Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-4

Subject: Food Engineering- BETFT14305

Type of course: Professional Core

Prerequisite: Basic knowledge of mathematics (calculus, differential equations), physics (thermodynamics, fluid mechanics), chemistry (physical chemistry)

Rationale: This course provides essential knowledge of Food Engineering integrates core engineering principles—such as heat and mass transfer, fluid dynamics, and thermodynamics—with the unique properties of food materials to design safe, efficient, and sustainable processing operations. This subject equips students to translate fundamental scientific concepts into practical solutions for preserving nutritional quality, extending shelf life, and optimizing production in the food industry. Understanding these interdisciplinary frameworks fosters innovation in product development and ensures compliance with quality and safety regulations.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Unit No.	Course content	Hrs.	% Weightage
1	**Fundamentals of Food Engineering** Introduction to Food Engineering, scope and relevance in the food industry, Dimension analysis, SI units, and engineering calculations, Basic concepts: system, process, properties of materials (density,	15	25%

	viscosity, etc.), Mass and energy balance: Principles and applications in food processing, Overview of process flow diagrams in food engineering		
2	**Fluid Flow in Food Processing** Properties of fluids: Newtonian and non-Newtonian behavior, importance in food, Principles of fluid statics and dynamics, Fluid transport systems used in food plants (e.g., pumps, piping, and valves), Continuity equation, Bernoulli's theorem, and energy relationships, Applications in food industry: juice extraction, milk transport, fluid foods	15	25%
3	**Heat Transfer in Food Engineering** Modes of heat transfer: conduction, convection, radiation with food applications, Heat exchangers: types and industrial relevance (plate, tubular, scraped surface), Calculation of heat transfer in food systems: slabs, pipes, and multi-layer, Applications: pasteurization, sterilization, evaporation, drying, Thermal properties of food (thermal conductivity, specific heat, etc.)	15	25%
4	**Mass Transfer and Unit Operations** Fundamentals of mass transfer and relevance in food processing, Key unit operations: evaporation, distillation, drying, and mixing, Principles and types of drying (tray, freeze, spray, drum), calculation of drying rates, Mass balances in food operations: practical examples, Introduction to membrane processes and other modern separation techniques	15	25%

Continuous Assessment:

Sr. No.	Active Learn	Marks
1.	**Case Study: Traditional vs Modern Processing** Compare traditional and industrial methods for a selected food product, highlighting engineering principles, pros/cons, and scale-up improvements then upload as a PDF to the GMIU Web Portal.	10
2.	**Heat Transfer Problem Set** Solve heat transfer calculations for processes like pasteurization or drying, including rate determination, processing time, and energy efficiency analysis and submit the brochure in PDF format on GMIU Web Portal.	10
3.	**Process Design Mini-Project** Design a small-scale unit (e.g., juice processing) with process flow diagram, equipment selection, and mass/energy balance, including safety and cost considerations and upload to the GMIU Web Portal.	10
Total		30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	40%	30%	10%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

List of Practical

Sr. No	Title	Hours
1	Determination of Thermal Properties of Food Materials	4
2	Viscosity Measurement of Food Products Using Viscometer	2
3	Heat Transfer Analysis in Plate Heat Exchanger	4
4	Fluid Flow Characteristics and Pressure Drop in Pipes	2
5	Mass Transfer Study - Drying Kinetics of Food Materials	4
6	Engineering Properties of Food Grains and Powders	2
7	Pumping Characteristics and Performance Analysis	4
8	Mechanical Properties and Texture Analysis of Foods	2
9	Energy Balance and Process Calculations in Food Systems	4
Total		30

Course Outcome:

After learning the course, the students should be able to:	
CO1	Apply mass and energy balance principles to model and analyze basic food processing systems.
CO2	Evaluate fluid flow behavior and design fluid transport systems for various food fluids.
CO3	Analyze and design heat transfer equipment for thermal processing of food materials.
CO4	Quantify mass transfer rates and design separation processes such as drying, evaporation, and membrane operations.

Instructional Method:

The course delivery method will depend upon the requirement of content and the need of students. The teacher in addition to the conventional teaching method by blackboard, may also use any of the tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content, 10% of topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done based on the Active Learning Assignment

Reference Books:

[1] Food Process Engineering and Technology by Zeki Berk
[2] Introduction to Food Engineering by R. Paul Singh and Dennis R. Heldman
[3] Food Engineering Fundamentals by Srinivasan Damodaran, Kirk L. Parkin, and Owen R. Fennema
[4] Unit Operations in Food Processing by R.L. Earle and M.D. Earle
[5] Heat and Mass Transfer Principles and Applications in Food Processing by S. Balasubramaniam and J.E. Mercier
[6] Food Microstructure and Its Relationship with Quality and Stability by E. Krokida and D. Saravacos