Maulana Abul Kalam Azad University of Technology, West Bengal

Department of Food Science

B. Sc (Food Science & Technology) Syllabus

Duration: 3 Years (Six Semesters)
Level: Under Graduate
Type: Degree
Admission: Through CET
Eligibility Criteria: Higher Secondary (Science) with Physics, Chemistry, Mathematics and Biology or Food & Nutrition or any allied subjects.

B.Sc. or Bachelor of Food Science and Technology is an undergraduate course. Food Science & Technology is the application of science and technology to the sorting, grading, processing, storage or preserving, refining , mixing, blending, heating, drying, manufacturing, handling, packaging, quality control, and distribution food materials , and also use of good quality, safe, nutritious, healthy,and wholesome food.
Increasing technology for value addition of plant, animal, and agricultural resources has made food production extremely complex thus causing a need for a very specialized knowledge based and trained Food Science & Technology professional who can grasp and apply such expertise effectively.
In addition the course also includes a significant quantum of industrial learning giving students the opportunities to boost their specialist professional skills facilitate independent learning and implement a reflective and practical approachto practice.
Under this program students gain a close perspective of real-world problems to food science and technology. Students interested in more detailed learning of the subject can apply for higher education in national or international forum.
The Bachelor degree course in Food Science & Technology is an important and careers oriented nature that opens a lot of job opportunities for the candidate in the position of Food technologist, Nutritional therapist, Product or Process development scientist, Quality control manager, Regulatory affairs officers or Food safety officers, Scientific laboratory technician, Production manager, Technical brewer, etc.

PROGRAM OUTCOMES (POs):

PO1- Technical knowledge and Modern tool usage: Apply the knowledge of mathematics, science, technical fundamentals, to create, select, and apply appropriate techniques, resources, using modern processing and IT tools.

PO2- Design/development and Problem analysis: Identify, formulate and analyze complex

technological problems in natural sciences, and technology with design solutions for different processes that meet the specified needs with appropriate consideration for the quality and safety, and the cultural, societal, and environmental considerations.

PO3- Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO4- Individual, team work and ethics: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings along with applying ethical principles and commit to professional ethics and responsibilities and norms of the technological practice.

PO5- Communication and society: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO6- Project management and entrepreneurship: Demonstrate knowledge and understanding of the management principles and apply these to one's own work, as an entrepreneur and leader in a team, to manage projects and in multidisciplinary environments.

PO7- Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of the program, the student

PSO1: should gain in-depth theoretical and practical knowledge in Food Chemistry, Food Microbiology, Food Processing Technology, Food Safety Laws and Food Analysis.

PSO2: should have the proficiency to contribute in food industry, food analytical laboratories, food safety & inspection and solve technological problems related to food processing industry.

PSO3: should attain the eligibility to pursue higher education and research. The students will develop ability to design or process newer food products and their preservation techniques as per the needs and specifications for safe and nutritious food.

PROPOSED SYLLABUS OF B.Sc. (H) FOOD SCIENCE &TECHNOLOGY

The course in Choice Based Credit System would be of 3 year (each year would consist of 2 semesters) duration having 6 semesters, divided into 14 Core Courses, 4 Discipline Specific Elective Courses, 2 Skill Enhancement Courses, 2 Ability Enhancement Compulsory Courses and 4 Generic Elective Courses. The new course has been prepared keeping in view, the unique requirements of B.Sc. (H) Food Science &Technology students. The objectives of the course are-

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

The contents have been drawn-up to accommodate the widening horizons of the discipline of **Food Science and Technology**. They reflect the current changing needs of the students. For the Generic Elective (GE) to be chosen by students, it is recommended that subjects like, Mathematics & Statistics, Computer Fundamental & Programming, Waste Management & Renewable Energy and Food & Nutrition be chosen as they are synergistic to the curriculum.

- For each paper, the course objectives have been listed along with the course outcomes (CO) mapped with each module and the contents divided into modules.
- The detailed syllabus for each paper is appended with the list of suggested readings.
- Teaching time allotted for each paper shall be 4 periods for each theory paper and 3 periods for each practical class per week for each paper per week.
- Each practical batch should ideally be between 15-20 students so that each student receives individual attention.

STRUCTURE OF B.SC HONOURS FOOD SCIENCE & TECHNOLOGY UNDER CBCS

❖ **CORE COURSE (CC) (All 14 Courses) (Total Credits: 14 x 6 =84)**

- **CC1– Food Microbiology: 4 Credits Theory + 2 Credits Practical**
- **CC2– Food Chemistry: 4 Credits Theory + 2 Credits Practical**
- **CC3– Nutritional Biochemistry: 4 Credits Theory + 2 Credits Practical**
- **CC4- Chemistry: 4 Credits Theory + 2 Credits Practical**
- **CC5- Principles of Food Science & Technology: 6 Credits (5+1)**
- **CC6- Principles of Food Preservation & Food Development Lab: 4 Credits Theory + 2 Credits Practical**
- **CC7- Food Processing Technology-I [Technology of Fruits, Vegetables and Beverages]: 4 Credits Theory + 2 Credits Practical**
- **CC8- Food Processing Technology-II [Technology of Milk & Dairy Food]: 4 Credits Theory + 2 Credits Practical**
- **CC9-Process Calculations and Thermodynamics: 6 Credits (5+1)**
- **CC10- Food Processing Technology-III [Technology of Cereals, Pulses and Oilseeds]: 4 Credits Theory + 2 Credits Practical**
- **CC11- Food Processing Technology-IV [Technology of Meat, Poultry and Egg]: 4 Credits Theory + 2 Credits Practical**
- **CC12- Instrumental Methods of Food Analysis: 4 Credits Theory + 2 Credit Practical**
- **CC13- Food Packaging Technology: 6 Credits Theory (5+1)**
- **CC14- Food Safety Standards, Adulteration& Food Law: 6 Credits Theory (5+1)**

❖ **DISCIPLINE SPECIFIC ELECTIVE(DSE) (Any four (one each from DSE-1, DSE-2, DSE-3 & DSE-4) (Total Credits: 4 x 6 = 24)**

[1] DSE-1: Concept of Food Engineering & Plant Hygiene

- **DSE–1A: Basic Concept of Food Engineering: 6 Credits Theory (5+1)**
- **DSE-1B: Food Plant Sanitization & Hygiene: 6 Credits Theory (5+1)**

[2] DSE-2: Bakery & Confectionery Technology

- **DSE–2A: Bakery Technology: 4 Credits Theory + 2 Credits Practical**
- **DSE–2B: Confectionery Technology: 4 Credits Theory + 2 Credits Practical**

[3] DSE-3: Fermentation Technology

- **DSE- 3A: Food Fermentation Technology: 4 Credits Theory + 2 Credits Practical**
- **DSE-3B: Fundamentals of enzymes, proteins & vitamins: 4 Credit Theory + 2 Credit Practical**

[4] DSE-4: Project

- **DSE–4: Project: 6 Credits**

❖ **GENERIC ELECTIVE (GE) [Any Four (each one from GE-1, GE-2, GE-3 & GE-4)] (Total Credits:4 x 6 = 24)**

[1] GE-1: Mathematics & Statistics

- **GE-1A: Basic Mathematics I: (6 Credit) (5+1)**
- **GE-1B: Basic Mathematics II: (6 Credit) (5+1)**
- **GE-1C: Introduction to Probability-Statistics-Data Analysis: 6 Credits Theory (5+1)**

[2] GE-2: Computer Fundamentals & Programming

- **GE-2A: Introduction to Computer Fundamentals: 4 Credits Theory + 2 Credits Practical**
- **GE-2B: C-Programming Language: 4 Credits Theory + 2 Credits Practical**
- **GE-2C: Python: 4 Credits Theory + 2 Credits Practical**

[3] GE-3: Waste Management & Renewable Energy

- **GE-3A: Waste treatment in Food Industries: (6 Credit) (5+1)**
- **GE- 3B: Renewable Energy Engineering: (6 Credit) (5+1)**

[4] GE-4: Food & Nutrition

- **GE-4A: Food Science & Nutrition: (6 Credit) (5+1)**
- **GE-4B: Nutraceuticals & Functional Foods: (6 Credit) (5+1)**

❖ **SKILL ENHANCEMENT COURSE (SEC) (All Two) (Total Credits: 2 x 2 = 4)**

- **SEC-1: Food Plant Layout & Design: 2 Credits**
- **SEC-2: Plant Training: 2 Credits**

❖ **ABILITY ENHANCEMENT COMPULSORY COURSES (AECC) (All Two) (Total Credits: 2 x 2 =4)**

- **AECC-1 (2 credits): English Communication**
- **AECC-2 (2 credits): Environmental Science.**

Total Credits: CC (84) + DSE (24) + GE (24) + SEC (4) + AECC (4) = 140

CBCS – MAKAUT UG degree (Hons.) 140 Credit FRAMEWORK

Subject Type	Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
CC	CC1, CC2	CC3, CC4	CC5, CC6, CC7	CC8, CC9, CC10	CC11, CC12	CC13, CC14
DSE					DSE 1, DSE 2	DSE 3, DSE 4
GE	GE 1	GE 2	GE 3	GE 4		
AECC	AECC 1	AECC 2				
SEC			SEC 1	SEC 2		
	4 (20)	4 (20)	5 (26)	5 (26)	4 (24)	4 (24)

B.Sc (Food Science & Technology) Hons. Curriculum Structure

1st Semester

Subject Type		Course Code	Course Name	Credit Points	Credit Distribution			Mode of Delivery			Proposed MOOCs
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC1	BSUFT-101 & BSUFT-191	Food Microbiology	6	4	2	0				
	CC2	BSUFT-102 & BSUFT-192	Food Chemistry	6	4	2	0				
GE	GE 1	BSUFT-103A/B/C	Mathematics & Statistics (GE 1A/B/C)	6	5	0	1				
AECC	AECC 1	BSUFT-104	English communication skill	**2**	**2**	**0**	**0**				
Semester Credits				**20**							

2nd Semester

Subject Type		Course Code	Course Name	Credit Points	Credit Distribution			Mode of Delivery			Proposed MOOCs
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC3	BSUFT-201 & BSUFT-291	Nutritional Biochemistry	6	4	2	0				
	CC4	BSUFT-202 & BSUFT-292	Chemistry	6	4	2	0				

GE	GE 2	BSUFT-203A/B/C & BSUFT-293A/B/C	Computer Fundamentals & Programming (GE 2A/B/C)	6	4	2	0				
AECC	AECC2	BSUFT-204	Environmental Science	2	2	0	0				
Semester Credits				**20**							

3rd Semester

Subject Type		**Course Code**	**Course Name**	**Credit Points**	**Credit Distribution**			**Mode of Delivery**			**Proposed MOOCs**
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC5	BSUFT-301	Principles of Food Science & Technology	6	5	0	1				
	CC6	BSUFT-302 & BSUFT-391	Principles of Food Preservation & Food Product Development	6	4	2	0				
	CC7	BSUFT-303 & BSUFT-392	Food Processing Technology I (Fruits, Vegetables & Beverages)	6	4	2	0				
GE	GE 3	BSUFT-304A/B	Waste Management & Renewable Energy (GE 3A/B)	6	5	0	1				
SEC	SEC1	BSUFT-305	Food Plant Layout and Design	2	2	0	0				
Semester Credits				**26**							

4th Semester

Subject Type		**Course Code**	**Course Name**	**Credit Points**	**Credit Distribution**			**Mode of Delivery**			**Proposed Moocs**
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC8	BSUFT-401 & BSUFT-491	Food Processing II (Technology of Milk & Dairy Foods)	6	4	2	0				
	CC9	BSUFT-402	Process calculations & Thermodynamics	6	5	0	1				
	CC10	BSUFT-403 & BSUFT-492	Food Processing Technology III (Cereals, Pulses & Oil seeds)	6	4	2	0				

GE	GE 4	BSUFT-404A/B	Food Science & Nutrition (GE 4A/B)	6	5	0	1				
SEC	SEC 2	BSUFT-405	Plant Training	2	0	2	0				
Semester Credits				**26**							

5th Semester

Subject Type		**Course Code**	**Course Name**	**Credit Points**	**Credit Distribution**			**Mode of Delivery**			**Proposed MOOCs**
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC 11	BSUFT-501 & BSUFT-591	Food Processing Technology IV (Technology of Meat, Poultry& Egg)	6	4	2	0				
	CC 12	BSUFT-502 & BSUFT-592	InstrumentalAnalysis of Food	6	4	2	0				
DSE	DSE 1	BSUFT-503 A/B	Concept of Food Engineering & Plant Hygiene (DSE 1A/B)	6	5	0	1				
	DSE 2	BSUFT-504 A/B & BSUFT-593A/B	Bakery & Confectionery Technology (DSE 2A/B)	6	4	2	0				
Semester Credits				**24**							

6th Semester

Subject Type		**Course Code**	**Course Name**	**Credit Points**	**Credit Distribution**			**Mode of Delivery**			**Proposed MOOCs**
					Th	Pr	Tu	Offline	Online	Blended	
CC	CC 13	BSUFT-601	Food Packaging Technology	6	5	0	1				
	CC 14	BSUFT-602	Food Safety Standards, Adulteration& Food Laws	6	5	1	0				
	DSE 3	BSUFT-603 A/B & BSUFT 691 A/B	Fermentation Technology (DSE 3A/B)	6	4	2	0				

DSE											
	DSE 4	BSUFT-604	Project(DSE 4)	6	4	2	0				
Semester Credits				**24**							

- **Generic Elective Basket (GE) [All GE courses of 6 credits each | 20 hours of MOOCs =1 credit | 10 hours of Blended/Offline - 1credit (choose any one from each basket)]**

GE Basket 1		**GE Basket 2**		**GE Basket 3**		**GE Basket 4**	
Mathematics & Statistics		**Computer Fundamentals & Programming**		**Waste Management & Renewable Energy**		**Food & Nutrition**	
1A	Basic Maths I	2A	Introduction to Computer Fundamentals	3A	Waste treatment in Food Industries	4A	Food Science & Nutrition
1B	Basic Maths II	2B	C-Programming Language	3B	Renewable Energy Engineering	4B	Nutraceuticals & Functional Foods
1C	Introduction to Probability-Statistics-Data Analysis	2C	Python				

- **Discipline Specific Elective (DSE) Basket**

DSE Basket 1		**DSE Basket 2**		**DSE Basket 3**		**DSE Basket 4**
Concept of Food Engineering & Plant Hygiene		**Bakery & Confectionery Technology**		**Fermentation Technology**		**Project**
1A	Basic Concept of Food Engineering	2A	Bakery Technology	3A	Food Fermentation Technology	
1B	Food Plant Sanitization & Hygiene	2B	Confectionery Technology	3B	Fundamentals of enzymes, proteins & vitamins	

PROPOSED SYLLABUS OF B.Sc. (H) FOOD SCIENCE &TECHNOLOGY

Semester I

Code	Course Title	Contact Hours (period/week)				Credits
CC	Theory	L	T	P	Total	
BSUFT-101	Food Microbiology	4	0	0	4	4
BSUFT-102	Food Chemistry	4	0	0	4	4
Total of Theory					**8**	**8**
CC	**Practical**					
BSUFT-191	Food Microbiology	0	0	3	3	2
BSUFT-192	Food Chemistry	0	0	3	3	2
Total of Practical					**6**	**4**
Total Credits of CC						**12**
GE	1) **Mathematics & Statistics (Theory)**					
BSUFT-103A BSUFT-103B BSUFT-103C	A) Basic Maths I B) Basic Maths II C) Introduction to Probability, Statistics & Data Analysis	5	1	0	6	6
Total of Theory					**6**	**6**
Total Credits of GE						**6**
AECC	**Theory**					
BSUFT-104	English communication skill	2	0	0	2	2
Total of Theory					**2**	**2**
Total Credits of AECC						**2**

Total Credits of Semester I: 12 + 6 + 2 =20

Semester II

Code	Course Title	Contact Hours (period/week)				Credits
CC	Theory	L	T	P	Total	
BSUFT-201	Nutritional Biochemistry	4	0	0	4	4
BSUFT-202	Chemistry	4	0	0	4	4
Total of Theory					**8**	**8**
CC	**Practical**					
BSUFT-291	Nutritional Biochemistry Lab	0	0	3	3	2
BSUFT-292	Chemistry Lab	0	0	3	3	2
Total of Practical					**6**	**4**
Total Credits of CC						**12**
GE	2) **Computer Fundamentals & Programming (Theory)**					

BSUFT-203A **BSUFT-203B** **BSUFT-203C**	A) Introduction to Computer Fundamentals B) C-Programming Language C) Python	4	0	0	4	4
Total of Theory					**4**	**4**
GE	2) **Computer Fundamentals & Programming (Practical)**					
BSUFT-293A **BSUFT-293B** **BSUFT-293C**	A) Introduction to Computer Fundamentals B) C-Programming Language C) Python	0	0	3	3	2
Total of Practical					**3**	**2**
Total Credits of GE						**6**
AECC	**Theory**					
BSUFT-204	Environmental Science	2	0	0	2	2
Total of Theory					**2**	**2**
Total Credits of AECC						**2**

Total Credits of Semester II: 12 + 6 + 2 =20

Semester III

Code	Course Title	Contact Hours (period/week)				Credits
CC	**Theory**	**L**	**T**	**P**	**Total**	
BSUFT-301	Principles of Food Science & Technology	5	1	0	6	6
BSUFT-302	Principles of Food Preservation & Food Product Development	4	0	0	4	4
BSUFT-303	Food Processing Technology I (Fruits, Vegetables & Beverages)	4	0	0	4	4
Total of Theory					**14**	**14**
CC	**Practical**					
BSUFT-391	Food Product Development Lab	0	0	3	3	2
BSUFT-392	Food Processing Technology I Lab	0	0	3	3	2
Total of Practical					**6**	**4**
Total Credits of CC						**18**
GE	3) **Waste Management & Renewable Energy (Theory)**					
BSUFT-304A **BSUFT-304B**	A) Waste Water Treatment in Food Industries B) Renewable Energy Engineering	5	1	0	6	**6**
Total of Theory					**6**	**6**
Total Credits of GE						**6**
SEC	**Theory**					
BSUFT-305	Food Plant Layout & Design	2	0	0	2	2

Total of Theory	**2**	**2**
Total Credits of SEC		**2**

Total Credits of Semester III: 18 +6 + 2 =26

Semester IV

Code	Course Title	Contact Hours (period/week)				Credits
CC	**Theory**	**L**	**T**	**P**	**Total**	
BSUFT-401	Food Processing Technology II (Technology of Milk & Dairy Food)	4	0	0	4	4
BSUFT-402	Process Calculations & Thermodynamics	5	1	0	6	6
BSUFT-403	Food Processing Technology III (Cereals, Pulses & Oil seeds)	4	0	0	4	4
Total of Theory					**14**	**14**
CC	**Practical**					
BSUFT-491	Food Processing Technology II (Technology of Milk & Dairy Food) Lab	**0**	**0**	**3**	**3**	**2**
BSUFT-492	Food Processing Technology III (Cereals, Pulses & Oil seeds) Lab	**0**	**0**	**3**	**3**	**2**
Total of Practical					**6**	**4**
Total Credits of CC						**18**
GE	4) **Food & Nutrition (Theory)**					
BSUFT-404A **BSUFT-404B**	A) Food Science & Nutrition B) Nutraceuticals & Functional Foods	5	1	0	6	6
Total of Theory					**6**	**6**
Total Credits of GE						**6**
SEC	**Sessional**					
BSUFT-405	Plant Training	0	0	2	2	2
Total of Theory					**2**	**2**
Total Credits of SEC						**2**

Total Credits of Semester IV: 18 +6 + 2 =26

Semester V

Code	Course Title	Contact Hours (period/week)				Credits
CC	**Theory**	**L**	**T**	**P**	**Total**	
BSUFT-501	Food Processing Technology IV (Meat, Poultry and Egg)	4	0	0	4	4
BSUFT-502	InstrumentalAnalysisof Food	4	0	0	4	4
Total of Theory					**8**	**8**
CC	**Practical**					

BSUFT-591	Food Processing Technology IV (Meat, Poultry and Egg) Lab	0	0	3	3	2
BSUFT-592	Food Analysis Lab	0	0	3	3	2
Total of Practical					**6**	**4**
Total Credit of CC						**12**
DSE	**Theory**					
BSUFT-503	**1) Concept of Food Engineering & Plant Hygiene**					
BSUFT-503A **BSUFT-503B**	A) Basic Concept of Food Engineering B) Food Plant Sanitization & Hygiene	5	1	0	6	6
BSUFT-504	**2) Bakery & Confectionery Technology**					
BSUFT-504A **BSUFT-504B**	A) Bakery Technology B) Confectionery Technology	4	0	0	4	4
Total of Theory					**10**	**10**
DSE	**Practical**					
BSUFT-593	2) **Bakery & Confectionery Technology**					
BSUFT-593A **BSUFT-593B**	A) Bakery Technology Lab B) Confectionery Technology Lab	0	0	3	3	2
Total of Practical					**3**	**2**
Total Credit of DSE						**12**

Total Credit of Semester V: 12 +12 =24

Semester VI

Code	**Course Title**	**Contact Hours (period/week)**				**Credits**
CC	**Theory**	**L**	**T**	**P**	**Total**	
BSUFT-601	Food Packaging Technology	5	1	0	6	6
BSUFT-602	Food Safety Standards, Adulteration& Food Laws	5	1	0	6	6
Total of Theory					**12**	**12**
Total Credits of CC						**12**
DSE	**Theory**					
BSUFT-603	3) **Fermentation Technology**					
BSUFT-603A **BSUFT-603B**	A) Food Fermentation Technology B) Fundamentals of Enzymes, Proteins & Vitamins	4	0	0	4	4
BSUFT-604	4) **Project**	4	0	2	6	6
Total of Theory					**10**	**10**
DSE	**Practical**					
BSUFT-691	**3) Fermentation Technology**					
BSUFT-691A **BSUFT-691B**	A) Food Fermentation Technology B) Fundamentals of Enzymes, Proteins &	0	0	3	3	2

	Vitamins					
Total of Practical					**3**	**2**
Total Credits of DSE						**12**

Total Credits of Semester VI: 12 +12 = 24

Detailed Syllabus of B.Sc. (H) Food Science & Technology

Semester I

BSUFT-101:Food Microbiology

(CREDITS 6: THEORY: 4, PRACTICAL: 2)

Course Outcomes (COs):

CO1: Recall the different types and morphology of microorganisms and magnification capacity of different types of microscopes.

CO2: Identify the factors affecting the growth in controlling the growth curve of microorganisms.

CO3: Analyse to preserve the perishable foods from different types of microbial spoilage.

CO4: Adapt the beneficial effects of microorganisms in the processing and development of fermented foods.

Theory:

Module I: Introduction and scope of food microbiology (**9 lectures**)

Introduction of microbiology and its relevance to everyday life. General characteristics of bacteria, fungi, virus, protozoa, and algae. Identification of microorganisms, Morphological characteristics important in food bacteriology, Industrial importance

Module II: Growth of microorganisms (**8 lectures**)

Growth curve-Intrinsic Factors (Substrate Limitations), nutrient content, pH and buffering capacity, antimicrobial barriers and constituents, water Activity, relative humidity, temperature, gaseous atmosphere

Module III: Microbiology of different foods (**10 lectures**)

Cereal and cereal products, Sugar and sugar products, Vegetables and fruits, Meat and meat products, Fish, egg and poultry, Milk and milk products, Canned foods.

Environmental microbiology: Water and water borne diseases, Air and air borne diseases, Soil and soil borne diseases, Sewage and diseases.

Waste product handling: – Planning for waste disposal, Solid wastes and liquid waste, Waste treatment and disposal, Biological oxygen demand (BOD)-Preliminary treatments, Chemical treatment, Biological treatment and disposal, Types of food wastes

Microbial intoxication and infections: Sources of contamination of food, mycotoxins, toxin production and physiological action, sources of infection of food by pathogenic organisms, symptoms and method of control.

Module IV: Beneficial effect of organism & Food safety (**9 lectures**)

Some applications of microorganisms-Food products: Alcoholic drinks, Dairy products, Bread, Vinegar, Pickled foods, Mushroom, Single-cell protein

Products from microorganisms: Enzymes, Amino acids, Antibiotics, Citric acid, Concepts of prebiotics, probiotics and organic food

Relevance of microbial standards for food safety.

Food Agricultural Organization (FAO),World Health Organization (WHO),The International Children's Emergency Fund (UNICEF),Codex Alimentarius, The International Commission on Microbiological Specifications for Foods(ICMSF),The Food and Drug Administration(FDA), United States Department of Agriculture(USDA).

Revision 4L

Total Lectures: 40L

PRACTICAL: BSUFT-191: Food Microbiology Lab
(CREDITS: 2)

Course Outcomes (COs)

CO1: Identify various instruments using in Food Microbiology laboraryand to study the morphology and special characteristics of microorganisms withstaining procedures.
CO2: Apply the knowledge of preparing culture media with aseptic inoculation techniques for microbial growth determination.
CO3: Analyze the bacterial growth curve.
CO4: Evaluate the occurrence of microorganisms in different food items and water sample qualitatively as well as quantitatively.

List of Experiments:

1. Study of equipments in a *microbiology* lab- microscope.
2. Preparation of laboratory media and special media, cultivation of bacteria, yeasts and moulds.
3. Staining of bacteria: gram-staining.
4. Cultivation and identifications of important molds and yeast in *food* items.
5. Study of bacterial growth: Growth curve

Recommended Readings:

1. Frazier, W. C. and Westhoff, D. C. (1988): 4th edition, Food Microbiology, McGraw Hill Inc.
2. Jay James. N. (1986): 3rd edition, modern Food Microbiology, Van Nestrand Reinhold Company Inc. 3. Peleezar, M.I. and Reid, K. D. (1978): Microbiology, McGraw Hill Company, New York.
4. Benson Harold, J. (1990): Microbiological Application, Publishers, U.S.A
5. Colling, C.E. and Lyne, P.M. (1976): Microbiological Methods Butterworth. London.

BSUFT-102: Food Chemistry
(CREDITS 6: THEORY: 4, PRACTICAL: 2)

Course Outcomes (COs):

CO1: Demonstrate the properties and reactions of the various food components.
CO2: Apply the basic principles and properties of starch proteins, fats and oils, pectin substances and spices and condiments.
CO3: Develop products with minimum nutritional loss based on the knowledge of food chemistry.
CO4: Evaluate the food quality on the basis of knowledge of different nutrients present in food.
CO5: Design diet chart from the knowledge of different nutrients calorific value and other health benefits.

Theory:

Module I: Basic concept on Food (**4 lectures**)

Nutrition and Nutrients, Classification of Food, Classification of Nutrients. Carbohydrates - Definition, Classification, Structure and properties.

Module II: Monosaccharides (**7 lectures**)

Glucose, fructose, galactose. Disaccharides - Maltose, lactose, sucrose. Polysaccharides - Dextrin, starch, glycogen, resistant starch.

Carbohydrates - Sources, daily requirements, functions. Effects of too high and too low carbohydrates on health. Digestion and absorption of carbohydrate

Module III: Lipids (**7 lectures**)

Definition, Classification & Properties. Fatty acids-composition, properties,types. Lipids - sources, daily requirements, functions. Digestion & Absorption ofnutrients. Role & nutritional significances of PUFA, MUFA, SFA, W-3 fatty acid.

Module IV: Proteins (**8 lectures**)

Definition, Classification, Structure & properties. Amino acids- Classification, types, functions. Proteins - Sources, daily requirements, functions.

Effect of too high - too low proteins on health. Digestion & absorption. Assessment of Protein quality (BV, PER, NPU). Factors affecting protein bio-availability including anti-nutritional factors.

Module V: (**10 lectures**)

Dietary Fibre - Classification, sources, composition, properties & nutritional significance. Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium), Vitamins - Bio-Chemical and Physiological Role Physiological role, bio-availability and requirements, sources, deficiency & excess. Water - Functions, daily requirements, Water balance.

Revision: 4L

Total Lectures: 40L

PRACTICAL: BSUFT-192: Food Chemistry Lab
(Credit: 2)

Course Outcomes (COs):
CO1: Identify laboratory equipment and the safety & measures.
CO2: Examine different products through laboratory analysis / experiments
CO3: Build himself / herself as a Food analyst / lab co-coordinator.

List of Experiments:
1. Determination of Moisture content in food
2. Determination of Ash content in food
3. Determination of sugar content in food
4. Determination of fat content in food by Soxhlet method.

5. Determination of calcium content in food
6. Determination of iron content in food
7. Determination of Vitamin C content in food

Recommended Readings:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
2. Food Chemistry by L. H. Meyer
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Bio Chemistry by Lehninger
5. Chemical changes in food during processing by Richardson
6. Nutrition and Dietetics by Rose, 2007.

BSUFT-103: Mathematics & Statistics
BSUFT-103A: Basic Mathematics I
(CREDITS: 6) (THEORY: 5 + 1)

Course Outcomes (COs):

CO1: Recall the basic of number system, identify and analyze the roots of polynomials, fundamental theorem of algebra, transformation of roots, Cardan's solutions of equation
CO2: Demonstrate the definition of determinants and solving problems using Cramer's rule, transform a given matrix into a diagonal matrix through eigen values and vectors.
CO3: Apply concepts of successive and partial differentiation, achieve the knowledge of calculating higher order derivatives, find maxima and minima of functions of two variables, use concepts of calculus to model real world problems.
CO4: Evaluate double and triple integrals, find areas of surfaces and volumes of solids, demonstrate vector differential operators, apply integral theorems to evaluate integrals.
CO5: Identify the types of ordinary differential equations, apply suitable methods for solving first order and second order differential equations, model practical problems using linear differential equations, form and solve partial differential equations of first order, solve engineering and food science problems.

Theory:

Module I: Number System: Basic idea about number theory (**2L**)

Module II: Theory of Equations (6L)

Polynomials, Division Algorithm, Remainder Theorem, Fundamental Theorem of Algebra, Descartes' Rule of signs, Relation between roots and coefficients of an equation, Symmetric functions of the roots, Transformation of equations, Cardan's solutions of equations

Module III: Determinant (4L)

Definition of determinant, Properties of determinant, Minor of an element in a determinant, Co-factor of an element in a determinant, Cramer's Rule for solutions of linear equations

Module IV: Matrix (5L)

Definition of Matrix, Different types of Matrices, Matrix operations, solution of linear equations using matrix inversion method

Module V: Differentiation (5L)

Meaning of Differentiation, Standard formulae, Differentiation of a function of a function, Successive Differentiation

Module VI: Partial Differentiation (4L)

Definition of Partial Differentiation, Successive Partial Differentiation

Module VII: Integration (8L)

Definition of Integration(Indefinite), Fundamental Theorems, Standard formulae, Method of Substitution, Method of By Parts, Definition of Definite Integration, Fundamental Theorem of Integral Calculus, Properties of Definite Integrals

Module VIII: Differential equation (Ordinary and Partial) (6L)

Formation of ordinary and partial differential equation, solution techniques, applications, system of ordinary differential equation

Module IX: Vector calculus (3L)

Operation on vectors and scalar functions, differentiations and integration of vector functions, applications

Module X: Numerical Analysis (3L)

Solution of equations and differential equations using numerical techniques

Revision: 4L

Total Theoretical Lectures: 50L

Tutorial: 10L

Total Lectures: 50L + 10L = 60L

Recommended Readings:

1. Higher Engineering Mathematics by B.S.Grewal, S. Chand, 43rd Edition 2015
2. Engineering Mathematics by Pal And Bhunia, OXFORD University Press.
3. Introductory Methods of Numerical Analysis by Sastry S.S, PHI.
4. Ordinary And Partial Differential Equations by Dr.M.D.Raisinghania, S.CHAND
5. Introduction to Partial Differential Equations by Rao Sankara, Prentice-Hall Of India Pvt. Limited, 2006.

BSUFT-103B: Basic Mathematics II
(CREDITS: 6) (THEORY: 5 + 1)

Course Outcomes (COs):
CO1: Relate real life problem associated with food science and technology with the help of optimization concept and solve it.
CO2: Apply the basic concepts in simplex method and LPP
CO3: Evaluate mathematical components of transportation problem in food industry

THEORY:

Module I: Linear programming, Non-linear programming, Optimization techniques, Maximization and minimization of a function, Convex set and combination, LPP, NLPP,

Constrained and unconstrained optimization, Simplex method for solving LPP, Graphical method. (**12L**)

Module II: Supply chain management problem food chain industry, Supply chain and logistic model formulation, Solving the problem with optimization concept. (**10L**)

Module III: Transportation problem for food industry. (**7L**)

Module IV: Assignment problem for food sector industry. (**7L**)

Revision: 4L

Total Theoretical Lectures: 40L

Tutorial: 10L

Total Lectures: 40L + 10L = 50L

Recommended Readings:

1. Higher Engineering Mathematics by B.S.Grewal, S. Chand, 43rd Edition 2015
2. Engineering Mathematics by Pal And Bhunia, OXFORD University Press.
3. Linear Programming & Game Theory, J.G. Chakraborty & P. R. Ghosh, Moulik Library
4. Operation Research by Man Mohan Kanti Swarup,Pk Gupta, S. Chand
5. Operation Research by Sumant Kapoor Vk Kapoor, S. Chand

BSUFT-103C: Introduction to Probability, Statistics & Data Analysis (CREDITS: 6) (Theory-5; Tutorial-1)

Course Outcomes (COs):

CO1: Recall the key terminology, concepts tools and techniques used in statistical analysis and identify the underlying assumptions of analysis tools.
CO2: Demonstrate the uses and limitations of statistical analysis.
CO3: Build the concepts of probability and solve problems on permutation, combination & Binomial Theorem

Module I: Probability theory (16L)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the Multinomial distribution, Poisson approximation to the Binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, Distribution functions and densities, Normal, Exponential and Gamma densities.

Module II: Statistics (16L)

Measures of Central tendency, Moments, Skewness and Kurtosis, Probability distributions:

Binomial, Poisson and Normal and evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Module III: Data analytics for food science related problem (14L)

Data analytics wit R, Real life case study associated with food science problem.

Revision: 4L

Total Theoretical Lectures: 50L

Tutorial: 10L

Total Lectures: 50L + 10L = 60L

Recommended Readings:

1. Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
3. S. Ross, A First Course in Probability, Pearson Education India
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
5. John E. Freund, Ronald E. Walpole, Mathematical Statistics, Prentice Hall.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
7. N.G. Das, Statistical Methods (Combined Volume), Tata-McGraw Hill.

BSUFT-104: ENGLISH COMMUNICATION
(Total Credits 2)

Course Outcomes (COs):

CO1: Recall English grammar correctly in order to make an error-free communication.
CO2: Apply writing skill to set a positive impression for them.
CO3: Organize vocabulary and use them effectively and appropriately.
CO4: Take part in group discussion. By looking at various scenarios, a student will learn key language for group discussion as well as gain some business etiquette
CO5: Defend in the personal interview, job interview, or any kind of presentation.
CO6: Build the four language skills to communicate more effectively and properly.

Topic:

Module I: Grammar (5 Lectures)
Sentence Structure, Voice, Narration

Module II: Writing Skills (3 lectures)
Report Writing (Structure, Types of report), Article/ Blogwriting

Module III: Business Correspondence (2 lectures)
Formal letter, Job Application, CV/ Resume, Email

Module IV: Reading Comprehension (Seen) (2 Lectures)
Selected pieces from literature (1 Prose & 1 Poetry)

Module V: Reading Comprehension (Unseen) (1 Lecture)
Skill of answering questions by understanding a given text

Module VI: Communication Skills (3 lectures)
Video & Audio Conferencing, Group Discussion, non-verbal skills

Module VII: Speaking Skills (4 lectures)
Mock Interview sessions, Group Discussion Practice, Extempore, Debate

Total Lectures: 20L

Suggested readings:

1. S R Inthira &, V Saraswathi, Enrich your English a) Communication skills b) Academic skills, CIEFL &,OUP

2. R.C. Sharma and K.Mohan Business Correspondence and Report Writing Tata McGraw Hill New Delhi,1994

3. Maxwell Nurnberg and Rosenblum Morris, All About Words- A Text-Book for English for Engineers &, Technologists General Book Depot, New Delhi,1995

Semester II

BSUFT-201: Nutritional Biochemistry

(CREDITS 6: THEORY: 4, PRACTICAL: 2)

Course Outcomes (COs):

CO1: Define the basics of biomolecules, their structures, relevant biochemical reactions and nutrition.
CO2: Explain the metabolism of different biomolecules and enzymatic pathways leading to end products.
CO3: Justify the structure, function and metabolism of vitamins, hormones and water.
CO4: Construct the concepts and functions of different enzymes and various coenzymes.

Theory:

Module –I: Basics of energy metabolism, nutrition & dietetics (7 lectures)

Module of measuring energy, calorific value of food, BMR & factors affecting it, SDA of food, calculation of energy requirement, balanced diet, Nutrition in health & diseases (protein energy malnutrition)

Module- II: Chemistry of carbohydrates, protein, lipids & their related metabolism (15 lectures)

Carbohydrates: Introduction, Definition, Classification, Biomedical importance, Brief outline of metabolism: Glycogenesis, Glycogenolysis, Glycolysis, Citric acid cycle & its significance, HMP shunt, Gluconeogenesis, regulation of blood glucose levels, Glucose tolerance test, Glycosurias, Hypoglycemia& its causes

Amino acids –Definition, classification, Essential & non essential amino acids.

Proteins: Introduction, definition, classification, biomedical importance Metabolism: Transformation, Decarboxylation, Transamination, Ammonia formation &transport, Urea cycle.

Lipids**:** Introduction, Definition, Classification, Biomedical importance, Essential fatty acids, Identification of fats &oils (saponification no, acid no, iodine no, acetyl no, reichert- miesel no. etc.), Brief outline of metabolism, Beta oxidation of fatty acids, ketosis

Module -III: Enzymes (7 lectures)

Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes- Creatinine kinase ,Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase

Module-IV: Vitamins, Hormones & Water metabolism (7 lectures)

Vitamins: Water & fat soluble vitamins, sources, requirements, deficiency disorders, Biochemical functions.

Hormones: Classification, general mode of action of hormones of -Pituitary, Thyroid, Parathyroid, Adrenals, Reproductive Glands, Pancreas,

Hormonal disorders, Counter regulatory hormones

Water: Distribution of fluids in the body, ECF, ICF, Water metabolism, dehydration

Revision 4L

Total Lectures: 40L

Practical: BSUFT-291: Biochemistry Lab
(Credit: 2)

Course Outcomes (COs)

CO1: Construct the method of evaluation of different biomolecules like protein, carbohydrate, digestive enzymes, and vitamins.
CO2: Organize the tests for proteins, carbohydrate, digestive enzymes, and vitamins.
CO3: Determine the quantity of different metabolites in blood.
CO4: Estimate the quality of water.

List of Experiments

1. Estimation of Protein (Biuret method and Lowry method)
2. Estimation of blood Glucose (Folin Wu method)
3. Estimation of inorganic phosphorus
4. Estimation of blood creatinine.
5. Test for carbohydrate, protein, lipid
6.Estimation of Vitamin C
7. Estimation of Amylase
8. Estimation of Lipase
9. Determination of BOD (biological oxygen demand)/ COD in waste water.

Recommended Readings:

1. West, E. S., Todd, W. R.; Mason. H.S. and Van Bruggen J.T. : 4th Ed. Text Book of Biochemistry. Amerind Publishing Co. Pvt. Ltd. 15.
2. Murray, r. K. Grannen, D. K.; Mayes, P. A. and Rodwell. V. W. : Harper's Biochemistry. Lange Medical Book.
3. Handler, P.: Smith E.I.; Stelten, D. W.: Principles of Biochemistry, Me. Grew Hill Book Co.
4. Lehninger, A.L.; Nelson, D. L. and Cox, M. M. Principles of Biochemistry. CBS Publishers and Distributors.
5. Devlin, T. M.: Text Book of Biochemistry with Clinical Corelations. John Wiley and Sons.
6. Strayer. L. Biochemistry. Freeman W.H. and Co.
7. Assaini. J. Kaur. Text Book of Biochemistry. C.B.S. Publication.
8. An introduction of Practical Biochemistry: D. Plummer

9. Practical Biochemistry: K Wilson and Walker
10. Biochemical Methods: S. Sadasivan and K Manikam.
11. Hawk's Physiological Chemistry: B. L. Oser (ed).
12. Practical biochemistry: R. L. Nath.

BSUFT-202: Chemistry

(CREDITS 6: THEORY: 4, PRACTICAL: 2)

Course Outcomes (COs)

CO1: Recall the fundamental theories and basic concepts of Thermodynamics, Dilute solutions, Colligative properties, Electrochemistry, Ionic Equilibrium, Reaction Mechanisms, chemistry of colloids and emulsions, the basics of nanotechnology and the chemistry of nanomaterial.
CO2: Explain the concepts of Thermodynamics, Dilute solutions, Colligative properties, Electrochemistry, Ionic Equilibrium, Reaction Mechanisms in food processing, food chemistry, quality control arenas.
CO3: Apply the concept of instrumental methods of spectral analysis and photochemistry.
CO4: Create emulsions and colloids for food related applications.

Theory:

Module I: Thermodynamics (**10 Lectures**):
Systems: Open, Close, Isolated. Definition with examples of Diathermic and Adiabatic wall. Extensive and Intensive property.
Process: Isothermal, Adiabatic, Isobaric, Isochoric.
First Law of Thermodynamics: Statement and mathematical form.
Internal energy: Definition, Example, Change in internal energy for ideal gas.
Enthalpy: Definition, Example, Change in internal energy for ideal gas.
Heat Capacity: Definition, Classification of heat capacity (C_p and C_v), Expression of C_p and C_v for ideal gas.
Reversible and Irreversible Processes: Definition. Work done in both processes for ideal gases.
Adiabatic Process: Work done.
Second Law of Thermodynamics.
Concept of Entropy: Introduction Expression (Mathematical). Change in entropy for both reversible and irreversible process.
Work functions and free energy: Gibbs and Helmholtz free energy. Condition of spontaneity of reaction.

Module II: Dilute solutions– Colligative properties (**3 lectures**)
Lowering of vapor pressure of solution, elevation of boiling point, freezing point depression, definition, principles, and laws of osmotic pressure.

Module III: Electrochemistry: (**8 lectures**)
Electrochemistry I: Conductance of Electrolytic solution. Specific conductance, Equivalent conductance, molar conductance, Ion conductance. Kohlrausch's law of independent migration of ions.
Electrochemistry II: Cell and EMF. Nernst's equation.
Ionic equilibrium: Solubility and solubility product, common ion effect, determination of solubility product by EMF method, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer.

Module IV: Reaction Mechanisms (**5 lectures**)
Reaction Dynamics: Reaction Laws: Rate and Order. Molecularity. Zero, First, and Second order Kinetics. Pseudo-molecular and Arrhenius reaction. Transition and Collision state theory.

Module V: Colloid chemistry (**4 lectures**)
Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of colloid and emulsion.

Module VI: Photochemistry (**4 lectures**)

Instrumental methods of spectral analyses, Photochemistry: Lambert's law and Beer's Law, Laws of photochemistry, Photochemical processes.

Module VII: Nanomaterial (**2 lectures**)
Basic principles of nano science and technology, classification, preparation, properties and application of nano material.

Revision 4L

Total Lectures: 40L

Practical: BSUFT-292: Chemistry
(CREDITS: 2)

Course Outcomes (COs)
CO1: Find the physical properties like surface tension, viscosity of materials.
CO2: Analyze the quality of water by hardness measurement and chloride content.
CO3: Develop the concept of acidimetry and alkalimetry and apply the same for determination of strength of acid or base.
CO4: Apply the concept of adsorption in thin layer chromagraphy.
CO5: Estimate the oxidation reduction titration for preparation of a primary standard and using the same to determine the strength of a secondary standard material.

List of Experiments:

1. Determination of surface tension and viscosity.
2. Determination of hardness of water.
3. Determination of chloride content of water.
4. pH metric titrations.
5. Thin layer chromatography.
6. Preparation and standardization of Mohr's solution by $KMnO_4$ solution.
7. Preparation of standard $K_2Cr_2O_7$ solution and standardization of Mohr's Salt solution.
8. Determination of Cu (II) using standard sodium thiosulphate solution.

Recommended Readings:

1. Engineering Chemistry: Bandyopadhyay and Hazra
2. Physical Chemistry: P.C. Rakshit
3. Organic Chemistry: Finar, vol-1
4. Engineering Chemistry: B.Sivasankar, Tata Mc Graw Hill, 2008
5. A Text book of Engineering Chemistry: S.S.Dara, 10th Edition, S.Chand & Company

Ltd., New Delhi, 2003.
6. Engineering Chemistry Simplified: S. Nandi and R. Bhattacharyya, Chayya Prakashani Pvt. Ltd.
7. Advanced practical chemistry, 3rd edition by Subhas C Das.
8. An advanced course in practical chemistry by Ghoshal, Mahapatra and Nad.

BSUFT-203: Computer Fundamentals & Programming
BSUFT-203A: INTRODUCTION TO COMPUTER FUNDAMENTALS
(CREDITS 6: THEORY: 4; Practical: 2)

Course Outcomes (COs):

CO1: Recall knowledge on the Binary logic, the use of number system and data representation.
CO2: Explain Boolean algebra and its significance in digital computer operations.
CO3: Design efficient combinational and sequential logic circuits.
CO4: Develop the various types of process, memory and their management.
CO5: Build the basic hardware of a digital computer and its workings.

Theory:

Module I: Basic concept of Computer System (5L)

Introduction, Characteristics of Computer, Components of Computer, Basic organization of Computer System (I/P, O/P, Memory & CPU Modules). Generation of Computer: 1st to 4th generations with characteristics, Classification of computer systems.

Module II: Operating System (18L)

Introduction (2L): What operation systems do? Operations of OS. Evolution of OS – Batch processing, Multiprogramming, Time sharing, Distributed.

Process Management (12L): Process concept, Process States, Process control block (PCB) Process scheduling: Schedulers (long-term, short-term and medium-term), Context switching, scheduling criteria, scheduling algorithms (FCFS, SJF, Priority, RR), Multilevel Queue scheduling and Multilevel Feedback Queue scheduling. Threads: Concept, Models, Multi-threading example (word processor).Process Synchronization: Cooperating process, Critical-Module problem and solution, Semaphores (Binary & counting).Deadlocks: Concept, Resource Allocation Graph, Necessary conditions for Deadlock, Handling deadlocks: Deadlock prevention and avoidance. Concept of Banker's algorithm with example, Deadlock recovery.

Memory management (8L): Memory management concept, Memory allocation rule, Swapping, Overlay, Paging, Demand paging, segmentation, virtual memory. Device management, File management.

Module III: Digital Logic (13L)

Number System: Positional & Non-positional, Representation of positional number system, Classification of positional number system (Decimal, Binary, Octal, Hexadecimal).

Inter-conversion: among known and unknown bases.

Digital Logic: addition, subtraction, multiplication, division, r's complement & (r-1)'s complement.

Boolean Algebra & Logic Gates Basic laws and postulates, Huntington postulates, Duality.

Logic Gates: AND, OR, NOT, NAND, NOR, XOR & XNOR with truth table.

Boolean Functions: Representation (Boolean expression, Truth Table & Circuit Diagram), Canonical Form (SOP, POS), Conversion between canonical forms.

Revision: 4L

Total Lectures: 40L

Recommended Readings:

1. Computer Fundamentals – by R.S. Salaria, Khanna Publishing House.
2. Computer Fundamentals – by Pradeep K Sinha, Priti Sinha.
3. Operating System Concepts – by Abraham Silberschatz, Peter B. Galvin, GergGange.
4. Operating System Concepts – by EktaWalia, Khanna Publishing House.
5. Operating System – by P. Bala Krishna Prasad.
6. Digital Design - by M. Morris R. Mano (Author), Michael D. Ciletti (Author).
7. Digital Logic and Computer Design – by M. Morris Mano

Practical: BSUFT-293A: Computer Fundamentals lab
(Credit: 2)

Course Objectives (COs)

CO1: Experiment with Binary logic, the use of number system and data representation.
CO2: Examine Boolean algebra and its significance in digital computer operations.
CO3: Test for efficient combinational and sequential logic circuits.

List of Experiments:

1. Usage of MS-DOS commands: basic concepts of internal & external commands, directory and file commands, copying, erasing, renaming, displaying files, introduction to pipes & filters, concept of batch file.
2. Microsoft word- concept of toolbar, character, paragraph & document formatting, drawing toolbar, header, footer, document editing,page set up.
3. Microsoft excel- concept of spread sheets, creating worksheet, well formatted document, concept of row, column,cell & formula bar, using function, using shortcuts, charts, goal , validation rule.
4. Microsoft Power Point presentation- slide layout & design, custom animation, image importing, slide transition.

BSUFT-203B: C-PROGRAMMING LANGUAGE
(CREDITS 6: THEORY – 4, PRACTICAL - 2)

Course Outcomes (COs):

CO1: Recall the knowledge to Design an algorithm and draw flowcharts.
CO2: Explain the fundamentals of programming.
CO3: Solve the problems through programming environment for simple applications.
CO4: Apply the use of Arrays, functions, pointers, structures and unions.

Theory:

Module I: 7L

Programming Language concepts & Introduction to C. C character set, Constants, variables and keywords. Type of variables & constants. Rules of constructing variable identifier.

Module II: 10L

Types of C Instructions (Type declaration, Arithmetic & Control Instructions), Data Types, Operators, Hierarchy of operators, Associativity of operators, Type conversion (explicit and implicit), Control Instructions: if-else, switch case, conditional operator. Loops (for, while, do-while). Break & continue statement.

Module III: 7L

Array: one-dimensional & multi-dimensional (2D) array. Function and Pointer: Prototype, definition and calling of function, Recursive functions, Call-by-value & Call-by-reference, passing array to function. Pointer concept, pointer to pointer, pointer operations, pointer and array.

Module IV: 10L

C Preprocessor: Concept, File inclusion & Macro expansion, Symbolic constants. Type modifiers (long, short & signed), Storage class (auto, extern, static & register). String: Pointer and String, Standard library functions (strlen(), strcpy(), strcmp(), strcat()). Structure and Union, Self-referential structure.

Module V: 6L

File handling: File opening modes, Reading from file, writing into file.

Total Lectures: 40L

Reference Books:

1. Problem Solving & Programming in C – by R.S. Salaria (Khanna).
2. Programming with C – by Byron Gottfried.
3. Let Us C -by Yashavant P. Kanetkar.

BSUFT-293B: C- Programming Lab (Credit: 2)

Course Outcomes (COs):

CO1: Test for fundamentals of programming.
CO2: Solve problems related to Arrays, functions, pointers, structures and unions.
CO3: Design algorithm and draw flowcharts

List of Experiments:

1. Write a program, which will take marks of five subject of a student and will give the output as sum & percentage of marks.

2. Write a program to determine inputted integer is even or odd.

3. Write a program to calculate sum of digits of an inputted integer.

4. Write a program to find reverse of an inputted integer. 5. Write a program to find weather given integer is palindrome or not.

6. Write a program which will calculate the electricity bill on the basis of following condition:

Bill amount = 1000 if Modules<500, Bill amount = 1000 + 2*(Modules – 1000) if Modules in between 500 and 1000, Bill amount = 1000 + 3*(Modules – 1000) if Modules is more than 1000.

7. Write programs to display following patterns based on height:

(a)

```
*
* *
* * *
* * * *
```

(b)

```
* * * *
* * *
* *
*
```

8. Write a program to find factorial of given positive integer.

9. Find the sum of several series up to nth term:

10. Write a program to calculate, where x and y are positive integers.

11. Find the sum of following series up to nth term:

12. Write a program to determine whether an inputted integer is prime or not.

13. Write a recursive function to calculate factorial of given positive integer.

14. Write a recursive function to obtain the first N numbers of a Fibonacci series.

15. Write a program to check whether given string is palindrome or not [use strcmp() function].

16. Write a menu driven program which has following options:

a. Factorial of a number. b. Prime or not. c. Odd or even. d. Exit.

17. Write a program to obtain transpose of a matrix. [Hints: The transpose of a matrix is obtained by exchanging the elements of each row with the elements of the corresponding column].

18. Write a program, which will produce an output to show student details (roll, name, city, phone number, and department) from an institution.

19. Write a program to calculate the number of characters, words, blanks, tabs & lines in a given text file.

20. Write a program to copy the content of a given text file into a newly created file.

BSUFT-203C: PYTHON
(CREDITS 6: THEORY – 4, PRACTICAL - 2)

Course Outcomes (COs):

CO1: Apply decision and repetition structures in program design.
CO2: Develop functions to improve readability of programs.
CO3: Design the programs with the use of Python lists and dictionaries.
CO4: Adapt file and exception handling mechanisms.
CO5: Build python program to solve real world problems.

Theory:

Module I: 3L

Introduction to Python, installation of Python, character set, Constants, variables and keywords. Type of variables & constants. Rules of constructing variable identifier.

Module II: 10L

Types of C Instructions (Type declaration, Arithmetic & Control Instructions), Data Types, Operators, Keywords, Hierarchy of operators, Associativity of operators, Type conversion (explicit and implicit), Different types of operators, Control Instructions: if-else, switch case, conditional operator. Loops (for, while), break & continue statement.

Module III: 8L

String operations- Asking the user for input, Comments, String slices, String length, Strings are immutable, in operator, String comparison, String methods, Parsing strings, Format operator,

Function calls- Built-in functions, Type conversion functions, Math functions, adding new functions, Function Definitions and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions,

Module IV: 4L

Files- Persistence, opening files, Text files and lines, reading files, searching through a file,User choose the file name, using try-except-open, Writing files.

Module V: 4L

Lists- list is a sequence, Lists are mutable, traversing a list, List operations, List slices, List methods, deleting elements, Lists and functions, Lists and strings, Objects and values, List arguments.

Module VI: 7L

Dictionaries- Dictionary as a set of counters, Dictionaries and files, Looping and dictionaries.

Tuples- Tuples are immutable, comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, Using tuples as keys in dictionaries.

Revision: 4L

Total Lectures: 40L

BSUFT-293C: Python Lab (Credit: 2)

Course Outcomes (COs):

CO1: Apply functions to improve readability of programs.
CO2: Design the programs with the use of Python lists and dictionaries.
CO3: Build python program to solve real world problems.

List of Experiments:

1. Write a program that uses input to prompt a user for their name and then welcomes them.
2. Write a program to prompt the user for hours and rate per hour to compute gross pay.
3. Write a program which prompts the user for a Celsius temperature, convert the temperature to Fahrenheit, and print out the converted temperature.
4. Write a program to prompt for a score between 0.0 and 1.0. If the score is out of range, print an error message. If the score is between 0.0 and 1.0, print a grade using the following-

Score	Grade
>= 0.9	A
>= 0.8	B
>= 0.7	C
>= 0.6	D
< 0.6	F

5. Write a program for pay computation with time-and-a-half for overtime and create a function called compute_pay which takes two parameters (hours and rate).
6. Write a program for the grade program (program 4) using a function called compute_grade that takes a score as its parameter and returns a grade as a string.
7. Write a program to find factorial of given positive integer using function.
8. Write a menu driven program which has following options using function:
   a. Factorial of a number. b. Prime or not. c. Odd or even.
   d. Exit.
9. Write a program which repeatedly reads numbers until the user enters "done". Once "done" is entered, print out the total, count, and average of the numbers. If the user enters anything other than a number, detect their mistake using try and except and print an error message and skip to the next number.
10. Write another program that prompts for a list of numbers as above and at the end prints out both the maximum and minimum of the numbers instead of the average.
11. Write a program to check whether given string is palindrome or not.
12. Write a program to read through a file and print the contents of the file (line by line) all in upper case.
13. Write a program to prompt for a file name, and then read through the file and copy the content to another file.
14. Write a program to open the file and read it line by line. For each line, split the line into a list of words using the split function. For each word, check to see if the word is already in a list. If the word is not in the list, add it to the list. When the program completes, sort and print the resulting words in alphabetical order.
15. Write a program to read a file and when you find line that starts with "From", you will split the line into words using the split function. Print each line from the second word on the “From” line.
16. Write a program that prompts the user for a list of numbers and prints out the maximum and minimum of the numbers at the end when the user enters "done". Write the program to store the numbers the user enters in a list and use the max() and min() functions to

compute the maximum and minimum numbers after the loop completes.

17. This program counts the distribution of the hour of the day for each of the messages (for a file stored relevant information). You can pull the hour from the "From" line by finding the time string and then splitting that string into parts using the colon character. Once you have accumulated the counts for each hour, print out the counts, one per line, sorted by hour

Reference Books:

1. Introduction to Python Programming language- Chaitanya Singh.
2. Python programming language- by G van Rossum.
3. Python Programming: An Introduction to Computer Science, by John Zelle.

BSUFT-204: Environmental Science
(CREDITS 2: THEORY – 2)

Course Outcomes (COs):

CO1: Recall knowledge on natural processes that sustain life, and govern economy.
CO2: Explain the consequences of human actions on the web of life, global economy and quality of human life.
CO3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
CO4: Apply the values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones.
CO5: Adapt sustainability as a practice in life, society and industry.

Theory:

Module I: Introduction (**2 lectures**)

Basic ideas of environment, basic concepts, man, society & environment, their inter-relationship. Mathematics of population growth and associated problems, Importance of population study in environmental engineering.

Module II: Environmental degradation (**5 lectures**)

Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of environmental science and engineering.
Ecology: Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function.
Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundarban); Food chain: definition and one example of each food chain, Food web.
Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur].

Module III: Air pollution and control (**4 lectures**)

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause.
Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).

Module IV: Water pollution and Control (**5 lectures**)
Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds.
River/Lake/ground water pollution: River: DO, 5 day BOD tests, Seeded BOD test, BOD reaction rate constants,
Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)
Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening].

Module V: Land Pollution (**2 lectures**)
Lithosphere; Internal structure of earth, rock and soil. Solid Waste: Municipal, industrial,commercial, agricultural, domestic, pathological and hazardous solid wastes; Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).

Module VI: Noise pollution (**2 lectures**)
Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise]
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18hr Index), Ldn. Noise pollution control.

Module VII: Environmental Management (**2 lectures**)
Environmental impact assessment, Environmental audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.

Total Lectures: 22L

Recommended Readings:
1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
2. De, A. K., "Environmental Chemistry", New Age International.

Semester III
BSUFT-301: Principles of Food Science& Technology
(CREDITS 6: THEORY – 5: Tutorial – 1)

Course Outcomes (COs):
CO1: Define Food Science precisely to integrate knowledge from various fields applied to the study of the foods.
CO2: Identify the important pathogens, and spoilage microorganisms in foods and the conditions under which they will grow.
CO3: Apply modern technology viz. Hurdle Technology, Minimal processing for implementation in Food Processing and Food Engineering area.
CO4: Evaluate the Food and water quality, CIP system, and methods of Sanitization and sensory analysis.
CO5: Discuss the various food groups, including meats, dairy, eggs, grains, legumes, fruits,

vegetables and discuss their nutritional contribution as food.

Theory:

Module I: Food dispersions (4 lectures)
Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agent, food foams, application of colloidal chemistry to food preparation.

Module II: Sensory evaluation of Food (4 lectures)
Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo trio test, triangle test, hedonic scale,

Module III: Growth of microorganisms in foods (3 lectures)
Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure**.**

Module IV: Hurdle technologies (3 lectures)
Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology.

Module V: Minimal processing (4 lectures)
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.

Module VI: Water disposals and sanitation (5 lectures)
Waste water, hardness of water, break point chlorination, physical and chemical of impurities, BOD, COD, waste water treatment, milk plant sanitation, CIP system, sanitizers used in food industry.

Module VII: Cereals and Millets (8 lectures)
Structure and composition of cereals
Wheat- structure and composition, types (hard, soft/ strong, weak) Diagrammatic representation of longitudinal structure of wheat grain. Malting, gelatinization of starch, types of browning-Maillard & caramelization.
Rice- structure and composition, parboiling of rice- advantages and disadvantages.

Module VIII: Pulses (6 lectures)
Structure and composition of pulses, toxic constituents in pulses, processing of pulses soaking, germination, decortications, cooking and fermentation.

Module IX: Oils (3 lectures)
Refining of oils, types- steam refining, alkali refining, bleaching, steam deodorization, hydrogenation**.**
Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.

Module X: Flesh Foods - Meat, Fish, Poultry (10 lectures)
Meat - 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.

Fish - Classification of fish (fresh water and marine), aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.
Poultry - Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers.

Total Theoretical Lectures: 50L

Tutorial: 10L

Total Lectures: 50L + 10L = 60L

Recommended Readings:

1. Essentials of Food & Nutrition (Volume 1 & 2) by Swaminathan.
2. Food Chemistry by L.H. Muyer.
3. Hames Nutrition & Dietetics by Rose.
4. Bawa. A.S, O.P Chauhan etal. Food Science. New India Publishing agency, 2013
5. Roday,S. Food Science, Oxford publication, 2011.
6. B. Srilakshmi, Food science, New Age Publishers,2002.
7. Meyer, Food Chemistry, New Age, 2004

BSUFT-302: Principles of Food Preservation& Food Product Development (CREDITS 6: THEORY – 4, PRACTICAL - 2)

Course Outcomes (COs):

CO1: Recall the knowledge to prevent the foods spoilage until it can be consumed.
CO2: Explain the Techniques of preservation by Thermal and non thermal methods
CO3: Apply the preservation techniques by reduction of moisture% and water activity of food stuffs.
CO4: Justify different processing methods for the increase of shelf-life of the processed food. Hence to develop new food products for betterment of society.

Theory:

Module I: Introduction, Objectives and Parameters influencing Microbial growth and Spoilage (5 lectures)

Objectives and techniques of food preservation; 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. Classification of food based on pH, Food infection, food intoxication, perishable foods, semi perishable foods, and shelf stable foods.

Module II: Food Preservation by Low temperature (4 lectures)

Freezing and Refrigeration: 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.

Module III: Food Preservation by high temperature (9 lectures)

Thermal Processing- Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching. Thermal process time calculations for canned foods, spoilage in canned foods

Module IV: Food Preservation by Moisture control (10 lectures)
Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. **(9 lectures)**
Evaporation – Definition, factors affecting evaporation, names of evaporators used in food industry. **(1 lectures)**

Module V: Food Irradiation and Other Techniques of Preservation (8 lectures)
Introduction, Modules of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. Use of preservative in foods: chemical preservative, biopreservative including antibiotics. Preservation by fermentation: curing and pickling; Hurdle technology.

Revision: 4L

Total Lectures: 40L

Recommended Readings:

1. B. Srilakshmi, Food science, New Age Publishers, 2002
2. Meyer, Food Chemistry, New Age, 2004
3. Bawa. A.S, O.P Chauhan et. al. Food Science. New India Publishing agency, 2013
4. Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004.

BSUFT-391: FOOD PRODUCT DEVELOPMENT LAB (CREDITS: PRACTICAL - 2)

Course Outcomes (COs):

CO1: Define the importance of development of food products in our society
CO2: Apply different processing methods to develop innovative food products for enrichment
CO3: Estimate the quality parameters and sensory evaluation of new developed products

List of Experiments/mini projects:

1. **Development of New Product**: Definition, Importance , objectives& Need of product development ,Reasons of failure, Types and Steps of product development ,Product development Tools and their use
2. **Projects on:**

i. Market and literature survey to identify the concepts of new products based on special dietary requirements, functionality, convenience and improvisation of existing traditional Indian foods.
ii. Screening of product concept on the basis of techno-economic feasibility.
iii. Development of prototype product and Standardization of formulation process.
iv. Proximate Analysis of New Product
v. Packaging, labeling and shelf-life studies.
vi. Cost analysis and Final Project Report

Each team/group of students would develop a food product on the basis of above mentioned lines /steps and would submit a project report.

Recommended Readings:
1. Fuller, Gordon W. 2004. New Product Development- From Concept to Marketplace, CRC

Press.
2. Anil Kumar, S., Poornima, S.C., Abraham, M.K & Jayashree, K.2004. Entrepreneurship Development. New Age International Publishers.
3. Moskowitz, Howard and Saguy,R. I. Sam 2009. An Integrated Approach to New Food Product, CRC Press.

BSUFT-303: Food Processing Technology-I (Fruits & Vegetables, & Beverages) (CREDITS 6: THEORY – 4 PRACTICAL - 2)

Course Outcomes (COs):

CO1: Recall fundamental knowledge about processing of fruits and vegetable to get a successful career in food processing industries especially in beverage industries.
CO2: Explain product formation with fruits and vegetables and their preservation techniques.
CO3: Apply basic knowledge about processing of spices and beverages

Theory:

Module I: Introduction (6 Lectures)
Importance of fruits and vegetable, need of preservation, reasons of spoilage, method of preservation (short & long term). 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**.**

Module II: Fruits Beverages (5 Lectures)
Introduction, Processing of fruit juices (selection, juice extraction, deaeration, straining, filtration and clarification), preservation of fruit juices (pasteurization, chemically preserved with sugars, freezing, drying, tetra-packing, carbonation), processing of squashes, cordials, nectars, concentrates and powder**.**

Module III: (13 Lectures)
Jams, Jellies and Marmalades (**7 Lectures)**
Introduction**,** Jam: Constituents, selection of fruits, processing & technology**,** Jelly: Essential Constituents (Role of pectin, ratio), Theory of jelly formation, Processing & technology, defects in jelly**,** Marmalade : Types, processing & technology, defects**.**
Pickles, Chutneys and Sauces (**3 Lectures)**
Processing, Types, Causes of spoilage in pickling**.**
Tomato Products (**3 Lectures)**
Selection of tomatoes, pulping& processing of tomato juice, tomato puree, paste, ketchup, sauce and soup**.**

Module IV: Dehydration (**4 Lectures)**
Sun drying, Mechanical dehydration, Processes for vegetables, Other Methods of dehydration, Packaging and storage.

Module V: Technology of Plantation Products (8 Lectures)
Spices (3 Lectures)
Processing and properties of major and minor spices, essential oils & oleoresins, adulteration**.Tea, Coffee and Cocoa (5 Lectures)**
Processing, Variety and Products**.**

Revision 4L

Total Lectures: 40L

Practical: BSUFT-392: Food Processing Technology- I(Fruits & Vegetables, & Beverages)
(Credit: 2)

Course Outcomes (COs):

CO1: Test for the food quality and proximate analysis of fruit and vegetable based products
CO2: Identification of adulterants in fruit and vegetable products
CO3: Estimate the characteristics of dehydrated fruits and vegetables.

List of Experiments:

1. Estimation of total soluble solids (TSS).
2. Estimation of pH and acidity of products.
3. Estimation of brix: acidity ratio.
4. Estimation of ascorbic acid and effect of heat treatment on it.
5. Preparation and evaluation of pectin products.
6. Adulteration of spices.
7. Dehydration & Rehydration of fruits and vegetables.

Recommended Readings:

1. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
2. W B Crusess.2004. Commercial Module 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, Second edition.
5. Srivastava, R.P. and Kumar, S. 2006. Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.

BSUFT-304: Waste Management & Renewable Energy
BSUFT 304A: Waste Treatment in Food Industries
(Credits 6: Theory-5: Tutorial-1)

Course Outcomes (COs):

CO1: Recall about different type of wastes in various food and fermentation industries.
CO2: Identify the various waste disposal methods and economic aspects of waste treatment and disposal.
CO3: Apply the various treatment methodologies of solid and liquid waste, isolation of value added products from different waste, biogas generation.
CO4: Analyze the composting of solid waste and removal technology for drinking water.

Theory:

Module I: (10 Lectures)

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat &Poultry industry, Sugar industry and Dairy industry; Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal.

Module II: (10 Lectures)

Treatment methods for liquid wastes from food process industries; Design of Activated Sludge Process, Rotating Biological Contactors, Trickling Filters, UASB, Biogas Plant.

Module III: (10 Lectures)
Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

Module IV: (10 Lectures)
Biofilters and Bioclarifiers, Ion exchange treatment of waste water, Drinking-Water treatment, Recovery of useful materials from effluents by different methods.

Revision: 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:
1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

BSUFT-304B: Renewable Energy Engineering
(Credits 6: Theory-5; Tutorial-1)

Course Outcomes (COs):

CO1: Recall basic knowledge to understand the impact of renewable energy in national, international, and societal context.
CO2: Demonstrate renewable energy technology and to apply the same for personal and professional growth.
CO3: Build integrated knowledge about utilization of agricultural products and their by-products to overcome emerging problems in renewable energy engineering and related areas.

Theory:

Module I: (6 Lectures)
Scenario of renewable energy (RE) Sources:
Present energy scenario of conventional and RE sources. Needs of RE, Advantages and limitations of RE.

Module II: (8 Lectures)
Solar energy:
Energy available from the Sun, Spectral distribution, solar radiation at earth's surface, and outside the earth's atmosphere, solar radiation geometry. Instruments for solar radiation measurements.

Module III: (16 Lectures)
Wind energy and Ocean energy: Energy available from wind, basics of wind energy conversion system, effect of density, angle of attack, wind speed, windmill rotors (horizontal and vertical axes), drag, lift, torque and power coefficients, tip speed ratio, wind turbine and its performance curves. OTEC principle, open, close and hybrid cycle OTEC system. Energy from tides, estimation of tidal power, future of tidal power plant.

Module IV: (10 Lectures)
Bio Energy: Types of Biogas plants, biogas generation, factors affecting biogas generation, Biomass energy, types and applications of gasifiers.

Revision: 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:

1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle,Oxford University Press (UK)
2. *Solar*, Ian McEwan, Random House.
3. Renewable: The World-Changing Power of Alternative Energy First Edition, Jeremy Shere.St. Martin's Press
4. Renewable: The World-Changing Power of Alternative Energy First Edition. CRC Press Ehrlich, Robert, CRC Press (Publisher).

BSUFT-305: Food Plant Layout & Design (Credits:2)

Course Outcomes (COs):
CO1: Recall the idea about the basic concepts of a food plant layout and design using the ISO, FCO & MCO requirements.
CO2: Demonstrate vivid understanding of the layout and design of a food plant with the provision of waste disposal and safety arrangements with special emphasis on bakery, fruits & vegetables and beverage processing.
CO2: Apply the aspects of the designing of a pilot & semi-commercial food plant using PERT & CPM.
CO4: Develop an idea about project engineering and gain knowledge about the selection of location, construction materials, and instruments and also about the specifications of the equipment and accessories used.

Theory:

Module I: 8L

Basicconceptsofplantlayoutanddesignincludingbasicunderstandingofequipmentlayoutventilation; Reference to bakery and biscuit, fruits, vegetable and beverage processing, and dairy industries; Miscellaneous aspects of plant layout and design like provision for wastedisposal, and safety arrangements.

Module II: 4L

Design consideration for location of food plants; ISO, FCO, MCO requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants.

Module III: 4L

Layout and designing aspects of pilot and semi-commercial food processing plants; Scale-up; Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoring.

Module IV: 4L

Introduction to project engineering; Selection of construction materials; Specifications of processing equipments and accessories.

Revision: 4L

Total Lectures: 24L

Recommended Readings:

1. Manufacturing Facilities Design and Material Handling by Fred E.Meyers, and Matthew P. Stephens, 3rd Edition, Pearson Prentice Hall, 2000
2. James M Moore, "Plant Layout and Design", Mcmillan & Co., (1959)
3. Bolz, Harold A George E., "Material Handling Handbook".
4. J M Apple, "Plant layout and Material Handling", John Willey & Sons, (1977).

Semester IV
BSUFT 401: Food Processing Technology II (Milk & Dairy Products)
(CREDITS 6: THEORY – 4; PRACTICAL - 2)

Course Outcomes (COs):

CO1: Demonstrate different Dairy products processing industries and to gather the knowledge on physical properties of liquid milk.
CO2: Identify nutrients viz. Carbohydrate (Lactose), Proteins, and Lipids, Enzymes etc. present in liquid milk.
CO3: Apply different processing techniques for development of milk products.
CO4: Build and analyse different products from milk maintaining quality parameters

Theory:

Module I: Introduction (2 Lectures)
Status of dairy industry in India.

Module II: Physical properties of milk (4 Lectures)
Color, taste, pH and buffering capacity, refractive index, viscosity, surface tension, freezing point, boiling point, specific heat, OR, electrical conductivity.

Module III: Constituents of Milk (12 Lecture)
Lactose (1 Lecture)
Lactose (alpha and beta forms and their differences), Significances of lactose in dairy industry.
Milk fat (6 Lectures)
Composition and structure, factors affecting melting point, boiling point, solubility and Refractive Index, fat constants (saponification value, iodine value, RM value, Polenske value, peroxide value). Chemical reactions of fat (hydrolysis, auto-oxidation), condition favouring autooxidation, prevention, measurement of auto-oxidation.
Protein and Enzymes (5 Lectures)
General structure, amphoteric nature, difference between casein and serum protein, different types of casein (acid and rennet), uses of casein, fractionation of protein.Enzymes- catalase, alkaline phosphatase, lipases and proteases.

Module IV: Market milk industry and milk products (8 Lectures)
Systems of collection of milk
Reception, Platform testing
Various stages of processing
- Filtration, Clarification
- Homogenization
- Pasteurization(LTLT, HTST, UHT)

Description and working of clarifier, cream separator, homogenizer and plate heat exchanger.

Module V: Brief idea of manufacturing of the following milk products – (8 Lectures)
Butter, ghee, flavored milk, shrikhand, ice-cream, condensed milk, milk powder, channa, paneer, yoghurt, dahi, kefir, kumiss, cheese (cheddar).

Module VI: Concepts of prebiotics and probiotics (2 Lectures).

Revision 4L

Total Lectures: 40L

Recommended readings:
1. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford.2007.
Hall GM, Fish Processing Technology, VCH Publishers Inc., NY, 1992
2. Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd ed., CBS Publishers, New Delhi 1988
3. Robinson RK. Modern Dairy Technology (vol. 1 & 2). 1996, Elsevier Applied Science Publication.
4. Outlines of Dairy Technology. De S. Oxford.

Practical: BSUFT-391: Food Processing Technology-II (Milk & Dairy Products) (Credit: 2)

Course Outcomes (COs):

CO1: Test the quality of milk at procurement
CO2: Evaluate microbial quality and nutritional components of milk
CO3: Develop innovative milk based products and their quality assessment.

List of Experiments:

1. To perform platform tests in milk. (Acidity, COB, MBRT, specific gravity, SNF).
2. To estimate milk protein by Biuret method.
3. To estimate milk fat by Gerber method.
4. Preparation of flavoured milk/Pasteurization of milk.
5. To prepare casein and calculate its yield.
6. Quality evaluation of Milk using Resazurin test.

Recommended Readings:

1. Modern Dairy Products. Lampert L.H. 1970, Chemical Publishing Company.
2. Milk and Milk Processing. Herrington B.L. 1948, Mc Graw Hill Book Company.

BSUFT-402: Process Calculations and Thermodynamics
(Credit 6: Theory – 5: Tutorial – 1)

Course Outcomes (COs):

CO1: Explain the material balances on Module operation , energy balance and processes .
CO2: Recommend the use of enthalpy changes, heat of reaction, heat of solution and usage of psychometric chart.
CO3: Ability to estimate thermodynamic properties of substances in gas and liquid states.
CO4: Determine thermodynamic efficiency of various energy related processes and heat sensors

Theory:

Module I: (10 Lectures)

Process Calculations, Material & Energy Balances: Mathematical requisites – use of log-log and semi-log graph papers, triangular diagram, graphical differentiation and graphical integration. Material balance without & with chemical reaction. Energy balance: enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

Module II: (10 Lectures)

Thermodynamics

Basic Concepts : The Ideal Gas; Review of first and second laws of thermodynamics; PVT behavior of pure substances; Virial equation of state; Application of the virial equations; Cubic equations of state; Generalized correlations for gases and liquids.

Vapour/Liquid, Liquid/Liquid, Solid/Liquid and Solid/Vapour Equilibria : Nature of equilibrium; Phase Rule; Duhem's theorem; Simple model's for vapour/liquid equilibrium; Rault's Law; Henry's Law; Modified Rault's Law; K-value correlations; VLE from Cubic Equations of State; Equilibrium and Stability; Liquid/liquid equilibrium; Solid/liquid equilibrium, Solid/vapour equilibrium.

Module III: (10 Lectures)

Application of Thermodynamics: Chemical potential and Phase Equilibria; Fugacity and

fugacity coefficient for pure species and solution; Generalized correlations for fugacity; the Ideal Solution; Property changes and heat effects of mixing processes. The Vapour-CompressionCycle; the choice of refrigerant; Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude. Carnot Cycle, Refrigeration cycle, Heat Pump. Joule Thomson Effect and J-T coefficient. Concept of Inversion temperature.

Module IV: (**10 Lectures**)
Modeling and Sensors in Food Processing: Introduction to sensors, biosensors, electronic noses for food control, biosensors for food analysis. The principles of modeling, continuous heating & cooling process. Modeling on food quality and microbiological safety.

Revision: 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:
1. Chemical Process Principles (Part one and two), Hougen, Watson & Ragatz, Asian Student Edition, Asia Publishing House
2. Basic Principles and Calculations in Chemical Engineering, Himmelblau, Prentice Hall (I) 6th Ed.
3. Engineering Thermodynamics (Fifth Edition), P.K. Nag. Mc Graw Hill Education.

BSUFT-403: Food Processing Technology- III (Cereals, Pulses and Oilseeds) (CREDITS 6: THEORY – 4; PRACTICAL - 2)

Course Outcomes (COs):
CO1: Define the importance of milling.
CO2: Differentiate between milling requirements of different cereals, pulses and oilseeds
CO3: Apply the knowledge for commercially important products from oil seeds and pulses
CO4: Compare between alcoholic and non-alcoholic beverages

Theory:

Module I: Technology of Cereals (**22 lectures**)
Introduction (**2 lectures**)
Wheat --Types, milling, flour grade, flour treatments (bleaching, maturing), flour for various purposes, Products and By-products. (**5 lectures**)
Rice- Physicochemical properties, milling (mechanical & solvent extraction), parboiling, ageing of rice, utilization of by products. (**5 lectures**)
Corn – Milling (wet & dry), cornflakes, corn flour (**3 lectures**)
Barley- Milling (pearl barley, barley flakes & flour) (**2 lectures**)
Oats – Milling (oatmeal, oatflour & oatflakes) (**2 lectures**)
Sorghum and millets – Traditional & commercial milling (dry &wet) (**2 lectures**)
Rye and triticale - milling (flour), uses (**1 lecture**)

Module II: Technology of Pulses (**4 lectures**)

Milling of pulses, Dry milling, Wet milling, Improved milling method.

Module III: Technology of Oilseeds (**6 lectures**)
Introduction, Extraction of oil and refining, Sources of protein (defatted flour, protein concentrates and isolates), properties and uses, protein texturization, fibre spinning.

Module IV: Alcoholic Beverages (**4 lectures**)
Beer, Wine, Distilled Spirits.

Revision 4L

Total Lectures: 40L

PRACTICAL: BSUFT-492: Food Processing Technology III Lab (Cereals, Pulses and Oilseeds) (Credit:2)

Course Outcomes (COs):

CO1: Estimate gluten content, wheat and rice cooking characteristics,
CO2: Identify good or bad quality of flour
CO3: Formulate new cereal based food with enhanced nutritional value

List of Experiments:

1. Physical characteristics of Wheat.
2. Estimation of Gluten Content of flour.
3. Estimation of Polenske Value of flour.
4. Estimation of Potassium Bromate in flour.
5. Fermenting Power of yeast.
6. Physical Characteristics of Rice and paddy.
7. Cooking characteristics of rice.
8. Determination of sedimentation power of flour.

Recommended Readings:

1. Kent, N.L. 2003. Technology of Cereal, 5th Ed. Pergamon Press.
2. Chakraborty. 1988. Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd.
3. Marshall, Rice Science and Technology. 1994. Wadsworth Ed., Marcel Dekker, New York.
4. Manay, S. and Sharaswamy, M. 1987. Food Facts and Priniciples.Wiley Eastern Limited

BSUFT 404: Food & Nutrition
BSUFT 404A: Food Science & Nutrition
(Credits 6: Theory-5: Tutorial-1)

Course Outcomes (COs):

CO1: Recall the food groups and their functions.
CO2: Develop different methods of cooking according to food product standards.
CO3: Build the skill on various methods of assessing nutritional status
CO4: Apply the knowledge of metabolism of macronutrients with health and comprehend their function

Theory:

Module I: Introduction to Food and Nutrition (7 lectures)
Basic terms used in study of food and nutrition, BMI and Nutritional Status. Understanding relationship between food, nutrition and health. Functions of food-physiological, psychological and social, Concept of Balanced Diet, Food Groups, Food Pyramid.

Module II: Nutrients (21 lectures)
Classification, digestion, functions, dietary sources, RDA, clinical manifestations of deficiency and excess and factors affecting absorption of the following in brief:

- Energy
- Carbohydrates, lipids and proteins
- Fat soluble vitamins-A, D, E and K
- Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C
- Minerals – calcium, iron, iodine, fluorine, copper and zinc.

Module III: Concepts of Meal Planning (4 lectures)
Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people.

Module IV: Methods of Cooking (4 lectures)
Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods.

Module V: Nutritional Labeling (4 lectures)
Importance, global trends, codex guidelines, nutritional labeling in India, FSSAI guidelines.

Revision 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi,(2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby 1996). Perspectives in Nutrition, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the Moduleed Nations / World Health Organisation,1993.
6. Food Safety and Standards Authority of India Portal, Government of India

7. Gopalan, C., (1990). NIN, ICMR. Nutritive Value of Indian Foods.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.
9. Introduction to Human Nutrition ed.Gibney et al, Blackwell Publishers, 2005
10. Khanna K, Gupta S, Seth R, Mahna R, Rekhi T (2004). The Art and Science of Cooking: A Practical Manual, Revised Edition. Elite Publishing House Pvt Ltd.
11. NIN, ICMR (1990). Nutritive Value of Indian Foods.
12. ICMR (2010). Nutrient Requirements and Recommended Dietary Allowances for Indians.

BSUFT-404B: Nutraceuticals and Functional Foods
(Credits 6: Theory-5; Tutorial-1)

Course Outcomes (COs):

CO 1: Recall the fundamental concept of nutraceuticals and functional Foods understand their origin, presence and functionality.

CO 2: Explain the disease preventing and health enhancing properties of nutraceuticals and functional foods.

CO 3: Apply the basic knowledge to comprehend the manufacturing of various fortified, value-added functional foods and nutraceuticals in different forms for consumption

CO 4: Analyze the toxicological aspect, related risks in formulating dosage and defining consumption patterns of nutraceuticals and functional foods.

CO 5: Evaluate regulatory and labeling issues related to manufacture, marketing and sale of nutraceuticals and functional foods.

Theory:

Module I: 10L

Introduction: Definitions of nutraceuticals and functional foods; difference between nutraceuticals and functional foods, Types of nutraceutical compounds – Phytochemicals, phytosterols and other bioactive compounds, peptides and proteins, carbohydrates [(dietary fibers, oligosaccharides and resistant starch)], prebiotics, probiotics and synbiotics, lipids (Conjugated Linoleic Acid,omega-3 fatty acids, fat replacers), vitamins and minerals: and their health benefits.

Module II: Functional Foods (10 lectures)

Types of functional foods: Concepts of Probiotic, Nutraceuticals, Spiceuticals,
Regulatory and labeling issues, CODEX.
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 (tea, wine etc), Fermented foods – their health benefits and role in conditions like cardiovascular diseases, hypertension, diabetes etc. 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.

Module III: Legal Aspects (8 lectures)

Stability of nutraceuticals. Safety, Consumer acceptance and assessment of health claims, labeling, marketing and regulatory issues related to nutraceuticals and functional foods.

Module IV: 8L
Nutritional significance: Role of nutraceutical/functional foods in cardiovascular health, diabetes, obesity, immunity, age related muscular degeneration, stress management; Dosage levels; Adverse effects and toxicity of nutraceuticals.

Revision: 4L

Total Theoretical Lectures: 40LTutorial:

10L

Total Lectures: 40L + 10L = 50L

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. Various journals of food technology, food science and allied subjects.

BSUFT-405: Plant Training (Credits 2)-Sessional paper

Course Outcomes (CO):

CO1. Identify different components of food science and technology, skills and scientific techniques followed in various food businesses/industries.

CO2. Relate between academia and ever changing demand driven industrial business scenario to develop the need of industry with the polarization paradigm.

CO3. Adopt basic industrial practices with ever changing food regulatory standards, ethics, legislation and food safety issues.

CO4. Apply the skills and knowledge required for a particular job function.

Syllabus:
Skill Enhancing

In plant training Students of B.Sc. Food Science & Technology should undergo a project/ in plant training work fora period of 15 days during the fourth semester. The programme is arranged by the department of Food Science & Technology (under the School of Food Science & Agro Technology) in consultation with the food industries inside and outside West Bengal.
The purpose of the programme is to get hands-on experience on various aspects of food industries that form the strong foundation for the young food technologists. The department will allot students to the industry, in consultation with the industry concerned and based on the merit of the students. The selected student should reportfor the programme on the stipulated date and attend the

programme regularly without any lapse.
On completion, each student should prepare a project / training report duly certified by the supervisor in theindustry, a seminar should be conducted in the department. The bonafide project/ training report attested by the headof the department will be evaluated by the external examiner and a viva voce will be conducted.

Semester V

BSUFT-501:Food Processing Technology –IV (Meat, Fish and Egg)
(CREDITS 6: THEORY – 4; PRACTICAL - 2)

Course Outcomes (COs):

CO1: Recall about meat and poultry industry in India.
CO2: Demonstrate animal slaughtering process and meat quality.
CO3: Apply Knowledge about fish processing and its bye products
CO4: Analyse the methods of egg preservation and quality

Theory:

Module I: Meat (**16 lectures**)
Introduction (**2 lecture**)
Livestock and Poultry population in India, Development of meat and poultry industry in India and its need in nation's economy, Glossary of live market terms for animals and birds.
Meat quality (**3 Lectures**)
Effects of feed, breed and environment on production of meat animals and their quality
Meat Quality-color, flavor, texture, Water-Holding Capacity (WHC), Emulsification capacity of meat.
Slaughter process (**6 lectures**)
Slaughter, inspection and grading, Antemortem examination of meat animals, slaughter of buffalo, sheep/ goat, poultry, pig A Generic HACCP model, dressing of carcasses, post-mortem examination of meat
Preservation of meat (**4 lectures**)
Refrigeration and freezing, thermal processing- canning of meat, retort pouch, dehydration, irradiation, and RTE meat products, meat curing. Sausages-processing, types and defects
By-products (**1 lecture**)
Importance, classification and uses, Manufacture of Natural casings.

Module II: Fish (**12 lectures**)
Classification, Handling, Storage, Spoilage and Processing of Fish: (**7 lectures**)
Classification of fresh water fish and marine fish; Commercial handling, storage and transport of fish; proximate composition and nutritive value of fish; Indices of freshness and its quality assessment; Spoilage of fish; Methods of Preservation of fish and fish products: Canning, Freezing, Drying, Curing, Smoking, Fermentation (fish sauce).
Fish byproducts (**5 lectures**)- production of fish meal, fish protein concentrate, and fish protein hydrolysate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish; Processing of fish wastes.

Module III: Egg (**8 lectures**)
Industry and Egg Production Practices (**1 lecture**)
The egg industry, its techniques of working, General management, structure, composition and nutritive value of egg and its products.

Preservation of eggs (**5 lectures**)
Refrigeration and freezing, thermal processing, dehydration, coating.
Quality identification of shell eggs (**2 lectures**)
Factors affecting egg quality and measures of egg quality.

Revision 4L

Total Lectures: 40L

PRACTICAL: BSUFT-591: Food Processing Technology IV Lab (Meat, Fish and Egg) (Credit: 2)

Course Outcomes (COs):

CO1: Identify different postmortem changes

CO2: Analyse the quality of Fish meat and poultry products

CO3: Formulate innovative types of fish meat and poultry based products

List of Experiments:

1) Estimation of moisture content of meat
2) Cutout analysis of canned meats/retort pouches
3) Estimation of protein content of meat
4) Analysis of frozen meat/meat emulsion products
5) To study shelf-life of eggs by different methods of preservation
6) Evaluation of eggs for quality parameters
7) To perform freezing of yolk/albumen
8) Meat/Egg product formulation

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 and Technology, 4th Ed. CBS Publication New Delhi, 2002
6) Carol E. Steinhart, M. Ellin Doyle, Food Safety, Food Research Institute, Marcel Dekker, Inc., New York : 1995
7) Sen DP, Advances in Fish Processing Technology, Allied Publishers Pvt.Limited 2005
8) Shahidi F and Botta JR, Seafoods: Chemistry, Processing, Technology and Quality, Blackie Academic & Professional, London,1994

BSUFT-502: Instrumental Analysis of Food (CREDITS 6: THEORY – 4: Practical - 2)

Course Outcomes (COs):

CO1: Explain different categories of fluid moving devices used in various engineering applications.
CO2: Demonstrate heat transfer equipment and to categorize the technological methods related to heat transfer in process plant.
CO3: Identifying a detailed overview of heat transfer equipment and problems associated at preliminary stage of design.
CO4: Distinguish temperature, pressure and flow measuring devices for industrial purposes as well as to set their control strategy.

Theory:

Module I: [4L]

Fluid Transmission: Classification of fluid transmission equipments, airlift, and positive displacement pumps, rotary and reciprocating pumps, centrifugal pumps, concept of cavitations and air binding.

Module II: [8L]

Mechanism of heat transmission: conduction, convection and radiation, steady state one dimensional conduction, Fourier law, heat conduction through solid slab**,** hollow cylinder and hollow sphere, Natural and forced convection, classification of heat exchangers and their description, introduction to evaporators, single effect and multiple effect forward feed, backward feed and mixed feed evaporators, steam economy.

Module III: [16L]

Distillation-batch and continuous, Rayleigh equation, rectification in plate columns, concept of theoretical and actual plate, McCabe Thiele method and its assumptions, description of bubble cap, sieve and valve tray columns. [**6L]**

Liquid – liquid and solid – liquid extraction (leaching) in batch, parallel and counter current mode, Classification and description of extractors used. [**3L]**

Absorption-an example of non equilibrium mass transfer, description of packed tower, concept of mass transfer coefficient, height of transfer Module and number of transfer Module, determination of packed height, concept of flooding and loading, determination of tower diameter.[**4L]**

Introduction to drying, bound and unbound moisture, free and equilibrium moisture, drying curve, constant and falling rate periods, classification of driers, brief description of rotary, drum, spray and infrared driers. [**3L]**

Module IV: [8L]

Temperature measuring devices, description of thermocouple and its principle, optical and radiation pyrometers, classification of pressure measuring devices for both above and below atmospheric pressure, description of bourdon pressure gauge, measurement of liquid level**. [5L]**

Introduction to control system, principle of feedback and feed forward control, different types of

controllers, viz. P, PI. PD and PID. **[3L]**

Revision: 4L

Total Lectures: 40L

Text Books and Reference Books:

1. Module operations of Chemical Engineering. McCabe W. L., Smith J.C., & Harriot P. McGraw Hill Education (India) Private Limited. Indian Edition, year 2014.
2. Transport processes and separation process principles. Geankoplis C.J. Pearson.
3. Heat Transfer. Kern D. Q., MGH.
4. Introduction to Chemical Engineering. Badger W. L. & Banchero J.T. MGH.
5. Chemical Engineers Handbook. Perry, Chilton, & Green. MGH.
6. Fundamentals of Industrial Instrumentation and Process Control. Dunn W. C.
7. Chemical Process Control. Stephanopoulis G. PHI.
8. Instrumentation, Measurement, and Analysis. Nakra B.C. & Chaudhury K. K. TMH.
9. Process Instrumentation, Potronavis,D.C.
10. Process System Analysis and Control, Coughanower, Koppel and Ragatz

Practical: BSUFT-592: Food Analysis Lab
(Credit: 2)

Course Outcomes (COs):

CO1: Apply the knowledge of analytical& instrumental part in Food analysis.
CO2: Develop himself/herself for analytical skills.
CO3: Analyze the different techniques he/she learnt from this part.
CO4: Create tests for food analysis and quality control.

List of Experiments:

1. Estimation of reducing sugar by Fehlings procedure
2. Estimation of salt content in brine
3. Estimation of salt content in butter
4. Preparation of brix solution and checking by hand refractometer
6. Demonstration of the Soxhlet method for determination of fat content
7. Determination of acidity of water
8. Determination of alkalinity/ hardness of water
9. Demonstration of the Kjeldahl's method for estimation of protein content
10. Determination of pH and Acidity of solid and liquid (two each) Foods.
11. Determination of Proximate Compositions of Foods: (i) Moisture, (ii) Carbohydrate, (iii) Protein, (iv) Fat, (v) Total ash, (vi) Crude Fiber, (vii) Calorific value.
12. Determination of Minerals of Food products: (i) Calcium by titration, (ii) Phosphorous by Spectrophotometer, (iii) Iron by Spectrophotometer.

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, 2000.
5. Jenkins WA and Harrington JP, Packaging Foods with Plastics, Technomic PublishingCompany 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

BSUFT-503: Concept of Food Engineering & Plant Hygiene
BSUFT-503A: Basic Concept of Food Engineering
(Credits 6: Theory-5: Tutorial-1)

Course Outcomes (COs):

CO1: Define modern food process Engineering operations and their techniques already implemented.

CO2: Apply the operational principle of heat transfer and different type of heat exchangers with brief discussion in different diffusion control mass transfer operations

CO3: Analyse the processing of foods in terms of unit operations.

CO4: Construct line or flow diagrams for different food process Engineering operations.

Theory:

Module-I: Introduction (Lectures-2)

Concept of unit operation, units and dimensions, unit conversions, Dimensional analysis, Mass and Energy Balance.

Module-II: Fluid Flow in food Processing (Lectures-6)

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 • Principles of Flow Measurement devices.

Module-III: Refrigeration and Freezing (Lectures- 10)

• Concept and selection of a refrigerant • Description of a Refrigeration cycle
•**Temperature-Entropy Diagram, Pressure-Enthalpy Diagrams (charts and Tables)**• Mathematical expressions useful in analysis of vapour compression refrigeration (VCR) cycle,• superheating and subcooling • freezing time calculation using Plank's Equation • Frozen food storage and transportation.

Module-IV: Heat and Mass Transfer (Lectures- 10)

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, Fick's Law of Diffusion, Mass transfer in packaging material, Membrane separation systems-Electro dialysis system, Reverse Osmosis Membrane System, and Ultrafiltration Membrane devices used for RO and UF.

Module-V: Psychometrics (Lectures- 4)
Absolute and Relative Humidity. Properties of Dry Air, Properties of Water Vapour, Properties of air-vapour mixture, Psychometric Chart.

Module-VI: Steam, Evaporation and Dehydration (Lectures-8)
• Generation of steam • Construction and functions of fire tube and water tube boilers • Thermodynamics of Phase change • Steam tables • Boiling Point elevation • Types of evaporators• Basic Drying Process • Moisture content on wet basis and dry basis •**Dryers (Tray dryer, Drum dryer, Spray Dryer, and Freeze-dryer)**.

Revision: 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings
1. Fundamentals of Food Process Engineering. Toledo R.T. 2nd Edition. 2000. CBS Publications.
2. The Fundamentals of Food Engineering. Charm S.E. 1963, AVI Publications.
3. Food Process Engineering. D.R. Heldman and R.P. Singh.
4.

BSUFT-503B: Food Plant Sanitation & Hygiene
(Credit: 6: Theory-5, Tutorial-1)

Course Outcomes (COs):

CO1: Define the requirement of food safety during various food service operations and apply the same at the time of food transportation, storage, and processing.
CO2: Explain the various contamination and their sources during food processing and to find out the sustainable methods to overcome such issues.
CO3: Analyse the proper strategies and techniques regarding food plant hygiene and sanitation for better utility, minimum losses, and more safety during food processing and storage.
CO4: Develop various techniques to control and utilization of wastes generated during food processing for better hygiene and safety.

Theory:

Module I: Introduction to Food Safety & Hygiene (10 Lectures)
Food hygiene and safety in transportation, with a focus on warehouse storage and refrigerated ships- Safe food storage at shopping outlets. Principles of Cold Chain Creation and Management. Physicochemical changes in stored products during storage.

Module II: Hygiene and Sanitation in Food Service Establishments (10 Lectures)
Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene. Testing of sanitizers and

disinfectants. Study of Phenol coefficient of sanitizers.

Module III: Food Plant Hygiene and Sanitation (10 Lectures)
Waste disposal, Control methods using Physical and Chemical Agents, Pest and Rodent Control, ETP Design and Layout. Food storage sanitation, transport sanitation and water

sanitation. By-products utilisation obtained from dairy plant, egg & poultry processing industry and meat industry. Preparation of a sanitation schedule for food preparation area.

Module IV: Waste Treatment (10 Lectures)
Determination of physico-chemical properties of wastewater. Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization,
physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments. Determination of BOD (biological oxygen demand)/ COD in waste water. Study of waste water treatment system/ETP.

Revision 4L
Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:
1. Norman G. Marriott and Robert B. Gravani. (2006). Principles of Food Sanitation,5th edition
2. Rao, D. G. (2010). Fundamentals of Food Engineering, PHI learning Private Ltd.
3. Fellows P. (2000). Food Processing Technology, 2nd Edition. Woodhead Publishing Limited and CRC Press LLC
4. James A (2013) The supply chain handbook, distribution group.
5. FAO, US (1984) Design and operations of cold store in developing
6. Forsythe, S.J. and Hayes, P.R. (1998). Food Hygiene, Microbiology and HACCP. Gaitersburg, Maryland: Aspen.
7. Hui, Y.H., Bruinsma, B., Gorham, R., Nip, W.-K. (2003). Food Plant Sanitation. New York: Marcel Dekker.
8. Rees, N. and D. Watson. (2000). International Standards for Food Safety. Gaitersburg, Maryland: Aspen.

BSUFT-504: Bakery & Confectionery Technology
BSUFT-504A: Bakery Technology
(Credits 6: Theory-4; Practical-2)

Course Outcomes (COs):
CO1: List the principles of baking and Interpret role of various ingredients used in baking.
CO2: Identify and control faults in baking.
CO3: Design a bakery unit and formulate innovative bakery products
CO4: Develop safety practices in bakery production.

Theory:

Module I: Bakery Industry (**4 lectures**)
Current status, growth rate, and economic importance of Bakery Industry in India. Product types, nutritional quality and safety of products, Bakery hygiene and cleanliness.

Module II: Bread, Buns and Pizza Base (**8 lectures**)
Ingredients & processes for breads, buns, pizza base, Equipments used, product quality characteristics, faults and corrective measures.

Module III: Cakes (**6 lectures**)
Ingredients & processes for cakes, Equipments used, product quality characteristics, faults and corrective measures. Different types of icings.

Module IV: Biscuits, Cookies & Crackers (**8 lectures**)
Ingredients & processes, Equipments used, product quality characteristics, faults and corrective measures.

Module V: Modified Bakery Products (**6 lectures**)
Modification of bakery products for people with special nutritional requirements e.g. high fibre, low sugar, low fat, gluten free bakery products.

Module VI: Breakfast Cereals, Macaroni Products and Malt (**4 lectures**)
Production and quality of breakfast cereals, macaroni products and malt.

Revision 4L

Total Lectures: 40L

Recommended Readings:

1. Bakery Technology & Engineering, Matz, S.A. 1960, AVI Publications.
2. Up-to-date Bread making. Fance W.J., & Wrogg B.H. 1968, Maclasen & Sons Limited.
3. Modern Cereal Chemistry. Kent-Jones DW & Amos A.J. 1967. Food Trade Press Limited.

PRACTICAL: BSUFT-593A: Bakery Lab
(Credit: 2)

Course Outcomes (COs):
CO1: Estimate the different quality parameters of flour and sensory evaluation of the finished product
CO2: Develop the various bakery products in lab scale
CO3: Design the newly developed products as per the societal demands

List of Experiments:
1. Determination of water absorption power and gluten quality & quantity of given flour.
2. Determination of yeast quality by its dough raising capacity
3. Preparation of bread(by straight dough method) and assessment of quality
4. Preparation of sponge cake with icing and assessment of its quality.
5. Preparation of egg less cake and assessment of quality.
6. Preparation of plain biscuits and assessment of quality.

BSUFT-504B: Confectionery Technology
(Credits 6: Theory-4: Practical-2)

Course Outcomes (COs):

CO1: Explain the principles of confectionery.
CO2: Demonstrate the role of various ingredients used in confectionery in the development of confectionery products.
CO3: Identify the faults in confectioning.
CO4: Construct a confectionery unit and sanitation and safety practices in confectionery production.

Theory:

Module I: (**6 lectures**)
Introduction: Introduction of raw materials like cane sugar, liquid glucose etc, classification of sugar confectionery. Cocoa processing. Crystalline and non-crystalline candy.

Module II: (**4 lectures**)
Introduction to basic tools used in the confectionery (with their principles).

Module III: (**6 lectures**)
Confectionery Products: Cake icings, hard-boiled candies, toffees, fruit drops, chocolates

Module IV: (**4 lectures**)

Other confections-ingredients, equipment's & processes, product quality parameters, faults and corrective measures.

Module V: (**8 lectures**)
General technical aspects of industrial sugar confectionery manufacture – compositional effects. Prevention of re-crystallization and stickiness Types of confectionery products-Caramel, Toffee and Fudge and other confections-:- ingredients – Formulation – Processing method- Quality control.

Module VI: (**8 lectures**)
Aerated confectionery- Methods of aeration- Manufacturing process Chemistry of Hydrocolloids, Hydrocolloid pre-treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products.

Revision 4L

Total Lectures: 40L

BSUFT 593B: Confectionery Lab
(Credits: 2)

Course Outcomes (COs):

CO1: Estimate the different quality parameters of sugar and other raw materials and sensory evaluation of the finished product
CO2: Develop the various confectionary products in lab scale
CO3: Design the newly developed products as per the societal demands

List of Experiments:

1. Determine the effect of heat on sugar solution and perform the thread and cold water test.

2. To study the process of inversion, melting and caramelization in sucrose.
3. Preparation of fondant, fudge and brittles.
4. Preparation of *Milk toffee.*
5. Preparation of candy (hard) and to perform quality assessment tests.

Recommended Readings:

1. Dubey, S.C. (2007). Basic Baking 5th Ed. Chanakya Mudrak Pvt. Ltd.
2. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
3. Manay, S. & Shadaksharaswami, M. (2004). Foods: Facts and Principles, New Age Publishers.
4. Barndt R. L. (1993). Fat & Calorie – Modified Bakery Products, Springer US.
5. Samuel A. Matz (1999). Bakery Technology and Engineering, PAN-TECH International IncorCOrated.
6. Faridi Faubion (1997). Dough Rheology and Baked Product Texture, CBS Publications.
8. Samuel A. Matz (1992). Cookies & Cracker Technology, Van Nostrand Reinhold
9. Raina et.al. (2003). Basic Food Preparation-A complete Manual. 3rd Ed. Orient Longman Pvt. Ltd.
10.Beckette S.T. (2009). Industrial Chocolate Manufacture, Blackwell Publishing Ltd.
11.Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication.
12. Mohini Sethi, Eram Rao (2011) Food science- Experiments and applications, 2nd ed., CBS publishers &Distributors pvt ltd.
13. Bakery Science & Cereal Technology: N. Khatrapaul, Grewal, Jood.
14. Baking Science and Industry: K. B. Kamaliya.
15. Industrial Chocolate Manufacture: S. T. Beckett
16. Sugar Confectionery: Jackson and Lees.

Semester VI
BSUFT-601: Food Packaging Technology
(Credits 6: Theory-5, Tutorial-1)

Course Outcomes (COs):

CO1: Classify about the need of food packaging materials, the different types of materials used for various type of food packaging,
CO2: Apply sustainable solutions to packaging problems.
CO3: Analyze the physical, chemical, and functional properties of various food packaging materials along with safety, convenience, and environmental issues related to various packaging techniques.
CO4: Evaluate and build the technology behind food packaging machineries for effective designing of the food packaging materials

Theory:

Module I:Introduction to Food Packaging (**2 Lectures**)
Packaging Functions and Requirements, Printing of packages, Barcodes & other marking, Labeling Laws.

Module II: Food Packaging Materials (**10 Lectures**)
Paper and paper-based materials, corrugated fiber board (CFB). Plastics, formation- Injection molding, Blow molding, Types of plastics, Lamination, Biodegradable plastics, Edible packaging and Bio-composites. Environmental Concerns, recycling and disposal of plastic waste

Metal packaging- Metals: Tinplate, tinning process, components of tinplate, tin free can (TFC) types of can, metallic films, lacquers Glass: Composition, Properties, Methods of bottle making, Types of closures.

Module III: Polymers (**7 lectures**)
Concepts, classifications and industrial applications. Polymer molecular weight (number avg. weight avg.: Theory and mathematical expression only), Polydispersity index (PDI).
Polymerization processes: addition and condensation Polymerization (mechanism not required), degree of polymerization, Copolymerization.
Preparation, structure and use of some common Polymers: plastic (PE: HDPE, LDPE, LLDPE, PP, PET).

Module IV: Package Designing for Foods (**7 Lectures**)
Package design for fresh horticultural produce and animal foods, dry and moisture sensitive foods, frozen foods, fats and oils, thermally processed foods and beverages.

Module V: Testing and Regulatory Aspects of Food Packaging (**8 Lectures**)
Testing Procedures for Packaging Materials- thickness, tensile strength, puncture resistance, bursting strength, seal strength, water vapor permeability, CO2 permeability, oxygen permeability, grease resistance, Testing Procedures for Packaged Foods - Compatibility and shelf life studies, evaluation of transport worthiness of filled packages. Food Packaging Laws and Regulations.

Module VI: Packaging Machinery and Systems (**6 Lectures**)
Bottling machines, Cartoning systems, Seal and Shrink packaging machine; Form, Fill and Sealing machine (FFS). Vacuum, Controlled and Modified atmosphere packaging systems; Aseptic packaging systems; Retort packaging, Active and Intelligent packaging systems.

Revision 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings:
1. Robertson GL, Food Packaging – Principles and Practice, CRC Press Taylor and Francis Group, 2012
2. Paine FA and Paine HY, A Handbook of Food Packaging, Blackie Academic and 46 Professional, 1992
3. Coles R, McDowell D, Kirwan MJ Food Packaging Technology. Blackwell, 2003.

BSUFT-602: Food Safety Standards, Adulteration& Food Laws (CREDITS 6: THEORY – 5; Tutorial - 1)

Course Outcomes (COs):
CO1: Summarise the Concept of hazards, food quality and safety.
CO2: Awareness about hygiene and sanitation in food manufacturing units.
CO3: Identify microbiological safety of foods
CO4: Develop awareness of domestic and international food laws

Theory:

Module I: Introduction to Food Safety (6 Lectures)
Definition, Types of hazards: Biological, Chemical, Physical hazards with common examples. Factors affecting Food Safety, Importance of Safe Foods. Packaging material as a threat, Impact on health, Control measures.

Module II: Food Hazards of Biological Origin (6 Lectures)
Introduction, Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes, Seafood and Shell fish poisoning, Mycotoxins.

Module III: Food Safety and Hazards Management (8 Lectures)
Need, Control of parameters, Temperature control, Food storage. Basic concept, Prerequisites- GHPs ,GMPs, HACCP, ISO series, TQM - concept and need for quality, components of TQM, Risk Analysis, Accreditation and Auditing.

Module IV: Hygiene and Sanitation in Food Service Establishments (6 Lectures)
Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control, Personnel Hygiene. Hygiene maintain in Food Industries.

Module V: Microbiological criteria (6 Lectures)
Microbiological standards and limits (for processed food, water), Sampling, Basic steps in detection of food borne pathogens, Water Analysis.

Module VI: Food laws and Standards (4 Lectures)
Indian Food Regulatory Regime, Global Scenario, Other laws and standards related to food.

Module VII: Recent concerns (4 Lectures)
New and Emerging Pathogens, Genetically modified foods/Transgenic, Organic foods, Newer approaches to food safety.

Revision: 4L

Total Theoretical Lectures: 44L

Tutorial: 10L

Total Lectures: 44L + 10L = 54L

Recommended Readings
1. Lawley, R., Curtis L. and Davis, J. The Food Safety Hazard Guidebook, RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997
3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
5. Forsythe,S.J.The Microbiology of Safe Food, second edition, Willey-Blackwell, U.K.,2010
6. Mortimore S.and Wallace C.HACCP,A practical approach,Chapman andHill, London, 1995
7. Blackburn CDW and Mc Clure P.J.Food borne pathogens. Hazards,risk analysis & control.CRC Press,Washington,U.S.A, 2005

BSUFT-603: Fermentation Technology
BSUFT-603A: Food Fermentation Technology
(CREDITS 6: Theory-4,PRACTICAL- 2)

Course Outcomes (COs):

CO1: Recall the fermentation techniques and biochemical engineering to food processing sector

CO2: Demonstrate the process parameters affecting the fermentation

CO3: Apply the knowledge of production and downstream techniques for ethanol, antibiotics, organic acids, SCP, ethnic foods and allied biochemicals through fermentation considering techno-economic feasibility.

Theory:

Module I: Introduction (**6 lectures**)
Parameters effecting fermentation: Medium composition(C-source, N-source, Vitamins, Minerals),pH, temperature, aeration, agitation, Surface culture and submerged culture.

Module II: Fermented and Microbial Foods (**6 lectures**)
Lactic acid bacteria, Single cell protein, Mushroom.

Module III: (**12 lectures**)
Bakers' yeast fermentation, Beer fermentation, Microbial production of vitamins (B_2 and B_{12}), Vinegar fermentation, Enzyme fermentation(Amylase, Invertase, Pectinase).

Module IV: **Non Dairy Fermented Foods** (**9 lectures**)
Sauerkraut, Kimchi, Tempeh, Natto, Kinema, Idli, Dhosa, Rice wine, Soy sauce, Fermented fish, Fermented meat.

Module V: **Fermentor** (**3 lectures**)
Different types of fermentors.

Revision 4L

Total Lectures: 40L

PRACTICAL: BSUFT-691A: Food Fermentation Technology Lab
(Credit:2)

Course Outcomes (COs):

CO1: Identify the state of fermentation, process of fermentation with different fermenters

CO2: Apply the outlines in relation to the production and recovery of fermented products.

CO3: Analyze the problems and find solutions for various food fermentation techniques to optimize production of high value biochemical.

List of Experiments:

1. Study of fermentation processes equipments: Fermenter and its operation.
2. Production of microbial biomass (bakers' yeast) and its economic aspects.
3. Alcohol fermentation: Evaluation and standardization of quality and safety.
4. Production, recovery and control tests of the amino acids fermentation.

5. Production of crude enzymes- their isolation and different purification processes (Solid state fermentation).
6. Fermentation production of modified carbohydrates, lipids and proteins and their purification techniques.

Recommended Readings:

1. Food Microbiology. 2nd Edition By Adams M & Moss, M. 2008. RSC Publishing.
2. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi V. K. & Pandey, A., Sanjanya Books 1999.
3. Essentials of Food Microbiology. Edited by John Garbutt. Arnold International Students Edition. 1997
4. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.Elsiever Applied Science Publication.1997
5. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall. 1995., Pergaman. McNeul and Harvey. (AC) NEW

BSUFT-604B:Fundamentals of Enzymes, Proteins & Vitamins (Credits:6: Theory-4, Practical-2)

Course Outcomes (COs):

CO1: Recall the structural and functional aspect of proteins, enzymes and vitamins.

CO2: Demonstrate the concept of protein quality, vitamins, their dietary requirements, deficiency syndromes and discuss the nature of interaction in proteins derived from different food sources.

CO3: Apply the knowledge of production, isolation and purification of crude enzyme and their relevance importance in food sectors.

CO4: Analyze the protein/enzyme sample using sophisticated instruments.

Theory:

Module I: 4L
Introduction to enzyme technology; Industrial enzymes– present status and opportunities with special reference to food industries; Catalytic properties of enzymes; Intracellular and extra-cellular enzymes.

Module II: 4L
Enzyme production technology; Enzyme reactors and process design; Application of recombinant DNA technique to enzyme technology.

Module III: 6L
Cell disintegration by physical, chemical and biological methods; Enzyme purification methods.

Module IV: 6L
Application of enzymes for production in biochemical and food processing industries; Application of immobilized enzymes and cells.

Module V: 4L
Purification, and Denaturation of proteins. Protein interaction and degradation. Protein-protein interaction. Protein-lipid and Protein-carbohydrate complexes.

Module VI: 4L
The nature of interaction in proteins derived from milk, Egg proteins, Meat proteins, Fish muscle proteins, Oil seed proteins, Cereal proteins. Metabolic antagonist and allergens associated with food proteins, concept of protein quality, dietary requirements, deficiency syndromes.

Module VII: 4L
Role of B-vitamins, vitamin C and vitamin D for immunity development. Role of vitamins in Food industries. Effect of various processing treatments and fortification of foods. Sources and effects of deficiency, Detection and analysis of vitamins.

Module VIII: 4L
Centrifugation; Ion exchange chromatography; Gelfiltration; Affinity chromatography; Electrophoresis; Crossfiltration; Ultrafiltration.
Revision: 4L

Total Lectures: 40L

Recommended Readings:

1. Biochemical Engg Fundamentals-Baily, Ollis.MGH.
2. Prescott & Dunn's Industrial Microbiology Macmiller.
3. Principles of Fermentation Technology-Wittaker and Stanby.
4. Altschul, A. Mand Wilcke, H.L Ed 1978. New protein Foods. Vol III. Academic Press, NewYork.
5. Bodwell, C.E.Ed. 1977. Evaluation of proteins for Humans. AVI, Westport.
6. Milner, M., Scrimshaw, N.S and Wang, D.I.C. Ed.1978. Protein Resources and Technology. AVI, West Cort.
7. Salunkhe,O. K and Kadam,S.S Eds.1999. Handbook of world legumes; Nutritional Chemistry, Processing Technology and Utilization. Volume I to III, CRC Press, Florida.
8. Salunkhe, D.K. Chavan,J.K., Adsule,R.N, Kadam,S.S 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York.
9. Bioseparation Engineering: Principles, Practise and Economics, M.Ladish; Wiley Interscience.
10. Principles of Food Chemistry. John M. de Man. 3rd Edition. Springer. Protein Biotechnology, Franks, F.; Humana Press.

Practical: BSUFT-691B: Fundamentals of Enzymes, Proteins & Vitamins (Credits: 2)

Course Outcomes (COs):

CO1: Apply the isolation techniques of various food components.

CO2: Analyze the quantitative and qualitative estimation of sugar, protein, enzyme and vitamins.

CO3: Evaluate the processes kinetics of enzyme catalyzed reactions

List of Experiments:

1. Understand the different methods of separation and isolation methods of biochemical components of food.
2. Quantitative estimation of protein.
3. Estimation of enzyme and evaluation of processes kinetics of enzyme catalyzed reactions.
4. Estimation of vitamins.
5. Estimation of reducing and non reducing sugar.
6. To gain knowledge on food standards, regulations and quality control.

BSUFT 604: Project (Credits 6) (Sessional)

Objective:

Students will be assigned with an objective oriented industrial problem related comprehensive project to be prepared highlighting techno-economic feasibility and sustainability

A time period of 2 month will be allowed to each student for completing their project work. It is expected from the students to make prior planning in the beginning of the semester to get associated with any Research Laboratory/ industry/organization/ individual-manoeuvre and utilize this limited time frame to complete the project. Students will get acquainted with the principle, theory, work flow, experimentation, proper referencing and acknowledgement. The evaluation will be based upon the depth of understanding of the project work, efforts and project presentation skills before the quorum panel.

Course Outcomes (COs):

CO1: The students should identify the topic of the project in consultation with the assigned Supervisor.
CO2: Student should summarize their concept through surveying the literature/journal.
CO3: Students will be able to design, develop, and execute the experiment.
CO4: On the basis of their experiment students should formulate results and they will submit the detailed report and demonstrate as seminar presentation.