Total Credits=20

SEMESTER VII		CONTACT HOURS			MARKS			CREDITS
SUBJECT CODE	SUBJECT NAME	L	T	P	INTERNAL	EXTERNAL	TOTAL	
BFOTS1-701	Food Storage Engineering	4	-	-	40	60	100	4
BFOTS1-702	Food Biotechnology	4	-	-	40	60	100	4
BFOTS1-703	Technology of Beverages	4	-	-	40	60	100	4
BFOTS1-704	Snacks and Extrusion Technology	4	-	0	40	60	100	4
BFOTS1-705	Technology of Beverages Lab	-	-	4	60	40	100	2
BFOTS1-706	Snacks and Extrusion Technology Lab	-	-	4	60	40	100	2
TOTAL		**-**	**-**	**-**	**280**	**320**	**600**	20

SEMESTER VIII

Total credits=20

SEMESTER VIII			CONTACT HOURS			MARKS			CREDITS
SUBJECT CODE	SUBJECT NAME		L	T	P	INTERNAL	EXTERNAL	TOTAL	
BFOTS1-801	PROJECT WORK	*Monthly Progress Report				100	-	100	4
		Seminar				100	100	200	8
		Viva-voice				100	100	200	8
TOTAL			**-**	**-**	**-**	**300**	**200**	**500**	**20**

*** Performa for monthly progress report will be designed by the department as per the suggestions of BOS.**

Overall

Semester	Marks	Credits
VII	600	20
VIII	500	20
Total	**1100**	**40**

FOOD STORAGE ENGINEERING

Subject Code: BFOTS1-701 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize students with the importance of scientific storage systems.
2. To understand various post-harvest changes and causes of spoilage in fruits and grains.
3. To provide the knowledge about various storage structures.
4. To create awareness regarding prevention methods to protect fruits and grains from insects and pests.
5. To understand the design of storage structures and various specifications for designs of storage systems.

Course Outcomes

1. Familiarize students with the importance of scientific storage systems.
2. Understanding various post-harvest changes and causes of spoilage in fruits and grains.
3. Providing knowledge about various storage structures.
4. Creating awareness amongst students about prevention of fruits and grains from insects and pests.
5. Understanding the design of storage structures and various specifications for designs of storage systems.

UNIT I (12 Hrs.)

Introduction**:** Importance of scientific storage systems, post-harvest physiology of semi- perishables and perishables, climacteric and non-climacteric fruits, respiration, ripening, changes during ripening, ethylene bio-synthesis. Damages Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control

UNIT II (17 Hrs.)

Storage structures: Traditional storage structures, improved storage structures, modern storage structures, godown layout, staking pattern and rodent proof godown design; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos. Storage of grains Respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation. Aeration and stored grain management Purposes of aeration, aeration theory, aeration system design, aeration system operation

UNIT III (16 Hrs.)

Damage due to insects and pests during storage and its control, seed coating, fumigations, etc.; Damage caused by rodents and its control. Storage of perishables cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage

UNIT IV (15 Hrs.)

Design of storage structures Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, BIS specifications, functional, structural and thermal design of cold stores

Recommended Readings:

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science Business Media, New York, USA. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
4. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA.
5. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2 nd Ed. Elsevier Science Ltd., Burlington, MA, USA.
6. J.F. Richarson and D.G. Peacock. 1994. Coulson & Richardsons's Chemical Engineering, Vol. 3, Chemical &Biochemical Reactors & Process Control, 3rd Ed. Elsevier Butterworth-Heinemann, Amsterdam, The Netherlands.
7. James R. Couper, W. Roy Penney, James R. Fair and Stanley M. Walas 2012 Chemical Process Equipment: Selection and Design. Elsevier Inc
8. Mahajani, V. V. and Umarji, S. B., Process equipment design, Macmillan.
9. Bhattacharyya, B. C., Introduction to Chemical Equipment design, CBS Publishers and Distributors.
10. Geankoplis C. J. Transport processes and unit operations, Prentice-Hall

FOOD BIOTECHNOLOGY

Subject Code: BFOTS1-702 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives

1. To impart knowledge about basics of food biotechnology.
2. To create the awareness about different toxins and various naturals antimicrobial agents used in food preservation.
3. To remember the concept of genetic engineering and its role in food production enhancement.
4. To understand the methods and applications of protein engineering in food technology.
5. To analyze the role of Intellectual property rights (IPR) in biotechnology and their associated benefits.

Course Outcomes

1. Imparting knowledge about basics of food biotechnology.
2. Creating the awareness about different toxins and various naturals antimicrobial agents used in food preservation.
3. Remembering the concept of genetic engineering and its role in food production enhancement.
4. Understanding the methods and applications of protein engineering in food technology.
5. Analyzing the role of Intellectual property rights (IPR) in biotechnology and their associated benefits.

UNIT I (15 Hrs.)

Introduction to food biotechnology: basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety.

UNIT II (16 Hrs.)

Natural antimicrobials for food preservation: Phytoalexins, essential oils and their components, bacteriocins of Lactic acid bacteria, nisin, pediocins etc, applications of bacteriocins in food systems. Aflatoxins - production, control and reduction using molecularstrategy.

UNIT III (14 Hrs.)

Protein engineering in food technology: Methods and applications of protein engineering (e.g. glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic nisin).

Biotechnology and Food ingredients: biogums, fat substitutes, biocolors, organic acids and sweetners.

UNIT IV (15 Hrs.)

Food Biotechnology and Intellectual property rights (IPR), benefits of securing IPRs; bioethicsin food biotechnology.

Transgenic plants and animals: Their contribution to food production enhancement.

Recommended Readings:

1. B.H. Lee, 'Fundamentals of Food Biotechnology', VCH Publishers, New York, U.S.A.
2. M.P. Tombs, 'Biotechnology in Food Industry', Wiley-Blackwell, U. K.
3. D. Knorr, 'Food Biotechnology', Marcel Dekker, INC, New York, U.S.A.
4. A. Schwartzberg and A Rao 'Biotechnology & Food Process Engineering' Marcel Dekker,INC, New York.
5. I. Goldberg and R. Williams, 'Biotechnology and Food Ingredients', Springer Science & Business Media, Germany.
6. R.D. King and P.S.J. Cheetham, 'Food Biotechnology', Elsevier Applied Science, London.

TECHNOLOGY OF BEVERAGES

Subject Code: BFOTS1-703 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives

1. To impart the knowledge of types and importance of beverages.
2. To understand the technology behind processing of different beverages to meet the legal specifications.
3. To familiarize with the concept of water treatment along with quality parameters involved.
4. To use different types of additives to address the specified needs of consumers.
5. To create awareness regarding quality control tests used in beverages.

Course Outcomes

1. Imparting the knowledge of types and importance of beverages.
2. Understanding the technology behind processing of different beverages to meet the legal specifications.
3. Familiarize with the concept of water treatment along with quality parameters involved.
4. Application of different types of additives to address the specified needs of consumers.
5. Creating awareness regarding quality control tests used in beverages.

UNIT-I (15 Hrs.)

History and importance of beverages and status of beverage industry, Processing of beverages: Packaged drinking water, juice-based beverages, synthetic beverages, still, carbonated, Low-calorie and dry beverages, isotonic and sports drinks Dairy based beverages Alcoholic beverages, fruit beverages, specialty beverages.

UNIT-II (15 Hrs.)

Tea, coffee, cocoa, plant extracts, etc. FSSAI specifications for beverages, Ingredients, manufacturing and packaging processes and equipment for different beverages, Water treatment and quality of process water.

UNIT III (15 Hrs.)

Sweeteners, colorants, acidulants, Clouding and clarifying and flavouring agents for beverages. Use of carbon dioxide in carbonation.

UNIT-IV (15 Hrs.)

Quality tests and control in beverages. Miscellaneous beverages: Coconut water, sweet toddy Sugar cane juice, coconut beverage, flavoured syrups.

Recommended Readings:

1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets.Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
2. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
4. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.

SNACKS AND EXTRUSION TECHNOLOGY

Subject Code: BFOTS1-704 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives

1. To acquire knowledge about compositions, formulations and quality testing of Snack foods.
2. To make students aware about Specifications, compositions, ingredients, processing techniques of breakfast cereals and texturized vegetable protein
3. To familiarise with different types of extruders.
4. To learn about manufacturing of different extruded products.
5. To get knowledge about Chemical and nutritional changes in food during extrusion.

Course Outcomes

1. Imparting knowledge about compositions, formulations and quality testing of Snack foods.
2. Creating awareness aware about specifications, composition, ingredients, processing techniques of breakfast cereals and texturized vegetable protein
3. Familiarizing with different types of extruders.
4. Understanding manufacturing of different extruded products.
5. Analyzing the chemical and nutritional changes in food during extrusion.

UNIT I (14 Hrs.)

Snack foods: Types, specifications, compositions, ingredients, Formulations, processing, equipment, packaging, storage and quality testing, Snack food seasonings

UNIT II (15 Hrs.)

Classification of Breakfast cereals: Raw materials, process and quality testing of vermicelli, spaghetti: and macronic products Texturized vegetable protein: Definition, processing techniques, and foods Ready to eat breakfast cereals by extrusion cooking. Specifications, compositions, ingredients Formulations, processing Packaging, storage and quality testing for breakfast cereals, macaroni and malts.

UNIT III (15 Hrs.)

Extrusion: definition, introduction to extruders, principles and types, Uses of extruders in the food industry, Single screw extruder: principle of working, factors affecting extrusion process, Twin screw extruder: counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder

UNIT IV (16 Hrs.)

Pre-conditioning of raw materials used in extrusion process Use of dry extruders in extrusion Chemical and nutritional changes in food during extrusion. Extrusion technology and applications in food processing.

Recommended Readings:

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.
2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. E.J. Pyler and L.A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4 th Ed. Sosland Publishing Company, Kansas City, MO, USA.
4. E.J. Pyler and L.A. Gorton. 2008. Baking Science & Technology, Vol. I: Fundamentals & Ingredients, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
5. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
6. John J. Kingslee. 2006. A Professional Text to Bakery and Confectionery. New Age International, New Delhi.
7. Harold Corke, Ingrid De Leyn, Nanna A. Cross, Wai-Kit Nip, Y.H. Hui. 2006. Bakery Products: Science and Technology. Blackwell Publishing Ltd., Oxford, UK.
8. Joseph Amendola and Nicole Rees. 2003. Understanding Baking: The Art and Science of Baking, 3rd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
9. Duncan Manley. 2000. Technology of Biscuits, Crackers and Cookies, 3rd Ed. Woodhead Publishing Limited, Cambridge, England.
10. N.L. Kent and A.D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
11. E.B. Jackson. 1995. Sugar Confectionery Manufacture, 2nd Ed. Springer-Verlag, US.
12. B.W. Minife. 1989. Chocolate, Cocoa, and Confectinery – Science and Technology, 3rd Ed. Chapman and Hall, Inc., New York, USA.
13. Samuel A. Matz. 1976. Snack Food Technology, 2nd Ed. AVI Publishing Co., Inc., Westport, Connecticut, USA.

TECHNOLOGY OF BEVERAGES LAB

Subject Code: BFOTS1-705 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives

1. To impart knowledge regarding quality analysis of water.
2. To understand the technology behind processing of different types of beverages.
3. To familiarize with the methods involved in determination of different additives used in the formulation of beverages.

4. To analyze different quality parameters of beverages so as to meet the legal specifications.
5. To understand the mode of working in industrial setups as an individual and as a team.

Course Outcomes

1. Imparting knowledge regarding quality analysis of water.
2. Understanding the technology behind processing of different types of beverages.
3. Familiarize with the methods involved in determination of different additives used in the formulation of beverages.
4. Analysis of quality parameters of beverages so as to meet the legal specifications.
5. Understanding the mode of working in industrial setups as an individual and as a team.

PRACTICALS

1. Quality analysis of raw water
2. Determination of brix value, pH and acidity of beverages
3. Determination of density and viscosity of caramel
4. Preparation of synthetic beverage
5. Determination of colours in soft drinks by wool technique
6. Preparation of iced and flavoured tea
7. Preparation of instant tea
8. Assessment of purity of carbon dioxide
9. Preparation of carbonated and non-carbonated beverages
10. Preparation of sports drink
11. Preparation of dairy/ fruit-based beverage
12. Determination of caffeine in beverages
13. Quality analysis of tea and coffee
14. Preparation of miscellaneous beverages
15. Visit to carbonation unit
16. Visit to mineral water plant

SNACKS AND EXTRUSION TECHNOLOGY LAB

Subject Code: BFOTS1-706 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives

1. To learn about identifications and composition of various ingredients used for manufacturing of snacks and extruded products.
2. To gain knowledge about testing of different raw materials used in preparation of snacks and extruded products.
3. To learn about manufacturing of different snack food products and extruded products.
4. To become familiarize with different tests to quality evaluation of extruded products.
5. To become aware about packaging of snack food products and extruded products.

Course Outcomes

1. Understanding of identifications and composition of various ingredients used for manufacturing of snacks and extruded products.
2. Imparting knowledge about testing of different raw materials used in preparation of snacks and extruded products.
3. Development of different snack food products and extruded products.
4. Familiarizing with different tests to quality evaluation of extruded products.
5. Creating awareness about packaging of snack food products and extruded products.

PRACTICALS

1. Identification and composition of various ingredients used for preparation of snacks
2. Flours, their classifications and characterization
3. Determination of flour gluten
4. Determination of water absorption characteristics and dough development time
5. Determination of dough rising capacity
6. Determination of calcium carbonate in fortified atta
7. Quality evaluation of selected snack items
8. Preparation of pasta
9. Preparation of macroni
10. Preparation of vermicelli
11. Preparation of noodles
12. Preparation of selected extruded products
13. Packaging and quality evaluation of extruded products
14. Visit to snack industry