



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Food Engineering & Technology

Subject Code: BE03051041

Subject Name :Engineering Properties of Biological Materials

WEF Academic Year :	2024-25
Semester :	3
Category of the Course :	BSC

Prerequisite:	Nil
Rationale:	Study about different engineering properties of foods is necessary to understand to determine the quality. It is important to gain knowledge of engineering properties during processing, packing, storage and transport. This subject will also impart knowledge about electrical properties of food and its applications in food engineering

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Identify the basic structure and importance of engineering properties of foods	RM
02	Understand different physical, thermal, frictional and aerodynamic properties of food materials and its application in food processing operations.	UN
03	Apply the rheological physical properties of food materials to design equipments.	AP
04	Discriminate between various foods based on its rheological state such Newtonian and non-Newtonian fluids.	AN
05	Develop food equipments based on thermal, electrical and magnetic properties of food	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

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)	
45	0	30	45	120	04	70	30	20	30	50	200

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.



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Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Introduction Classification and importance of engineering properties of Agricultural Produce	2	05
2	Physical properties shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area of grains, fruits and vegetables.	5	20
3	Thermal properties Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion	5	20
4	Frictional and Aerodynamic properties Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose, Flow of bulk granular materials, Aero dynamics of agricultural products, drag coefficients, terminal velocity.	4	20
5	Rheological properties Force, deformation, stress, strain, elastic, plastic and viscous behaviour, Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods, Flow curves.	6	20
6	Electrical properties Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination. Application of engineering properties in handling processing machines and storage structures	4	15

Reference Book:

- 1) Mohesin, N.N. 1980. Physical Properties of Plants & Animals. Gordon & Breach Science Publishers , New York.
- 2) Mohesin, N.N. 1980. Thermal Properties of Foods and Agricultural Materials. Gordon & Breach Science Publishers , New York.
- 3) Prentice, J.H. 1984. Measurement in Rheological Properties of Food Stuffs. Elsevier Applied science Pub. Co. Inc. New York.
- 4) Rao, M.A. and Rizvi, S.H., 1995. Engineering Properties of Foods. Marcel Dekker Inc. New York.
- 5) Singhal O.P.& Samuel D.V.K. 2003. Engineering Properties of Biological Materials. Saroj Prakashan.



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Suggested Course Practical List:

- 1) Determination of the size, shape, sphericity of food products.
- 2) Determination of roundness and roundness ratio of agricultural produce.
- 3) Determination of volume and surface area of grain, fruits and vegetables.
- 4) Determination of bulk density, true density and porosity of food grains.
- 5) Determination of porosity and specific gravity of grains.
- 6) Determination of frictional properties (angle of repose and coefficient of friction) of food grains.
- 7) Determination of average particle size and distribution of powdered material.
- 8) Determination of color of various food grains, fruits, vegetables, spices and processed foods by hunter color lab.
- 9) Determination of rheological properties of food material by viscometer.
- 10) Determination of electrical properties of food materials.

List of Laboratory/Learning Resources Required:

Equipment:

- 1) Digital Vernier Calipers
- 2) Weighing balance
- 3) Angle of repose measurement apparatus
- 4) Tilting table apparatus for coefficient of friction
- 5) Terminal velocity measurement set up with Anemometer
- 6) Brookfield viscometer
- 7) Hunter colorimeter

List of Open Source Software/learning website:

- 1) <https://agrimoon.com/wp-content/uploads/Engineering-Properties-of-Biological-Materials-and-Food-Quality.pdf>
- 2) https://ecourses.icar.gov.in/e-Learningdownload3_new.aspx?Degree_Id=04

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 to food processing unit, R&D center, food testing lab (e.g., dairy, bakery, oil mill, FSSAI lab)	10 h (Visit + Report)	Report with observations, flow diagram, critical control points



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2	Technical Video-Based Learning	Unit operations (drying, milling), food safety (HACCP, ISO 22000), thermal processing	10 h	Report/Presentation based on learning outcomes
3	Assignment Writing (Numericals)	Mass/energy balance, drying rate, thermal conductivity, food refrigeration load	10 h	Based on assignment depth and accuracy
4	Problem Solving / Coding	Shelf life prediction models, food drying simulation (using Python/Excel), curve fitting for kinetics	10 h	Based on correctness and code output
5	Online Course (MOOCs)	NPTEL/SWAYAM course on Food Processing, Food Microbiology, Packaging Technology	10 h	Based on completion certificate and assessment
6	Complex Problem Solving	Case: Spoilage in packaged milk; identify root cause and solution	10 h	Based on root cause analysis and justification
7	Industrial Safety Videos	Food plant safety, hygiene and sanitation, machinery safety	10 h	Based on quiz or summary report
8	Discussion on Research Papers	Food fortification, novel food packaging, extrusion, nanotechnology in food	20 h (5 papers × 4 h)	Evaluation of scientific depth, summary of findings
9	Poster/Chart/PowerPoint Presentation	Food adulteration detection, cold chain, pasteurization process, millet-based products	6 h	Presentation clarity and content relevance
10	Model Development (Working/Non-working)	Mini spray dryer, solar dryer, shell & tube heat exchanger, agitator mixer	8–12 h	Internal/external demonstration and explanation
11	Industrial Exposure (2–3 Days)	Observe processes in dairy/fruit processing/bakery/oil refinery, identify inefficiencies	20 h	Critical evaluation report with suggested solutions
12	Group Discussion	Food sustainability,	1 h per	Technical input and



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	(Technical Trends)	functional foods, AI in food industry, alternative proteins	GD	communication skill
13	Case Study-Based Learning	Real case: Maggi ban (regulatory aspect), Patanjali contamination issue, FSSAI recall cases	10 h	Report with fact analysis and regulatory links
14	Application / Software Development	Nutrition calculator app, food label generator, moisture loss calculator	10 h	Based on functionality and usability

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