Integral University, Lucknow

Effective from Session: 2025-2026							
Course Code	**BE231**	**Title of the Course**	Food Microbiology	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**2**	**1**	**2**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The course is designed to acquaint the students with the fundamental knowledge of microbiology and its utility in food along with acquiring practical knowledge about the microorganisms and their isolation and identification						

Course Outcomes	
CO1	Describe the history of microbiology and advent of microbial techniques, categorize the various types of microorganisms, and differentiate and summarize the features of prokaryotic and eukaryotic cells.
CO2	Describe various types of media and methods of microbial isolation, analyze the growth pattern of microorganisms and illustrate the methods of growth measurement, types of microbial cultures and summarize their characteristics.
CO3	Describe and analyze the intrinsic and extrinsic parameters affecting microbial growth and discuss the application of microorganisms in food industry.
CO4	Classify food related disorders caused by microbial contamination and evaluate and apply the existing knowledge in assessing food safety.
CO5	Demonstrate microbiological media preparation and instrument handling.
CO6	Demonstrate microbial isolation and detection by different methods and identify them through staining techniques.
CO7	Perform MBRT test to evaluate the quality of milk.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Microbiology	Definition, history of microbiology. Basic knowledge of microorganisms: Bacteria, fungi, actinomycetes, protozoa etc. prokaryotic and eukaryotic cells.	8	CO 1
2	Microbial Media, types and isolation techniques	Microbial media and types, microbial isolation techniques: dilution, pour plate and streak plate. Microbial growth curve and growth measurements, pure culture, starter culture, cultural characteristics of bacteria.	8	CO 2
3	Factors affecting microbial growth And Microbial Spoilage of Food Products	Intrinsic (pH, moisture content, redox potential, nutrient content, antimicrobial constituents and biological structures) and extrinsic factors (temp., RH, presence and concentration of gases) governing growth of microorganisms in food. Microbiology of raw milk and fermented milk products viz yoghurt, cheese, fruits and vegetable, meat and meat product, egg and fish.	8	CO 3
4	Microbial Food borne diseases	Introduction and types (foodborne intoxications and foodborne infections), Toxins produced by *Staphylococcus, Clostridium, Aspergillus*	8	CO 4

PRACTICAL

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Introduction to microbiological instruments and their working principle (Autoclave, air laminar flow, incubator, Hot air oven and Microscopes).	2	CO5
2	Preparation of media NAM (Nutrient agar medium) and PDA (potato dextrose agar) and glass ware sterilization by autoclave.	2	CO5
3	Isolation of microorganism (bacteria and fungi) from air by plate exposure method.	2	CO6
4	Isolation of microorganism (bacteria & fungi) from soil by spread plate method by using dilution technique.	2	CO6
5	Detection and enumeration of spoilage microorganisms (Psychrotrophic count and proteolytic count).	2	CO6
6	Differentiate bacteria by Gram-staining technique	2	CO6
7	Endospore staining.	2	CO6
8	Isolate the fecal coliform from sewage water and determine the MPN (Most probable no.) of sample.	2	CO6
9	Determine the quality of milk by using methylene blue reduction test (MBRT).	2	CO7

Reference Books:

1. Pelczar, M. J., Chan, E. G. S. and Krieg, N.R. (2002). *Microbiology 5th edition*, Tata McGraw Hill and Co, New Delhi.
2. Frazier, W. C. &Westhoff, D. C. (1996). *Food Microbiology*, Tata McGraw Hill and Co.
3. N. Shakuntala Manay& M Shadakshra Swamy; revised edition, new age international publisher.
4. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).
5. Lab Manual by K. R Aneja

e-Learning Source:

https://www.youtube.com/watch?v=--OvDvS-Pec

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

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO-PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		1		1	1					3		1	1
CO2	3	1	2	2	3	2					3		2	2

CO3	3	1	3	1	1	3					3	2	3	3
CO4	3	1	2	1	1	3					3	1	2	2
CO5	3	3	1	1	2	1	1	3	1		3		1	2
CO6	3	3	2	2	2	2	1	3	1		3	1	2	3
CO7	3	3	2	3	2	3	1	3	1		3	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: 2025-26							
Course Code	**BE 232**	**Title of the Course**	Food engineering-I	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**4**	**5**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To impart knowledge of basic engineering processes involving in food science and technology.						

Course Outcomes	
CO1	Understand the fundamental of engineering properties of food and derived units.
CO2	Evaluate, flow behavior of fluids and analyze the f basic principles of dimension less numbers and its applications
CO3	Analyze the basic principles of Diffusion, mass transfer, and flow in pipe
CO4	Apply the concept of separation process, Reverse-Osmosis, Membrane filtration and Ultrafiltration.
CO5	Define the idea and basic principle of filtration and centrifugation
CO 6	Demonstrate fluid flow behavior by plotting flow nets and experimentally verifying Bernoulli's Equation.
CO 7	Calibrate flow measuring devices (Venturi-meter, orifice meter, and notches) and analyze the relationship between discharge coefficients and Reynolds number.
CO 8	Study the transition from laminar to turbulent flow and analyze fluid velocity distribution within a pipe.
CO 9	Analyze the friction factor in turbulent flow through commercial pipes and experimentally verify the impulse-momentum equation in fluid mechanics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Food Engineering**	Dimensions, Engineering Units, System, State of a System, Density, Concentration, Moisture Content, Temperature, Pressure, Enthalpy, Equation of State and Perfect Gas Law, Phase Diagram of Water, Conservation of Mass.	8	CO1
2	**Basics of Fluid Mechanics**	Liquid Transport Systems, Properties of Liquids, Handling Systems for Newtonian Liquids, Force Balance on a Fluid Element Flowing in a Pipe—Derivation of Bernoulli Equation, Pump Selection and Performance Evaluation, Flow Measurement, Measurement of Viscosity.	8	CO2
3	**Mass Transfer Operations**	The Diffusion Process, Steady-State Diffusion of Gases (and Liquids) through Solids, Convective Mass Transfer, Laminar Flow over a Flat Plate, Turbulent Flow Past a Flat Plate, Laminar Flow in a Pipe, Turbulent Flow in a Pipe, Mass Transfer for Flow over Spherical Objects, Unsteady-State Mass Transfer, Transient-State Diffusion, Diffusion of Gases.	8	CO3
4	**Separation Process**	Electrodialysis Systems, Reverse Osmosis Membrane Systems, Membrane Performance, Ultrafiltration Membrane Systems, Concentration Polarization, Types of Reverse-Osmosis and Ultrafiltration Systems, Plate and Frame, Tubular, Spiral-Wound, Hollow-Fiber.	8	CO4
5	**Filtration and Centrifugation**	Filtration: Operating Equations, Mechanisms of Filtration. Sedimentation: Sedimentation Velocities for Low and high Concentration Suspensions. Centrifugation: Basic Equations, Rate of Separation, Liquid-Liquid Separation. Mixing: Agitation Equipment, Power Requirements of Impellers	8	CO5

PRACTICAL

Experiment No.	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Hele-Shaw apparatus	To illustrate the pattern of fluid movement by plotting a flow net with the use of the Hele-Shaw apparatus	4	**CO 6**
2	Bernoulli's Equation	To verify Bernoulli's Equation experimentally.	4	**CO 6**
3	Venturi meter	To calibrate the Venturi-meter and investigate the dependency of the discharge coefficient on the Reynolds number.	4	**CO 7**
4	Orifice meter	To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.	4	**CO 7**
5	Notch apparatus	To determine the discharge coefficient by calibrating the given V-notch or rectangular notch.	4	**CO 7**
6	Reynold's Apparatus	To Study the transition from laminar to turbulent flow and determine the lower critical Reynolds number.	4	**CO 8**
7	Velocity Distribution	To study how fluid velocity is distributed along different points within the pipe's diameter	4	**CO 8**

8	Friction factor	To analyze the variation of the friction factor 'f' with respect to turbulent flow in commercially available pipes.	4	**CO 9**
9	Impact of Jet apparatus	To conduct an experiment that demonstrates and confirms the impulse-momentum equation in fluid mechanics.	4	**CO 9**

Reference Books:

1. Brennan JG, Butters JR, Cowell ND & Lilly AEI. 1990. Food Engineering Operations. Elsevier.
2. Fellows P. (1988). Food Processing Technology: Principle and Practice. VCH Publ.
3. McCabe WL & Smith JC. (1999). Unit Operations of Chemical Engineering. McGraw Hill.
4. Sahay KM & Singh KK. (1994). Unit Operation of Agricultural Processing. Vikas Publ. House

e-Learning Source:

Journal of Food Engineering | ScienceDirect.com by Elsevier

Food Engineering Reviews | Home (springer.com)

https://www.youtube.com/watch?v=9ENRUaa2JkY

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			1	3	1	2	2			3	1	3
CO2	2	2	1		2	2	2	1	2			2	2	2
CO3	1	1	1		3	2	3	1	1			2	2	1
CO4	2	1	2		3	3	2	3	1			1	1	1
C05	2	1	2		3	3	3	3	2			1	2	1
C06	3	3	2	2	3	2	2	1	2	2	1	3	3	3
C07	3	3	2	2	3	2	2	2	2	2	1	3	3	3
CO8	3	3	2	1	3	2	1	2	2	2	1	3	3	3
CO9	3	3	2	1	3	2	2	1	2	2	1	3	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Corre2lation

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

Integral University, Lucknow

Effective from Session: 2025-2026							
Course Code	BE233	**Title of the Course**	Food Chemistry	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**2**	**0**	**4**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The core competency of this course is for students to differentiate chemical interactions and reactions of food components and their effect on sensory, nutritional, and functional properties of foods, and how processing influences these properties.						

Course Outcomes	
CO1	Explain the influence of water on food stability and its interactions with other food components using scientific principles.
CO2	Analyze the properties and interactions of carbohydrates to regulate specific quality attributes in food systems.
CO3	Evaluate the role of proteins and enzymes in food systems and apply biochemical principles to control food quality in industrial applications.
CO4	Assess the chemical composition, physical properties, and health implications of lipids while designing strategies to modify lipid characteristics for improved food quality and stability.
CO5	Estimate the proximate analysis of foods.
CO6	Demonstrate the biochemical analysis in terms of estimation of nutritional value of foods.
CO7	Estimate the physiochemical characteristics of different foods

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to food chemistry	Introduction; Definition of food chemistry. Water; structure of water, water solute interactions, water activity, moisture sorption isotherms	8	CO 1
2	Carbohydrates	Carbohydrates- Monosaccharide's, monosaccharide isomerization and reactions, Oligo saccharides- lactose, maltose, sucrose; Polysaccharides: Starch-structure, retro-gradation and gelatinization. Structure and functional properties of Gums, pectin, cellulose, dietary fibre	8	CO 2
3	Proteins	Protein- structure, denaturation, functional properties, viscosity, protein quality and digestibility. Enzymes- types and chemical nature, factors influencing enzyme activity, enzyme inactivation, coenzymes. Uses of enzymes in food processing. Browning and its control.	8	CO 3
4	Fats	Fats- Classification, Fatty acids, Oxidative Rancidity of fats, Lipid Refining, Hydrogenation and Inter-esterification of fats. Safety of hydrogenated fats. Food Lipids and Health: Bioactivity of Fatty Acids, Trans Fatty Acids, ω-3 Fatty Acids	8	CO 4

PRACTICAL

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Determination of moisture content.	4	CO 5
2	Detection of reducing sugar by Fehling and Benedict test.	4	CO 7
3	Determination of fat content of a food sample.	4	CO 6
4	Detection of amino acid, protein and peptides by Ninhydrin test.	6	CO 7
5	Determination of protein.	6	CO 5
6	Determination of titrable acidity.	4	CO 7
7	Determination of Ash content.	4	CO 6
8	Detection of presence of starch by Iodine test.	4	CO 7
9	Determination of water activity of different food materials.	4	CO 7
10	Determine the vitamin C content of any fruit.	4	CO 6

Reference Books:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
2. Food Chemistry by L. H. Muyer.
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Fennema, O. R., Damodaran, S. (2008). Food Chemistry, 4th Edn. CRC Press USA

e-Learning Source:

1. Food Chemistry | Journal | ScienceDirect.com by Elsevier

	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	1	1	1	1			1	1	1	1	1
CO2	1	1	1	1	1	1	1			1	1	1	1	1
CO3	1	1	1	1	1	1	1			1	1	1	1	1
CO4	1	1	1	1	1	1	1			1	1	1	1	1
CO5	1	1	1	1	1	1	1			1	1	1	1	1
CO6	1	1	1	1	1	1	1			1	1	1	1	1
CO7	1	1	1	1	1	1	1			1	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:2025-26							
Course Code	BE 234	**Title of the Course**	REFRIGERATION AND COLD CHAIN	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**0**	**0**	**2**
Pre-Requisite	NONE	**Co-requisite**	NONE				
Course Objectives	• To understand the fundamental principles of refrigeration, refrigerants and cold storage systems, including their components and working mechanisms. • To explore thermodynamic cycles used in refrigeration and air conditioning, including the Carnot and vapour compression cycles. • To understand the design, construction, and functional requirements of cold storage systems for various food products. • To study different freezing systems and their applications in food preservation.						

Course Outcomes	
CO1	Will be able to comprehend and apply the fundamental principles of refrigeration and air conditioning, including the classification of refrigerants, and their physical, chemical, and thermodynamic properties for efficient system performance.
CO2	Will be able to analyze and implement thermodynamic refrigeration cycles, assess the functionality of refrigeration system components, and apply principles of ice manufacturing for industrial applications.
CO3	Will be able to design and optimize cold storage systems, evaluate insulation properties, estimate cold load, and analyze the applications of refrigeration in food preservation, including storage of fruits, vegetables, meat, poultry, and dairy products.
CO4	Will be able to evaluate and apply freezing system technologies, including indirect and direct contact freezing methods, analyze frozen food properties, and determine freezing and thawing times to enhance efficiency in cold chain management.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction & properties of refrigerants	Definition of refrigeration and air conditioning, necessity of refrigeration and air conditioning. Refrigerants, definition, classification, nomenclature, methane and ethane series. Desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical, Azeotropes.	8	CO1
2	Thermodynamic cycles & Ice manufacturing	Carnot Cycle for Refrigeration, Reverse Carnot Cycle, Refrigerator and Heat Pump, Coefficient of Performance (COP). Net refrigerating effect, ton of refrigeration. Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve. Ice manufacture, principles of ice production, Brines, Freezing tanks, ice cans, air agitation, quality of ice.	8	CO2
3	Cold chain & applications of refrigeration	Introduction, Functional Requirements of Cold Storage, Cold Storage Design and Construction, Small and large commercial storages, Cold Room temperatures, Insulation, Properties of insulating materials, Cold load estimation. Applications of refrigeration in different food products – fruit, vegetable, meat products, fish, poultry products, dairy products etc.	8	CO3
4	Food Freezing	Food Freezing: Freezing systems: indirect contact systems, plate freezers, air blast freezers, and freezers for liquid foods. Direct contact systems, air blast immersion, frozen food properties, density, Thermal conductivity enthalpy, apparent specific heat and thermal diffusivity, freezing time, factors influencing freezing time, freezing rate, thawing time.	8	CO4

Reference Books:

1. Arora CP, Refrigeration and air conditioning, Tata Macgraw Hill.
2. Manohar Prasad, Refrigeration and air conditioning, New Age Publication.
3. Singh RP and Heldman DR.1993, 2003, 2009. Introduction to food engineering. Academic press 2nd, 3rd and 4th edition.
4. Fellow P. 1988 Food processing technology. VCH Ellis Horwood

e-Learning Source:

1. https://www.youtube.com/watch?v=nlsNmhiID74&list=PLfUUbFVTz-XcXbSUD0BXdPxGXFGkcdLXa

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	PSO5	PSO6	PSO7
CO1	3	3	2	2	2	2	-	1	-	1	3	3	2	2			
CO2	3	3	3	3	2	2	-	1	-	1	3	3	3	2			
CO3	3	2	3	3	2	2	-	1	-	3	3	3	3	3			
CO4	3	2	3	3	2	2	-	1	-	3	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: 2025-2026							
Course Code	BM226	**Title of the Course**	Human Values & Professional Ethics	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**2**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To help students understand the importance of human values and ethics in professional and personal life. • To develop a sense of social and environmental responsibility. • To enhance decision-making capabilities based on moral values and professional ethics. • To create awareness about the ethical responsibilities of engineers towards society. • To equip students with tools to handle ethical dilemmas in the workplace effectively.						

Course Outcomes	
CO1	Develop an understanding of human values, morals, and ethics for professional and personal growth.
CO2	Analyze and apply ethical reasoning in decision-making for professional and social well-being.
CO3	Demonstrate awareness of environmental, social, and sustainability responsibilities in engineering practices.
CO4	Identify ethical dilemmas and implement professional ethics in engineering projects.
CO5	Develop skills for effective communication, teamwork, and leadership while adhering to ethical values.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Human Values	Definition, Types of Values, Morals, Ethics, and Character, Need for Ethics in Engineering. Value Education, Self-Exploration. Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Understanding Happiness and Prosperity correctly.	6	CO1
2	Introduction to Ethical Concept	Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law.	6	CO2
3	Corporate Social Responsibility & Sustainability	The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Role of Engineers in Society, Ethical Theories, Decision Making Frameworks, Conflicts of Interest Environmental and Social Responsibilities, Sustainability, Safety, and Risk Assessment	6	CO3
4	Ethical Dilemmas and Case Studies	Senses of 'Engineering Ethics', variety of moral issues, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Valuing Time, Case Studies on Professional Ethics, Corporate Misconduct, Whistleblowing	6	CO4
5	Communication and A Glimpse of Life Stories on Leadership with Ethics	Effective Communication, Teamwork, Leadership, and Ethical Conduct. Environmental ethics, computer ethics, weapons development, engineers as managers consulting engineers, engineers as expert witnesses and advisors, moral leadership. Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs.	6	CO5

Reference Books:

- R. R. Gaur, R. Sangal, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics," Excel Books, 2010.
- Govindarajan M., Natarajan S., Senthil Kumar V. S., "Engineering Ethics (Includes Human Values)," PHI Learning, 2013.
- Charles D. Fleddermann, "Engineering Ethics," Pearson Education, 4th Edition, 2012.
- Mike W. Martin, Roland Schinzinger, "Ethics in Engineering," McGraw Hill, 4th Edition, 2013.
- R.S. Naagarazan, "Professional Ethics and Human Values," New Age International, 2006.

e-Learning Source:

https://www.youtube.com/watch?v=XiN8iqJGb48&list=PLFW6lRTa1g83uYgRiZEy_F4pzedPNWpew

https://www.youtube.com/watch?v=vS31O3XfH_0&list=PLyVhmjhvTvDYR2K4FgFYuK2gfUibZG8YA

https://www.youtube.com/watch?v=8gpzLafYPcA

https://www.youtube.com/watch?v=xXyatU-l07w

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

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

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

Integral University, Lucknow
Attributes &SDGs Common for all branches/Disciplines

Course Code	Course Title	Attributes							SDGs No.
ES203	Disaster Management and Mitigation	Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
						√			SDGs 3,11 & 17

B.Tech. (All Branches)

Effective from Session:							
Course Code	**ES203**	**Title of the Course**	**Disaster Management and Mitigation**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	2	1	**0**	**3**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	1. **Understand** the various types of disasters and analyze their profiles in the Indian context. 2. **Explain** the causes and **evaluate** the impacts of different disasters through case studies of national and global events. 3. **Apply** risk reduction approaches in disaster management and **analyze** safety measures for mitigating industrial disasters. 4. **Comprehend** the fundamental concepts of the Disaster Management Cycle and **implement** appropriate risk reduction strategies. 5. **Examine** national disaster mitigation acts and policies, and **assess** the roles of key stakeholders such as the Army, Police, Community, Corporate sector, and Media in post-disaster management from both national and global perspectives.						

Course Outcomes	
CO1	Students will be able to learn types of disasters and its profile in India
CO2	Students will be able to understand the causes and impacts of disasters on environment
CO3	Students will be able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction
CO5	Students will be able to learn the role of Acts, Policies, National and International Organizations in Disaster Management
CO6	Students will be able to learn about Global Perspectives of Disasters

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to disaster	Introduction to Disasters, Concepts, Definition and types (Natural and Man-made), Disaster profile of India.	6	CO1
2	Impact of Disaster	Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem., Case studies from Disasters, Large Hydro projects and its risks for Disasters.	8	CO2
3	Disaster Risk Reduction	Approaches to Disaster risk Reduction, Risk Assessments and Vulnerability Analysis Techniques, Safety issues in mitigating, Case studies, EHS	7	CO 3
4	Disaster Management	Disaster Management Cycle. Reconstruction and Rehabilitation. Early warning Systems Pre-Disaster Management, Post Disaster Management	6	CO4
5	Disaster Act and Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, NDRF, National Policy for Disaster Management 2009, Role of Army and Police Force in Disaster, Role of International/National Humanitarian aid/ Relief Organizations for Disaster management, Role of Community, Corporate, Media etc. for post Disaster Management.	9	CO5
6	Global Perspective (Natural and Manmade Disasters)	Case Studies of disasters induced by Human Activities and climate change such as earthquake, forest fire, flood, drought, landslides, Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	9	CO 6

Reference Books:

(1) Gupta Harsh K., Disaster Management, Hyderabad University Press, Publications-Meerut.
(2) Sethi, V.K., Disaster Management, New Delhi Maxford Books
(3) Bhattacharya, Tushar, Disaster Science and Management, New Delhi Tata Mc Graw Hill.
(4) Nidhi Gauba, Dhawan/ Ambrina Sardar Khan, Disaster Management and Preparedness, CBS

e-Learning Source:

https://www.youtube.com/watch?v=9WIwlljva_s

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

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	PSO4	PSO5	PSO6
CO1	2	1	1	1	1	2	3	-	2	2	1	2	1	2	-	-	-	-
CO2	2	2	2	1	2	2	3	-	2	2	2	2	1	2	-	-	-	-
CO3	3	2	2	1	2	2	3	-	2	2	1	2	1	2	-	-	-	-
CO4	2	2	3	1	2	2	3	-	2	1	1	2	1	2	-	-	-	-
CO5	1	1	2	2	1	1	2	-	2	2	1	2	1	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: 2025-26							
Course Code	**BE-235**	**Title of the Course**	**Food engineering II**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**2**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To impart knowledge on thermal processes, molecular diffusion, freezing and dehydration processes.						

Course Outcomes	
CO1	Analyze heat conduction in different geometries and Apply concepts of extended surfaces, thermal insulation, and unsteady-state conduction for efficient heat transfer in food processing
CO2	Evaluate convection and radiation mechanisms using dimensionless numbers and Design optimal heat exchanger systems for food processing applications.
CO3	Assess pasteurization, sterilization, and UHT processing, calculate process parameters, and recommend suitable thermal treatments for food safety and quality. .
CO4	Apply Plank's law to estimate freezing times, analyze freeze concentration and evaporation, and Evaluate energy balances in multiple-effect evaporators.
CO5	Examine drying mechanisms, interpret drying curves, and develop efficient drying strategies for food products
CO6	Analyze and evaluate heat transfer processes including natural and forced convection, conduction through composite walls, and thermal performance of heat pipes using experimental methods, and compare the effectiveness of different materials in heat transfer applications.
CO7	Apply experimental methods to analyze heat transfer mechanisms—convection, conduction, radiation, boiling, and condensation—by determining key parameters and evaluating the performance of heat exchangers.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Heat transfer	Heat transfer: Conduction: steady state heat conduction equation, heat conduction in slabs, cylinders and Spheres. Extended surfaces, effectiveness of fins, thermal insulation and their selection. Unsteady state heat conduction.	8	CO1
2	Convection	Convection: Free and forced convection, dimensionless numbers in heat transfer, expressions for calculating heat transfer coefficients, Laminar and turbulent heat transfer inside and outside tubes. Radiation: Kirchoffs Law, Stephen-Boltzman's Law. Heat exchanger, Classification, applications, mode of operation, Effectiveness, flow arrangement.	8	CO2
3	Thermal operations	Thermal operations: Pasteurization and Sterilization - Basic concept, pasteurization of unpackaged and packaged foods, effects of pasteurization on foods. Energy requirement and rate of operations involved in process time evaluation in batch and continuous sterilization, UHT processing; aseptic packaging.	8	CO3
4	Freezing	Freezing: Plank's law and estimation of freezing time of foods; equipment, freeze concentration of liquid food. Rate of freezing. Concentration and Evaporation: Concentration of liquid foods in batch and continuous type evaporators; heat and energy balance in multiple effect evaporators.	8	CO4
5	Drying of Foods	Drying of Foods: various mechanisms of moisture removal in solid and liquid foods during drying; properties of air-water vapor mixture, drying curves, different types of dryers.	8	CO5
PRACTICALS				

	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
	Natural convection Experiment	To determine the surface heat transfer coefficient for a vertical tube losing heat by natural Convection.	4	**CO6**
	Force convection Experiments	To find the heat transfer coefficient of forced convection in internal pipe flow.	4	**CO6**
	Composite Wall Experiment	To study the heat transfer through conduction in composite wall, and calculate thermal resistance, thermal conductivity and plot the temperature profile along the composite wall.	4	**CO6**
	Heat Pipe Experiment	To study the variation of heat sink temperature and longitudinal temperature distribution for heat pipe and compare it with stainless steel, copper and GI pipe.	4	**CO6**
	Steffen's Boltzmann Experiment	To determine the Steffen's Boltzmann Constant	4	**CO7**
	Heat Exchanger Experiment	To determine the LMTD, overall heat transfer coefficient and effectiveness of a heat Exchanger working in parallel flow mode.	4	**CO7**
	Heat Exchanger Experiment	To determine the LMTD, overall heat transfer coefficient and effectiveness of a heat Exchanger working in counter flow mode.	4	**CO7**
	Boiling and Condensation Experiment	To observe the process of boiling and condensation	4	**CO7**
	Condensation Experiment	To study the heat transfer in the process of condensation	4	**CO7**

Reference Books:

McCabe WL & Smith JC. 1999. *Unit Operations of Chemical Engineering*. McGraw Hill.

Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.

Fellows P. 1988. *Food Processing Technology: Principle and Practice*. VCH Publ.

Singh RP and Heldman DR. 1993.*Introduction to Food Engineering*. Academic Press.

e-Learning Source:

food engineering rpaulsingh

	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	1	1	1	2						3	3	3
CO2	3	3	1	1	1	2						3	3	3
CO3	3	3	1	1	1	2					2	3	3	3
CO4	3	3	1	1	1	2				1	2	3	3	3
CO5	3	3	1	1	1	2				1	2	3	3	3
CO6	3	3	2	3	3	2	2	1	2	2	1	1	1	2
CO7	3	3	2	3	3	2	2	1	2	2	1	1	1	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: 2025-26							
Course Code	**BE236**	**Title of the Course**	**Principles of Food Preservation and Processing**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**4**	**5**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	The primary objective of this subject is to impart knowledge of various preservation techniques and their use to increase the shelf life of foods.						

Course Outcomes	
CO1	Explain and Analyze methods of in activation of micro-organisms at high temperature.
CO2	Apprehend ways of restriction of growth of microorganisms at low temperature.
CO3	Analyze the methods of preservation by food additives.
CO4	Evaluate and apply advanced thermal and non-thermal processing techniques.
CO5	Analyze the role of processing in terms of shelf life, safety, nutritional and economic value of fruit and vegetables.
CO6	Assess the role in pre- and post-harvest changes in fruits and vegetables on product quality.
CO7	Demonstrate the production, preservation and packaging of jam, jelly, marmalade, pickles, and candies.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction and Historical Development of Food Preservation	Introduction and Historical Development of Food Preservation. Preservation by heat; Principles of heat preservation, heat resistance of micro-organisms and their spores. Thermal death time; Heat penetration studies. Heat treatments- boiling, pasteurization, sterilization, canning.	08	CO1
2	Preservation by low temperature	Preservation by low temperature - Low temperature storage, refrigeration and freezing. Preservation by drying; Phenomenon and methods of drying-dehydration by air drying, sun drying and freeze drying. Intermediate moisture foods.	08	CO2
3	Preservation by food additives and irradiations	Preservation by food additives: definitions, classification and functions. Preservation by radiations: Ionizing and Ultraviolet irradiations, Effect on micro-organisms, Applications.	08	CO3
4	Novel techniques	Microwave heating- Properties, mechanism, microwave generator and microwave food application. Introduction to hydrostatic pressure technology, ohmic heating and extrusion cooking. Processing using ultrasound: Theory, Application to processing.	08	CO4

PRACTICAL

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	Carry out preservation of certain vegetables by dehydration.	3	CO5
2	Study the re-hydration characteristics of dried vegetable.	3	CO5
3	Carry out the preservation of fruits and vegetables by pickling.	3	CO7
4	Perform osmotic dehydration of certain fruits and vegetables by sugar and salt solution.	3	CO7
5	Study different parameters during processing of rice e.g. cooking time, %elongation, %width, expansion, %water uptake, CDC ratio.	3	CO5
6	Preparation of squash to demonstrate the preservation by sugar.	3	CO7
7	Bottling of peas.	3	CO5
8	Preservation of vegetable with the help of fermentation technique (sauerkraut).	3	CO6,7
9	Examination of canned pineapple.	3	CO5,7
10	Estimation of shelf life of foods on the basis of water activity and temperature.	3	CO5
11	Preservation of food products by refrigeration and freezing.	3	CO6

Reference Books:

1. Norman N. Potter, Joseph H. Hotchkiss , Food Science – 5th ed. Springer, 1998 – Technology & Engineering – 608 pages.
2. Giridhari Lal, G.S. Siddappa and G. L. Tandon, Preservation of Fruits and Vegetables; CFTRI, ICAR , New Delhi -12.
3. Mircea Enachescu Dauthy, 'Fruit and vegetable processing', FAO Agricultural Services Bulletin 119; International Book Distributing Co.
4. B J B Wood, Microbiology of Fermented Foods, Vol. I; Elsevier Applied Science Publishers.
5. Penfield, M. P., Campbell, A. M., & Penfield, M. P. (1990). Experimental food science (pp. 442-446). San Diego: Academic press

e-Learning Source:

1. Ajita, Tiwari. "Extrusion cooking technology: An advance skill for manufacturing of extrudate food products." *Extrusion of metals, polymers and food products* (2018).

2. Balasubramaniam, V. M., Daniel Farkas, and Evan J. Turek. "Preserving foods through high-pressure processing." *Food technology (Chicago)* 62.11 (2008): 32-38.

3. https://www.youtube.com/watch?v=XKvo9_Jdjt4

	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	3	2	3	2				2	3	3	3	2
CO2	2	1	3	2	3	2				2	3	3	3	2
CO3	3	2	3	2	2	3				3	3	3	3	2
CO4	3	2	3	2	2	3				3	3	3	3	2
CO5	2	2	3	2	2	1				1	3	2	2	3
CO6	3	2	3	2	2	2				2	3	2	2	3
CO7	2	2	3	2	2	1				1	3	3	3	3

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

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

Effective from Session: 2025-26							
Course Code	BE-237	Title of the Course	DAIRY TECHNOLOGY	L	T	P	C
Year	II	Semester	IV	2	1	2	4
Pre-Requisite	None	Co-requisite	None				
Course Objectives	To impart knowledge of principles of processing of milk and milk products						

Course Outcomes	
CO1	Understand the basic knowledge of milk composition with procurement and transportation methodology and national and international standards.
CO2	Evaluate the quality of milk along with sources of contamination and how the milk spoiled.
CO3	Understand the good hygiene practices, and various procedures for manufacturing and apply knowledge for the prevention of milk spoilage and methodology of Pasteurization, standardization, toning, homogenization, and cream separation from milk
CO4	Evaluate the application and technology applied for the development of dairy products along with ghee preparation and other milk-based dairy products in a n economic way.
CO5	Develop Sterilized flavored milk, UHT milk and design Aseptic packaging and storage
CO6	Demonstrate the microbiological analysis in terms of shelf life, safety, nutritional and economic value of dairy products.
CO7	Perform pre- and post-safety in dairy product quality.
CO8	Gain knowledge on production of dairy and dairy products such as ice creams, Paneer, khoa etc including their quality assurance.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to milk**	Milk: Definition, composition. Physical-chemical properties, nutritive value of milk, milk products, and its national and international standards. Practices related to procurement and transportation of milk, t h e introduction of white revolution.	8	CO1
2	**Testing of milk and milk products**	Testing of milk and milk products: Detection of non-milk fats, water, non-milk proteins. Microbiology of milk: Milk as a substrate for bacteria, spoilage micro-organisms, pathogenic micro-organism, sources of contamination of milk.	8	CO2
3	**Good hygienic practice in milk processing**	Good hygienic practice in milk processing: Principal hazards, cleaning and disinfection in a dairy industry, disinfection agents. Pasteurization, standardization, toning, homogenization and cream separation from milk.	8	CO3
4	**Technology of traditional Indian dairy products**	Technology of traditional Indian dairy products. Technology of fat rich dairy products: Cream, butter, ghee. Technology of fermented milk and milk products and probiotic milk based products.	8	CO4
5	**New concepts in dairy technology**	Sterilized flavored milk, UHT milk, Aseptic packaging and storage, Milk products utilization, Irradiation of milk, Application of stabilizers and emulsifiers in dairy products	8	CO5

PRACTICALS

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Platform Test	Determination of quality of raw milk (eq. COB, MBRT, Resazurin Test, Lactometer reading, pH & acidity, fat contents, SNF content, specific gravity etc).	3	CO5
2	Pasteurization conformity Test	Determination of adequacy of pasteurization (Phosphatase test).	3	CO6
3	Microbial Analysis	Determination of microbiological quality (TPC/SPC) of pasteurized and sterilized/flavored milk samples & some milk products like ice cream.	3	CO4
4	Product quality Test	Determination of certain dairy products (eg. Khoya, paneer, flavoured milk, yogurt, cream, ice cream, srikhand etc.) and assessment of yield and quality of the prepared products.	3	CO7
5	Qualitative Analysis	Determination of solubility, dispersibility of dried milk powders (spray & drum-dried samples).	3	CO3
6	Biochemical Analysis	Determination of certain key parameters in dairy products (eg overrun in ice cream, salt content in butter, moisture content in ghee etc.)	3	CO4
7	Industrial Visit	Visit to a dairy/ice cream factory/food industry.	3	CO8

Reference Books:

1. Smit, G., Dairy processing - improving quality; Woodhead Publishing.
2. Walstra P., Geuits T.J., Noomen A., Jellema A. and Van Boekel M.A.J.S., Dairy technology- Principles of milk properties and processes; Marcel Dekker Inc.
3. Spreer E., Milk and dairy product technology; Marcel Dekker Inc.
4. Gupta R.P., Dairy India year Book 2007.

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	3		2	1	1	2		2			3	2	2	2
CO2	2		2	2	3	3		2			2	2	3	3
CO3	2		2	2	1	2		3	3		2	3	2	3
CO4	3	1	2	2	2	2	2	2	2	2	2	2	3	3
CO5	2	2	2	2	3	2	2	2	3	3	2	2	3	3
CO6	2	2	3	2	3	2	2	2	3	3	2	2	3	3
CO7	2	3	2	2	3	2	2	2	3	3	2	2	3	3
CO8	2	3	2	2	3	2	2	2	3	3	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: 2025-2026							
Course Code	**BE 238**	**Title of the Course**	**Energy Utilization in Food Industry**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**0**	**3**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives							

Course Outcomes	
CO1	Understand the basic knowledge of energy its norms and scenarios; energy auditing, data collection and analysis for energy conservation in food processing industries energy sources, and Applications of renewable energy in the food industry.
CO2	Analyze the fundamental aspects of biomass as an alternate source of energy along with its merits and demerits.
CO3	Evaluate and apply basic knowledge of solar energy and its application in the Indian food industry and other heavy industries along others alternative sources of energy.
CO4	Apply the application of energy audit and its management with a case study

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Energy Form and units	Common forms of energy, their units, norms and scenarios, Energy chain, Classification of energy source. Salient features of Energy Conservation Act. Principles of energy conservations.	8	CO1
2	Biomass, Biodiesel and their utilization	Biomass (useable form of biomass, Conversion Technologies) and their utilization, Characterization of biomass; briquetting and baling of biomass, biomass combustion, liquefaction, gasification, biogas plants, biodiesel: (composition, properties, preparation and applications)	8	CO2
3	Renewable and non-renewable sources of energy	Importance of conventional and non-conventional forms of energy. Solar Energy: Solar passive heating, solar active heating, photovoltaic cells and arrays; Brief introduction to wind energy, hydroelectric energy, ocean energy, nuclear energy.	8	CO3
4	Energy accounting methods, audit and Management	Energy accounting methods, Energy audit and design of computer-based energy management systems, Energy management in various operational units of the agro-processing units (Case studies).	8	CO4

Reference Books:

1. Kennedy WJ Jr. & Wayne C Turner.1984. Energy Management. Prentice Hall.
2. Pimental D. 1980. Handbook of Energy Utilization in Agriculture. CRC.
3. Rai GD. 1998. Non-conventional Sources of Energy. Khanna Publ.
4. B H Khan. 2006. Non-Conventional Energy Resources. Tata McGraw Hill.

e-Learning Source:

https://www.hindawi.com/journals/jre/

	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	1	1	1	2		1		3	1	2	2	2
CO2	2	1	3	1	1	2	3	1		1	1	1	1	2
CO3	3	3	2	2	2	2	3	1		1	2	1	1	2
CO4	2	3	2	2	1	1	3	2	3	3	2	1	2	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: 2025-26							
Course Code	**BE-239**	**Title of the Course**	**Plantation Products and Spices Technology**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	IV	**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	Understanding processing methods and equipment's used in the manufacture of different tea types, evaluating quality parameters and types of tea.
CO2	Understand the technological objectives coffee beans processing, analyzing physiological effect of coffee consumption and evaluating chemical changes occurring during processing.
CO3	Understand and evaluating the concept of different unit operations employed in cocoa processing, chocolate manufacture.
CO4	Understand and analyzing the concept and method of spice processing, extraction of essential oil, and spice oleoresins processing.

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	2	1		1			1	2	3	3	3
CO2	3	2	2	2	1		1			1	2	3	3	3
CO3	3	2	2	2	1		1			1	2	3	3	3
CO4	3	2	2	2	1		1			1	2	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: 2025-26							
Course Code	BE 240	**Title of the Course**	**Artificial Intelligence In Food Technology**	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**2**	**1**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	The curriculum aims to equip food technology students with the essential knowledge and skills to leverage artificial intelligence for innovative research and applications.						

Course Outcomes	
CO1	Explain the fundamentals, history, and ethical aspects of artificial intelligence in food technology.
CO2	Apply machine learning techniques such as feature selection, natural language processing (NLP), and sentiment analysis to food-related datasets
CO3	Use statistical tools and exploratory data analysis for data interpretation and conservation strategies in food research.
CO4	Identify various AI applications and develop AI-driven solutions for process optimization, energy efficiency, waste reduction, and robotic automation in the food industry.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to artificial intelligence	History and evolution of AI, comparison of human and computer skill, Component of AI, Scope and significance in different domains, Ethical considerations in AI development and deployment, Intelligent Agent, logical agent. **Problem solving through AI:** Defining problem as a state space search, analyzing the problem, solving problem by searching, informed search and Uninformed Search.	8	CO1
2	Machine Learning Basics	Neural networks and Deep Learning, Supervised and unsupervised learning, Feature selection and engineering, learning from observation, knowledge in learning. **Natural Language Processing:** Brief history of NLP, Text processing, Sentiment analysis, language translation, Early NLP system, ELIZA system, LUNAR system, General NLP system**.**	8	CO2
3	Data Science for Biologists	Data collection and cleaning of biological data set. Feature Selection and Data preprocessing, Exploratory data analysis, Statistical tools for data interpretation, conservation strategies with machine learning, text mining in literature review in research, ethical considerations in AI research	8	CO3
4	Introduction to AI in the Food Industry	AI Applications in Food Production, AI in Food Safety and Quality Assurance, Predictive Maintenance, Supply Chain Optimization, Process Optimization, Energy Efficiency, Human-Machine Collaboration, Waste Reduction, Robotic Automation, Smart Labelling and Packaging.	8	CO4

Reference Books:

1. Hassanien, A.E. and Soliman, M. eds., 2022. Artificial Intelligence: A Real Opportunity in the Food Industry (Vol. 1000). Springer Nature.
2. Chhikara, N., Panghal, A. and Chaudhary, G. eds., 2023. Novel Technologies in Food Science. John Wiley & Sons.

e-Learning Source:

1. https://www.cas.org/resources/cas-insights/embracing-future-ai-food-industry
2. https://www.sciencedirect.com/science/article/pii/S2666154320300144

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

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

Name& Signof ProgramCoordinator	**Sign& Sealof HoD**

Integral University, Lucknow

Effective from Session: 2025-26 (NEP)							
Course Code	CS203	**Title of the Course**	Cyber Law and Information Security	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	0	0	3
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• Knowledge about cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft. • Knowledge on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents. • Knowledge about Information System and principles of Information Security (as confidentiality, integrity, and availability). • Knowledge of cryptography and techniques used to detect and prevent network intrusions.						

Course Outcomes	
CO1	Understand key terms and concepts in cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft.
CO2	Apply and analyze knowledge of technology, E-business, and law to minimize the occurrence and impact of information security incidents.
CO3	Understand and evaluate the principles of Information Security, including confidentiality, integrity, and availability, in relation to information systems.
CO4	Understand and apply cryptographic techniques and methods to detect and prevent network intrusions, ensuring secure data transmission.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Fundamentals of Cyber Law**	Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, CopyRight, Trademark law, Law related to semiconductor layout & design.	8	CO1
2	**E - Commerce**	Security Threats to E - Commerce, Virtual Organization, Business Transactions on Web, EGovernance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E- Agreement, Legal recognition of electronic and digital records, E- Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures - Technical issues, legal issues, Electronic Records, Digital Contracts, and Requirements of Digital Signature System.	7	CO2
3	**Investigation and Ethics**	Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security threats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs. Introduction to biometric security and its challenges, Finger prints, Cyber crime forensic: CASE STUDY in Cyber Crime.	9	CO3
4	**Information security**	Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security services - Authentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection.	9	CO4

Reference Books:

Harish Chander "Cyber Law and IT Protection" , PHI Publication, New Delhi

Merkov, Breithaupt," Information Security", Pearson Education

"Cyber Law in India" - Farooq Ahmad-Pioneer books.

K. K. Singh, Akansha Singh "Information Security and Cyber law", Umesh Publication, Delhi

e-Learning Source:

https://nptel.ac.in/courses/106106248

https://onlinecourses.swayam2.ac.in/cec24_cs14/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	1	2	1	2	1	3	1	1		1	1	2		2
CO2	3	1	2		2			2	2		2		2	
CO3	2	2		1	1	1	3	2	1	1	1	2	1	3
CO4	1		2		2			1					3	1

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

Integral University, Lucknow

Effective from Session: 2025-2026							
Course Code	BE 241	**Title of the Course**	HYGIENE AND FOOD SAFETY	**L**	**T**	**P**	**C**
Year	**III**	**Semester**	V	2	1	0	3
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-aidded 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/0BPOPbAqWqoPfnVDc3lEVnNXZmxrSmtNT21nOGFnRDQ2ZWdPeFVfZ WZTXzl0cC1LMmk3b2s?resourcekey=0-81g_wC6VCDeGb8EN_43cfg&usp=sharing

https://drive.google.com/drive/folders/0BPOPbAqWqoPfnVDc3lEVnNXZmxrSmtNT21nOGFnRDQ2ZWdPeFVfZ WZTXzl0cC1LMmk3b2s?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: 2025-26							
Course Code	BE 242	**Title of the Course**	Food Biotechnology	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	2	1	0	3
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/PMCC2408621/
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**