



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-331	Title of the Course	UNIT OPERATIONS IN FOOD PROCESSING	L	T	P	C
Year	3 rd	Semester	5 th	3	1	0	4
Pre-Requisite	BE-238	Co-requisite	None				
Course Objectives	This course is aimed to impart basic knowledge about components of different process equipment and unit operation associated with them.						

Course Outcomes

CO1	Understand the food process engineering calculations
CO2	Apply the principles of different types of material handling equipments and their application.
CO3	Evaluate the knowledge on importance of size reduction and energy requirement
CO4	Determine the mechanism of crystallization, distillation and leaching process
CO5	Discuss and interpret the principles of mixing and homogenization.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Cleaning and Conveying	Preliminary unit operation: Cleaning, sorting and grading – aims, methods and applications, physical properties of food materials. Conveying and Handling: Various unit operations in post-harvest handling, study of different conveying systems like belt conveyors, chain conveyors, screw conveyors, pneumatic conveyors, vibrating and oscillating conveyors, bucket elevators – their selection, operation and maintenance.	8	1
2	Size Reduction and Sieve Analysis	Theory of comminution, size reduction laws- calculation of energy required during size reduction, size reduction equipment's: Crushers-grinders, ultrafine grinders, cutters, size enlargement. Effects of size reduction on sensory characteristics and nutritive value of food. Sieving, separation based on size (mesh size), Types of screens: stationary screens – grizzlies, gyrating screens, vibratory screens, and effectiveness of screens.	8	2
3	Mixing and Homogenization	Mixing & Agitation: Measurement of mixing, rate of mixing, liquid mixing, mixing equipments-liquid mixer, powder & particle mixer, dough & paste mixer, jet mixer, static mixer, purpose of agitation, agitated vessels – impellers, propellers & turbines, kneading, Homogenization - Principle & equipment.	8	3
4	Separation Process	Filtration-principle of filtration; types of filtration. Equipment- filter press, rotary drum, shell & leaf filter, vacuum filter, centrifugal filter, filter media, filter aid, filter cake.	8	4
5	Other Unit Operations	Ultrafiltration, membrane filtration, reverse osmosis. Sedimentation- Stoke's law. Free and hindered settling. Crystallization, nucleation, crystal growth.	8	5

Reference Books:

- Sahay, K.M. and Singh, K. K. 1998. Unit Operations of Agricultural Processing, Kalya Publishers, Ludhiana.
- McCabe W. L. and Smith J. C. 2005. Unit operations of chemical engineering. McGraw Hill Publication.
- Geankoplis C. J. (3rd Edition). Transport processes in unit operations. Prentice Hall of India.
- P.Fellows. 2000. Food processing technology. Principles and practice. Ellis Horwood England and V C H publishers Germany.

e-Learning Source:

- https://onlinecourses.nptel.ac.in/noc22_ag08/preview
- <http://ecoursesonline.iasri.res.in/course/view.php?id=172>
- <https://www.classcentral.com/course/swayam-thermal-operations-in-food-process-engineering-theory-and-applications-14333>
- <https://www.youtube.com/watch?v=fIX-nOHHExs>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	1	1	3	3	1					1	3	1	3
CO2	1	1	1	3	3	1					1	3	1	3
CO3	1	1	1	3	3	1					1	3	1	3
CO4	1	1	1	3	3	1				2	1	3	1	3
CO5	1	1	1	3	3	1				2	1	3	1	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-2025

Course Code	BE332	Title of the Course	Post-Harvest Physiology, Handling, And Storage Of Fruits And Vegetables	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To provide knowledge on the composition, post-harvest physiology, ripening processes, handling, transportation, and storage of fruits and vegetables, enabling the evaluation and application of strategies to maintain quality and extend shelf life.						

Course Outcomes

CO1	To understand the composition, nutritive value, and analyse the post-harvest changes in fruits and vegetables,
CO2	Analyze the effects of respiration, water loss, and ethylene biosynthesis on the post-harvest quality of horticultural crops.
CO3	Evaluation of physiological changes in fruit ripening and develop strategies to regulate the process using knowledge of climacteric behavior and post-harvest techniques.
CO4	Evaluate post-harvest handling and transportation methods, and create solution to reduce losses and maintain quality.
CO5	Evaluate different storage systems for fruits and vegetables and develop effective storage strategies to enhance shelf life and quality.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction and Composition	Composition and nutritive value of important fruits and vegetables. Post-harvest changes in fruits and vegetables. Factors responsible for changes in color, texture, and flavor after harvest.	8	CO1
2	Respiration	Respiration and water loss; Physiology of respiration. Factors affecting rate of respiration. Respiratory quotient and calculations based on Q10. Loss of water from harvested horticultural crops. Biosynthesis of ethylene- its regulation and action on harvested fruits. Role of ethylene in fruit ripening. Various controlling agents are used to regulate ethylene action.	8	CO2
3	Physiology	Ripening process; Fruit maturation and ripening. Physiological changes occur during the ripening of fleshy fruits. Climacteric and non-climacteric fruits. Climacteric drift with special reference to apple and avocado. Non-ripening mutants of tomato.	8	CO3
4	Post-Harvest Handling and Losses	Post-harvest handling and transportation of fruits and vegetables; Its Importance and Need. Perishable and durable crops, post-harvest losses in fruits and vegetables. Maturity indices for harvesting- Cooling of products and methods of transportation.	8	CO4
5	Storage Technology	Storage systems for fruits and vegetables; Types of storage; zero energy cool chamber, low-temperature storage, hypobaric storage, modified atmospheric storage, controlled atmospheric storage.	8	CO5

Reference Books:

- Kadar AA.1992. *Post-harvest Technology of Horticultural Crops*.2nd Ed. University of California.
- Pantastico B. 1975. *Post-Harvest Physiology, Handling, and Utilization of Tropical and Subtropical Fruits and Vegetables*. AVI Publ.
- Salunkhe DK, Bolia HR & Reddy NR. 1991. *Storage, Processing and Nutritional Quality of Fruits and Vegetables*. Vol. I. *Fruits and Vegetables*. CRC.
- Thompson AK. 1995. *Post-Harvest Technology of Fruits and Vegetables*. Blackwell Sci.
- Verma LR. & Joshi VK. 2000. *Post-Harvest Technology of Fruits and Vegetables*. Indus Publ.
- Lloyd, A. &Penizer, R. 1998. *Handling, transportation, and storage of fruits and vegetables*, AVI Publications.

e-Learning Source:

- <https://www.youtube.com/watch?v=tyaFKBOJIHY>

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	1				2	3	2	1
CO2	3	3	3	2	3	3		2			2	3	3	1
CO3	3	3	3	3	3	3	2	2	1	1		3	3	1
CO4	2	3	3	2	2	3	2	3	1	1	2	2	2	2
CO5	3	3	3	2	3	3	2	2			2	3	3	3

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-333	Title of the Course	Cereal and Legume Technology	L	T	P	C
Year	3 rd	Semester	5 th	2	1	0	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To impart knowledge about the nutritional composition, functional properties and processing of different cereals and legumes						

Course Outcomes

CO1	Understand the basic composition, structure, and nutritional value of different cereals and legumes.
CO2	Apply the principles of milling operations in the processing of cereals and legumes..
CO3	Analyze the processing techniques involved in converting food grains into value-added products.
CO4	Evaluate the utilization and management of by-products generated during cereal and legume processing.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	General introduction, production and utilization trends. Structure of different grains- Wheat, Rice, Barley, Oat, Corn, beans, peas and Millets. Chemical composition of cereals and pulses.	8	1
2	Wheat	Wheat: Types and physicochemical characteristics; wheat milling -products and byproducts; Flour milling, extraction rate and milling systems (Flow diagrams). Improvers and bleachers used in flour. Significance of ingredients used in bakery products like bread, biscuits, cake etc. and preparation method of the same.	8	2
3	Rice	Rice: Classification, physicochemical characteristics; cooking quality; rice milling technology; by- products of rice milling and their utilization; Parboiling of paddy. Rice bran oil and its properties.	8	3
4	Other Cereals and Legumes	Wet and dry milling of maize. Preparation of oat flakes, porridge (dalia) and oat meal. Pearlring and Malting of Barley. Technology of other cereals. Legumes: composition, anti-nutritional factors, processing and storage. Processing of legumes for protein concentrates and isolates. Milling of pulses.	8	4

Reference Books:

- Chakrabarty MM. 2003. *Chemistry and Technology of Oils and Fats*. Prentice Hall.
- Dendy DAV & Dobraszczyk BJ. 2001. *Cereal and Cereal Products*. Aspen.
- Hoseney RS. 1994. *Principles of Cereal Science and Technology*. 2nd Ed. AACC.
- Kay DE. 1979. *Food Legumes*. Tropical Products Institute.

e-Learning Source:

- [Legume Science - Wiley Online Library](#)
- [Cereal Chemistry - Wiley Online Library](#)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	1	1	1		1	3	3	3	3
CO2	2	2	2	3	3	1	1	1		1	3	3	3	3
CO3	2	2	2	3	3	1	1	1		1	3	3	3	3
CO4	2	2	2	3	3	1	1	1		1	3	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	BE334	Title of the Course	Dairy Product Technology	L	T	P	C
Year	III	Semester	V	2	1	0	3
Pre-Requisite	BE 242	Co-requisite	BE-337				
Course Objectives	The objective is to impart valuable training and guidance to the students on packaging, processing, transportation, storage and distribution of dairy products.						

Course Outcomes	
CO1	Explain the technology, processing, and microbiology of concentrated and dried milk products.
CO2	Apply knowledge of chemistry, technology, and microbiology for the processing of fat-rich dairy products.
CO3	Analyze the technological aspects, processing methods, and microbiological safety of frozen and traditional dairy products.
CO4	Evaluate hygiene and sanitation practices in dairy processing plants.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Concentrated and Dried Milk Technology	Concentrated and dried milk products- Basic technology of concentration and drying. Manufacture of concentrated milk, bulk condensed milk, canned evaporated milk, sweetened condensed milk and recombined concentrated milk. Manufacture of skim milk powder, whole milk and high fat milk powder. Changes affecting structure and quality of concentrated and dried milk products. Microbiology of concentrated and dried milk products. Nutritive value of concentrated and dried milk products	8	1
2	Fat Rich Dairy Products Technology	Cream, butter, margarine, spreads and cheeses- Handling of cream, processing of single, double, and coffee, whipped, scalded, dried and frozen creams. Chemistry and microbiology of cream and its application in non-dairy products. Chemistry, technology and microbiology of butter, margarine, spreads. Nutritive value of cream based milk products.	8	2
3	Frozen and Traditional Dairy Products Technology	Frozen and Indian dairy products- Ice cream-role of ingredients, technology of ice creams, low fat frozen desserts, sherbets and ices. Physico-chemical nature of ice cream and microbiology of ice creams. Scope of Indian dairy products. Manufacture of Dahi, Srikand, Panir, Ghee, Khoa and Channa.	8	3
4	Hygiene and Sanitation	Dairy hygiene and sanitation-Introduction to hygiene and sanitation, CIP and COP scheduling, deposit formation, cleaning and disinfection. Legal standards for milk and milk products.	8	4

Reference Books:

1. Smit, Gerrit. 2003. Dairy processing: improving quality, Woodhead publishing limited, England.
2. De, Sukumar. 1991. Outlines of dairy technology, Oxford university press, Delhi.
3. Varnam, A.H., Sutherland, J.P. 1994. Milk and milk products, Chapman and Hall, New York, USA
4. Walstra, P., Geurts, T.J., Noomen, A., Jellema, A., Boekel, M.A.J.S. 1999. Dairy Technology: Principles of milk properties and processes, Marcel Dekker Inc, New York.

e-Learning Source:

[Journal of Dairy Science](#)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1	1	1	1	1	3	2	2	2
CO2	2	2	3	2	2	1	1	1	1	1	3	2	3	2
CO3	2	2	3	2	2	1	1	1	1	1	3	2	3	2
CO4	2	2	3	3	2	1	1	1	1	1	3	3	3	2

1- 2Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE 335	Title of the Course	FOOD ADDITIVES AND INGREDIENTS	L	T	P	C
Year	III	Semester	V	2	1	0	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	The objective is to impart knowledge about various categories of food additives their functions, permissible limits to be used in various food products.						

Course Outcomes

CO1	Understanding Food Additives & their safety, evaluate health risks, and sustainable solutions for food additives, contaminants, and GRAS compliance.
CO2	Classify food additives, analyze the chemistry, functions, and applications of food additives, and evaluate their roles in food formulations using the international numbering system.
CO3	Analyze food colorants, pigments, and flavoring agents, investigate their health impacts, and design formulations using stabilizers, thickeners, and chelating agents for enhanced food safety and quality.
CO4	Understanding the classification of food ingredients, analyze sweetener chemistry and functional roles, and design optimized food formulations using sugars, starches, fibers, proteins, and fats.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Additives in food processing and preservation	Additives in food processing and preservation - classification and their functions. Safety and quality evaluation of additives and contaminants, acute and chronic studies, NOAEL, ADI, LD50. Indirect food additives. GRAS and naturally occurring compounds.	8	CO1
2	Classification of Additives	Various additives such as preservatives, antioxidants, antimicrobials, colors, flavor, emulsifiers, humectants, hydrocolloids, sweeteners, acidulants, anticaking agents, buffering salts etc. with respect to chemistry, food uses and functions in food formulations acids, bases and buffers. International numbering system for Food Additives.	8	CO2
3	Functional Additives	Food colorants: Introduction; Natural & Synthetic food colorants; Classification of Food colorants; Impact on health. Pigments: Importance; Chelating agents- Naturally & synthetic; Mode of action of chelating agents; Applications of antioxidants and chelating agents, Stabilizers, thickeners, Bleaching & maturing agents, Taste and Flavoring agents: Introduction; Classification of flavors- natural & synthetic; Flavor enhancer/ Potentiation	8	CO3
4	Ingredients used in food production Ingredients used in food production	Ingredients used in food production e.g. sugar, starches/modified starches, fibers, proteins/protein hydrolysates and fats etc. and their technology of production and application. Sugars and Sweeteners: Sugars, syrups, sugar alcohols, potent sweeteners, sugar products, caramelization. Sweetener chemistry related to usage in food products.	8	CO4

Reference Books:

1. Branen, A. F. et al, Food Additives; Marcel Dekker.
2. George, A. B., Encyclopedia of food and color additives, Vol III; CRC Press.
3. Nakai, S. and Modler, H. W, Food proteins. Processing Applications; Wiley
4. Inteaz Ali, Food Quality Assurance-Principles and Practices; CHIPS, Texas.

e-Learning Source:

<https://drive.google.com/open?id=1a73lvsoXtlJTUsLjl7YHXRXnkdI8g5fl&authuser=0>
<https://drive.google.com/open?id=1a73lvsoXtlJTUsLjl7YHXRXnkdI8g5fl&authuser=0>
<https://drive.google.com/open?id=1qnjA06Zo1uossjurOsg79m1q9jgxp04K&authuser=0> ,
https://drive.google.com/open?id=1c5h633il_54EKG5z_WI_O6xFu5kIOoRF&authuser=0

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	2		1	2				2	2	3	2
CO2	3	3	2	2	1	2	1				2	3	3	2
CO3	3	3	1	2	1	2	2	1	1	1	2	3	3	2
CO4	2	3	3	2		2	3	2	2	2	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-336	Title of the Course	Cereal and legume technology lab	L	T	P	C
Year	3 rd	Semester	5 th	0	0	6	3
Pre-Requisite	None	Co-requisite	BE333				
Course Objectives	The objective of the lab is to determine the various physicochemical characteristics of the cereals and legumes						

Course Outcomes

CO1	Students will learn the proximate analysis of cereals
CO2	Students will learn to develop different types of bakery products
CO3	Students will get the industrial exposure for better understanding of subject
CO4	Students will learn the quality control testing of bakery
CO5	Students will learn the protein extraction from legumes

Unit No.	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Proximate analysis	Determination of physical characteristics of cereals. Determination of moisture content of different cereal grains. Determination of crude fibre in wheat flour. Determination of ash of flour	12	1
2	Product development	Preparation and evaluation of Bread, cookies and cakes.	9	2
3	Visit to an Industry	Visit to local roller flour mill. Visit to local rice hulling unit.	6	3
4	Quality control	Determination of gluten. Determination of sedimentation value of the Maida. Cooking quality of rice. Determination of alcoholic acidity of the sample of the wheat flour/Maida	12	4
5	Isolation of protein	Protein isolation and extraction soybeans and legumes.	3	5

Reference Books:

Kay DE. 1979. *Food Legumes*. Tropical Products Institute.

Kent NL. 1983. *Technology of Cereals*. 4th Ed. Pergamon Press.

Kulp K & Ponte GJ. 2000. *Handbook of Cereal Science and Technology*. 2nd Ed. Marcel Dekker.

e-Learning Source:

[Cereal Chemistry - Wiley Online Library](#)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	3	1	2	1	1	1	1	1	3	3	3
CO2	1	2	3	1	1	2	1	1	1	1	1	3	3	3
CO3	1	2	1	1	1	2	3	1	1	1	1	3	3	3
CO4	1	2	1	3	1	2	1	1	1	1	1	3	3	3
CO5	1	2	1	3	1	2	1	1	1	1	1	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session:		2024-2025					
Course Code	BE 337	Title of the Course	DAIRY PRODUCT TECHNOLOGY LAB	L	T	P	C
Year	III	Semester	V	0	0	6	3
Pre-Requisite	None	Co-requisite	BE-334				
Course Objectives	The lab is designed to train the students in understanding manufacturing principles and various quality parameters including microbiological and biochemical analysis of various dairy products.						

Course Outcomes	
CO1	Understand role of various ingredients in manufacturing of various dairy products
CO2	To determine quality evaluation of various dairy products.
CO3	Gain Knowledge on production of dairy products.

Unit No.	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Flavored milk	Preparation of flavored milk.	6	CO1, CO2
2	Cream processing	Cream separation, neutralization and ripening.	6	CO1, CO2
3	Butter	Preparation of butter.	6	CO1, CO2
4	Khoa	Preparation of Khoa.	6	CO1, CO2
5	Paneer	Preparation of Paneer (cottage cheese).	6	CO1, CO2
6	Ice cream	Preparation of common varieties of ice-cream.	6	CO1, CO2
7	Milk Product analysis	Quality evaluation of milk and milk products.	6	CO3
8	Industrial Visit	Visit to different milk processing plants to learn about milk condensing and drying operations.	6	CO3

Reference Books:

Miller, D.D. and Yeung, C.K., 2022. Food chemistry: A laboratory manual. John Wiley & Sons.

Aggarwala, A.C. and Sharma, R.M., 1961. A laboratory manual of milk inspection. A laboratory manual of milk inspection., (4th edition).

e-Learning Source:

https://www.fssai.gov.in/upload/uploadfiles/files/MILK_AND_MILK_PRODUCTS.pdf

https://fssai.gov.in/upload/uploadfiles/files/Guidance_Document_Milk_14_03_2019.pdf

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	1	1	2	1	2	2	3	3
CO2	1	3	2	2	1	1	1	1	1	1	1	2	3	3
CO3	2	3	2	2	2	1	1	1	1	1	2	3	3	3
CO4														
CO5														

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

 Name & Sign of Program Coordinator					 Sign & Seal of HoD				
---	--	--	--	--	---	--	--	--	--



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	BE 338	Title of the Course	Food Biotechnology	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To equip students with a comprehensive understanding of food biotechnology and IPR frameworks, enabling them to design sustainable engineering solutions and ensure regulatory compliance in emerging food technologies.						

Course Outcomes	
CO1	Analyze the significance of DNA/RNA in GMOs and microorganisms in food biotechnology using scientific principles and modern tools."
CO2	Analyze gene expression patterns and r-DNA enzyme functions to design effective strategies for metabolic overproduction in biotechnological systems.
CO3	Apply cloning vector techniques to design and analyze GMO crop production strategies integrating engineering principles, ethics, and sustainability.
CO4	Apply biotechnological principles to analyze and evaluate GMO applications in food, agriculture, industry with regulatory and social considerations.
CO5	Apply engineering fundamentals to critically analyze and design IPR strategies by evaluating patents, copyrights, trademarks, and legal frameworks.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Food Biotechnology	Signification of DNA and RNA in GMO/GMC, Role of microorganism in food biotechnology	8	CO1
2	Concepts of Genetic Engineering	Basic concept of gene expression and gene complexity in prokaryotes and eukaryotes, Enzymes involved in r-DNA technology resistant. Concepts for overproduction of metabolites.	8	CO2
3	Molecular Methods and Production	Cloning vectors for production of GMO/GMC, production of genetically modified organisms and crops using vectors (eg: Bt. Cotton, Bt. Brinjal etc.) Developmental technique for new plant varieties.	8	CO3
4	Applications of Food Biotechnology	Applications of GMO/GMC in food, agriculture and industrial sector, Regulatory and Social aspects of Food Biotechnology	8	CO4
5	IPR	Basic concept of IPR (patent with patenting step, copy right, trademarks, GI and PBR), Indian patent Act and PCT, TRIP, Infringement, GEAC, RCGM	8	CO5

Reference Books:

1. Principles of gene manipulation-Old and Primrose
2. Molecular Cloning (Vol 1,2,3)-Sambrook and Russell
3. Food Biotechnology: Dietrich Knorr, Inc. New York and Basel
4. Perry Johnson-Green. Introduction to Food Biotechnology. CRC Press

e-Learning Source:

1. <http://www.webmd.com/food-recipes/news/20160517/genetically-modified-crops-are-safe->
2. <http://www.ncbi.nlm.nih.gov/pmc/article/PMC2408621/>
3. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3791249/>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	3	1	1	1	1	1	3	2	2
CO2	3	3	3	3	2	1	1	1	1	1	1	2	1	1
CO3	3	2	3	2	2	2	2	1	1	1	1	3	2	2
CO4	3	3	2	2	1	3	3	1	2	1	1	3	3	3
CO5	3	3	1	3	2	2	3	1	1	2	1	1	1	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2024-2025

Course Code	BE 339	Title of the Course	HYGIENE AND FOOD SAFETY	L	T	P	C
Year	III	Semester	V	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	The objective of this course is to explain the common causes of food borne illness; to outline fundamental microbiological concepts; to describe the characteristics of important food borne pathogens and hazards; to detect and identify food borne pathogens and be able to list the steps in the inspection process; to summarize the procedures to be used in the control of food borne illness; to impart knowledge about sanitation and hygiene.						

Course Outcomes

CO1	Identifying the sources of contamination, analyze microorganisms involved in food spoilage, and evaluate preservation strategies
CO2	Analyzing sterilization methods (heat, filtration, radiation, chemicals) and evaluating their role in microbial inactivation
CO3	Identify foodborne pathogens, explain their symptoms, transmission modes, and designing prevention strategies to mitigate microbial-aided health hazards
CO4	Analyzing the concepts of food and personal hygiene, evaluating its the role in food safety, and designing strategies to enhance food and water quality.
CO5	Evaluating efficacy of cleanability, pasteurization, and sterilization methods, and design strategies for microbiologically safe aseptic packaging

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Food Spoilage	Food spoilage: Definition, sources of contamination and microorganisms involved in spoilages of various foods: Milk, Bread, Canned food, Vegetables and fruits, Fruit juices, Meat, Eggs and Fish.	8	CO1
2	Microbial Destruction Methods	Physical and chemical means used in destruction of microbes: Definition of sterilization and disinfection, role of heat, filtration and radiation in sterilization, use of chemical agents- alcohol, halogens and detergents.	8	CO2
3	Food Borne Infections and Intoxications	Public health hazards due to microbial contamination of foods: Important food borne infections and intoxications due to bacteria, moulds, viruses (Salmonella typhi, Helicobacter pylori, Campylobacter jejuni, Yersinia enterocolitica, Bacillus cereus, Staphylococcus aureus, Clostridium botulinum, Escherichia coli, Mycotoxins, Hepatitis A virus & Rota virus)- Symptoms, mode of transmission and methods of prevention.	8	CO3
4	Food Hygiene and Sanitation	General principles of food hygiene, relation to food preparation, personal hygiene. Food handling habits and water sources. Impurities in water supply and treatment	8	CO4
5	Aseptic condition maintenance	Method for assessing the in-place cleanability of food processing equipment. Microbiologically safe aseptic packing of food products, method for the assessment of in-line pasteurisation of food processing equipment, method for the assessment of in-line sterilisability of food processing equipment.	8	CO5

Reference Books:

1. Gaston, Ed & Tiffney. 2000. Guide to improving food hygiene.
2. Mountney. J. & Geod. W.A. 2000. Practical food microbiology and Technology (2nd edition)
3. Hobbs. Betty C. 1998. Food Poisoning and food hygiene - (3rd Edition).

e-Learning Source:

https://drive.google.com/drive/folders/0BPOPbAqWqoPfnVDc3lEVnNXZmxrSmtNT21nOGFnRDQ2ZWdPeFVfZWZTXzl0cC1LMmk3b2s?resourcekey=0-81g_wC6VCDeGb8EN_43cfg&usp=sharing

https://drive.google.com/drive/folders/0BPOPbAqWqoPfnVDc3lEVnNXZmxrSmtNT21nOGFnRDQ2ZWdPeFVfZWZTXzl0cC1LMmk3b2s?resourcekey=0-81g_wC6VCDeGb8EN_43cfg&usp=sharing

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1				2	3	3	2
CO2	3	3	2	2	1	2	1				2	3	3	2
CO3	3	3	3	2	1	3	2				2	3	3	2
CO4	3	3	3	2	1	3	2				2	3	3	2
CO5	3	3	3	2	2	2	1				2	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



Integral University, Lucknow

Effective from Session: 2024-2025

Course Code	BE349	Title of the Course	Sustainable Food Science and Technology	L	T	P	C
Year	III	Semester	V	2	1	0	3
Pre-Requisite	BE-238	Co-requisite	None				
Course Objectives	The aim is to give a broad overview and basic understanding of sustainable food processing technology and its role in reducing hunger, creating jobs, and fostering responsible production and consumption cycles.						

Course Outcomes

CO1	Understand the effect of food on various diseases and food toxicants
CO2	Apply the knowledge about post-harvest losses
CO3	Evaluate the impact of various food products on the environment
CO4	Analyze the insights about sustainable food systems and problems associated with the food distribution.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Sustainable diets and food safety	Effect of foods on cardiovascular diseases, diabetes, and constipation. Interface gastrointestinal tract (GIT) and microbiota, Food allergy, Obesity, Mother milk vs infant formula, The birth of food safety - evolutionary theory of food culture, level of toxicity. Human tolerance to poisons - Daily tolerable amount (TDI), environmental hormones - the poison of the century dioxin, environmental hormones - plastics for plasticizers, food, Bacteria, Relationship, - bacteria with food, Toxic substances produced during cooking - polycyclic aromatic hydrocarbons (PAH).	8	1
2	Postharvest loss prevention	Postharvest Loss, Food Insecurity, Overview of the Postharvest Supply Chain and the Role of Mechanization, The Economics of Postharvest Loss: Structural Issues, Trends in International Awareness of Postharvest Loss, A Prevention Framework for post-harvest losses.	8	2
3	Food and Our Environment	Role of fertilizers and pesticides on the environment, the role of animal meat on our planet, the impact of Seafood and Egg Consumption on our planet, the role of paddy in global warming, Packaging, and Reducing Food Waste.	8	3
4	Future Food problems	Sustainable Food Systems, Wasted Food, Food Shortage, Production limiting factors, Vulnerability to famines, Food shortage or distribution problem	8	4

Reference Books:

1.	Food and Chemical Toxicology: Food and Chemical Toxicology Journal ScienceDirect.com by Elsevier
2.	Food Security: Food Security Home (springer.com)
3.	Food Policy: Food Policy Journal ScienceDirect.com by Elsevier
4.	Journal of Agricultural and Food Chemistry: About the Journal (acs.org)
5.	Journal of Agricultural and Food Chemistry: About the Journal (acs.org)
6.	Food processing technology principles and practices; P. Fellows; CRC Press, Boca Raton Boston New York Washington, DC
7.	Norman N. Potter and Joseph H. Hotchkiss, Food Science

e-Learning Source:

[Sustainability | An Open Access Journal from MDPI](#)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2	2							1	3	3	2
CO2	1	2	2	2	1	1	1	1			2	3	3	2
CO3	1	2	2	2	1	1	3	1		1	2	3	3	2
CO4	1	2	2	2	1	1	3	1		1	3	3	3	2

3- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator					Sign & Seal of HoD				
------------------------------------	--	--	--	--	--------------------	--	--	--	--



Integral University, Lucknow

Effective from Session: 2024-2025

Course Code	BE 349	Title of the Course	Industrial Training	L	T	P	C
Year	IV	Semester	VII	0	0	0	0
Pre-Requisite	None	Co-requisite	None				
Course Objectives	This course aims to help students understand real-world food industry operations and workplace culture, apply theoretical food technology knowledge to practical industrial applications and processes, analyze industrial processes, techniques, and quality systems through direct exposure and training, and prepare a structured technical report based on their industrial training experience, which will be assessed through a brief viva voce.						

Course Outcomes

CO1	Understand the structure, functioning, and workflow of food technology and associated industries.
CO2	Apply concepts of food technology and techniques learned in academics to real industrial settings and practical tasks.
CO3	Industrial training ensures students to interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
CO4	Create a detailed training report based on the industrial visit and participate in a viva voce examination to demonstrate the knowledge and skills acquired.

Unit No.	Skill Set	Content of Unit	Mapped CO
1	Industry Orientation	Understand the organizational structure, manufacturing processes, and workflow in food industries.	CO1
2	Practical Application	Apply theoretical food technology knowledge in real-life processes and operational environments.	CO2
3	Analytical Skills Development	Analyze and critically evaluate processes, equipment, and workflows observed during industrial training.	CO3
4	Communication and Reporting	Prepare structured reports and professional presentations based on industrial experience.	CO4

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	2	2	1	2	3	3	2
CO2	2	3	3	2	3	2	1	2	2	2	2	3	2	3
CO3	3	3	3	3	2	1	1	1	2	2	2	3	2	3
CO4	2	2	2	2	1	2	1	2	3	3	3	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-2025

Course Code	BE-340	Title of the Course	Meat, fish, and poultry technology	L	T	P	C
Year	3rd	Semester	6th	3	1	0	4
Pre-Requisite	None	Co-requisite	BE345				
Course Objectives	Through this course, students will learn the scientific principles involved in the processing of meat, fish, and poultry.						

Course Outcomes

CO1	Understand and analyze the sources, economic significance, and current status of meat, poultry, and fish industries in India, along with the chemical composition and microscopic structure of meat.
CO2	Evaluate and apply various slaughtering techniques, including pre-slaughter care, ante-mortem and post-mortem inspection, stunning, and dressing methods, as well as understanding rigor mortis.
CO3	Demonstrate and assess different methods of meat processing, including tenderization, curing, smoking, pickling, and preservation techniques, to enhance shelf life and quality.
CO4	Analyze and examine the structure, composition, and nutritive value of poultry products, assess egg quality, and implement appropriate egg preservation methods.
CO5	Classify and apply fish processing techniques, including post-mortem handling, preservation, and canning, while assessing the nutritional quality of different fish types.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Sources of meat and meat products in India, its importance in national economy. Per capita consumption of meat, poultry and fish. Present status of meat, poultry and fish industries in India. Chemical composition and microscopic structure of meat.	8	1
2	Slaughtering Techniques	Methods of slaughtering & meat processing- Pre-slaughter care, Antemortem inspection of meat animals. Methods of stunning, slaughtering and dressing of meat animals and poultry birds Post mortem examinations of meat-Rigor mortis. Packaging and shelf life of meat.	8	2
3	Processing Methods	Methods of meat tenderization. Meat curing- types and factors affecting quality of cured meats. Preparation of smoked meats, pickled meats, sausages and hamburgers. Methods of meat preservation- refrigeration, refrigeration, thermal processing and dehydration.	8	3
4	Poultry and Egg	Poultry products- Structure, composition, nutritive value and functional properties of eggs. Grading of eggs. Factors affecting egg quality and measures of egg quality. Preservation of eggs by different methods- freezing, dehydration and coating.	8	4
5	Fish Processing	Fish products- Types of fish, composition, structure, post mortem changes in fish. Handling of fresh water fish. Nutritional quality of fish. Canning of fish.	8	5

Reference Books:

Lawrie, R. A. 1975. Lawrie's Meat Science. 2nd Edn. Pergamon Press. Oxford UK.

G. C. Mead. 2004. Poultry Meat Processing and Quality. CRC Press

A K Biswas and P K Mandal. 2014. Textbook of Poultry, Egg and Fish Processing Technology. Studium Press India Pvt Ltd

e-Learning Source:

Meat Science; <https://www.journals.elsevier.com/meat-science>

Animal Science Journal; [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1740-0929](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1740-0929)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	2			3	1				2	2	3	2
CO2	2	2	3		2	2	3				1	2	3	2
CO3	3	2	3	2	3	2	2				2	3	3	3
CO4	3	2	3	2	3	2	2				2	3	3	3
CO5	3	2	3	2	3	2	2				2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
---	-------------------------------



Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	BE 341	Title of the Course	Bakery and Confectionery Technology	L	T	P	C
Year	III	Semester	VI	2	1	0	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	This course will help the students in understanding the status of bakery and confectionary industries in India. They will also learn about the technologies behind bakery and confectionary products and the innovations in this sector.						

Course Outcomes	
CO1	Examine the status of the bakery industry, assessment of raw material specifications, and developing manufacturing techniques for bakery products.
CO2	Classify types of bread, prepare bread, rusks, buns, and pizza bases using various methods, and evaluate the quality of bakery products.
CO3	Identify types of bakery products, demonstrate preparation methods, analyze their faults and remedies, and assessment of product quality.
CO4	Examine confectionery ingredients and manufacturing technologies, evaluate quality parameters of products, and designing plant layouts.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introducon	Status of bakery industry in India & Govt. Licensing Policy. Raw material for bakery products and their PFA specification. Flour, sugar, shortening, yeast, salt, emulsifiers, oxidants and reducing agents. Structure and function of wheat proteins (gluten). Manufacturing techniques, uses & functionality of vital wheat gluten.	8	CO1
2	Bread and Other Similar Products	Different types of bread and preparation of bread using different methods. Quality evaluation of bread. Preparation of rusks, buns and pizza bases.	8	CO2
3	Soft Wheat Products	Cakes, their types, methods of preparation of different cakes. Cake faults and their remedies. Technology of manufacture, Types and quality evaluation of Biscuits, cookies, crackers and Muffins.	8	CO3
4	Confectionary Products	Different ingredients used in candy, fruit butter and chocolate. Technology of manufacture, quality parameters of Liquorice paste, aerated confectionery, Lozenges, sugar panning and Chewing gum,-Quality aspects. Bakery Plant - Layout, setting up of units and hygienic conditions, operation and maintenance.	8	CO4

Reference Books:

1. Bernrd. Minife. W. Chocolate, Cocoa and Confectionary. Edition 2003; Springer Science & Business Media
2. Mathur. R.B.L. Handbook of cane sugar technology, Edition 1999; CBS Publishers.
3. Faridi Hamed. The Science of Cookie and Cracker Production. Edition 2003; Springer US.
4. Matz. Bakery Engineering and Technology, Vol I and II, CBS Publishers, New Delhi.

e-Learning Source:

<https://www.youtube.com/watch?v=2kttVvakHN4>, <https://www.youtube.com/watch?v=QvR6YLTFGeI>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)-

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	1				2	3	3	2
CO2	3	2	3	2	1	2	1				2	3	2	2
CO3	3	3	3	2	1	2	1				2	3	3	3
CO4	3	3	3	2	1	2	1				2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-343	Title of the Course	Food Plant Layouts	L	T	P	C
Year	3 rd	Semester	6 th	2	1	0	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To provide comprehensive knowledge on plant location, layout design, factory building construction, cost analysis, and maintenance strategies, enabling the evaluation and optimization of industrial operations for efficiency, sustainability, and profitability.						

Course Outcomes

CO1	To understand the factors influencing plant location and layout design, and formulate optimal layout strategies to enhance efficiency and productivity.
CO2	To analyze layout designs for various food and fermentation industries, and apply network analysis techniques like PERT and CPM to optimize process efficiency.
CO3	To analyze the factory building design and cost factors, and apply economic analysis methods to assess profitability and sustainability..
CO4	Evaluate different plant maintenance strategies and implement effective maintenance plans to enhance operational efficiency and reliability.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Plant Layout	Plant Location and Layout-Concept and factors governing plant location. Location economics-comparison of rural vs urban plant sites, plant site selection guide. Classes of layout problems, objectives, principles and types of layouts – process layout, product layout, combination layout, fixed position layout; methods and tools of plant and factory layouts; plant layout procedures.	10	1
2	Layout of Different Food Industries and Network Analysis Process	Layouts of different types of food and fermentation industries – canning, dairy, bread, biscuit, beer, tomato processing, rice mill and wheat mill. Network Analysis of Processes-Basic terms, objectives and advantages of network analysis, various network techniques, PERT and CPM techniques, smoothing.	10	2
3	Cost Analysis	Factory Building and Cost Analysis- Considerations in building design, types of factory buildings, building construction materials for floors, walls, roofs, etc. Fixed cost, variable cost, depreciation, methods of economic analysis, profitability analysis of a plant.	10	3
4	Plant Maintenance	Plant Maintenance-Objectives and importance of maintenance, types of maintenance – corrective or breakdown maintenance, scheduled maintenance, preventive maintenance and predictive maintenance.	10	4

Reference Books:

1. Peters, M.S. and Timmerhaus, K.D. Plant Designs and Economics for Chemical Engineers 4th Edition. McGraw Hill.
2. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas (2005) Food Plant Design, Taylor and Francis
3. Apple, J.M. (2000). Plant Layout and Material Handling. Willey eastern Pub.
4. Sahay, K.M. and Singh, K. K. (1998) Unit Operations of Agricultural Processing, Kalya Publishers, Ludhiana.

e-Learning Source:

1. <http://ecoursesonline.iasri.res.in/course/view.php?id=529>
2. <https://www.igmpiindia.org/industry-certificate-in-Food-Plant-Layout-and-Design.html>
3. <https://www.youtube.com/watch?v=kbbPtK7EQ9Y>
4. https://link.springer.com/chapter/10.1007/978-1-4615-0725-3_1

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	1	1			3	3	2	1
CO2	3	3	3	2	3	3	2	1			2	3	3	1
CO3	3	3	3	3	3	3	2	1	1	1		3	3	2
CO4	2	3	3	2	2	3	2	1	1	1	2	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE 344	Title of the Course	Fruit and Vegetable Technology	L	T	P	C
Year	III	Semester	VI	3	1	0	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To learn about the different techniques involved in the processing of fruits and vegetables.						

Course Outcomes

CO1	Analyze the global scenario of fruit and vegetable processing, demonstrate pre-processing techniques, evaluate canning methods, and design processing strategies for food preservation.
CO2	Define fruit products, formulate and prepare various products, and evaluate their compliance with FPO standards.
CO3	Prepare and formulate tomato products, pickles, evaluate their compliance with FPO standards, and analyze spoilage
CO4	Analyze freezing and drying methods, evaluate their advantages and disadvantages, and design solutions to address challenges in the fruit and vegetable processing industry.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Basic Processing of Fruits and Vegetables	Indian and global scenario of Fruit and Vegetable production and processing. Preparing fruits and vegetables for processing; Basic steps in pre-processing; Blanching, Peeling etc and their importance in processing. History of canning, types of cans. Methods and steps involved in canning of fruits and vegetables. Calculation of vacuum in cans. Difference between canning and bottling. Spoilage of canned foods. Retortable pouches and retort processing.	8	CO1
2	Fruit and Vegetable Products	Fruit products; Definition, formulation, preparation and FPO standards of fruit juices, squashes and cordials, fruit syrups and nectar, pulp, jams, jellies, marmalades and juice powders.	8	CO2
3	Ready to use Products	Tomato products and pickles; Preparation, formulation and FPO standard for tomato juice, tomato puree, paste, ketchup, sauce, chutney. Pickeling process, types of pickels and spoilage of pickles.	8	CO3
4	Techniques based preservation of Fruits and Vegetables	General methods of freezing fruits and vegetables, their packaging and storage. Advantages and disadvantages of freezing. Drying of fruits and vegetables; Sun drying, its advantages and disadvantages. Dehydration of fruits and vegetables. Osmo dehydration of fruits and vegetables. Problems faced by Fruit and Vegetable processing industry	8	CO4

Reference Books:

1. Girdhari Lal & Sidappa. Fruits and vegetable preservation, ICAR (New Delhi).
2. Srivastava. 2000. Preservation of fruits and vegetable, IBD Co. Lucknow.
3. Khader Vijaya. 2000. Preservation of fruits and vegetable, Kalyani Publication.
4. Verma. L. R. & Joshi. V. K. 2000. *Post harvest technology of fruits and vegetables*. Indus Publishing.

e-Learning Source:

<https://www.youtube.com/watch?v=k-KHRJkVaGI>, <https://www.youtube.com/watch?v=HrpMUaM3Lrw>,
<https://www.youtube.com/watch?v=drqVnUq5oag>, <https://www.youtube.com/watch?v=3qEwflif89U> <https://www.youtube.com/watch?v=o-5b2TnsuAk>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)-

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	1				2	3	3	2
CO2	3	2	3	2	1	2	1				2	3	3	2
CO3	3	3	2	2	1	2	2				2	3	3	3
CO4	3	3	3	2	1	2	1				2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-345	Title of the Course	MEAT, FISH, AND POULTRY TECHNOLOGY LAB	L	T	P	C
Year	3 rd	Semester	6 th	0	0	6	3
Pre-Requisite	None	Co-requisite	BE-340				
Course Objectives	To perform different experiments involved in meat, fish, and poultry industries.						

Course Outcomes

CO1	Able to perform the proximate analysis of meat and meat products.
CO2	Able to perform the microbial analysis of meat and meat products.
CO3	Able to perform the quality tests of egg, meat and fish
CO4	The students will get exposure of meat industry.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Proximate analysis	Moisture analysis of meat and meat products. Fat content of meat products. Protein content of meat and meat products	9	1
2	Microbial analysis	Total plate count of meat samples Yeast and mold count of meat samples	9	2
3	Quality	Measures of egg quality. Sensory analysis of meat/fish/poultry products. Develop HACCP for meat processing	9	3
4	Visit	Visit to meat, fish and poultry processing industries	9	4

Reference Books:

G. C. Mead. 2004. Poultry Meat Processing and Quality. CRC Press

A K Biswas and P K Mandal. 2014. Textbook of Poultry, Egg and Fish Processing Technology. Studium Press India Pvt Ltd

e-Learning Source:

Meat Science; <https://www.journals.elsevier.com/meat-science>

Animal Science Journal; [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1740-0929](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1740-0929)

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	1			1			2	3	3
CO2	3	3	2	3	3	2	2		1			2	3	3
CO3	3	2	2	3	3	2	2		1			2	3	3
CO4	2	1	2	2	2	3	2	2	2	2		1	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator

Sign & Seal of HoD



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE 346	Title of the Course	Fruit and Vegetable Technology Lab	L	T	P	C
Year	III	Semester	VI	0	0	6	3
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To perform experiments relevant to fruit and vegetable processing industries.						

Course Outcomes

CO1	Understand the role of processing in terms of shelf life, safety, nutritional and economic value of fruit and vegetables.
CO2	Assess the role in pre- and post-harvest changes in fruits and vegetables on product quality.
CO3	Understanding production, preservation and packaging of jam, jelly, marmalade, pickles, and candies.

Unit No.	Title of Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Fruit juices	Preparation of fruit juices.	3	CO1, CO2
2	Squashes	Preparation of squashes.	3	CO2, CO3
3	Jam	Preparation of jams.	3	CO2, CO3
4	Jellies, Marmalades	Preparation of jellies, marmalades etc.	3	CO2, CO3
5	Pickles	Preparation of pickles	3	CO2, CO3
6	Tomato Products	Preparation of tomato puree, paste and ketchup	3	CO2, CO3
7	Dehydration & Drying	Dehydration and sun drying of fruits and vegetables.	3	CO1, CO3
8	Organoleptic evaluation	Organoleptic evaluation of fruit and vegetable products prepared in class practical.	3	CO2
9	Industrial Visit	Visit to a local fruit processing plant.	1	CO1, CO2, CO3

Reference Books:

1. Girdhari Lal & Sidappa. Fruits and vegetable preservation, ICAR (New Delhi).
2. Srivastava. 2000. Preservation of fruits and vegetable, IBD Co. Lucknow.
3. Khader Vijaya. 2000. Preservation of fruits and vegetable, Kalyani Publication.
4. Verma. L. R. & Joshi. V. K. 2000. *Post harvest technology of fruits and vegetables*. Indus Publishing.

e-Learning Source:

<https://www.youtube.com/watch?v=id1Op4Rfgyc>, <https://www.youtube.com/watch?v=hI2pKiJ9ZLQ>

Course Articulation Matrix: (Mapping of COs with POs and PSOs)-

PO- PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	3	3	2	3	3	2	2	2	3	3
CO2	2	2	1	2	2	3	2	3	3	2	2	3	3	3
CO3	2	3	3	2	3	2	1	3	3	2	2	2	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	BE347	Title of the Course	Fermentation Technology	L	T	P	C
Year	3	Semester	6	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To impart fundamental and applied knowledge of microbial fermentation and mass transfer principles, enabling students to analyze, design, and optimize bioprocesses and traditional fermented food products.						

Course Outcomes	
CO1	Evaluate fermentation history, metabolite dynamics, raw material quality, and pre-treatment processes to design and synthesize sustainable, innovative engineering solutions.
CO2	Evaluate fermentation kinetics, design effective fermenters for aerobic/anaerobic systems, and optimize batch, fed-batch, continuous operations innovatively.
CO3	Analyze and apply mass transfer principles to evaluate oxygen dynamics and optimize bioreactor performance in bioprocesses.
CO4	Apply fermentation principles to analyze and optimize production processes for alcoholic beverages and fermented vegetable products.
CO5	Analyze microbial processes and design optimized production strategies for baker's yeast and cereal-based fermented foods.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Fermentation	Definition and brief history of fermentation, Primary and secondary metabolite, Raw material availability, quality processes and pre-treatment of raw materials.	8	CO1
2	Design and kinetics	Design of fermenter, Aerobic and anaerobic fermentation. Biomass, Substrate and product kinetics in kinetics in Batch, Fed batch Continuous mode of reaction.	8	CO2
3	Mass transfer in fermenter	Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.	8	CO3
4	Fermented beverages & Vegetables	Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles, Saurkarnt).	8	CO4
5	Fermented cereals	Production of Baker's Yeast, Cereal based fermented food: Idli, Dosa, Dhokla, Soy sauce, Tofu, Tempeh, Natto.	8	CO5

Reference Books:

1. Handbook of Indigenous Fermented Foods, K.H. Steinkrus, Marcel Dekker, 1996, Reprint: 1997.
2. Outlines of Dairy Technology, Sukumar De, Oxford University Press, 1980, Reprint: 2001.
3. Industrial Microbiology, Prescott & Dunn, CBS Publishers, Reprint: 2004.

e-Learning Source:

1. <https://www.edx.org/learn/cooking/harvard-university-food-fermentation-the-science-of-cooking-with-microbes>
2. https://onlinecourses.swavam2.ac.in/nou19_ag06/preview

PO- PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	1	1	1	1	2	3	3	2
CO2	3	3	2	2	2	2	2	1	2	1	2	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	2	3	3	2
CO4	3	3	3	2	2	2	2	1	2	1	2	3	3	3
CO5	3	2	3	2	2	3	2	1	2	2	2	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------



Integral University, Lucknow

Effective from Session: 2024-25

Course Code	BE-348	Title of the Course	Food and Nutrition	L	T	P	C
Year	3 rd	Semester	6 th	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	After completing this course, the students will be able to discuss human nutrition for healthy adults. Discuss the role of diet in causing and preventing various diseases, particularly chronic diseases. Describe methods used to assess nutrition status. Explain how dietary recommendations are formulated.						

Course Outcomes

CO1	Understand the fundamentals of food and nutrition and its requirements in humans.
CO2	Analyze the basic principles of energy values and the importance food components carbohydrates, proteins, fat, minerals, vitamins and water in food.
CO3	Define immunity, infection, and nutrition.
CO4	Apply the concept of nutritional quality of diet and its requirements.
CO5	Evaluate the emerging concepts in human nutrition.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Nutrient Requirements – Macronutrients	Historical perspective of nutrient requirements, methods of assessment of nutrient needs – a critical review, critical evaluation of sensitive methods and derivations of requirements and recommended dietary allowances of macronutrients for all age groups.	8	1
2	Energy Values	Energy values of carbohydrates and dietary fibre, proteins and amino acids, lipids, water, critical evaluation of national and international nutrient allowances; factors affecting the nutritional requirements.	8	2
3	Nutrition, Immunity and Infection	Host defense mechanisms and nutrients essential in the development of immune system, effect of Infections on the nutritional status of an individual, nutrient deficiencies and excesses affecting the immuno-competence and susceptibility to infections, operational implications.	8	3
4	Nutritional Quality of Diets	Ways of enhancing nutritional quality of diets, assessment of protein quality, dietary diversification, bioavailability of nutrients, nutrient losses during cooking and processing.	8	4
5	Emerging Concepts in Human Nutrition	Ongoing nutrition transition and its implications, changing trends in life style patterns in population groups and their implications, nutrigenomics, nutraceuticals, bioactive compounds.	8	5

Reference Books:

- Carolyn D. Berdanier, (2014) Handbook of Nutrition and Food, Third Edition, CSC Press.
- David A. Bender, (2014) A dictionary of food and nutrition, Oxford University Press.
- Joshi, S.A. (2000) Nutrition and dietetics, Tata McGraw Hill and Co.
- Sunetra Roday. (2018). Food Science and Nutrition, Oxford University Press.

e-Learning Source:

- <https://iuns.org/iuns-publications/nutrition-e-learning/>
- <https://www.elearningcollege.com/learn/diet-and-nutrition-short-course>
- <https://in.coursera.org/browse/health/nutrition>
- https://onlinecourses.swavam2.ac.in/cec19_ag02/preview

PO-PSO CO	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	2		1			2	3	1	3
CO2	2	2	2	1	1	2		1			2	3	1	3
CO3	2	2	2	1	1	2		1			2	3	1	3
CO4	2	2	2	1	1	2		1			3	3	1	3
CO5	2	2	2	1	1	2	2	1		2	3	3	1	3

3- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	Sign & Seal of HoD
------------------------------------	--------------------