ENGINEERING PROPERTIES OF BIOMATERIALS

ENAE 203

Lecture : 2 **Year : II**
Tutorial : 0 **Part : I**
Practical : 1.5

Course Objectives:
The objective of this course is to acquaint and equip the students with different techniques of measurement of engineering properties and their importance in the design of processing and material handling equipment. Additionally, the course aims to equip students with up-to-date standards and practices necessary to ensure and maintain food quality.

1 Importance of Engineering Properties of Bio-materials (2 hours)

1.1 Physical properties, mechanical properties, optical properties
1.2 Application of engineering properties in handling, processing and storage

2 Geometrical Properties (3 hours)

2.1 Shape, size, volume, sphericity, roundness, surface area
2.2 Importance and measurement of geometrical properties
2.3 Characterization of shape and size of irregular shaped materials

3 Gravimetric Properties (3 hours)

3.1 Bulk density, true density, specific gravity, porosity
3.2 Importance and measurement of gravimetric properties

4 Optical Properties (2 hours)

4.1 Color, gloss, hue, Commission Internationale de l'Éclairage (CIE) color model.
4.2 Importance of optical properties and their measurement

5 Electrical Properties (3 hours)

5.1 Dielectric constant, dielectric loss tangent, electrical conductivity, resistance, capacitance, dielectric loss factor
5.2 Importance of electrical properties and their measurement

6 Thermal Properties (3 hours)

6.1 Thermal conductivity, thermal diffusivity, co-efficient of thermal expansion
6.2 Specific heat, heat of respiration, heat capacity
6.3 Importance of thermal properties and their measurement

7 Aerodynamic Properties (3 hours)

7.1 Aerodynamic behavior of grains and their byproducts
7.2 Terminal velocity, drag coefficient
7.3 Importance of aerodynamic properties and their measurement

8 Frictional Properties (3 hours)

8.1 Static friction, kinetic friction, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials
8.2 Importance of frictional properties and their measurement

9 Rheological Properties (4 hours)

9.1 Rheological characteristics of food, elastic, plastic and viscous behaviour, visco-elasticity; rheological models to explain food characteristics
9.2 Fluid behaviour as Newtonian, non-Newtonian, pseudo-plastic, dilatant, thixotropic, rheopectic and Bingham plastic
9.3 Textural characteristics of foods

10 Quality control (4 hours)

10.1 Concept, objectives and need of quality
10.2 Quality control, methods of quality control
10.3 Sampling: Purpose, sampling techniques for liquid, powdered and granular material
10.4 Sensory and statistical quality control
10.5 Consumer preferences and acceptance
10.6 Total quality management (TQM) and total quality control (TQC)
10.7 Food grades and standards: Bureau of Indian Standard (BIS), Agriculture + Mark Certification (AGMARK), Polyfluoroethylene (PFA), Food Products Order (FPO)
10.8 Codex Alimantarious Commission (CAC)
10.9 Sanitation in food industry, Good Manufacturing Practices (GMP), Hazard Analysis & Critical Control Point (HACCP) and ISO 9000 Series
10.10 Food laws and regulation
10.11 Non-destructive methods of quality determination of foods
10.12 Principles of machine vision systems, spectroscopy, hyperspectral imaging and acoustic techniques

Practical (22.5 hours)

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 grains
4. Determination of the volume, density and specific gravity of large individual objects (F and V)
5. Determination of the surface area of the F and V
6. Determination of angle of repose, co-efficient of friction of different grains on different surfaces and angle of internal friction
7. To study the terminal velocity of grains and separating behavior of grains in a vertical wind tunnel (Aspirator Column)
8. Determination of specific heat and thermal conductivity of some food grains
9. Determination of electrical properties of food materials
10. Determination of hardness of food materials
11. Determination of viscosity of food
12. Study and comparison of color of food materials

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	2	3
2	3	3
3	3	3
4	2	3
5	3	3
6	3	3
7	3	3
8	3	3
9	4	3
10	4	3
Total	**30**	**30**

* There may be minor deviation in marks distribution.

References

1. Mohesenin, N.N. (1980). Physical Properties of Plant and Animal Materials. Gordon & Breach Science Publication.
2. Mohesenin, N.N. (1980). Thermal Properties of Foods and Agricultural Materials. Gordon & Breach Science Publication.
3. Peleg, M., Bagelay, E.B. (1983). Physical Properties of Foods. AVI Publ. Co.

4. Rao, M.A., Rizvi, S.S.H. (Eds.). (1986). Engineering Properties of Foods. Marcel Dekker.
5. Singhal, O.P., Samuel, D.V.K. (2003). Engineering Properties of Biological Materials. Saroj Prakasan.
6. Hallstrom, B., Meffert, H.F., ThSpesis, W.E.L., Vos, G. (1983). Physical Properties of Food. Elsevier.
7. Ronal, J., Felix, E., Bengt, H., Hans, F., Th., M., Walter, E.C.S., Gilbert, V. (1983). Physical Properties of Foods. Applied Science Publication.