Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	**BE231**	**Title of the Course**	**Food Microbiology**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**0**	**3**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To acquaint with the basic knowledge of microbiology of foods and impart knowledge which would be useful to the students for industrial job after they complete the program and go to practical field.						

Course Outcomes	
CO1	The learner will gain basic knowledge of food and its microbiological aspects in term of quality and spoilage activity along with structural composition, nutrient value and biological value and their mechanisms.
CO2	Learners also will gain the fundamental aspects of bacterial growth by using different media and its role in the sustainable growth of bacteria. Aware about media preparation and culture characteristic of bacteria which grow on that media as food by utilizing food nutrient as substrates.
CO3	Learners would have acquired basic knowledge of food properties like intrinsic and extrinsic parameter and its significance of spoilage mechanism in food
CO4	Understand the application of fermentation and their importance in the development of fermented food along with the biological and nutritive value of fermented food developed as yoghurt, cheese, fruits and vegetable, meat and meat product, egg and fish in daily life.
CO5	Know about the symptoms as well as detection of food borne diseases along with fundamental knowledge of toxins produced by Staphylococcus, Clostridium, Aspergillus

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Microbiology	Introduction to microbiology: definition, history of microbiology. Basic knowledge of microorganisms: Bacteria, fungi, actinomycetes, protozoa etc. prokaryotic and eukaryotic cells.	8	CO1
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	CO2
3	Factors affecting microbial growth	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.	8	CO3
4	Microbial spoilage of food products	Microbial spoilage of Food Products: Microbiology of raw milk and fermented milk products viz yoghurt, cheese, fruits and vegetable, meat and meat product, egg and fish.	8	CO4
5	Microbial foodborne diseases	Microbial foodborne diseases: introduction and types (foodborne intoxications and foodborne infections), Toxins produced by Staphylococcus, Clostridium, Aspergillus.	8	CO5

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.

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	2	2	1	2	1	1	3	3	1	2	1	3	3	2	3
CO2	2	3	2	2	2	1	1	2	1	1	1	3	3	2	2
CO3	1	3	2	2	2	1	1	2	2	1	1	3	3	2	2
CO4	3	3	3	3	2	2	2	1	2	1	1	3	3	3	3
CO5	1	2	2	1	2	2	2	1	1	1	1	3	3	3	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: 2020-21							
Course Code	**BE-232**	**Title of the Course**	**Food engineering-I**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To impart knowledge of basic engineering processes involving in food science and technology.						

Course Outcomes	
CO1	Students will learn the fundamental and derived units.
CO2	Knowledge of basic principles of fluid mechanics and its applications.
CO3	Understand the basic principles of diffusional mass transfer.
CO4	Understand the basic principle of Electrodialysis, Reverse-Osmosis and Ultrafiltration.
CO5	Understand the basic principle of filtration and centrifugation.

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	1
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	2
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	3
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	4
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	5

Reference Books:

Brennan JG, Butters JR, Cowell ND & Lilly AEI. 1990. Food Engineering Operations. Elsevier.

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

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.

e-Learning Source:

Journal of Food Engineering | ScienceDirect.com by Elsevier

Food Engineering Reviews | Home (springer.com)

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	**BE233**	**Title of the Course**	**Food Chemistry**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**0**	**3**
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	Students are expected to understand water's influence on food stability in a broader context
CO2	To understand the properties of different carbohydrate components and interactions among these components to regulate the specific quality attributes of food systems.
CO3	Students are expected to understand the role of proteins /enzymes in foods and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.
CO4	To understand the chemical composition of lipids, their physical properties, methods to modify the fatty acid and triacylglycerol composition, tendency of lipids to undergo oxidative deterioration, and the role of lipids in health and disease

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	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	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	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	4

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:

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

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

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

Integral University, Lucknow

Effective from Session:2020-21							
Course Code	**BE 234**	**Title of the Course**	**Refrigeration and Cold Chain**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**0**	**3**
Pre-Requisite	**NONE**	**Co-requisite**	**NONE**				
Course Objectives	1. To understand the underlying principles of operation in different Refrigeration and cold storage systems and its components. 2. To provide the knowledge about cold storage systems in food industry.						

Course Outcomes	
CO1	Explained the basic concepts of refrigeration and air conditioning, necessity of refrigeration and air conditioning.
CO2	Explained about desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical. Components of vapor compression refrigeration system.
CO3	Explained the applications of refrigeration in different food products – fruit and vegetable products, meat products, fish, poultry products, dairy products etc.
CO4	Explained the concepts of Freezing systems: indirect contact systems, plate freezers, air blast freezers, and freezers for liquid foods. Direct contact systems, air blast immersion, frozen food properties.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction	Definition of refrigeration and air conditioning, necessity of refrigeration and air conditioning. History of refrigerants, Refrigerants, definition, classification, nomenclature, methane and ethane series.	8	CO1
2	Desirable properties of refrigerants	Desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical. Azeotropes. Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve. Ice manufacture, principles of ice production, different systems. Treatment of water for making ice, Brines, Freezing tanks, ice cans, air agitation, quality of ice.	8	CO2
3	Applications of refrigeration	Applications of refrigeration in different food products – fruit and vegetable products, 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	PO12	PSO1	PSO2	PSO3	PSO5	PSO6	PSO7
CO1	3	2	1	-	1	2	3					2	3	2	2			
CO2	3	2	1	-	1	2	1					2	3	3	2			
CO3	2	1	-	1	2	2	-					3	3	2	2			
CO4	3	3	2	2	2	3	-					2	3	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: 2020-21							
Course Code	**BM-229**	**Title of the Course**	**PRINCIPLES OF MANAGEMENT INDUSTRIAL ECONOMICS & IPR**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**0**	**3**
Pre-Requisite	**none**	**Co-requisite**	**none**				
Course Objectives	The course curriculum helps to understand about the basic knowledge of Engineering Economics, Management skills and its functions. It also helps in understanding the Banking system its function and also about various aspects of Bio-safety and IPR						

Course Outcomes	
CO1	Knowledge of Engineering Economics and its functions
CO2	Basic Knowledge of concept and functions of economics banking sector and functions of money
CO3	Knowledge of Management & its functions Personality Development and group behavior
CO4	Knowledge of Concepts of IPR
CO5	Basic knowledge about biosafety and Legal implications in bioethics

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Industrial Economics**	Industrial Economics: Concept, Nature and Significance; Demand and Supply; Concept law; Elasticity of demand and supply; Theory of Consumer Behavior, Indifference curve analysis	8	**CO 1**
2	**Money**	Money: Concepts Inflation and Deflation, Banking system in India: Commercial and Central banking structure and types.	8	**CO 2**
3	**Management**	Management: Introduction, functions, Evaluation of Management thoughts; Human Behavior in organization: Perception, Personality development and interpersonal relationship.	8	**CO 3**
4	**IPR**	Jurisprudential definitions and concepts of property, rights duties and their correlation, History and evolution of IPR (patent, design, copyright and Geographical indication) Significance of IPR: Requirement of a patentable novelty: Obtaining patent; Invention step and prior art and state of art procedure; Issues related to IPR protection of software and database; IPR protection of life forms: biological products, International convention in IPR; Infringement or violation, remedies against infringement: civil and criminal . Indian patent act 1970 (amendment 2000) Major changes in Indian patent system as post TRIPS effects	8	**CO 4**
5	**Bio-safety**	Safety guidelines of rDNA research containment facilities and its disposal; Radiation hazards; Safety concerns about transgenics; Environment Health, Economic. Bioethics; Introduction, necessity and limitation; Ethical conflicts in Biotechnology; Different paradigms of bioethics: National and International, Bioethics of genes; Bioethics in health care: Bioethical dilemmas in medical and surgical treatment; Legal implications in bioethics.	8	**CO 5**

Reference Books:

1. Industrial Economics and Principles of management Chabra.T.N. Dhanpat Rai and Co., New Delhi

2.Old and Primrose “Principles of Gene Manipulation”

3. Keru M “Ethical Biotechnology”,Global Vision Publishing House.

4. IHUxley TH “Evolution and ethics”, Princeton University Press.

e-Learning Source:

https://youtu.be/nK7Xo3v0i7M, https://youtu.be/CpC9E0oc2Cc

https://youtu.be/a6fgzjPd_7w,https://youtu.be/z1L9Ye6cK6U, https://youtu.be/DBwqr2UPVtk, https://youtu.be/xBaLgJZ0t6A, https://youtu.be/dhYoZ4lORYA

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	2	2	1	3	1	2	3	3	1	2	1
CO2	3	2	1	1	1	2	2	2	2	2	3	2	-	2	1
CO3	2	2	2	1	1	2	2	2	3	2	2	3	-	1	2
CO4	3	2	2	3	2	3	2	3	1	2	2	3	2	2	2
CO5	3	2	2	2	1	3	3	3	2	2	1	3	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	**MT203**	**Title of the Course**	**Numerical and Statistical Analysis**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**3**	**1**	**0**	
Pre-Requisite	**10+2 with PCM/PCB**	**Co-requisite**	**None**				
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of numerical and statistical analysis. Numerical and statistical analysis plays very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to calculate and analyze Errors in numerical computations. Students will also be able to find the solutions of algebraic and transcendental equations using Bisection method, Iteration method, False position method and Newton-Raphson method.
CO2	Students will be able to understand difference operators and Factorial polynomials. They will also be able to interpolation for equal and unequal intervals by using Newton's forward and backward formula, Stirling's formula, Bessel's formula Laplace Everett's interpolation, Divided difference, Newton's divided difference formula, Lagrange's Interpolation formula.
CO3	Students will be able to compute differentiation using interpolation methods and will also be able to find Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, Simpson's3/8 rule, Boole's rule, Weddle's rule.
CO4	Students will be able to understand the concept of probability, addition and multiplication theorem of probability, conditional probability and probability distributions namely Binomial distribution, Poisson distribution and Normal distribution.
CO5	Students will be able to understand the concept of probability, addition and multiplication theorem of probability, conditional probability and probability distributions namely Binomial distribution, Poisson distribution and Normal distribution.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Errors in numerical computations, numerical solution of algebraic and transcendental equations by Bisection method, Iteration method, Regula false method, Newton- Raphson's method.	07	CO1
2		Finite differences: forward and backward differences, properties of operators, factorial polynomials, Interpolation: Newton Gregory forward and backward interpolation formula. Interpolation formula for unequal intervals, divided differences formula, central interpolation formula: Bessel, Stirling and Laplace Everett's interpolation formulae	09	CO2
3		Numerical differentiation, Numerical integration by Trapezoidal rule, Simpson's 1/3 rule, 3/8 rule, Boole's rule, Weddle's rule.	07	CO3
4		Probability: Classical and axiomatic definition of probability. Addition and Multiplication theorem of probability. Conditional probability. Probability distributions: Binomial distribution, Poisson distribution and Normal distribution.	08	CO4
5		Testing of Hypothesis: Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, critical region, type I and II error, power of a test. Test of significance based on t, F and chi-square distribution. Basic concepts of Simple random sampling and Stratified random sampling. Analysis of variance (ANOVA): One-way and two way classification.	09	CO5

Reference Books:

1. Text book of Numerical Analysis: H.C. Saxena (S. Chand Publication)

2. Numerical Analysis: S. S., Shastri

3. Numerical Analysis: B.S. Grewal.

4. Numerical Analysis: A.R. Vashistha.

5.Q.S Ahmad, V. Ismail and S.A Khan: Biostatistics, laxmi Publications Pvt.Ltd

6.S.C. Gupta and VK. Kapoor: Fundamental of Mathematical Statistics, Sultan Chand publication

e-Learning Source:

https://nptel.ac.in/courses/111/106/111106101/

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

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	1	2	1	2	2	2	2	2
CO2	3	1	2	3	3	3	2	2	2	2	2	2
CO3	3	1	2	3	3	3	2	2	2	2	2	2
CO4	3	1	2	3	3	3	3	3	3	3	3	3
CO5	3	1	2	3	3	3	3	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:2020-21							
Course Code	**ES202**	**Title of the Course**	**Disasters, Management**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**2**	**1**	**-**	**3**
Pre-Requisite	**10+2 having a minimum of 45% marks in the aggregate from a recognized Board/University**	**Co-requisite**	**None**				
Course Objectives	• To Study the types of Disasters and its profile in India. • Knowledge of causes and impacts of Disasters, and Case studies of National and Global Disasters. • To learn about risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters. • Basic concepts of Disaster Management Cycle and its Risk Reduction Measures. • To know the National Acts and policies for mitigating disasters. Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.						

Course Outcomes	
CO1	Students are able to learn types of disasters and its profile in India
CO2	Students are able to understand the causes and impacts of disasters on environment
CO3	Students are 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	To understand the concept of Disaster Management Cycle and its Risk Reduction

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.	8	CO1
2	Impact of Disaster	Causes and Impacts of Disasters, Global and National Perspective, Case studies from Disasters, Large Hydro projects and its risks for Disasters	8	CO2
3	Disaster Risk Reduction	Approaches to Disaster risk Reduction, Safety issues in mitigating Industrial disasters, Case studies, EHS etc.	8	CO4
4	Disaster Management	Disaster Management Cycle, Risk Reduction Measures (Preparedness, Mitigation, Response	8	CO3
5	Disaster Act. and Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, NDRF,	8	CO3

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	1	3	2	1	1	2	1	1	1	1	1	-	-
CO2	2	2	2	1	2	3	3	2	2	2	2	2	2	1	2	2	-	-
CO3	3	2	2	1	2	2	3	2	2	2	1	2	1	1	1	2	-	-
CO4	3	2	2	1	2	2	3	2	2	1	1	2	1	1	1	2	-	-
CO5	3	1	3	2	2	2	2	2	3	2	1	2	1	1	2	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: 2020-21							
Course Code	**BM-226**	**Title of the Course**	**Human Values & Professional Ethics,**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**3**	**-**	**-**	******
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	➢ To understand the moral values that ought to guide the Management profession, Resolve the moral issues in the profession, ➢ To justify the moral judgment concerning the profession. ➢ To create an awareness on Management Ethics and Human Values. ➢ To inspire Moral and Social Values and Loyalty. Intended to develop a set of beliefs, attitudes, and habits that engineers should display concerning morality. ➢ To create awareness about the important global issues: . Multinational corporations - Environmental ethics - computer ethics - weapons development						

Course Outcomes	
CO1	Development of moral and ethical values, right understanding and relationships
CO2	Knowledge of Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property rights and its laws.
CO3	Awareness about the Professional Responsibility of engineers, Responsibility of engineers related to risks, hazards and safety.
CO4	Development of Engineers Ethics. Understanding of variety of moral issues, moral judgment concerning the profession.
CO5	Understanding of various of global issues; Environmental ethics - computer ethics - weapons development.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Human Value Education	Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration. Its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, 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	Professional Responsibility	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 Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, hazards and risks.	6	CO3
4	Engineers Ethics	Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles theories about right action – Self-interest - customs and religion - uses of ethical theories. Valuing Time – Cooperation – Commitment.	6	CO4
5	A Glimpse of Life Stories, Global Issues	Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs. Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership.	6	CO5

Reference Books:

1. R.S. Naagarazan 2006, "A Textbook on Professional Ethics and Human values" New Age International Publisher.
2. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.

e-Learning Source:

1. Value Education website, http://www.uptu.ac.in . 2. Story of Stuff, http://www.storyofstuff.com

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	3	3			3		2		2	2	2	3
CO2	3	3	2	3	3			2					2	3	3
CO3	2	3	2	3	2			3		3			3	3	3
CO4	2	3	2	3	2			2				1	3	3	2
CO5	3	2	3	3	2			3		2		1	2	2	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: 2020-21							
Course Code	**ME223**	**Title of the Course**	**Fluid Mechanics Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**0**	**0**	**4**	**2**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	• To impart practical knowledge/techniques to verify Bernoulli's Theorem and its application. • To impart practical knowledge/techniques to Plot the flow pattern net using the Hele-Shaw apparatus • To impart practical knowledge/techniques to study the transition from laminar to turbulent flow and determine the lower critical Reynolds number. • To impart practical knowledge/techniques to measure the flowrate in pipe flow and find the velocity distribution in the pipe flow. • To impart practical knowledge/techniques to determine the variation of friction factor 'f', for turbulent flow in commercial pipes and find the Coefficient of Discharge in rectangular notch.						

Course Outcomes	
CO1	Learn the concept of Bernoulli's Theorem and apply it to find the discharge using Venturi meter and Orifice meter.
CO2	Plot the flow pattern net using the Hele-Shaw apparatus
CO3	Study the transition from laminar to turbulent flow and determine the lower critical Reynolds number.
CO4	To calibrate the venturi meter, orifice meter and find the velocity distribution in the pipe flow.
CO5	Determine the variation of friction factor 'f', for turbulent flow in commercial pipes. and find the C_D in rectangular notch.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Bernoulli's Equation	To verify Bernoulli's Equation experimentally.	4	CO1
2	Hele-Shaw apparatus	To Plot the flow net using the Hele-Shaw apparatus	4	CO2
3	Laminar and Turbulent flow	To Study the transition from laminar to turbulent flow and determine the lower critical Reynolds number.	4	CO3
4	Venturi meter	To calibrate a venturi-meter and study the variation of the coefficient of discharge with the Reynolds number.	4	CO4
5	Orifice meter	To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.	4	CO4
6	Velocity Distribution	To study the velocity distribution in a pipe.	4	CO4
7	Friction factor	To study the variation of friction factor 'f', for turbulent flow in commercial pipes.	4	CO5
8	Notch apparatus	To calibrate a given v-notch or a rectangular notch and determine the coefficient of discharge	4	CO5

e-Learning Source:

https://fm-nitk.vlabs.ac.in/

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

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	**BE235**	**Title of the Course**	**Food Chemistry Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**0**	**0**	**4**	**2**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	**The objective of this lab is to ensure that the students are able to determine the various physicochemical properties of the food products.**						

Course Outcomes	
CO1	Understand the biochemical analysis in terms of estimation of proximate analysis of foods.
CO2	Understand the biochemical analysis in terms of estimation of nutritional value of foods.
CO3	Understand the biochemical analysis in terms of estimation of physiochemical characteristics of foods

Unit No.	Title of the Experiment	Content of Unit	Contact Hrs.	Mapped CO
1	Moisture content	Determination of moisture content.	4	1
2	Reducing sugar	Detection of reducing sugar by Fehling and Benedict test	4	3
3	Fat content	Determination of fat content of a food sample	4	1
4	Amino acid, Protein and Peptides	Detection of amino acid, protein and peptides by Ninhydrin test	4	1
5	Protein	Determination of protein	4	1
6	Titrable acidity	Determination of titrable acidity	4	3
7	Ash content	Determination of Ash content	4	1
8	Starch	Detection of presence of starch by Iodine test	4	3
9	Water activity	Determination of water activity of different food materials	4	3
10	Vitamin C content	Determine the vitamin C content of any fruit	4	2
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	1	3	1	2	1	1	1	1	2	1	2	2	1	3	3
CO2	1	3	1	2	1	1	2	1	1	1	2	2	1	3	3
CO3	2	3	2	2	2	1	1	1	1	1	2	2	1	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 236**	**Title of the Course**	**Food Microbiology lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**0**	**0**	**2**	**1**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	**The lab is designed to train the students in understanding various testing of microorganisms like Bacteria, fungi, Algae including microbiological analysis of microorganisms related to food and other sources.**						

Course Outcomes	
CO1	Understand the pre-preparation of microbiological media and instruments handling
CO2	Understanding the pre-post observation of microbiological experiments
CO3	Gain knowledge on various isolation and identification of techniques for microorganisms

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

Reference Books:

Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

Lab Manual by K. R Aneja

e-Learning Source:

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

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	**BE237**	**Title of the Course**	**Food Informatics**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**0**	**3**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	The course is designed to acquaint the food technology students with the knowledge of databases, data warehousing, and the basic concepts of visualization and docking studies of biomolecules.						

Course Outcomes	
CO1	Understand the basics of Food Informatics and its applications.
CO2	Explain the basic concepts of data, data collection, and databases.
CO3	Explain the concepts of data warehousing and databases related to food.
CO4	Describe the file formats for biomolecule visualization and docking studies.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Food Bioinformatics	Basic knowledge of Bioinformatics vs Food informatics. Role of internet in Bioinformatics. Applications of food informatics in food industry.	8	CO1
2	Concept of Database	Basic concept of data, Data collection and organization in areas of food and nutrition. Types of databases and their applications	8	CO2
3	Data Retrieval tools	Data warehouse, merits and demerits, Tools for access to database and their applications. Databases of foods: plant, crop and food biomolecules databases.	8	CO3
4	Molecular docking and visualization tools	File formats, Basic knowledge of Molecular docking software, Molecular Visualization tools: PyMOL, Rasmol.	8	CO4

Reference Books:

1. B.N. Mishra; Bioinformatics: Concept and Application, Pearson Education (In Press).
2. O'Reilly; Developing Bioinformatics Computer Skill-1st Indian Edition, SPD Publication.
3. Anthony J. F. Griffiths et al; An Introduction to Genetic Analysis 1st Ed.
4. Michael Starkey and Ramnath Elaswarapu ; Genomics Protocols, Humana Press.

e-Learning Source:

https://pymol.org/2/

https://www.rcsb.org/

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

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	**BE-238**	**Title of the Course**	**Food engineering II**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To impart knowledge on thermal processes, molecular diffusion, freezing and dehydration processes.						

Course Outcomes	
CO1	Understand the basic modes of heat transfer in foods.
CO2	Interpret and analyze forced and free convection heat transfer.
CO3	Formulate and solve convective heat transfer problems.
CO4	Able to calculate freezing time and freezing rate.
CO5	Understand mechanisms of moisture removal in foods.

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

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	PO12	PSO1	PSO2	PSO3	PSO5	PSO6	PSO7
CO1	3	3	1	1	1	2	1	1	1	1	2	3	3	3	3			
CO2	3	3	1	1	1	2	1	1	1	1	2	3	3	3	3			
CO3	3	3	1	1	1	2	1	1	1	1	2	3	3	3	3			
CO4	3	3	1	1	1	2	1	1	1	1	2	3	3	3	3			
CO5	3	3	1	1	1	2	1	1	1	1	2	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: 2020-21							
Course Code	**BE239**	**Title of the Course**	**Principles of Food Preservation and Processing**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**0**	**3**
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	Understand methods of in activation of micro-organisms at high temperature.
CO2	Apprehend ways of restriction of growth of microorganisms at low temperature.
CO3	To understand the methods of preservation by food additives.
CO4	To understand the methods of processing and preservation by advanced thermal and non-thermal techniques.

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

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.

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.

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

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

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

Integral University, Lucknow

Effective from Session: 2020-2021							
Course Code	**BE240**	**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	The learners will gain basic knowledge of energy its norms and scenario; energy auditing, data collection and analysis for energy conservation in food processing industries energy sources, Applications of renewable energy in food industry.
CO2	The learners also will gain the fundamental aspects of biomass as an alternate source of energy along with its merits and demerits.
CO3	The learners would have acquired basic knowledge of solar energy and its application in Indian food industry and other heavy industry along others alternative sources of energy.
CO4	Understand 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 scenario, 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	PO12	PSO1	PSO2	PSO4
CO1	3	2	1	1	1	2	3	1	2	1	1	1	2	1	1
CO2	3	3	3	1	1	2	3	1	2	1	1	1	2	2	2
CO3	3	3	2	2	2	2	3	1	2	1	2	2	1	1	2
CO4	2	3	2	2	1	1	1	2	3	2	2	1	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: 2020-21							
Course Code	BE241	**Title of the Course**	**Industrial fuels and process calculations**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**3**	**1**	**0**	**4**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To build up knowledge of fuel and combustion, and to enable the students to perform material and energy balances of unit operations and complete processes.						

Course Outcomes	
CO1	Identify different types of solid fuels along with their utilities.
CO2	Identify different types of liquid and gaseous fuels.
CO3	Understand the stoichiometry of reactions and perform simple material balances.
CO4	Execute material balances in complex situations.
CO5	Perform energy balances on simple and complex processes.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Fuels**	Fuels: Origin, chemical composition, classification, storage, and general uses of industrial fuels. Types of solid fuels, proximate and ultimate analysis of coal, calorific values of fuels, specification of fuel oil.	8	CO1
2	**Types of Fuels**	Types of gaseous fuels, control of combustion. Types of liquid fuels, petroleum and its distillation products, coal tar and its distillation products, modified and synthetic fuels, fuels for cryogenic engines.	8	CO2
3	**Process calculations**	Process calculations: Systems of units. Stoichiometry and composition relations. Material balances: Material balance of physical processes with and without reaction, including recycle, purge and bypass.	8	CO3
4	**Material balance for various unit operations**	Material balance for various unit operations like absorption, distillation, crystallization etc.	8	CO4
5	**Energy balance**	Energy balance: Energy balance for closed system and open system, total energy balance.	8	CO5

Reference Books:

1. Singh. R. Paul & Heldmann. Dennis R, (2000), Introduction to Food Engineering, 3rd Edition, Academic Press, London, UK.
2. Riggs, J. B., Himmelblau, D. M. (2012). Basic Principles and Calculations in Chemical Engineering. United Kingdom: Prentice Hall.

e-Learning Source:

1. https://nptel.ac.in/courses/103105110
2. https://nptel.ac.in/courses/103105209

	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	PSO5	PSO6	PSO7
CO1	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	-	-	-
CO2	**2**	**1**	**2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	-	-	-
CO3	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**3**	-	-	-
CO4	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**3**	-	-	-
CO5	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**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-242**	**Title of the Course**	**DAIRY TECHNOLOGY**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**2**	**1**	**0**	**3**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	To impart knowledge of principles of processing of milk and milk products						

Course Outcomes	
CO1	The Learner will gain basic knowledge of milk and physicochemical aspects along with procurement and transportation methodology and national and international standards.
CO2	The Learner also will gain the fundamental aspects of testing of milk quality along with sources of contamination and how the milk spoiled
CO3	The Learner would have acquired basic knowledge of hygiene, cleaning procedures and application methodology of Pasteurization, standardization, toning, homogenization and cream separation from milk
CO4	Understand the application and technology applied for the development of dairy products along with ghee preparation and other milk based dairy products in economic way.
CO5	Know about the Sterilized flavoured milk, UHT milk, Aseptic packaging and storage

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, 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-organism, 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 by- products utilization, Irradiation of milk, Application of stablizers and emulsifier in dairy products	8	CO5

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	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	2	2	1	2	2	1	2	2	2
CO2	2	2	2	2	3	3	2	2	2	2	2	2	2	3	3
CO3	2	3	2	2	1	2	2	3	3	2	2	2	3	2	3
CO4	3	1	2	2	2	2	2	2	2	2	2	2	2	3	3
CO5	2	2	2	2	3	2	2	2	3	2	2	2	2	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: 2020-21							
Course Code	BE- 243	**Title of the Course**	**Food Preservation And Processing Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**0**	**0**	**4**	**2**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objectives	The aim of the lab is to enable students to understand the food preservation and processing operations and be able carry out these operations in the food processing operations.						

Course Outcomes	
CO1	Understand the role of processing in terms of shelf life,safety, nutritional and economic value of fruit and vegetables.
CO2	Assess the role in pre- and post-harvest changes in fruitsand vegetables on product quality.
CO3	Gain knowledge on 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	Dehydration	Carry out preservation of certain vegetables by dehydration.	3	CO1
2	Re- Hydration	Study the re-hydration characteristics of dried vegetable.	3	CO1
3	Pickling	Carry out the preservation of fruits and vegetables by pickling.	3	CO1
4	Osmotic dehydration	Perform osmotic dehydration of certain fruits and vegetables by sugar and salt solution.	3	CO1
5	Processing of rice	Study different parameters during processing of rice e.g. cooking time, %elongation, %width, expansion, %water uptake, CDC ratio.	3	CO1
6	Squash	Preparation of squash to demonstrate the preservation by sugar.	3	CO2
7	Bottling	Bottling of peas.	3	CO2
8	Fermentation	Preservation of vegetable with the help of fermentation technique (sauerkraut).	3	CO2,3
9	Canning	Examination of canned pineapple.	3	CO2,3
10	Water Activity	Estimation of shelf life of foods on the basis of water activity and temperature.	3	CO3
11	Refrigeration and Freezing	Preservation of food products by refrigeration and freezing.	3	CO3

Reference Books:

1. Handbook of food preservation.
2. Penfield, M. P., Campbell, A. M., & Penfield, M. P. (1990). *Experimental food science* (pp. 442-446). San Diego: Academic press.
3. Nielsen, S. S. (2017). *Food analysis laboratory manual*. Springer.

e-Learning Source:

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

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

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

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