Control, ETP Design and Layout.
11. **Scope of Cold Chain** **(4 hours)**
    Scope of cold chain for enhancing marketing potentials of perishables in domestic and international markets, Principles of Cold Chain Creation and Management.
12. **Wastewater and solid waste treatment** **(4 hours)**
    Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

Recommended Readings:

1. Norman G. Marriott and Robert B. Gravani, Principles of Food Sanitation, 5th ed, 2006.
2. Rao, DG, Fundamentals of Food Engineering, PHI learning Private Ltd, 2010
3. Fellows P, Food Processing Technology, 2nd Edition. Woodhead Publishing Limited and RC Press LLC, 2000
4. James A, The supply chain handbook, distribution group, 2013
5. FAO, US, Design and operations of cold store in developing countries, 1984
6. Hui YH, Bruinsma B, Gorham R, Nip WK, Food Plant Sanitation, Marcel Dekker, New York, 2003
7. Rees, N. and D. Watson, International Standards for Food Safety. Aspen Gaitersburg, Maryland, 2000

BFT 355 Bioethics, Biosafety and IPR (Theory)

UNIT 1

1. **Introduction** **(4 hours)**
   Relevance of Science, Technology, Society and Environment in science curriculum, technology and social responsibility, public acceptance of modern technology and products.
2. **Issues of modern technology** **(4 hours)**
   Issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, technology in international relations, globalization and development divide.
3. **Bioethics** **(4 hours)**
   The principles of bioethics Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc.

UNIT 2

4. **Bioethics and food biotechnology** **(4 hours)**
   The expanding scope of ethics from biomedical practice to modern food technology, ethical conflicts in food biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of food biotechnology, bioethics vs. business ethics
5. **Biosafety concepts and issues** **(4 hours)**
   Biosafety concepts and issues, Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biosafety concerns at the level of individuals, institutions, society, region, country and the world.
6. **Biosafety in the laboratory and process industry** **(4 hours)**
   Laboratory associated infections, bioprocess industrial hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory and process industry, Biosafety assessment procedures in India and abroad

UNIT 3

7. **Food Biotechnology and food safety** **(4 hours)**
   The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.
8. **Hazards and risk** **(4 hours)**
   Difference between hazard and risk, risk management, risk groups, different biosafety levels, protocols, containment
9. **General Principles of International dimensions of IPR** **(4 hours)**
   Introduction to Intellectual Property, Philosophical Justification of Intellectual Property, Western Theories on Private and IP, Indian Theory on Private Property, International Scenario, Economic Development and IPR Protection

UNIT 4

10. **Law Relating to Patents** **(4 hours)**
    Introduction to Patents, Patentable subject-Matter, Procedure for Obtaining of Patents, Working of Patents, Infringement –Compulsory License.
11. **Intellectual Property Rights and WTO** **(4 hours)**
    GATT and WTO, WTO and Economic Development, TRIPs Agreement and Its relation with other International IPR Treaties, TRIPs Agreement TRIPs and Environment.
12. **Biotechnology and IPR** **(4 hours)**
    Biotechnology and Law, Patenting Biological Invention, Plant Varieties Protection, Food Security, Genetic Engineering and Biotechnology, Biotechnology and International Treaties-UPOV, Convention on Biological Diversity, TRIPs, ITPGRFA

Recommended Readings

1. Thomas JA, Fuch RL, Biotechnology and Safety Assessment, 3rd Ed, Academic Press. 2002
2. Fleming DA, Hunt DL, Biological safety Principles and practices, 3rd Ed, ASM Press, Washington. 2000
3. William H. Lesser and Robert T. Masson, An Economic Analysis of the Plant Variety Protection Act, 1983
4. Carlos M. Correa, Oxford Commentaries on The GATT. WTO Agreements, Oxford University Press. 2007.
5. Alfredo Ilardi and Michael Blakeney (Ed.), International Encyclopedia of Intellectual Property Treaties (2004), Oxford University Press.

BFT 356 Nutraceuticals, Functional Foods, Food Waste Utilization (Practical-16)

1. Identification of various nutraceuticals available in the markets
2. Identification of functional foods available in the market.
3. Estimation of chlorophyll content of green vegetable.
4. Determination of lycopene in fruit/vegetable.
5. Determination of total pectin in plant material.
6. Estimation of crude fibre/dietary fibre content in cereals and their products.
7. Estimation of anthocyanins in food sample.
8. Preparation and evaluation of probiotic/prebiotic foods.
9. Isolation of Lactic acid bacteria from curd.
10. Proteolytic activity of gut waste of fish.
11. Isolation of pectin from citrus fruit peel.
12. Isolation of chitin from shrimp shells.

BFT 357 Enzyme Technology and Sanitation (Practical-17)

1. Assay of alpha amylase in the germinating barley.
2. Assay of proteolytic activity in the papaya fruit.
3. Assay of lysine activity in egg.
4. Assay of alkaline phosphatase in the hepatopancreas of shrimps
5. Design and layout of various food processing systems and food service areas.
6. Effect of pH on enzyme activity.
7. Effect of temperature on enzyme activity.
8. Effect of inhibitors on enzyme activity.
9. Determining K_m value and V_{max} value of an enzyme.
10. Tenderization of meat using protease.
11. Preparation of a sanitation schedule for food preparation area.
12. Study of Phenol coefficient of sanitizers.

BFT 358 Project Work