Integral University, Lucknow

Effective from Session: 2021							
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	To provide the knowledge of oil extraction from the various oil seeds.
CO2	To provide the basics of the critical parameters involved in the extraction, refining, bleaching, deodorization of fats and oils and their modifications (blending, interesterification, emulsification, votation, fractionation and genetic manipulation) into functional shortenings and the subsequent handling and the preservation of their quality
CO3	To provide the basic chemistry of fats and oils with focus in the understanding of the relevance of their physicochemical and biochemical properties in their functions as ingredients in foods.
CO4	To provide knowledge and understanding of the changes and reactions of fats and oils in the food system influencing the stability of the finished food. To provide knowledge and understanding of the changes and reactions of fats and oils in the food system influencing the stability of the finished food.

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
2	**Types of Fats**	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. Specialty fats and designer lipids for nutrition and dietetics, especially by biotechnology.	8	CO2
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 and Storage**	Processing of vegetable oils. Hydrogenation of vegetable oils, shortenings and margarine. Fractionation, winterzation, inter-esterification etc. for obtaining tailor-made fats and oils. Rancidity and flavor reversion, mechanism and their control measures. Quality assessment tests of fats and oils, oil and fat adulterants, Packaging and storage of fats and oils.	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	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	1	1	2	2	2	3	2
CO2	3	2	3	2	2	2	2	2	2	1	1	2	2	2	2
CO3	3	3	1	2	1	2	2	2	2	2	2	2	3	3	3
CO4	2	3	3	2	2	2	2	1	1	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: 2020-21							
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	The students will get proper knowledge about the food hygiene, analysis, sampling techniques, storage and preservation.
CO2	The students will learn role of physicochemical properties of food and its analysis in food industries and food quality management systems.
CO3	The students will get proper knowledge about quality management systems to food production processes, food safety regulations and Food Standards Code and laws.
CO4	The students will learn about the quality assessment of food materials and its handling in industrial level and the role of sanitation in food industries.

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	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	3	1	1	1	1	2	1	3	3	1	3
CO2	1	1	1	3	3	1	1	1	1	2	1	3	3	1	3
CO3	1	1	1	3	3	1	1	1	1	2	1	3	3	1	3
CO4	1	1	1	3	3	1	1	1	1	2	1	3	3	1	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: 2020-21							
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	Enhance their knowledge on processing methods and equipment's used in the manufacture of different tea types, manufacture of instant and decaffeinated teas, and physiological effects of tea drinking.
CO2	Understand the technological objectives of grinding and roasting of coffee beans, manufacture of instant and decaffeinated coffee and Coffee substitutes, physiological effect of coffee consumption and Chemical changes during the processing of coffee.
CO3	Understand the concept of different unit operations employed in cocoa processing, chocolate manufacture.
CO4	Understand the concept of spice processing, spice essential oil and spice oleoresins with respect to method of extraction, isolation, and encapsulation.

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	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	1	1	3	1	1	3	3	3	3
CO2	3	3	2	2	3	3	1	1	3	1	1	3	3	3	3
CO3	3	3	2	2	3	3	1	1	3	1	1	3	3	3	3
CO4	3	3	2	2	3	3	1	1	3	1	1	3	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
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	The main objective of this subject is to impart knowledge and skills related to designing packaging systems in food products and developing skills in handling of packaging equipment in the students.						

Course Outcomes	
CO1	Understand the objectives and functions of packaging and the basic packaging requirements of a wide range of foods.
CO2	Know different types and characteristics of packaging materials viz paper and plastic.
CO3	Comprehend about metal packaging and different types of metal packages.
CO4	To understand the manufacturing process and properties of glass.
CO5	To understand the principle and applications of advanced food packaging techniques like active and intelligent packaging, vacuum packaging, ascetic packaging, etc.

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

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

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	3	1	2	2	1	2	3	3	3
CO2	3	3	2	1	1	2	2	2	1	2	1	2	3	3	3
CO3	3	2	3	1	2	2	2	2	1	2	1	2	3	3	3
CO4	3	2	3	1	2	2	2	2	1	2	1	2	3	3	3
CO5	3	2	1	1	2	2	2	2	1	2	1	2	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
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	The students will get to know about theory and application of High-pressure processing.
CO2	The students will get to know about theory and application of pulsed electric field processing.
CO3	The students will get to know about theory and application of osmotic dehydration and membrane separation.
CO4	The students will get to know about theory and application of ultrasound processing operations in food processing.
CO5	The students will get to know about theory and application of alternate thermal processing operations 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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	3	1	1	2	2	1	1	3	3	3
CO2	3	2	2	1	1	2	2	1	1	2	1	1	3	3	3
CO3	3	3	3	2	2	2	2	1	1	2	1	2	3	3	3
CO4	3	2	2	1	1	2	2	1	1	2	1	1	3	3	3
CO5	3	3	3	2	2	2	2	1	1	2	1	2	3	3	3

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	**BE436**	**Title of the Course**	**Analytical Techniques**	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Specific goal of this course is to acquaint the students with characteristics and working mechanisms of common analytical tools and the application of analytical methods to current scientific challenges.						

Course Outcomes	
CO1	Apply statistically valid sampling techniques to food samples and understand different spectroscopic methods.
CO2	Use chromatographic techniques to analyze complex food samples.
CO3	Design electrophoretic and radiochemical methods of analysis of food samples.
CO4	Analyze the texture of different food samples.
CO5	Evaluate the rheometric, Viscometric and color profile of provided food samples.

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	PO12	PSO1	PSO2	PSO3
CO1	**2**	**2**	**2**	**2**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**3**	**3**	**2**
CO2	**3**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**3**	**1**
CO3	**2**	**2**	**2**	**2**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**3**	**1**
CO4	**2**	**2**	**2**	**2**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**3**	**1**
CO5	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**3**	**1**

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	**BE437**	**Title of the Course**	**Enzyme Technology**	**L**	**T**	**P**	**C**
Year	**4th**	**Semester**	7th	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To enable the students with the know-how of designing enzymatic processes and reactors, understanding enzyme kinetics, understanding and designing immobilization process and application of enzyme technology in the food industry.						

Course Outcomes	
CO1	Gain knowledge about structure, properties of enzymes, enzyme types Understand the process of industrial enzyme production and applications in various sectors
CO2	Analyze the mathematical derivations to understand enzyme reaction kinetics and types of inhibition.
CO3	Apply engineering principles in understanding immobilized enzyme reactions.
CO4	Evaluate and design different enzyme reactors and apply research-based knowledge to design solutions for large scale applications.
CO5	Evaluate applied research about enzymes using recent studies about enzymes.

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:

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

e-Learning Source:

4. 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	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**	**2**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**1**	**3**	**2**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**0**	**3**	**3**	**3**	**2**

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
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	To understand the concept of nutraceutical science and its relation with other sciences.
CO2	Acquire knowledge of various biomolecules showing health benefits.
CO3	Understand various physiological and biochemical aspects of life-threatening and chronic diseases and nutraceuticals as their remedies.
CO4	Apply their knowledge regarding extraction, isolation, characterization, and application of nutraceuticals in food industries.
CO5	To understand 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	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	2	1	1	2	2	2	3	2
CO2	3	2	3	2	2	2	2	2	2	1	1	2	2	2	2
CO3	3	3	1	2	1	2	2	2	2	2	2	2	2	3	3
CO4	2	3	3	2	2	2	2	1	1	2	2	2	2	3	3
CO5	3	2	2	1	1	1	2	1	2	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: 2020-21							
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	The aim of the lab is to determine the various physicochemical properties of the oil seeds and other oil products.						

Course Outcomes	
CO1	To be able to perform the quality control testing of edible oils
CO2	To be able to identify the shelf life of oil.
CO3	To be able to understand the processing parameters of edible oils.

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	1,2
5	Visit	Visit to an oil extraction, refining and vanaspati unit.	3	2
6	Saponification value	Determination of the saponification value of different oils.	3	3
7	Smoke point	Determination of the smoke point of different oils.	3	3
8	Peroxide value	Determination of the peroxide value of oil samples.	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:

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	2	2	1	2	2	2	2	2	3	2
CO2	3	3	2	2	2	2	2	2	2	2	2	2	3	3	3
CO3	3	3	2	2	3	2	2	2	2	2	2	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: 2021-2022							
Course Code	**BE300**	**Title of the Course**	**Industrial training**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	**7th**	**0**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	This course deals with the students to provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.						

Course Outcomes	
CO1	Industrial training teaches and gives one the requisite skills using which students can effectively use his/her knowledge to achieve the pre-defined goals of the company or firm.
CO2	Industrial training provides them with the required exposure to the real working condition and workplace. The newly acquired experience proves to be quite helpful for them when they are employed at some place after their training is complete.
CO3	Industrial training ensures students to interact with industrial personnel and follow engineering practices and discipline prescribed in industry.
CO4	Develop awareness about general workplace behavior and build interpersonal and team skills. Prepare professional work reports and presentations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**

Reference Books:

e-Learning Source:

https://in.indeed.com/career-advice/career-development/internship-report

https://www.youtube.com/watch?v=nXmrI2A8Rv8

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	1	2	2	1	2	2	3	3	3
CO2	2	1	2	1	2	1	1	1	2	2	2	2	3	2	3
CO3	3	2	3	2	2	1	1	1	2	1	2	2	1	2	3
CO4	2	2	2	1	1	1	1	1	2	2	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: 2021-2022							
Course Code	**BE451**	**Title of the Course**	**Seminar**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	8th	**0**	**0**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To develop the Communication & Research Comprehension. To developed leadership skills. To develop the ability to seek knowledge and defend the idea.						

Course Outcomes	
CO1	Learner should be able review available literature and extract idea from them.
CO2	Learner should be able to work in a team as leader or effective team member.
CO3	Learner should be able to write technical reports and to present their work.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	3	1	1	3	3	3	1	3	3	3	3
CO2	1	1	1	3	3	1	1	3	3	3	1	3	3	1	3
CO3	1	1	1	1	3	1	1	1	3	3	1	3	1	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: 2021-2022							
Course Code	**BE499**	**Title of the Course**	**B.Tech Project**	**L**	**T**	**P**	**C**
Year	4th	**Semester**	8th	**0**	**0**	**0**	**12**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To enable students to work as a team to develop the methodology for the project. To develop the capability to apply the engineering principles to carry out the project work. To define the conclusion of the project undertaken with in depth understanding of the topic.						

Course Outcomes	
CO1	Ability to work as a team of plan the execution of the undertaken project.
CO2	Capability to use the engineering knowledge and principles on an undertaken project.
CO3	Capacity to complete the undertaken project on time with effective communication to deliver the project successfully.

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)														
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	3	3	2	1	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	2	1	3	3	3	3	3	3	1	3
CO3	3	3	3	3	3	2	1	3	3	3	3	3	1	2	2

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

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