



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: Under Graduate

Branch: Food Engineering & Technology

Course / Subject Code: BE05051021

Course / Subject Name: Fruits and Vegetables Process Engineering

w. e. f. Academic Year:	2026-27
Semester:	05
Category of the Course:	Professional Core

Prerequisite:	NA
Rationale:	The course aims to familiarize and prepare students with the fundamental principles and techniques used in the processing of fruits and vegetables. It also provides understanding of the design, operation, and key characteristics of equipment employed in fruit and vegetable processing industries. The course enables students to gain knowledge of modern processing technologies and equipment necessary to ensure product quality and efficient processing operations.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Identify and explain the basic structure and significance of engineering properties of fruits and vegetables.
02	Understand the various physical, thermal, frictional, and aerodynamic properties of fruits and vegetables and their role in food processing operations
03	Apply the rheological and physical properties of fruits and vegetables for the design and development of processing equipment.
04	Differentiate among various fruits and vegetables based on their rheological behavior, such as Newtonian and non-Newtonian fluids
05	Develop or evaluate food processing equipment by considering thermal, electrical, and magnetic properties of fruits and vegetables.

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE(E)	PA(M)	PA(I)	PBL(I)	ESE(V)	



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45	0	30	15	90	03	70	30	20	30	50	200
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Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End- Semester Examination, PA = Progressive Assessment

*** Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Structure, Nutritional Value, Ripening, and Spoilage of Fruits and Vegetables : Importance of post-harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.	6	13
2.	Post-Harvest Operations: Cleaning, Grading of Fresh Produce : Harvesting methods of fruits and vegetables and washing and cleaning of fresh produce, Sorting and grading techniques, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables.	8	18
3.	Principles of Cold Storage and Packaging in Fruit and Vegetable Processing: Cold storage of fruits and vegetables, controlled atmosphere packaging of fruits and vegetables, Use of chemical preservatives, gas composition, quality of storage. Packaging methods for processed fruit and vegetable products.	7	15
4.	Dehydration Technologies and Modern Processing Methods for Fruits and Vegetables : Processing equipment used in fruit and vegetable industry, Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.	8	18
5.	Intermediate Moisture Foods, Emerging Technologies, and Packaging in Fruit and Vegetable Processing : Intermediate moisture foods (IMF) and their characteristics, Principle of ohmic heating (electrical resistance heating), High pressure processing (HPP) of fruits and vegetables and its applications, Sensory analysis and evaluation of fruit and vegetable products, Packaging systems and technologies for fruits and vegetables.	8	18



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6.	Quality Standards, Regulatory Aspects, and Food Safety in Fruit and Vegetable Processing: Fundamentals of quality standards and quality control, Food Products Order (FPO) and regulatory aspects, Quality parameters and attributes of fruits and vegetable products, Modified atmosphere packaging (MAP) and controlled atmosphere storage (CA), Hygiene, sanitation and food safety practices in processing units	8	18
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	20	20	15	20	00

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

The syllabus of Fruits and Vegetables Process Engineering directly contributes to:

SDG 2	Zero Hunger
SDG 3	Good Health and Well-Being
SDG 4	Quality Education
SDG 9	Industry, Innovation and Infrastructure
SDG 12	Responsible Consumption and Production
SDG 13	Climate Action

References/Suggested Learning Resources:

(a) Books:

- 1) Reference Book : 1. Geankoplis, C.J. —Transport Processes and Separation Process Principles, 4th Edition, Prentice Hall, 2003.
- 2) McCabe W.L., Smith J.C. —Unit Operations in Chemical Engineering, 7th Edition, McGraw – Hill Int., 2001,
- 3) Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
- 4) Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi..

(b) Open-source software and website:

- 1) <https://agrimoon.com/wp-content/uploads/Engineering-Properties-of-Biological-Materials-and-FoodQuality.pdf>



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Suggested Course Practical List :

1. Determination of moisture content of different food samples by air oven method
2. Determination of moisture content by infrared moisture balance
3. Solving problems on single and multiple effect evaporator
4. Determination of collection efficiency in cyclone separator.
5. Study of different types of cleaning/grading equipments.
6. Determination of particle size of granular foods by sieve analysis.
7. Determination of performance characteristics in size reduction using the burr mill.
8. Determination of energy requirement in size reduction using the ball mill and hammer mill.
9. Performance evaluation of pin mill and hammer mill.
10. Determination of fineness modulus and average particle size.
11. Study of milling process of cereal crops
12. Study of milling process of pulse crops
13. Study of milling process of oilseed crops
14. Determination of equilibrium moisture content (EMC) of food grain.
15. Study on working of different types of mechanical dryers.

List of Laboratory/Learning Resources Required :

1. Hot air oven
2. Infrared moisture meter
3. Hammer mill
4. Ball mill
5. Burr mill
6. Pin mill
7. Separator

*** List of suggested activities for Problem Based Learning:**

Sr. No.	Activity Name	Suggested Topics/Focus Area	Hours	Evaluation Criteria
1	Industry/Research Laboratory Visit	Visit fruit & vegetable processing units (e.g., juice plant, canning unit, dehydration unit) to observe operations like washing, peeling, pulping, blanching, concentration, and packaging.	10 h (Visit + Report)	Report with process flow diagrams, equipment study, and identification of quality control points and losses..



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2	Assignment (Numericals)	Solve problems related to heat transfer in blanching, evaporation, drying calculations, and mass balance in juice processing.	10 h	Evaluation based on accuracy, method, and understanding of processing concepts.
3	Complex Problem Solving	Drying rate of fruits/vegetables, refrigeration load for cold storage, thermal processing calculations(pasteurization/sterilization).	10 h	Based on analytical approach, correctness, and depth of solutions.
4	Problem Solving / Coding	NPTEL/SWAYAM courses on Fruit and Vegetable Processing, Food Preservation, or Cold Chain Management.	10 h	Functionality, correctness, usability, and validation with sample data.
5	Online Course (Mos)	NPTEL/SWAYAM courses on Fruit and Vegetable Processing, Food Preservation, or Cold Chain Management	10 h	Based on course completion certificate and assessment performance.
6	Industrial Safety Videos	Study safety, hygiene, sanitation practices in fruit and vegetable processing plants, including handling of perishables and equipment safety.	10 h	Evaluation through report, quiz, or safety protocol analysis.
7	Discussion on Research Papers	Review 4–5 research papers on topics like minimal processing, value addition, novel preservation methods, or packaging of fruits and vegetables.	20 h (5 papers × 4 h)	Based on understanding, critical analysis, and summary presentation.
8	Poster/Chart/Power Point Presentation	Topics such as cold chain system, fruit ripening methods, dehydration techniques, juice processing, or post-harvest losses.	6 h	Clarity, technical accuracy, and presentation effectiveness.
9	Model Development (Working/Non-working)	Develop a model of solar dryer, cold storage system, fruit pulper, or juice extraction unit to demonstrate working principles.	8–12 h	Innovation, demonstration quality, and explanation of concept.
10	Industrial Exposure (2–3 Days)	Field exposure in fruit markets, cold storage units, processing plants to identify losses, inefficiencies, and suggest improvements	20 h	Detailed report with observations, problem identification, and practical solutions.
