Semester	**:**	**III**		
Course No.	**:**	**PFE-231**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Engineering Properties of Agricultural Produce and Food Science**		

SYLLABUS

Objectives : To make the students acquainted with the different engineering properties of agricultural produce and to help them to understand the importance of these properties in handling, processing and storage.

THEORY

Different engineering properties of food and their importance; Application of engineering properties in handling, processing and storage; Physical properties, viz. shape, size, roundness, sphericity, volume, density, porosity, specific gravity, surface area; Colour properties, CIE colour model.

Thermal properties viz., heat capacity, specific heat, thermal conductivity, thermal diffusivity, heat of respiration, co-efficient of thermal expansion; Electrical and dielectric properties as resistance, capacitance, dielectric loss factor, loss tangent and dielectric constant; Frictional properties, viz. static friction, kinetic friction, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials; Aero-dynamic characteristics such as drag coefficient, terminal velocity.

Rheological characteristics of food, elastic, plastic and viscous behaviour, visco-elasticity; Rheological models to explain food characteristics; Fluid behaviour as Newtonian, non-Newtonian, pseudo-plastic, dilatant, thixotropic, rheopectic and Bingham plastic; Textural characteristics of foods; Non-destructive methods of quality determination of foods; Principles of machine vision systems, spectroscopy, hyperspectral imaging and acoustic techniques.

Introduction to Food Science and Food Technology; Biochemical reactions involved in food processing and storage; Food spoilage agents, general methods for food preservation (physical, chemical and biological methods); Food microbiology: Classification of microorganisms, Multiplication of bacteria, Different beneficial and harmful microorganisms in relation to food preservation and spoilage, Industrial Bacteriology and Food fermentation.

PRACTICAL

Determination of the size of grains, fruits and vegetables using measuring instruments and using projection system; Determination of the shape (sphericity and roundness); Determination of the bulk and particle volume, bulk and particle density, specific gravity and porosity of grains; Determination of the volume, density and specific gravity of large individual objects (F and V); Determination of the surface area of the F and V; Determination of angle of repose, co-efficient of friction of different grains on different surfaces and angle of internal friction; To study the terminal velocity of grains and separating behavior of grains in a vertical wind tunnel; Determination of specific heat and thermal conductivity of some food grains; Determination of electrical properties of food materials; Determination of hardness of food materials; Determination of viscosity of food; Study and comparison of colour of food materials; Determination of carbohydrates; Determination of total nitrogen; Determination of oil content; Determination of ash content; Study of different types of microorganisms and microbiological examination of food products.

TEACHING SCHEDULE

THEORY [PFE-231]

Lecture No.	Topic	Sub-topics/ Key points	Weightage (%)
1	Engineering Properties	Different Engineering properties of food and their importance	10
2	Application of Engineering Properties	Application of Engineering properties in handling, processing and storage	
3 - 6	Physical Properties	viz., Shape, Size, Roundness, Sphericity, Surface area, Volume, Density, Porosity, Specific gravity	15
7	Colour Properties	CIE colour model	15
8 - 10	Thermal Properties	Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration, Coefficient of thermal expansion	
11 - 12	Electrical and Dielectric Properties	Resistance, Capacitance, Dielectric loss factor, Loss tangent and Dielectric constant	
13 - 14	Frictional Properties	Static friction, Kinetic friction, Rolling resistance, Angle of internal friction, Angle of repose, Flow of bulk granular materials	10
15	Aero-dynamic Characteristics	Drag coefficient, Terminal velocity	
16 - 18	Rheological Characteristics of Food	Elastic, plastic and viscous behaviour, Visco-elasticity, Rheological models to explain food characteristics	15
19 - 21		Fluid behaviour as Newtonian, Non-Newtonian, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham plastic; Textural characteristics of foods	
22 - 24	Non-destructive Methods of Quality Determination of Foods	Principles of machine vision systems and its application, Spectroscopy, Hyperspectral imaging and Acoustic techniques	15

Continued…

25	Introduction to Food Science and Food Technology	Introduction to Food Science and Food Technology	10
26	Biochemical Reactions	Biochemical reactions involved in food processing and storage	
27	Food Spoilage Agents	Food spoilage agents	
28	General Methods for Food Preservation	Physical, chemical and biological	
29	Food Microbiology	Classification of microorganisms, Multiplication of bacteria	
30 - 31	Different Microorganisms	Different beneficial and harmful microorganisms in relation to food preservation and spoilage	10
32	Industrial Bacteriology and Food Fermentation	Industrial Bacteriology and Food fermentation	
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [PFE-231]

Exercise No.	Exercise Title
1	Determination of the size of grains, fruits and vegetables using measuring instruments and using projection system.
2	Determination of the shape, sphericity and roundness.
3	Determination of the bulk and particle volume, bulk and particle density, specific gravity and porosity of large individual objects (Fruits, Vegetables and Grains)
4	Determination of the surface area of F & V.
5	Determination of angle of repose, co-efficient of friction of different grains on different surfaces and angle of internal friction.
6	To study the terminal velocity of grains and separating behavior of grain in a vertical wind tunnel.
7	Determination of specific heat and thermal conductivity of some food grains.
8	Determination of electrical properties of food materials.
9	Determination of hardness of food materials.
10	Determination of viscosity of food.
11	Study and comparison of colour of food materials.
12	Determination of carbohydrates.
13	Determination of total nitrogen.
14	Determination of oil content.
15	Determination of ash content
16	Study of different types of microorganisms and microbiological examination of food products.

Suggested Readings [PFE-231]:

1. Mohesin N.N. 1980. *Physical Properties of Plants & Animals*. Gordon & Breach Science Publishers, New York.
2. Singhal O.P. and Samuel D.V.K. 2003. *Engineering Properties of Biological Materials*. Saroj Prakasan, New Delhi.
3. Rao M.A. and Rizvi S.H. 1995. *Engineering Properties of Foods*. Marcel Dekker Inc. New York.
4. Jha. S.N. 2010. Non-destructive evaluation of food quality theory and practice. Springer -Verlag Berlin Heidelberg,
5. Ana Maria Jimenez-carvelo, Alejandra Arroyo-Carvelo & Luis Cuadros-Rodriguez. 2024. Non-invasive and Non-destructive methods for food integrity. Springer Nature Switzerland AG, Gewerbestrasse 11,6330, Cham Switzerland.
6. Notes of IGNOU, The people's university. Indira Gandhi National Open University of school of continuing education.
7. Vijaya Khader. 2001. Textbook of food science & Technology. Directorate of knowledge management in agriculture, (ICAR), Pusa, New Delhi.
8. William C. Frazier, Dennies C Westhoff. 2014. Food microbiology. McGraw hill education Pvt. Ltd. Chenni, India
9. Vijaya Khader. 2017. Preservation and processing of fruit and vegetables. Kalyani publication, New Delhi, India.
10. R.P.Shiratsava & Sanjeev Kumar. 2002. Fruit and vegetable preservation principle and practices. CBS publisher & distributor Pvt. Ltd. New Delhi, India
11. Fundamental of food microbiology, Chapter 1. Introduction to food microbiology, (Notes of IGNOU, The people's university. Indira Gandhi National Open University of School of Continuing Education).
12. L.E. Casida. 1968. Industrial Microbiology.
13. Serpil S. and Servet G S. 2005. *Physical Properties of Foods*. Springer Science + Business Media, LLC, 233 Spring Street, New York.