Integral University, Lucknow

Effective from Session: 2024-25							
Course Code	**BE 431**	**Title of the Course**	**Edible Oil Processing Technology**	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	2	1	0	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To acquaint the students with production, unit operation, and causes of spoilages of edible oils.						

Course Outcomes	
CO1	Understanding the basic chemistry of fats and oils, classify the oil seeds based on their nutritional composition
CO2	Summarizing various oil sources on the basis of composition. Analyzing the difference between oils and fats, their quality. Designing a storage facility for oils and oils seeds
CO3	Analyze critical parameters in fat and oil extraction, refining, and processing, evaluate their physicochemical and biochemical properties, and determine shelf life for food applications..
CO4	Assess the health impact of fats, develop specialty fats through modifications, and investigate factors influencing oil spoilage and shelf life.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction**	Introduction-Importance of oil seed processing industry in India, storage of oil seed grains. Oils, fats, waxes, mineral oils, essential oils, their sources, composition and structures. Constituents of natural fats Glycerides and fatty acids, their nomenclature. Types of edible oils.	8	CO1, CO2
2	**Types of Fats, Quality Assessment and Storage**	Types of fats and their composition-Animal- Lard, margarine their technology and applications. Vegetable oils, Hydrogenated fats. Cocoa butter equivalents, shortenings, low fat spreads, peanut butter etc. Quality assessment tests of fats and oils, oil and fat adulterants, Packaging and storage of fats and oils.	8	CO2,CO4
3	**Technologies for Extraction and Analysis**	Processing technologies for oil extraction-Traditional and Expellers Extraction methods, types of expellers and solvent extraction technology. Refining of oil seeds. Rendering of animal fats. Physico-chemical characteristics: Oiliness and viscosity, cloud point, melting point, smoke, flash and fire points, Boiling point; refractive index. Acid value, saponification value, Iodine value, acetyl and hydroxyl value, Peroxide Value.	8	CO3
4	**Processing of Vegetable Oils**	Processing of vegetable oils. Hydrogenation of vegetable oils, shortenings and margarine. Specialty fats and designer lipids for nutrition and dietetics, especially by biotechnology. Fractionation, winterzation, inter-esterification etc. for obtaining tailor-made fats and oils. Rancidity and flavor reversion, mechanism and their control measures.	8	CO4

Reference Books:

1.Williams. P.N. & Devine. J. (1996). The Chemistry and Technology of Edible Oil and Fats.

2.Berk & Bhatia (2008). Handbook of Industrial Oil and Fat Products, Vol 1-4. CBS Publishers, New Delhi.

3. Meyer (1998). Food Chemistry. CBS Publishers, New Delhi.

4. Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.

5. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and utilization. VNR, New York.

6. Wolf, I.A. Ed. 1983. Handbook of Processing and Utilization in Agriculture. (2 vol. set). CRC Press, Florida

e-Learning Source:

https://www.youtube.com/watch?v=76rW59zlejA, https://www.youtube.com/watch?v=AJngmAeeCCg

https://www.youtube.com/watch?v=60CrOpRCPzo, https://www.youtube.com/watch?v=bCYyW67hVNQ

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	3	2	1	2				1	3	2	3	2
CO2	3	3	3	2	1	2				1	3	2	2	3
CO3	3	3	1	2	2	2	2			2	3	3	3	3
CO4	2	3	3	2	2	2	2			2	2	2	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-432**	**Title of the Course**	**Food Regulation and Quality Control**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	7th	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To provide the students an opportunity to learn food safety and management systems and to learn international food laws and quality standards.						

Course Outcomes	
CO1	Describe the general principles of food hygiene and apply proper sampling, storage, and preservation techniques for food analysis while demonstrating understanding of personal hygiene in food handling.
CO2	Explain the principles of quality control and differentiate between various quality attributes such as colour, texture, and flavour by employing sensory evaluation techniques.
CO3	Analyze the proximate composition of food products and evaluate food quality standards by applying knowledge of HACCP, ISO systems, and national and international food laws.
CO4	Assess the quality of various food materials and demonstrate appropriate food handling and water sanitation practices while identifying common food hazards and impurities in water.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**General Principles of Food Hygiene**	General principles of food hygiene, relation to food preparation, personal hygiene. Introduction to food analysis, sampling techniques, storage and preservation of samples, expression of results.	8	1
2	**General Principles of Quality**	General principles of quality control, quality attributes, colour, gloss, viscosity and consistency, size and shape, and texture, flavour, taste, sensory evolution techniques.	8	2
3	**Proximate Analysis and Food Quality**	Proximate analysis of foods: Principles of estimation of moisture, fat, protein, carbohydrates, crude fibre, minerals and vitamins in foods. Principles of food quality assurance, objectives, raw material quality assurance, finished product quality assurance. Food laws and standards, national and international regulatory agencies, Concept of HACCP & ISO 9000 series. Food adulteration: methods of evaluation of different food adulterants.	8	3
4	**Methods of Quality Assessment**	Methods of quality assessment of food materials: Fruits, vegetables, cereals, dairy products, meat products and eggs. Food hazards and food handling habits. Sources of water, sanitary aspects of water supply, quality of water. Impurities in water supply and their treatment.	8	4

Reference Books:

1. Krammar & Twigg (2017), Quality Control for The Food Industry Fundamentals & Applications, CBS Publishers.
2. Y. Pomeranz und C. E. Meloan (1978), Food Analysis: Theory and Practice, The Avi Publishing Company. Inc., Westport, Connecticut.
3. Ronald, S. Kirk, & Ronald, Sawyer (1991). Pearson's Composition & Analysis of Foods, 9th Edition, Longman Scientific & Technical, U. K.
4. Kilcast D (2010), Sensory Analysis for Food And Beverage Quality Control: A Practical Guide, Woodhead Publishing Ltd

e-Learning Source:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=185
2. https://onlinecourses.swayam2.ac.in/cec20_ag06/preview
3. https://sac-elearning.com/courses/food-safety-and-quality-control-2/
4. https://onlinelibrary.wiley.com/journal/17454557

	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	2	3	2
CO2	3	2	2	2	3	1					2	3	2	2
CO3	2	2	2		2	3	3			1	1	2	3	3
CO4	2	2	2	2	3	2	2			1	2	2	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-433**	**Title of the Course**	**Plantation Products and Spices Technology**	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To acquaint the students with the methods for processing of various spices, tea, coffee, and cocoa.						

Course Outcomes	
CO1	Analyze the production and processing methods of different types of tea leaves including black, green, and oolong tea, and explain the chemistry involved in the manufacture of instant and decaffeinated tea.
CO2	llustrate the processing of coffee cherries using wet and dry methods, and evaluate the technological aspects of roasting, grinding, brewing, and production of instant and decaffeinated coffee.
CO3	Describe the processing and chemical composition of cocoa beans and demonstrate the steps involved in chocolate and confectionery manufacturing including tempering, moulding, and enrobing.
CO4	Classify various spices based on their properties and explain the pre- and post-harvest processes, along with the methods of extraction and utilization of essential oils and oleoresins.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Production and Processing of Tea Leaves**	Tea: Leaf Processing: Black tea, Green tea and Oolong tea. The Major Components in Tea. Chemistry of Tea Manufacture: manufacture of black and green tea. Instant tea, decaffeinated tea	8	CO1
2	**Coffee**	Production Practices, Processing of coffee cherries by wet and dry methods to obtain coffee beans. Coffee Processing: Blending, Roasting, Grinding, Brewing. Soluble/Instant coffee, Use of chicory in coffee, decaffeinated coffee.	8	CO2
3	**Cocoa Processing**	Production, processing and chemical composition of cocoa beans. Processing of Fermented Cocoa Beans Manufacturing process for chocolate: Ingredients, Mixing, Refining, Conching, Tempering, Moulding etc. Enrobed and other confectionary products.	8	CO3
4	**Spices**	Types, production, pre-harvest and post-harvest problems in processing, properties, drying, storage and packaging, health benefits, Flavour components. Essential oils and oleoresins: their characteristics, extraction procedure and utilization.	8	CO4

Reference Books:

1. Tea Production and Processing. B. Banerjee, Oxford & IBH Pub. Co., 1st Edition, 1993.
2. Coffee Technology. M. Sivetz, AVI publishing Co., 1st Edition, 1979.
3. Minor Spices and Condiments: Crop Management and Post Harvest Technology. J.S. Purthi, ICAR publication, 1st Edition, 2001.
4. Major Spices of India: Crop Management and Post Harvest Technology. J.S. Purthi, ICAR publication, 1st Edition, 2003.
5. Tree Nuts: Production, Processing, Products. J. G. Woodroof, AVI Pub. Co., 1st Edition, 1979.

e-Learning Source:

1. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=coffee+processing&oq=coffee+proce#d=gs_qabs&t=1671185466368&u=%23p%3D4kyoPvxSWq0J
2. https://youtu.be/Yx8EmMuMjgM

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	1					1	3	2	3
CO2	3	3			2	1					1	3	3	2
CO3	3	2			2						1	3	1	3
CO4	3	2			2						1	3	2	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 429**	**Title of the Course**	**Food Packaging Technology**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	7th	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To equip students with comprehensive knowledge of food packaging materials, technologies, safety considerations, and functional properties, enabling the selection, evaluation, and design of effective packaging solutions for diverse food products.						

Course Outcomes	
CO1	To understand food packaging materials, functions, and safety considerations, and develop suitable packaging solutions for various food products to ensure quality and compliance.
CO2	Evaluate the properties of paper- and plastic-based packaging materials and design appropriate packaging solutions ensuring functionality and safety.
CO3	To analyze metal packaging materials, manufacturing processes, and quality control measures, and create effective packaging solutions ensuring durability and safety
CO4	Evaluate glass packaging materials, manufacturing processes, and properties, and design effective glass container solutions ensuring functionality and safety.
CO5	Evaluate aseptic, active, and vacuum packaging technologies, and develop safe and efficient packaging solutions to enhance food preservation and quality.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Packaging Technology**	Definition, Factors involved in the evolution and selection of a food package, functions of packaging. Packaging operations and packaging functions. Safety considerations in food packaging, types of food safety problems associated with package, package labeling and food safety. Packaging requirements of selected foods- cereal and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen foods, horticulture products and microwavable foods.	8	CO1
2	**Paper and Plastic Packaging Materials**	Paper and paper based packaging materials, types of paper and paper products, functional properties of paper. Plastic packaging material, and classification of polymers. Functional and mechanical properties of thermoplastic polymers, testing of plastic packages.	8	CO2
3	**Metal Packaging Materials**	Metal packaging materials, container making process (end manufacture, three piece can manufacture and protective and decorative coatings), functional properties of metal containers. Tin plate containers-Quality control tests.	8	CO3
4	**Glass Packaging Materials**	Glass packaging materials, composition and manufacture of glass container, glass container-closure functions, closure terminology and construction. Properties of glass container, mechanical, thermal and properties. Testing of glass containers.	8	CO4
5	**Other Packaging Techniques**	Aseptic packaging: Sterilization of packaging material food contact surfaces & aseptic packaging systems. Active food packaging- definition, scope, physical and chemical principles involved. Vacuum packaging in food products.	8	CO5

Reference Books:

1. Scharow, S., and Griffin, R.C. *Principles of Food Packaging*, 2nd Edition, AVI Publications Co. Westport, Connecticut, USA.
2. Rooney, M.L. *Active Food Packaging*. Blackie Academic & Professional, Glasgow, U.K.
3. Bakker, M. *The Wiley Encyclopedia of Packaging Technology*, John Wiley & Sons Inc: New York.
4. Robertson, G.L. *Principles of Food Packaging*. CRC Press, USA.

e-Learning Source:

1. https://youtu.be/A_M8WBJMcM0

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

4- 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-435**	**Title of the Course**	**Novel Food Processing Technologies**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	7th	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To acquaint the students with the scope of emerging food processing technologies and their limitations.						

Course Outcomes	
CO1	Understand the principles and applications of high-pressure processing in food preservation and examine its effect on food quality
CO2	Apply knowledge of pulsed electric field processing for microbial inactivation and food preservation.
CO3	Analyze the effectiveness and applications of osmotic dehydration and membrane separation in food processing.
CO4	Examine the role of ultrasound processing in food preservation and its effects on food properties.
CO5	Evaluate the efficiency of alternative thermal processing techniques, including microwave heating, radio-frequency processing, and freeze-drying in food processing.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**High Pressure Processing**	High Pressure Processing: Principles of high-pressure processing, Effects of high pressure on food quality: Pressure effects on microorganisms, texture and nutrients of food. Hurdle Technology Concept; effect on preservation of food.	8	1
2	**Pulsed Electric Field**	Pulsed electric fields processing: PEF treatment systems, main processing parameters. Mechanisms of action: mechanisms of microbial inactivation.	8	2
3	**Osmotic Dehydration and Membrane Processing**	Osmotic dehydration: mechanism of osmotic dehydration, application of osmotic dehydration. Membrane separation: Principle, different types of Membrane processing, Application in Food industry.	8	3
4	**Ultrasound Processing**	Ultrasound processing: fundamentals of ultrasound, ultrasound as a food preservation and processing aid, effects of ultrasound on food properties.	8	4
5	**Alternate Thermal Processing**	Microwave heating, Radio-frequency processing: dielectric heating, radio-frequency heating; Ohmic heating, Freeze drying, freeze concentration, UV radiation towers.	8	5

Reference Books:

5. P. J. Fellows (2009). Food Processing Technology: Principles and Practice. Third edition. Wood Head Publishing in Food Science, Technology and Nutrition.
6. Howard Q. Zhang, Gustavo V. Barbosa-Cánovas, V. M. Bala Balasubramaniam, C. Patrick Dunne, Daniel F. Farkas, James T. C. Yuan (2011). Nonthermal Processing Technologies for Food. Wiley-Blackwell.
7. Ortega-Rivas, Enrique (2012). Non-thermal Food Engineering Operations. Springer.
8. H. L. M. Lelieveld, S. Notermans, and S. W. H. De Haan (2007). Food preservation by pulsed electric fields: From research to application. Wood Head Publishing Limited.

e-Learning Source:

5. https://onlinecourses.nptel.ac.in/noc22_ag03/preview
6. https://www.eitfood.eu/education/courses/how-food-is-made-understanding-food-processing-technologies
7. https://www.youtube.com/watch?v=odBo9csZJxI
8. https://ifst.onlinelibrary.wiley.com/journal/17454549

	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	3	1	1	2	2	1	3	3	3
CO2	3	2	2	1	1	2	2	1	1	2	1	3	3	3
CO3	3	3	3	2	2	2	2	1	1	2	2	3	3	3
CO4	3	2	2	1	1	2	2	1	1	2	1	3	3	3
CO5	3	3	3	2	2	2	2	1	1	2	2	3	3	3

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

Integral University, Lucknow

Effective from Session: 2024-2025							
Course Code	BE436	**Title of the Course**	ANALYTICAL TECHNIQUES	**L**	**T**	**P**	**C**
Year	4	**Semester**	7	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To equip students with theoretical knowledge and practical skills in advanced analytical techniques for food analysis, ensuring accuracy, safety, and quality assessment in food systems and products.						

Course Outcomes	
CO1	Apply spectroscopic techniques and sampling strategies to analyze food components, ensuring safety and valid interpretations.
CO2	Apply and analyze chromatographic techniques to separate food components using modern tools for accurate interpretation.
CO3	Apply modern biochemical and radiochemical techniques for accurate food analysis, ensuring valid, ethical, and safe outcomes.
CO4	Analyze food texture using appropriate instrumentation and techniques, interpreting data to ensure accurate and valid conclusions.
CO5	Apply rheological and colorimetric techniques using appropriate instruments to analyze food properties and interpret quantitative data.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Introduction to Food Analysis: Safety in Laboratory. Sampling and sampling techniques, sample preparation for analysis. Basic principles of spectroscopy: UV-VIS molecular absorption spectrometry, atomic absorption & emission spectrometry, fluorescence spectrometry, Atomic mass spectrometry, IR spectrometry.	8	CO1
2	**Separation Science**	Separation Science: Basic principles of chromatography, HPLC, GC, TLC, Super critical fluid extraction chromatography.	8	CO2
3	**Electrophoresis**	Electrophoresis methods, Immunoassays analysis, ELISA testes. Radiochemical Methods: Use of radioisotopes. Modern techniques used for proximate analysis.	8	CO3
4	**Textural Analysis**	Textural analysis-Instrumentation, measurement of textural property, types of probes, load cells, TPA, presentation of texture analysis graphs, suitability of food material for textural analysis, factors affecting the texture analysis.	8	CO4
5	**Rheometry and Colour Analysis**	Rheometry-Instrumentation. Viscometry-instrumentation, principle, measurement of parameter from viscometry. Food colour analysis.	8	CO5

Reference Books:

1. S.S. Neilson, Food analysis, Springer.
2. AOAC methods for Food Analysis.
3. Y. Pomeranz and C. E Meloan, Food Analysis, Theory and practice; AVI Publishing Company, INC West Port, Connecticut, USA.
4. Fung, D.Y.C. and Matthews, R., Instrumental Methods for Quality Assurance in Foods; Marcel Dekker, Inc. New York.
5. Moskowitz, H. R., Food Texture: Instrumental and Sensory Measurement; Marcel Dekker, Inc. New York.

e-Learning Source:

1. https://www.youtube.com/watch?v=oM04xQuLOuo&list=PL04lTsIC4hVJMp1Cq16G864UI9CpbA896
2. https://www.youtube.com/watch?v=pPD3rWOplFE
3. https://www.youtube.com/watch?v=Yw9cctUHULo

	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	3	3	2	2	1	2	1	2	3	3	2
CO2	3	3	2	3	3	2	2	1	2	1	2	3	3	2
CO3	3	3	2	3	3	2	3	1	2	1	2	3	3	3
CO4	3	3	2	3	3	2	2	1	2	1	2	3	2	3
CO5	3	3	2	3	3	2	2	1	2	1	2	3	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	BE437	**Title of the Course**	ENZYME TECHNOLOGY	**L**	**T**	**P**	**C**
Year	4	**Semester**	7	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To impart knowledge on enzyme classification, kinetics, immobilization, and industrial applications, enabling students to design biocatalytic processes and apply enzymatic technologies in food and bioprocess industries.						

Course Outcomes	
CO1	Classify enzymes, explain mechanisms and kinetics, and evaluate enzyme production, extraction, and purification processes.
CO2	Analyze enzyme kinetics, evaluate inhibition effects, and determine kinetic parameters for single and multi-substrate reactions.
CO3	Evaluate immobilization methods, analyze mass transfer effects, and optimize immobilized enzyme systems for enhanced operational stability.
CO4	Design enzyme reactors and apply enzymatic processes for starch, protein, and lipid modifications in food technological applications.
CO5	Apply enzymatic processes in dairy, meat, fish, egg, baking, brewing, and flavor industries for product enhancement.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Introduction: classification and nomenclature, mechanism of enzyme action, factors affecting the rate of enzymatic reactions, sources of enzymes, production, extraction and purification of enzymes (extra-cellular and intra-cellular).	8	CO1
2	**Enzyme kinetics**	Enzyme kinetics of free enzymes: Michaelis-Menten kinetics, kinetics for reversible reactions; Effect of various types of inhibition, evaluation of kinetic parameters; Multi-substrate reactions and their kinetics.	8	CO2
3	**Immobilized Enzymes**	Enzyme immobilization, factors affecting immobilized enzyme and its kinetics, internal and external mass transfer effects in immobilized-enzyme reactions, intra-particle diffusion, micro-environmental effects on enzyme kinetics, enzyme deactivation, operational stability and optimization, general design considerations for the immobilization process.	8	CO3
4	**Enzyme Reactors**	Basic design of enzyme reactors under Ideal conditions (Batch and continuous mixed reactors, continuous packed bed reactor under plug flow regime). Enzymes for starch modification (maltodextrins and corn syrup solids: liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup, fructose and fructo-oligosaccharides). Enzymes for protein modification, Enzymes for Lipid modification.	8	CO4
5	**Application of Enzymes**	Role of enzymes in Dairy processing, Role of enzymes in meat processing and fish processing, Egg processing. Role of enzymes in Brewing, Baking and Role of enzymes in the production of flavors.	8	CO5

Reference Books:

1. Muthuswamy C., “Enzymes in Food and Beverage Processing”, CRC Press, London 2015.
2. Aehle W, “Enzymes in Industry: production and applications”, Wiley- VCH Verlag GmbH & Co.
3. Ray R.C. and Rosell C.M., “Microbial Enzyme Technology in Food Applications”, CRC Press, London 2017 ISBN: 1498749844.

e-Learning Source:

1. https://onlinecourses.nptel.ac.in/noc23_bt05/preview

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	1	2	2	1	1	1	1	1	2	3	2	2
CO2	3	3	1	3	3	1	1	1	1	1	2	3	3	2
CO3	3	3	3	3	3	2	1	1	1	1	3	3	3	3
CO4	3	3	3	2	3	2	1	1	1	2	2	3	3	3
CO5	3	2	3	1	2	3	1	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	**BE438**	Title of the Course	**Nutraceuticals and Functional Foods**	L	T	P	C
Year	4th	Semester	7th	3	1	0	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To acquaint students with the therapeutic properties of major fruits, vegetables, spices and herbs.						

Course Outcomes	
CO1	Understand the concept of nutraceutical science and its relation with other sciences.
CO2	Evaluate the various biomolecules showing health benefits.
CO3	Analyze various physiological and biochemical aspects of life-threatening and chronic diseases and nutraceuticals as their remedies.
CO4	Apply the concept and knowledge regarding extraction, isolation, characterization, and application of nutraceuticals in food industries.
CO5	Define various inhibitors present in food and their prevention, the role of prebiotics and probiotics as nutraceuticals.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Nutraceuticals as Science**	Historical perspective, classification, scope & future prospects. Applied aspects of Nutraceutical Science. Nutritive and Non-nutritive food components with potential health effects. Effect of processing on Nutrients.	8	CO1
2	**Functions of Nutraceuticals**	Properties, structure, and functions of various Nutraceuticals: Glucosamine, Octacosanol, Lycopene, Carnitine, Melatonin, and Ornithine alpha-ketoglutarate. Use of pro anthocyanidins, grape products, and flaxseed oil as Nutraceuticals.	8	CO2
3	**Food as Remedies I**	Nutraceuticals bridge the gap between food and drug, Nutraceuticals in treatment for cognitive decline, and Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, and hypoglycemia.	8	CO3
4	**Food as Remedies II**	Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis, Ulcers, etc. A brief idea about some Nutraceutical rich supplements, e.g., Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina, etc.	8	CO4
5	**Anti-nutritional Factors Present in Foods**	Types of inhibitors present in various foods and how they can be inactivated. General idea about the role of Probiotics and Prebiotics as nutraceuticals. Role of Dietary fibers in disease prevention. Assessment of nutritional status and Recommended Daily allowances.	8	CO5

Reference Books:

1. Handbook of Nutraceuticals and Functional Foods Edited by Robert E.C. Wildman, Routledge Publishers.
2. Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press.
3. Methods of Analysis for Functional Foods and Nutraceuticals Edited by W. Jeffrey, Hursts, Routledge Publishers.
4. Dietary Supplements and Functional Foods -Geoffrey P. Webb.

e-Learning Source:

1. https://youtu.be/7z2TA06xvNk
2. https://youtu.be/DpgmHx-dl1A
3. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=nutraceuticals+in+food&btnG=#d=gs_qabs&t=1671185962784&u=%23p%3DDDYcMvUbtrUJ

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	2		1			1	2	3	2
CO2	3	2		2	2	2		1			1	2	2	2
CO3	3	3	1	2	1	2		1			2	2	3	3
CO4	2	3	3	2	2	2		1			2	2	3	3
CO5	3	2	2	1	1	1	1	1		1	3	3	2	2

8- 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	BE300	**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 biotechnology industry operations and workplace culture, apply theoretical biotechnology 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 biotechnology and associated industries.
CO2	Apply biotechnological concepts 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 biotech industries.	CO1
2	Practical Application	Apply theoretical biotechnology 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: 2024-25							
Course Code	**BE- 434**	**Title of the Course**	**Edible Oil Processing Technology Lab**	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**0**	**0**	**4**	**2**
Pre-Requisite	None	**Co-requisite**	BE-431				
Course Objectives	To provide hands-on experience in analyzing oil quality parameters and to offer industrial exposure to oil processing techniques.						

Course Outcomes	
CO1	Perform basic analytical techniques to determine fat content and acidity levels in oils.
CO2	Analyze chemical properties related to the quality and stability of oils.
CO3	Demonstrate understanding of industrial oil processing through practical exposure and advanced tests.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Fat content	Determination of fat content of oil seeds.	3	1
2	Acid value	Determination of acid value of the extracted oils.	3	1
3	Fatty Acid	Determination of free fatty acids of oil samples.	3	1
4	Iodine Value	Determination of the iodine value of oil samples.	3	2
5	Peroxide Value	Determination of peroxide value	3	2
6	Saponification value	Determination of the saponification value of different oils.	3	2
7	Smoke point	Determination of the smoke point of different oils.	3	2
8	Visit	Visit to an oil extraction, refining and vanaspati unit.	3	3

Reference Books:

1. Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.
2. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and
3. Utilization. VNR, New York.

e-Learning Source:

1. https://www.youtube.com/watch?v=sVDZnx0Ro_o

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

9- 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	BE451	**Title of the Course**	Seminar	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	0	0	0	3
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course is designed to develop students' abilities to independently explore recent developments in biotechnology and allied fields, critically review and analyze scientific literature, synthesize and organize technical information, prepare a structured review report, and deliver an effective oral presentation.						

Course Outcomes	
CO1	Understand recent trends, research advancements, and technological developments in biotechnology and allied areas.
CO2	Apply knowledge of biotechnology to identify, gather, and review relevant scientific literature on a chosen topic.
CO3	Analyze scientific findings, critically evaluate published work, and organize information logically.
CO4	Prepare a well-structured review report and deliver an effective oral presentation to communicate findings.

Unit No.	**Skill Set**	**Content of Unit**	**Mapped CO**
1	Research Orientation	Understand research areas, recent developments, and advancements in biotechnology and allied fields.	CO1
2	Application of Knowledge	Apply academic learning to identify and review current research topics and trends.	CO2
3	Critical Thinking and Analysis	Analyze and critically evaluate scientific papers, methods, and results.	CO3
4	Communication Skills	Prepare a technical report and deliver an oral presentation to effectively convey key findings.	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	1	2	1	2	3	3	2
CO2	2	3	2	3	2	2	1	2	2	2	2	3	3	3
CO3	3	3	3	2	2	1	1	1	2	2	2	2	2	3
CO4	2	2	1	1	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 Session: 2024-25							
Course Code	BE 499	**Title of the Course**	B.Tech Project	**L**	**T**	**P**	**C**
Year	4th	**Semester**	8th	**0**	**0**	**8**	**4**
Pre-Requisite		**Co-requisite**	None				
Course Objectives	The B.Tech Project aims to equip students with the ability to integrate interdisciplinary engineering knowledge (mathematics, sciences, domain fundamentals) to solve complex problems in biotechnology, food technology, or biomedical engineering. It fosters skills in critical problem analysis, research design, and sustainable innovation, emphasizing ethical practices, societal-environmental impact, and resource efficiency. Students develop proficiency in experimental investigations, modern tools, and project management, while cultivating teamwork, communication, and lifelong learning to address real-world challenges responsibly and adaptively.						

Course Outcomes	
CO1	Apply knowledge of mathematics, science, and engineering fundamentals to solve complex problems in biotechnology, food technology, or biomedical engineering.
CO2	Identify and analyze research problems by critically reviewing literature, aligning with sustainable development goals.
CO3	Design and develop effective engineering solutions or systems with considerations of health, safety, societal, and environmental aspects.
CO4	Use research-based knowledge and methods including experiments, data analysis, and interpretation to investigate complex problems.
CO5	Utilize modern tools, digital technologies, and project management principles to model, simulate, and manage engineering solutions.
CO6	Demonstrate ethical behavior, communication skills, teamwork, and commitment to lifelong learning in professional and societal contexts.

PO/ PSO	**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		2		2							3	2	
CO2	2	3		2		2					1	2	1	
CO3	2	1	3		1	3						2	3	1
CO4	1			3	2							2	3	2
CO5				1	3					3	2	1	3	2
CO6						2	3	3	3	2	3	1	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	BE412	**Title of the Course**	Educational Tour	**L**	**T**	**P**	**C**
Year	IV	**Semester**	VIII	0	0	0	2
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course is designed to help students understand the structure and functioning of biotechnology and associated industries, apply theoretical biotechnology concepts in real-world industrial and academic environments, analyze techniques, systems, and workflows observed during the educational tour, and prepare a structured technical report based on the visit, assessed through a viva voce.						

Course Outcomes	
CO1	Understand the structure, operations, and research environment of biotechnology industries, pharmaceutical companies, and academic institutes.
CO2	Apply theoretical concepts of biotechnology to practical observations made during the educational tour.
CO3	Analyze industrial processes, research methodologies, and laboratory practices observed during the visit.
CO4	Prepare a detailed educational tour report and participate in a viva voce examination to demonstrate learning outcomes and skills acquired.

Unit No.	**Skill Set**	**Content of Unit**	**Mapped CO**
1	Industry and Institute Orientation	Understand the organizational setup, research focus, manufacturing processes, and workflows in biotech industries and academic institutes.	CO1
2	Practical Application of Knowledge	Apply academic knowledge of biotechnology in real-world industrial and research environments.	CO2
3	Analytical and Critical Thinking	Analyze techniques, methodologies, and operational systems encountered during the tour.	CO3
4	Technical Communication	Prepare a structured report and participate in a viva voce to effectively communicate observations and learning	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	1	1	1	1	1	2	2	1	2	3	3	2
CO2	2	3	2	2	2	2	1	2	2	2	2	3	2	3
CO3	3	3	2	2	2	1	1	1	2	2	2	3	2	3
CO4	2	2	1	1	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**