Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(Lead College of Karmaveer Bhaurao Patil University, Satara)

Reaccredited by NAAC with 'A^{+}' Grade

Syllabus for

Bachelor of Science

Part - II

B.Sc. Food Technology

Syllabus

to be implemented from June, 2024 onwards

(As Per NEP-2020 Guidelines)

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Lead college of Karmaveer Bhaurao Patil University, Satara

Syllabus for Bachelor of Science Part II

1. **Title**: B.Sc. Food Technology
2. **Year of Implementation**:2024-25
3. **Preamble:**

B.Sc. Food Technology course under autonomy has been prepared keeping in view the unique requirements of B.Sc. Food Technology students. The emphasis of the contents is to provide students the latest information along with due weightage to the concepts of classical trends in Processing and Packaging in food so that they are able to understand the all subjects.

The course content also lists new practical exercises so the students get hands on experience of the latest techniques that are currently used in Food industries. Project curriculum spanning over the one year of the course is designed in a way to understand he basics of food technology Along with students are also provided with an opportunity to peruse the practical knowledge about subject. The course will also inspire students to pursue higher studies and research in Food Processing and Packaging, for becoming an entrepreneur a deniable students to get employed in Food, Nutraceutical and Agriculture Industries.

4. **General Objectives:**

- To construct and designing of the courses to suite industrial needs.
- To more emphasis on applied aspects of Food Technology.
- To develop aptitude of students in the field of research.
- To enrichment of basic knowledge in areas of Food Technology.
- To shape good and informed citizens from the students entering into the programme.

5. Programme Outcomes:

i] The students will graduate with proficiency in the Food technology

ii] The students will be eligible to continue higher studies in Food technology

iii] The students will be eligible to pursue higher studies abroad.

iv] The students will be eligible to appear for the examinations for jobs in government organizations.

v] The students will be eligible to apply for jobs with a minimum requirement of B.Sc. programme

6. PROGRAM SPECIFIC OBJECTIVES

i. The broad goal of the teaching of under graduate students in Food technology is to provide an understanding of various basic concepts in wide ranging contexts which involve the use of knowledge and skills of Food Technology.

ii. Their understanding, knowledge and skills in food technology needs to be developed through a thorough teaching learning processes in the class, practical skills through the laboratory work, their presentation and articulation skills, exposure to industry and interaction with industry experts, write short research-based projects where they are guided and mentored by the academic and other experts of the subject.

iii. The graduate students of Food Technology should have knowledge of the diverse places were food technology is involved. The graduate students of food technology should have understood of diverse food technology processes.

iv. The graduate students of food technology should have basic skills such as food analysis, food processing, shelf-life testing, sensory analysis, food preservation techniques, etc.

v. The main objective of the course is to provide students with the basis to face the study of the major fundamentals of food chemistry, food processing, food microbiology, food preservations, food packaging, food engineering etc.

vi. At the time of completion of the programme the student will have developed extensive knowledge of food safety and regulation.

7. PROGRAM SPECIFIC OUTCOMES

At the end of the three-year programme the student will understand and be able to explaindifferent branches of food technology.

ii] The student will be able to explain about various applications of food technology such asfood processing, food packaging, food preservation, food analysis etc.

iii] The students will be able to design and execute experiments related to Basic of foodchemistry, food analysis, food processing, etc.

iv] The students will be able to execute a short research project incorporating techniquesof Basic and Advanced food technology under supervision

8. **Duration**: Three/Four Year
9. **Exam Pattern:** Semester
10. **Medium of Instruction**: English

11. Structure of B. Sc. II:

Credit Distribution for Second Year of Four Year UG Honors Degree

Class	Level	Sem	Subject-1 Major		Subject-2 Minor		VSC	SEC	AEC	VEC	CC	Total
			T	P	T	P						
B.Sc. II	5.0	III	4 (2 Theory Papers)	4 (2 Theory Papers)	2	2	2	2	4	2	-	22
		IV	4 (2 Theory Papers)	4 (2 Theory Papers)	2	2	2	2	4	-	2	22

Note: VSC- Vocational skill courses, SEC- Skill Enhancement Course, VEC- Value Educational Course, AEC – Ability Enhancement Course, CC- Co-curricular courses

B. Sc. II SEMESTER III COURSE STRUCTURE

Sr. No.	Course Category	Course Code	Name of the Course
1	Major I	BFTT 231	Processing of Milk and Milk Products
2	Major II	BFTT 232	Processing of Meat, Fish and Poultry
3	Lab I	BFTP 233	Major Practical III
4	Lab II	BFTP 234	Major Practical IV
5	Minor I	BFTT 235	Fermentation Technology
6	Lab III	BFTP 236	Minor Practical III
7	VSC	BFTP VSC 1	Analytical Techniques in Food Technology
8	SEC	BFTP SEC 2	Food chemistry
9	AEC	BFTT AEC 1	English for Communication I
10	AEC	BFTT AEC 2	English for Communication II
11	VEC	BFTT VEC 2	Environmental Awareness in Food Processing

Note: VSC- Vocational skill courses, SEC- Skill Enhancement Course, VEC- Value Educational Course, AEC – Ability Enhancement Course

B. Sc. II SEMESTER IV COURSE STRUCTURE

Sr. No.	Course Category	Course Code	Name of the Course
1	Major I	BFTT 241	Oilseeds and Fats processing Technology
2	Major II	BFTT 242	Processing of Cereals and Pulses
3	Lab I	BFTP 243	Major Practical V
4	Lab II	BFTP 244	Major Practical VI
5	Minor I	BFTT 245	Food Safety and Plant Sanitation
6	Lab II	BFTP 246	Minor Practical IV
7	VSC	BFTP VSC 2	Human Physiology
8	SEC	BFTP SEC 3	Processing of Bakery and Confectionary Products
9	AEC	BFTT AEC 3	English for Communication III
10	AEC	BFTT AEC 4	English for Communication IV
11	CC	BFTT CC 2	Yoga and Diet

Note ; VSC- Vocational skill courses, SEC- Skill Enhancement Course, VEC- Value Educational Course, AEC – Ability Enhancement Course, CC- Co-curricular courses

SEMESTER III

MAJOR –I

BFTT 231 PROCESSING OF MILK AND MILK PRODUCTS

Course Objectives: Students should be able to…

1. know the present status and scope of dairy industry in India and its layout.
2. explain the composition, food value and processing of milk.
3. understand the processing of different milk products such as cream, butter, cheese.
4. illustrate the byproducts of milk and its utilization.

Credits (Total 02 Credits)	BFTT 231 PROCESSING OF MILK AND MILK PRODUCTS	No. of hours (30 hrs.)
UNIT-I	**Introduction to food**	**7**
	• Development of milk processing industry in India- present status and scope • Dairy layout for small scale industry, sanitation layout, dairyequipment and sanitation.	
UNIT-II	**Primary processing.**	**8**
	• Food value and Composition of milk. • Factors affecting Composition of milk, Buying, receiving, collection, Transportation of milk, storage and distribution of milk, processing of milk, filtration, clarification, cream separationand heat.	
UNIT-III	**Secondary processing.**	**8**
	• Milk product Processing – Cream, Butter, Khoa, Paneer, Ice-cream Condensed milk and evaporated milk. • Judging and grading of milk and its products • Manufacturing of Cheddar cheese–Introduction, Manufacturing process, packaging, storage, defects and theirprevention • Dried milk products–Buttermilk powder, Whey Powder, IceCream mix Powder, Infant milk food, WMP and SMP.	
UNIT-IV	**Common food processing**	**7**
	• Introduction, Classification and Composition of byproducts. • Principles and methods of Utilization Whey utilization and whey-based beverages like lassi and buttermilk.	

Course Outcomes: Student will be able to…

1. utilize the processing of different milk products- cream, , butter khoa, paneer, ice-
2. apply the process to evaporate milk and know the process of cheddar cheese, dried milk products.
3. know the buying, receiving, collection, transportation, storage and distributionof milk
4. identify the composition of byproducts

REFERENCE BOOKS:

1. Outlines of Dairy Technology, Sukumar De, Oxford University Press, 1st edition, 2001.(Unit-I)
2. Dairy Engineering Advanced Technologies and Their Applications, Rupesh S Chavan, Netra R Goyal, Murlidhar Meghwal, TaylorandFancis,1stedition,2017..(Unit-II)
3. Dairy Technology, Shivashraya Singh, illustrated, New India Publishing Agency-Nipa, 2013. .(Unit-III)
4. Structure of Dairy Products, A.Y.Tamime, Wiley-Blackwell, 1stedition, 2007. (Unit-IV)
5. Indian Dairy Products, Rangappa K.S., AsiaPub.House, 2nd edition, 1975. .(Unit-Iand UnitII)

SEMESTER III

MAJOR –II

COURSE BFTT 232: - PROCESSING OF MEAT, FISH & POULTRY

Course Objectives: Students should be able to…

1. know the importance of meat production, chemical composition in India
2. understand the structure, composition and nutritive value, quality evaluation of eggs.
3. illustrate the fish processes and factors affecting the quality of fresh fish.
4. summarize the principle of fish canning.

Credits (Total 02 Credits)	BFTT 232 PROCESSING OF MEAT, FISH & POULTRY	No. of hours (30 hrs)
UNIT-I	**Introduction to Meat & Meat Products**	**07**
	• Introduction and Importance of meat products in India. • Ante-mortem examination of meat animals, Pre – slaughtering operation, Scientific techniques of slaughtering, Post- morteminspection, Storage, Preservation	
UNIT-II	**Egg & Poultry processing.**	**08**
	• Egg: Structure, composition and nutritive value,Storage and shelf-life problems, Quality evaluation of eggs, Egg products: egg powder, value added egg products, Preservation. • Poultry products: types, chemical and nutritive valueof poultry meat, Slaughtering and evaluation of poultry carcasses, Poultry cut-up parts and meat / bone ratio, Preservationof poultry meat	
UNIT-III	**Introduction of Sea Foods**	**07**
	• Introduction, fisheries resources of the world, Types of fish, Water activity and shelf-life, Factors affecting quality of fresh fish. • Fish processing: manufacturing of fish paste and sauces, fish oil, fish protein concentrates and fishmeal, By-products of the fish industry and their utilization.	
UNIT-IV	**Chilling, Freezing & Canning**	**08**

	• Relationship between chilling and storage life, MAP, general aspects of freezing, Freezing systems (air blast freezing, plate or contact freezing, sprayer immersion freezing), Changes in quality in chilled and frozen storage, thawing. • Principles of canning, classification based on pH groupings, Effect of Heat Processing On fish, Pre- process operations and post process operations, Storage of- Canned fish, Cannery operations for specific canned products-Tuna, Mackerel, Sardine.	

Course Outcomes: **Student will be able to…**

1. determine the chemical composition and structure of meat.
2. describe the pre and post inspection, storage and preservation of meat and poultry products.
3. identify fishery resources, types of fish, water activity and shelf-life.
4. analyze the general aspects of freezing, chilling and canning of fish.

REFERENCE BOOKS:

1. Meat, Poultry & Fish Products Technology, Syed Imran Hashmi, VNMAU Parbhani
2. Principles of Meat Science Aberle E. D. Kendall Hunt Publication, Fifth edition,2012
3. Meat Processing Improving Quality, Joseph Kerry.
4. Meat Science, Lawrie R A, Lawrie' Wood head Publisher England, 5th Ed, 2017
5. Processed Meats, A.M. Pearson, Second Edition 2011
6. Fish Processing Technology, George. M. Hall published by Back i.e academic and professional, 2nd edition
7. Post-harvest technology of fish and fish products, K. K. Bala Chandran published DAYA publishing house, 2016
8. Advances in Fish Processing Technology, D. P. Sen, published, Allied Publishers, Feb 2005
9. Applications of Seafood By-products in food industry and Human Nutrition, Janak. K. Vidanarachchi, Senaka Ranadheera, Wijerathne, R.M.C,S.M.C, Himali, Udayagani and Jana Pick ova published Springer New York, Editors: Se-Kwon Kim

Major Practical

III

BFTP 233- Major Practical III
BFTP 233- PROCESSING OF MILK AND MILK PRODUCTS

Course Objectives: Students should be able to…

1. know the present status and scope of dairy industry in India and its layout.
2. explain the composition, food value and processing of milk.
3. understand the processing of different milk products such as cream, butter, cheese.
4. illustrate the byproducts of milk and its utilization.

Credits (Total Credit 02)	**BFTP 233- PROCESSING OF MILK AND MILK**	**No. of hours per unit/credits (60 hrs)**
	PROCESSING OF MILK AND MILK PRODUCTS	
1	Platform tests in milk.(Acidity, COB, specific gravity, SNF, Organoleptic test)	
2	Estimation of milk fat	
3	Adulteration tests for different foods: Milk and milk products	
4	Preparation of Flavoured milk	
5	Preparation of Curd	
6	Preparation of Shrikhand	
7	Preparation of Khoa	
8	Preparation of Paneer	
9	Preparation of Condensed milk	
10	Preparation of whey based beverages	
11	Preparation of Ice-cream and Kulfimix	
12	Preparation of Kunda	
13	Preparation of Gulabjamun	
14	Preparation of Rasmalai	
15	MBRT and Phosphatase test for milk.	

Course Outcomes: **Student will be able to…**

1. perform plat form test of milk.
2. prepare different types of dairy products like ice-cream paneer, khoaand condensed milk etc.
3. study the composition and byproducts of Milk

PRACTICAL REFERENCE:

1. Outlines of Dairy Technology, Sukumar De, Oxford University Press, 1st edition, 2001.(Unit-I)
2. Airy Engineering Advanced Technologies and Their Applications,Rupesh S Chavan, Netra R Goyal, Murlidhar Meghwal, Taylorand Fancis,1stedition,2017.
3. Indian Dairy Products, RangappaK.S., AsiaPub.House,2ndedition,1975.
4. Structure of Dairy Products, A.Y.Tamime, Wiley-Blackwell, 1stedition, 2007.
5. Indian Dairy Products, Rangappa K.S., AsiaPub.House, 2nd edition, 1975. .(Unit-Iand UnitII)
6. Packaged Fluid Milk Sales in Federal Milk Order Markets by Size and Type of Containers, and Distribution Method during November 1975, AMS-553, July 1977.

Major Practical IV

BFTP 234- Major Practical IV
BFTP 234- PROCESSING OF MEAT, FISH AND POULTRY

Course Objectives: Students should be able to…

1. demonstrate the method of slaughtering and dressing of meat animals
2. summarize the quality analysis of meat, egg etc.
3 evaluate Quality of fish/prawn.

Credits (Total Credit 02)	**BFTP 234- PROCESSING OF MEAT, FISH AND POULTRY**	**No. of hours per unit/credits (60 hrs)**
	PROCESSING OF MEAT, FISH AND POULTRY	
1	Slaughtering and dressing of meat animals.	
2	Analysis of frozen meat/meat emulsion products (Chemical and Microbial)	
3	Evaluation of eggs for quality parameters market eggs	
4	Formulation of fish products	
5	Meat/Egg product formulation	
6	Quality Evaluation of Fish/prawn. (Physical Parameters)	
7	Pre-Canning operation of fish (selection, sorting, descaling, washing, nobbing, brining)	
8	Formulation of Fish Products.	
9	To study shelf life of eggs by different methods of preservation	
10	To study the anatomy of Fish	
11	Determination of moisture content from the different fish samples	
12	Estimation of moisture content of meat	
13	Preservation of meat by different method	
14	Determination of acidity of brine from canned fish.	
15	To perform freezing of yolk/albumen	

Course Outcomes: **Student will be able to…**

1. formulate the products of meat/egg.
2. study the shelf life of eggs.
3. determination of fishery resource, water activity and shelf life.

PRACTICAL REFERENCE:

1. Meat, Poultry and Fish Products Technology, Syed Imran Hasmi, DAYA Publishing house, 2nd Edition, 2015
2. Manuals of Methods of Analysis of Foods Meat and Meat Products, Food Saftey Standards, Authority of India Ministry of Health and Family Welfare Government of India New Delhi, 2016
3. Advances in Fish Processing Technology, D.P. Sen, Published, Allied Publishers, Feb 2005.
4. Fish Processing Technology, K.K. Balachandran Published academic and professional, 3rd Edition, 2014
5. Meat and Meat Products Technology Including Poultry Products Technology, BD Sharma, 2nd Edition, Jan 2019
6. Meat, Poultry and Fish Products Technology, Syed Imran Hasmi, DAYA Publishing house, 2nd Edition, 2015

SEMESTER III

MINOR III

COURSE BFTT 235: - FOOD FERMENTATION TECHNOLOGY

Course Objectives: Students should be able to…

1. know basics of fermentation.
2. understand the microbial products.
3. summarize the traditional fermented products.
4. illustrate the enzyme in food industry and fermentation economics.

Credits (Total 02 Credits)	BFTT 235 FERMENTATION TECHNOLOGY	No. of hours (30 hrs)
UNIT-I	**Basics of Food Fermentation**	**8**
	• Fermenter design, operation, measurement and control in fermentation, Media for Industrial Fermentation, Sterilization of air and media, inoculum Preparation, Scale up in fermentation • Batch and continuous process, Solid substrates fermentation, down stream processing and Product recovery.	
UNIT-II	**Microbial Product**	**7**
	• Primary, secondary metabolites – Organic acids (Citric Acid, Lactic acid), alcohol, PenicillinandVitaminB12. • Microbial biomass production- baker's yeast, single cell protein and mushroom.	
UNIT-III	**Traditional fermented Foods and Beverage.**	**7**
	• Traditional fermented foods like idli, dosa, Soya-sauce, Miso, Sauerkraut. Beverage – vinegar, beer, wine, whisky, rum, vodka.	
UNIT-IV	**Enzyme Technology in Food Industry and Fermentation Economic**	**8**
	• Enzyme technology in food industry- Industrial enzymes (with respect to food processing industry) Enzyme Immobilization. • Fermentation economics- Market Potential, Fermentation and Product Recovery Costs, Process Appraisal.	

Course Outcomes: **Student will be able to…**

1. learn fermenter design, operation, measurement and controlling in fermentation technology.
2. know primary, secondary metabolites and learn microbial biomass production.
3. develop traditional fermented foods and know beverage production.
4. extend enzyme technology in food industry and learn fermentation economics.

REFERENCE BOOKS:

1. Peter F Stanbury and Whitaker A. ,Elsevier, 2008 Principles of Fermentation Technology
2. L. E. J. R. Casida , New age international publishers, 2007 Industrial Microbiology
3. Peppler, Perimam Volume II, 2 nd edition, 2007 Microbial Technology Fermentation Technology
4. Ramesh C Ray and Montet Didier Published August 21, 2014 Microorganisms and Fermentation of Traditional Foods (Food Biology Series)
5. P.-L. Yu (Editor) 31 August 1990 Fermentation Technologies: Industrial applications Hardcover
6. Fermentation Technologies: Industrial applications Hardcover – Illustrated, 31 August 1990

Minor Practical III

BFTP 236- Minor Practical III

BFTP 236- FERMENTATION TECHNOLOGY

Course Objectives: Students should be able to…

1. understand the growth of curve bacteria.
2. analyze effect of temperature & pH on bacterial growth.
3. demonstrate microbial examination of food.
4. learn to develop fermented food.

Credits (Total Credits 02)	BFTP 236 - FERMENTATION TECHNOLOGY	No. of hours (60 hrs)
1.	Determination of Growth curve of bacteria.	
2.	Effect of temperature on bacterial growth.	
3.	Effect of pH on bacterial growth.	
4.	Microbial examination of food.	
5.	Development of a fermented Kimchi.	
6.	Detection of food borne pathogens.	
7.	Primary screening of antibiotic producers by crowded plate technique.	
8.	Immobilization of yeast cell by Sodium – alginate entrapment method & determination of viability of immobilized cells by invertase activity.	
9.	Fermentative production of Amylase.	
10.	Development of a fermented drink utilizing plant products/ animal products or byproducts as substrate.	
11.	Development of a fermented food.	
12.	Identification of Molds by lactophenol blue staining.	
13.	Development of a Traditional fermented .	
14.	Development of a Vinegar by using different fruits.	
15.	Development of a fermented Jalebi.	

Course Outcomes: **Student will be able to…**

1. learn basics of fermentation
2. understand the microbial fermentation products
3. develop the traditional fermentation production
4. Determine microbial analysis of food.

REFERENCE BOOKS:

1. Food Quality Evaluation, Rao E. S., Variety Books, 2013
2. Principles of Sensory Evaluation of food, Amerine, Pang born and Roessler, Academic Press, London,1965
3. Michael M. Cramer, CRC Press, 3rd edition, 2013 Food Plant Sanitation: Design, Maintenance and Good Manufacturing Practices.
4. Sensory Evaluation Techniques, Meilgard, 3rd ed. CRC Press LLC, 1999.
5. Principles of Food Chemistry, de Man J. 3rd ed., Springer.62, 2007.

SEMESTER III

VSC

COURSE BFTP VSC 1: Analytical Techniques in Food Technology

Course Objectives: Students should be able to…

1. Know the primary and secondary solution.
2. explain methods of the determination of moisture content, ash content, fat content, fiber content, protein content of in different food sample.

Credits (Total Credit)	SEMESTER-III BFTP VSC 1: Analytical Techniques in Food Technology	No.ofhoursperunit/credits
PART-I	**PART-I Analytical Techniques in Food Technology**	
1	To estimate carbohydrates by phenol sulfuric acid method.	
2	To estimate protein by Biuret method.	
3	To estimate reducing sugar from food.	
4	To estimate non- reducing sugar from food.	
5	To study the preparation of primary solutions.	
6	To study the preparation of secondary solutions.	
7	To determine the pH of different food samples.	
8	To determine the acidity of given food samples	
9	To determine the moisture Content from given food samples.	
10	To determine the ash content from given food samples.	
11	To determine the fiber content from given food samples.	
12	To determine the fat content from given food samples.	
13	To study the preparation of Normal solution.	
14	To study the preparation of Molar solution.	

Course Outcomes: Student will be able to…

1. analyze the fat and acidity indifferent food sample.
2. determine moisture content, ash content, fat content, fiber content, protein content of in different food sample.

REFERENCE BOOKS:

1. Connie M. Weaver, James R. Daniel, The Food Chemistry Laboratory: A Manual for Experimental Foods, Dietetics, and Food Scientists, 1996.
2. Morris B. Jacobs, The chemical analysis of foodsand food products, CBS Publishers and distributors New Delhi.3rd edition 2018.
3. S. Ranganna, Hand book of analysis and quality control for fruit and vegetable products, (Tata McGraw Hill Publishing Co. New Delhi, 2003.
4. Dennis D. Miller, Food Chemistry: A Laboratory Manual, Wiley 2017.

SEMESTER III

SEC

COURSE BFTP SEC 2: - FOOD CHEMISTRY

Course Objectives: Students should be able to…

1. know the method of estimation of carbohydrates and protein in food samples.
2. understand the method of estimation of reducing and non-reducing sugars and starchin food samples.
3. identify the estimation of hardness of water.
4. clarify the Chromatographic Techniques.

Credits (Total Credit)	SEMESTER-III BFTP SEC 2- FOOD CHEMISTRY	No.of hours peruni t/credi ts
	FOOD CHEMISTRY	
1	Determination of hardness of water.	
2	Estimation of carbohydrates by phenol sulfuric acid method.	
3	Estimation of protein by Biuret method.	
4	Estimation of reducing and non-reducing sugars.	
5	Estimation of starch by anthrone method.	
6	Separation of amino acids by two dimensional paper chromatography.	
7	Determination of Thin Layer Chromatography.	
8	Determination of carotenoids with respects to flour pigments.	
9	Determination of Vitamin C (Ascorbic acid)	
10	Estimation of salt content in brine.	
11	Demonstration of instrument: HPLC, UV-Spectrophotometer.	
12	Estimation of Fat by Soxhlet method.	

Course Outcomes: **Student will be able to…**

1. understand the method of determination of hardness of water.
2. estimate total carbohydrates, protein, starch, ash, moisture content from different food samples.
3. know reducing and non-reducing sugars from different food samples
4. learn method of separate of amino acids by two- dimensional paper chromatography and thin layer chromatography.

REFERENCE BOOKS:

1. Connie M. Weaver, James R. Daniel, *The Food Chemistry Laboratory: AManualfor Experimental Foods, Dietetics, and Food Scientists*, 1996.
2. Dennis D. Miller, *Food Chemistry: A Laboratory Manual*,(Wiley 2017)
3. Morris B. Jacobs, *The chemical analysis of foods and food products*, (CBS Publishers and distributors New Delhi) 3rd emoticon.
4. S. Ranganna, *Hand book of analysis and quality control for fruit and vegetable products*, (Tata McGraw Hill Publishing Co. New Delhi, 2003)
5. Pomeranz Y., Meloan**,** *Food Analysis: Theory and practice*, (Clifton E. 1994. 3Edn. IS: 6273 (Part- 1and Part-2). Chapman and Hall, 3rd edition, 2004.)
6. D.T. Plummer, *An introduction to practical biochemistry*,(Tata McGraw HillPublishing Co. New Delhi, 3rd edition, 2004.)

SEMESTER III

BFTT VEC 2

BFTT VEC 2 Environmental Awareness in Food Processing

Course Objectives: The students should be able to:

1. To understand the Environmental issues
2. To relate Environmental issues and Environmental Laws and ethics
3. To know Sustainable development goals
4. To correlate knowledge of Role of Food processing in meeting the sustainable development goals

COURSE **BFTT VEC 2 Environmental Awareness in Food Processing**

Course Outcomes : Students should be able to…

1. understand the Environmental issues.
2. relate Environmental issues and Environmental Laws and ethics.
3. know Sustainable development goals.
4. correlate knowledge of Role of Food of Food processing in meeting the sustainable development goals.

Credits (Total 02 Credits)	**BFTT VEC 2 I Environmental Awareness in Food Processing**	**No. of hours (30 hrs)**
UNIT-I	**Environmental issues**	**8**
	• Pollution (Air, Water and Land), Fresh water overuse, Natural disasters, Increase in wasteland, Biodiversity loss. • Global warming and climate change (causes and intensity of the problem). • Role of food processing in creation of environmental issues – Air pollution- emission, water excessive use- In food industry	
UNIT-II	**Environmental Laws and ethics**	**7**
	• Environmental protection Act, Wildlife Protection Act, forest Conservation Act,. Prevention and control of pollution Act (Air, Water and Land), from unsustainable to Sustainable development, • Responsibilities of an Environmentally aware Citizens.	

UNIT-III	**Sustainable development goals**	**7**
	• Introduction of Sustainable development, Needs of sustainable development goals, Origin of Sustainable development goals. • Precursor of Sustainable development goals – Milennium Development goals, Nationally determined targets. • global efforts for realization of SDGs, India's Performance SDGs	
UNIT-IV	**Role of Food processing in meeting the sustainable development goals**	**8**
	• Sustainable Agriculture, Mitigation of Degraded Environment with help of sustainable processing industries. • Post Harvest Losses. • Food Wastage Minimize Rules, Waste utilization of food industries.	

Course Outcomes : The students will be able to :

1. explain the Environmental issues.
2. learn of Environmental Laws and ethics.
3. discuss concepts related to Sustainable development goals.
4. understand the importance of sustainable development Goals

Reference Books:

1. "Food Processing and the Environment" by Francis J. Francis
2. "Environmental Impact Assessment in Food Processing" by J.M. Aguilera and D.W. Stanley
3. "Sustainable Food Processing" by J.M. Krochta, J.S. Bower, and R.C. Anantheswaran
4. "Green Food Processing Techniques: Emerging Trends and Applications" edited by S.K. Goyal and S. Kumar
5. "Environmental Issues in Food Production and Consumption" by J.P. Watanabe
6. "Food, Environment, and Health" by S.R. Goyal
7. "Sustainable Food Systems: A Global Perspective" by P. S. Vijay Kumar
8. "Food Processing and Environmental Sustainability" by A.K. Rai and J.P. Watanabe

SEMESTER IV

SEMESTER IV

MAJOR –I

BFTT 241 OIL SEEDS AND FATS PROCESSING TECHNOLOGY

Course Objectives: Students should be able to…

1. know physical and chemical characteristics of dietary oilseeds and fats.
2. understand the extraction processes of oilseeds and fats.
3. demonstrate the refining process and its methods.
4. explain the processing of butter and other products.

Credits (Total Credits 2)	SEMESTER-IV BFTT 241 OIL SEEDS AND FATS PROCESSING TECHNOLOGY	No. of hours per unit/credits
UNIT - I	**Introduction Processing of Oil Seeds and Fats**	**(11)**
	A) Sources; chemical composition; physical and chemical characteristics; Functional and nutritional importance of dietary oilseeds and fats. **B)** Post-harvest handling storage Processing of oilseeds for directs use and consumption**.**	
UNIT - II	**Extraction**	**(11)**
	A) Extraction of oil by mechanical expelling and solvent extraction and obtaining de oiled cakes suitable for edible purposes. B)Processing of other plant sources of edible oils and fats like coconut, cottonseed, rice bran, maze germ, etc.	
UNIT - III	**Refining**	**(12)**
	A) Refining: Clarification, degumming, neutralization (alkali refining), bleaching, deodorization techniques / processes. Blending of oils. B) Processing of refined oils: Hydrogenation, fractionation, winterization, inter-esterification etc. for obtaining tailor-made fats and oils.	
UNIT - IV	**Processing of Butter**	**(11)**
	A) Production of butter oil, lard, tallow, Margarine, Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Specialty fats and designer lipids for nutrition and dietetics, especially by biotechnology.	

Course Outcomes: **Student will be able to…**

1. understand post-harvest storage processing of oilseeds for consumption.
2. apply extraction method for oil seeds and fats
3. learn the refining processes and its methods.
4. recall specially fats and designer lipids

REFERENCE BOOKS:

1.	David Firestone, Physical and chemical characteristics of oils, fats and waxes, Amer oil chemists society, 3rd Edition, 2006
2.	John Wiley and Sons, Bailey's Industrial Oil and Fat Products, , 4th edition, 2004
3.	Frank D.Gunstone, Vegetables and oils in food technology.2002
4.	Dimitrios Boskou, Olive oil chemistry, , 2 edi .1996.

SEMESTER IV

MAJOR –II

COURSE BFTT 242: - PROCESSING OF CEREALS AND PULSES

Course Objectives: Students should be able to…

1. know the structure and composition of cereals and pulses.
2. categories the different types of milling processes and different by products.
3. describe various cooking methods.
4. identify different types of improved milling methods of pulses.

Credits (Total 02 Credits)	BFTT 242 PROCESSING OF CEREALS AND PULSES	No. of hours (30 hrs)
UNIT-I	**Wheat Processing**	
	• Structure and chemical composition of wheat grain, Criteria of wheat quality physical and chemical factors. Wheat milling general principles and operations, cleaning, conditioning and roller mill system.	**8**
UNIT-II	**Rice Processing**	
	• Structure and chemical composition of rice grain, milling of rice– types of rice mill; Sheller-cum-cone polisher mill, Modern rice milling, Factors affecting rice yield during milling, rice bran as rice milling by products, Rice parboiling technology.	**7**
UNIT-III	**Corn Processing**	
	• Structure and composition of corn grain, differenttypes of corn. • Wet and dry milling of corn, and their products, Corn sweeteners (high fructose corn syrups) and theiruses. • Barley malting process: steeping, germination anddrying; significance of malting; Different types of malts and their food applications	**7**
UNIT-IV	**Pulses Processing**	
	• Structure, and composition of pulses, Toxic constituents in pulses, Processing of pulses, soaking,germination, decortications, cooking and fermentation	**8**

	• Milling of pulses-Dry milling, Wet milling,Improved milling methods.	

Course Outcomes: **Student will be able to…**

1. explain the structure and chemical composition, types and milling of rice.
2. understand the structure and chemical composition, toxic constituents of pulses.
3. examine the different types of milling methods of pulses.
4. learn different types of improved milling methods of pulses

REFERENCE BOOKS:

1. Post harvest technology of cereals, pulses and oil seeds, A. Chakraverty, Oxford and IBH PublishingCompany,2014.(Unit I,II)
2. Cereal Processing Technology Gavin Ovens, Wood Head Publishing LTD,2000.
3. Food Science, B. Srilakshmi, New Age International Pvt Ltd Publisher7th Edition,2018.(Unit-I,II,III)

Major Practical V

COURSE BFTP 243 MAJOR PRACTIAL V
OIL SEEDS AND FATS PROCESSING TECHNOLOGY

Course Objectives: Students should be able to…

1. know the detection of adulteration in oil.
2. evaluate adulteration in oils.
3. find out adulteration fats samples.
4. to carryout qualitative estimation of different fats and oils

Credits (Total Credits 4)	SEMESTER-IV BFTP 243- OIL SEEDS AND FATS PROCESSING TECHNOLOGY	No. of hours per unit/credits
PART-I	**PROCESSING OF OIL SEEDS AND FATS**	
1	To prepare test samples and determine moisture content of fats and oils.	
2	Determination of Specific gravity and Refractive index of fats and oils.	
3	Qualitative estimation of Rice bran oil and mustard oil.	
4	Qualitative estimation of Sesame oil.	
5	Qualitative estimation of Cotton seed oil.	
6	Determination of Melting point of fats and oils.	
7	Determine carotenoid content in raw Palmoil	
8	To determine adulteration in fats and oils.	
9	Determination of animals fat in vegetables fat	
10	Detection of presence of rancidity	

Course Outcomes: **Student will be able to…**

1. Prepare test sample and determine moisture content of fats
2. determine test sample and determine moisture content of oils
3. detect adulteration oil samples.
4. estimation of different fats and oils

REFERENCE BOOKS:

1. David Firestone, Physical and chemical characteristics of oils, fats and waxes, Amer oil chemists society, 3rd Edition, 2006
2. John Wiley and Sons, Bailey's Industrial Oil and Fat Products, , 4th edition, 2004
3. Frank D.Gunstone, Vegetables and oils in food technology.2002
4. Dimitrios Boskou, Olive oil chemistry, , 2 edi .1996.

Major Practical VI

BFTP 244- Major Practical VI

BFTP 244 - PROCESSING OF CEREALS, PULSES

Course Objectives: Students should be able to…

1. determine the physico-chemical properties of food grains and pulses
2. understand different type of milling processes and different byproduct
3. know the cooking quality of rice
4. Study the different types milling methods

Credits (Total Credit 04)	BFTP 244 - PROCESSING OF CEREALS, PULSES	No. of hours per unit/credits (120 hrs.)
PART - II	**PROCESSING OF CEREALS, PULSES AND OIL SEEDS**	
1	Determination of gluten content in wheat flour	
2	Preparation of malt	
3	To study the cooking quality of rice using water up takes method	
4	To study Physico-chemical properties of food grains	
5	Determination of physical properties pulses.	
6	Determination of Hundred grain weight of grains	
7	Determination of bulk density, true density, porosity of grains.	
8	Parboiling of paddy	
9	Preparation of instant dhokla mix	

Course Outcomes: **Student will be able to…**

1. understanding the structure and chemical composition , types of milling rice.
2. demonstrate the criteria for flour quality, milling method of wheat.
3. learn the structure and chemical composition, toxic constituents of pulses
4. prepare different types of malts

REFERENCE BOOKS:

1. Post harvest technology of cereals, pulses and oil seeds, A. Chakraverty, Oxford and IBH PublishingCompany,2014.(Unit I,II)
2. Cereal Processing Technology Gavin Ovens, Wood Head Publishing LTD,2000.
3. Food Science, B. Srilakshmi, New Age International Pvt Ltd Publisher7th Edition,2018.(Unit-I,II,III)

SEMESTER IV

MINOR IV

BFTT 245 – Minor IV
FOOD SAFETY AND PLANT SANITATION

Course Objectives: Students should be able to…

1. demonstrate food safety and food related hazards and risks
2. summarize the food safety management tools.
3. Know the food laws and food safety standards.
4. analyze the food hygiene and sanitation of plant.

Credits (Total 02 Credits)	BFTT 245 - FOOD SAFETY AND PLANT SANITATION	No. of hours (30 hrs)
UNIT-I	**Introduction to Food Safety and Food related hazards**	**8**
	• Definition of food safety, Importance of food safety, Hazards-Types of hazards, biological, chemical, physical hazards, Importance of Safe Food, microbiological considerations in food safety. • Acute toxicity, Mutagenicity and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immunotoxicity.	
UNIT-II	**Food Safety Management Tools**	**7**
	• Basic concept of food safety, Prerequisites- GHPs, GMPs, HACCP, ISO series, • TQM - concept and need for quality, components of TQM, Kaizen, Risk Analysis-Risk assessment and risk benefit Indices of human exposure, Accreditation and Auditing.	
UNIT-III	**Food Laws and Standards**	**7**
	• AGMARK and Bureau of Indian standards, Additional food laws – Federal Poultry products Inspection Act of 1957. • Federal Trade Commission act, Infant formula Act of 1986, Nutrition labeling and education act of1990. • Consumer protection Act, Food Safety and Standards 2006,Other laws and standards related to food.	
UNIT-IV	**Food Plant Hygiene and Sanitation**	**8**
	• 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 utilization obtained from dairy plant, egg and poultry processing industry and meat industry. • Wastewater and solid waste treatment: - Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, Secondary and tertiary (advanced) treatments.	

Course Outcomes: **Student will be able to…**

1. extend the importance of food safety and to know food related hazards and risks.
2. learn food safety management tools and to understand risk analysis and risk assessment.
3. understand food laws and to learn food safety standards.
4. summarize waste management system and to learn food hygiene and sanitation of plant.

REFERENCE BOOKS:

1. Training manual for Food Safety Regulators, Vol II 2010 Food Safety Regulations and Food Safety Management
2. Food Quality and Safety Systems-A training manual on Food Hygiene and the Hazard Analysis and Critical Control Point(HACCP) system, 1998 Food and AgricultureOrganizationoftheUnitedNations,Rome,PublishingManagement Group, FAO Information Division
3. Michael M. Cramer, CRC Press, 3rd edition, 2013 Food Plant Sanitation: Design, Maintenance and Good Manufacturing Practices.
4. Keith W Waldron, ELSEVIER, 2007 Handbook of waste management and co- product recovery in food processing, Vol I
5. Sunetra Roday, McGraw Hill Education (India) Private Limited, 2nd edition, 2017 Food Hygiene and Sanitation

Minor Practical IV

BFTP 246– Minor Practical IV

BFTP 246- FOOD SAFETY AND PLANT SANITATION

Course Objectives: Students should be able to…

1. Understand BOD and COD determination in industrial effluent.
2. Know the testing of sanitizers and disinfectants
3. classify physico-chemical estimation from sewage and industrial effluent.
4. interpret bacteriological analysis of water by qualitative and quantitative method.

Credits 2 (Total Credits)	BFTP 246 - FOOD SAFETY AND PLANT SANITATION	No. of hours (60 hrs)
1	Determination of BOD (Biological oxygen demand) of industrial effluent.	
2	Determination of COD (Chemical oxygen demand) of industrial effluent.	
3	Identification of Enteric Bacilli by IMViC test.	
4	To determine acidity of waste water.	
5	Estimation of TS, TSS, TDS from sewage and industrial effluent.	
6	Bacteriological analysis of water by presumptive test, confirmed and completed test.	
7	Determination of oil from industrial waste.	
8	Assessment of surface sanitation by swab method.	
9	To determine alkalinity of waste water.	
10	Evaluation for effectiveness of disinfectants (Detection of phenol coefficient of disinfectant).	
11	Testing of carcinogenicity of a substance by Ame's test.	
12	Determination of grease from industrial waste.	
13	Bacteriological Analysis of Water by MPN method.	
14	Enumeration of aerial micro flora using PDA, NAD.	
15	Assessment of surface sanitation by rinse method.	

Course Outcomes: **Student will be able to…**

1. determine BOD and COD in industrial effluent.
2. interpret physico-chemical estimation from sewage and industrial effluent
3. analyze testing of sanitizers and disinfectants
4. examine bacteriological analysis of water by qualitative and quantitative method.
5. determine acidity and alkalinity of water.

REFERENCE BOOKS:

1. Rao E. S., Variety Books, 2013, Food Quality Evaluation
2. Pang born and Roessler, Academic Press, London,1965 Principles of Sensory Evaluation of food, Amerine
3. Michael M. Cramer, CRC Press, 3rd edition, 2013 Food Plant Sanitation: Design, Maintenance and Good Manufacturing Practices.
4. Meilgard, 3rd ed. CRC Press LLC, 1999Sensory Evaluation Techniques.
5. De Man J. 3rd ed., Springer.62, 2007, Principles of Food Chemistry.

Semester IV
BFPTVSC 2

BFTP VSC 2

BFTP VSC 2- HUMAN PHYSIOLOGY

Course Objectives: Students should be able to…

1. Understand the microscopic study of different systems in human body.
2. Understand the methods for testing of blood groups, coagulation time and bleeding time of blood.
3. Understand the method of measuring the blood pressure using sphygmomanometer, effect of exercise on pulse rate, and blood pressure.
4. Understand the anatomy of heart, kidney.

Credits 2 (Total Credits)	BFTP VSC 2 - HUMAN PHYSIOLOGY	No. of hours (60 hrs)
1	Standardization of weights and measurements.	
2	Testing of blood groups	
3	Determination of coagulation time, bleeding time of blood.	
4	Reading of pulse rate, body temperature.	
5	Measurement of blood pressure at normal conditions and during exercise using sphygmomanometer.	
6	Estimation of Haemoglobin by Sahli'sMethod.	
7	Recording blood pressure using sphygmomanometer, effect of exercise on pulse rate, and blood pressure	
8	Anatomy of heart, kidney	
9	Microscopic study of different tissues - Epithelial, connective, muscular and nervous tissues	
10	Microscopic study of digestive organs - Pancreas, stomach, small intestine, liver	
11	Microscopic study of respiratory organs - Lung, trachea	
12	Microscopic study of excretory system - Kidney, nephron	

13	Microscopic examination of prepared slides - Fresh mount of blood and stained blood smear	

Course Outcomes: **Student will be able to…**

1.	Understand the different systems in human body
2.	Understand the methods for testing of blood groups, coagulation time and bleeding time of blood.
3.	Understand the methods of measuring the blood pressure using sphygmomanometer, effect of exercise on pulse rate, and blood pressure.
4.	Understand the anatomy of heart, kidney.

REFERENCE BOOKS:

1.	A textbook of Practical Physiology,V.G.Ranade, Dr.P.N.Joshi and Shalini Pradhan Published PVG Prakashan ,Pune.
2.	Practical Handbook of Human Physiology,Vadivelan Ramachandran, Satish Mutthurreddy Natraj, elango Kannan by Lambert Academic Publishing

Semester IV

SEC 3

BFTP SEC 2

BFTP SEC 2- PROCESSING OF BAKERY AND CONFECTIONARY

Course Objectives: Students should be able to…

1. know principle and bakery processing
2. learn principle and Confectionary processing
3. understanding the different types of ingredients used in bakery product and their functions
4. evalute the different types of ingredients used in Confectionary product and their functions

Credits 2 (Total Credits)	BFTPSEC3 - PROCESSING OF BAKERY AND CONFECTIONARY	No. of hours (60 hrs)
1	Preparation of bread and assessment of its quality.	
2	Preparation of pizza base and assessment of its quality	
3	Preparation of biscuits and assessment of its quality.	
4	Preparation of Chocolate chip cookies and assessment ofits quality	
5	Preparation of Rusk and assessment of its quality.	
6	Preparation of instant cake mix and assessment of its quality and prepare icings and introduction of decorating agentsin sponge cake.	
7	Preparation of Crackers and assessment of its quality	
8	Preparation of toast and assessment of its quality.	
9	Preparation of fondant, assessment of its quality.	
10	Preparation of fudge and assessment of its quality.	
11	Preparation of fondant, assessment of its quality.	
12	Preparation of toffee and their quality assessment tests	
13	Preparation of Chocolate and their quality assessment tests	
14	To study the process of inversion, melting and caramelization in sucrose and effect of heat on sugar solution.	
15	Preparation of Hard confectionery and their quality assessment tests	

Course Outcomes: **Student will be able to…**

1. operate microwave oven.
2. understand the preparation of butter cake , sponge cake, and instant cake
3. Prepare different chocolate cake
4. Develop different sugar based product

REFERENCE BOOKS:

1. Khetarpaul. N.,Grewal. B. R. 2022. Bakery science and cereal technology, Daya Publication House, Delhi.
2. Davidson. I. 2022. Biscuit, Cookie and Cracker Production. Academic Press. Elsevier, London.
3. Wayne Gisslen, 2021. Professional Baking, 8th edition Wiley Blackwell Publication, New Jersey, UK.
4. Rashmi. S. Sharma, 2020. Handbook of Baking and Bakery products, Wood Head Publishing Ltd, New Delhi.
5. Ducan Manley, 2019. Manual 1 Ingredients. Wood Head Publishing Ltd, Cambridge.
6. Ducan Manley, 2019. Manual 2 Biscuit Doughs. Wood Head Publishing Ltd, Cambridge.
7. Ducan Manley, 2019. Manual 3 Biscuit Dough Piece Forming. Wood Head Publishing Ltd, Cambridge.
8. Ducan Manley, 2019. Manual 4 Baking and Cooling of Biscuits. Wood Head Publishing Ltd, Cambridge.
9. Ducan Manley, 2019. Manual 5 Secondary Processing in Biscuit Manufacturing. Wood Head Publishing Ltd, Cambridge.
10. Ducan Manley, 2019. Manual 6 Biscuit Packaging and Storage. Wood Head Publishing Ltd, Cambridge.
11. Bakery and Confectionery, Acharya NG Ranga Agricultural University
12. William P Edwards, 2018. The Science of Sugar confectionery, Royal Society of Chemistry, 2nd edition, Wood Head Publishing Ltd, New Delhi.
13. Hui. Y. H. 2014, Bakery Products Science and Technology, Wiley Blackwell Publication, New Jersey, UK.
14. Gavin Owens, 2012. Cereal Processing Technology, Wood Head Publishing Ltd, New Delhi.
15. Peter P. Greweling, 2012. Chocolate and Confections; Formula, Theory and Technique for the Artisan Confectioner, 2nd edition, Wiley-Blackwell New Jersey, UK.

Semester IV

CC 2

BFTTCC 2: Yoga and Diet

Structure of the Course:

Duration	Theory Periods	Total Periods	**Credits**	No. of Students in batch
1 Year	30	30	**2**	

Course Objectives: Students should be able to…

1. understand the basic principles of yoga
2. learn about basic knowledge of various yogic texts
3. explain the basic concept of yogic diet.
4. classify different diet therapy for treatment of diseases according to ayurveda

Credit(1)	**Name of the Unit**	**No of Hrs. (30)**
Unit I	**Basic Principles of Yoga** • Concept of Yoga: Its Definition, Aim, Objectives and Misconception. • Significance of Hatha Yoga Practices- Shatkriyas,• Yogasana – Pranayama – Mudra – Bandha - Dhyana. • Roles and Responsibilities of Yoga. • Knowledge of use props: ropes/belt/cushions/special aids. • Importance of pre-procedural preparedness for performing Yoga	8
Unit II	**Yoga in Traditional Yoga Text** • Basic Knowledge of various yogic texts such as Patanjala Yogsutra, Hathapradipika, Gheranda Samhita . • Knowledge of schools of Yoga: Karma Yoga, Bhakti Yoga, Jnana Yoga and Dhyana Yoga. • Concept of klesha, Concept of chitta vritti , • Ashtanga Yoga and its therapeutic importance. • Principles of Hathayoga , Hatha yogic practices in view of therapy.	7
Unit III	**Concept of Yogic Diet.**	

	• Meaning and definition of Mithahara Indicated and contra indicated food • Yogic diet for practice of Pranayama • Sattvik, Rajasic and Tamic foods as per Bhagavad Gita	**8**
Unit IV	**Diet Therapy For Treatment of Diseases According To Ayurveda** • Diet according to Shadrasas and Doshas • Diet therapy for digestive disorders • Diet therapy for Diabetes • Diet therapy for Circulatory disorders	**7**

Course outcomes:

Students will be able to…

1. explore the different schools of Yoga
2. aware abut significance of Hatha Yoga Practices
3. develop and implement different yogic diet
4. apply diet according to disease.

Reference Books:

1. Hathayoga_Radha, Sivananda_ jaico Publishing House, Delhi, 2004.
2. Asana, Pranayama, Bandha, Mudra_Saraswati, Swami Satyanand_Bihar School of Yoga, Munger.
3. History of Yoga_Singh, S.P.& Chattopadhyaya, D.P._ MLBD, New Delhi, 2010Hollebeek, L. D., Glynn, M. S. and Brodie, R. J., 2014.
4. Swami Mukhtibodhananda , Hatha Yoga Pradeepika, Bihar School of Yoga,Munger,Bihar; 1998
5. Swami Diagambarji, DrM.L Gharote, Gheranda Samhitha, S.M.Y.M Samithi Kaivalyadhama, Lonavla Maharashtra; 1997.
6. Dr.B Athavale, Basic principles of Ayurveda, Sanathan Samstha, 206 Sion Main Road, Mumbai 1980
7. Alladi Mahadeva Shasthri, The Bhagavath Geetha;With the Comentry of Shankaracharya, Samatha Books, 10 Kamaraj Bhavan, Mount Road Madras; 1997