GUJARAT TECHNOLOGICAL UNIVERSITY

FOOD PROCESSING & TECHNOLOGY (14)
FOOD ENGINEERING TRANSPORT PHENOMENON
SUBJECT CODE: 2141406
B.E. 4th SEMESTER

Type of course: Food Processing Technology

Prerequisite: Basic integration and derivatives, vectors

Rationale: Identify and obtain values of fluid property and relationship between the properties
Understand the principles of continuity and momentum

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total
L	T	P	C	Theory Marks			Practical Marks			Marks
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Fluid Properties:** Definition of a fluid, continuum, properties of fluid density, specific eight, specific volume, specific gravity bulk modulus of elasticity, Vapour pressure, Surface tension, capillarity, viscosity, dynamic & Kinematic viscosity.	5	20
2	**Fluid Statics:** Pressure at a point, basic equation of fluid statics, Units and scales of pressure measurement, Pressure measurements, Forces on immersed plane and curved surface, Buoyant force, Stability of floating and submerged bodies. Relative equilibrium.	9	18
3	**Fluid-Flow Concepts And Basic Equations:** Flow characteristics, definitions, Continuity equation. Velocity potential and stream function, Euler's equation of motion along a streamline, Integration of Euler's equation of motion. Bernoulli equation; Reversibility Irreversibility and losses. Application of Energy equation to steady Fluid-Flow situations. Orifice meter, Venturi meter, Nozzle meter, pitot tube, Notches and Weirs. Momentum equation orifice and mouthpiece, Applications of Linear- Momentum equation, Moment of Momentum equation.	9	15
4	**Dimensional Analysis And Dynamic Similitude:** Dimensions and units, Dimensional homogeneity and dimensionless ratios. The Pi Theorem, Discussion of Dimensionless Parameters, Similitude, Model Studies.	7	15
5	**Viscous Effects:** Laminar incompressible steady flow, through circular tubes. Reynolds's Number. Velocity distribution in Turbulent flow. Resistance to turbulent flow in closed and open conduits, steady in compressible flow through simple pipe systems. Steady uniform flow in open channels, Boundary layer concepts, Boundary layer thicknesses, Drag on immersed bodies.	6	16
6	**Diffusivity and Mechanism of Mass Transfer:** Definitions of	4	16

Concentrations, Mass fluxes, Fick's Law of Diffusion, Theories if Ordinary Diffusion in Liquids.	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
28%	25%	18%	13%	16%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

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 above table

Reference Books:

1. Transport Phenomena by R.Byron Bird, Warron E. Stewart & Edwin N. Lightfoot, Wiley International Edition, John Wiley & Sons.
2. Transport Process & Unit Operations, Christie J. Geankoplis, Prentice Hall of India Private Limited. Modi P. N. and Seth S. M Hydraulics and Fluid Mechanics, Standard Book House.
3. Streeter V. L. and Wylie E. B. Fluid Mechanics, McGraw Hill, SI Edition
4. Bansal R K. Fluid Mechanics and Hydroulics, Laxmi publications, New Delhi.

Course Outcomes:
At the end of this syllabus students will be able to :

1. apply fundamental knowledge of mathematics to modeling and analysis of fluid flow problems in food processing technology
2. conduct experiments in pipe flows and open-channel flows and interpreting data from model studies to prototype cases

List of Practicals:

1. To verify Bernoulli's Theorem
2. To find out average value of discharge coefficient for notch- rectangular and triangular
3. To find out friction factor of pipes having various sizes and materials
4. To find out metacentric height of ship model
5. Calibration of venturimeter and orificemeter and get average value of discharge coefficient, Cd
6. For forced vortex: To find out height difference between two points on free surface by calculations and compare with observed one
7. To find out (1) loss coefficient for given elbow, bend, and sudden contraction (2) Compare theoretical and actual loss for sudden expansion
8. To find out (1) Cv,Cc,Cd for orifice meter (2) Cd for external mouthpiece
9. To find out theoretical and actual force acting on stationary flat vane and curved vane
10. To find out type of flow and critical Reynolds number

Open Ended Problems:
The syllabus of this subject would be useful to application based knowledge among students Like modeling and analysis of the systems, disasters which are the result of incorrect analysis in hydraulic engineering system

Major Equipments

1. Setup of Bernoulli's theorem
2. Setup of orifice meter, venturi meter, mouthpiece
3. Setup of pipe friction and joints
4. Setup of free and forced vortex formation

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.