GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Food Engineering & Technology

Subject Code: BE04051031

Subject Name: Fluid Mechanics

WEF Academic Year :	2025-26
Semester :	**4**
Category of the Course :	Professional Core

Prerequisite :	**Nil**
Rationale :	The course is designed to give fundamental knowledge of fluid, its properties and behavior under various conditions.

Course Outcome :

After Completion of the Course, Student will able to :

No.	Course Outcomes
01	Implement the basic concepts of fluid-flow phenomena in food processing.
02	Discuss various fluid flow theorems and implement various flow measuring devices.
03	Explain the laminar viscous fluid flow behavior in pipes.
04	Describe the requirements, working principle and construction of various pumps.
05	Discuss about viscometry and determine pressure drop in fluidized bed

Teaching and Examination Scheme:

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

Course Content :

Sr. No.	Course Content	No. of Hours	
1	**Introduction to fluid flow** • Introduction of Fluid • Types of Fluid • Classification of Fluid • Physical properties of fluids like mass density, specific gravity, viscosity, pressure, factors affecting the rheological parameters; • fluid pressure and its • Fluid measurement; manometers, simple manometers, differential manometers; • concept of Reynolds's number.	**10**	**20**
2	**Fluid flow measurement** • Derivation of continuity equation; • different types of energies of a liquid in motion; • derivation of Bernoulli's equation; • practical applications of Bernoulli's equation like venturi meter, orifice meter, pitot tube, rotameter. Numerical problems.	**8**	**15**
3	**Laminar viscous fluid flow** • Flow of viscous fluid through circular pipe, • Coefficient of friction; head loss due to Friction in pipes; head loss due to sudden enlargement, • contraction, vena contract, • entrance and exit losses; Stokes law (laminar flow around a sphere); laminar flow through porous media; pressure drop in flow through porous media. • Theory and working of capillary tube viscometer for Newtonian and non-Newtonian fluids	**10**	**20**
4	**Pumps & Valve** • Types of pumps and classification criteria, • Theory and working of centrifugal pump, • reciprocating pumps, • external gear pump (rotary pump), • Lobe pump, • Vane pump etc.	**8**	**20**

	• Introduction to Valves • Types of valve and working Principal		
5	**Fluidization** • Physical properties of particles like size, shape, sphericity, porosity, superficial and interstitial velocity, hydraulic radius, equivalent diameter etc. • Mechanism of fluidization, characteristics of gas – solid fluidized systems, • Fanning friction factor for porous media; minimum porosity, bed weight, pressure drop in fluidized bed, • theory and analysis of fluidization process; particulate fluidization; aggregative (or bubbling) fluidization; • principle of fluidized bed drying equipment; pneumatic conveyers. Numerical problems.	**9**	**25**

Reference Book :

1. McCabe & Smith Unit Operations in Chemical Engineering,
2. V Gupta & S.K. Gupta Fluid Mechanics & Application,
3. G S Sawhney Fundamentals of Fluid Mechanics
4. R K Bansal A Text book of Fluid Mechanics and Hydraulic machines
5. Arora K. R Fluid Mechanics Hydraulic and Hydraulic machines
6. Ghosal, S K, Sanyal S K and Datta S Introduction to Chemical Engineering,
7. Ibraz Albert and Barbosa-Canovas G V Unit Operations in Food engineering
8. S C Rao & C Guha Transport Phenomena

Suggested Course Practical List :

1) Determination of coefficient of discharge of Venturi meter.
2) Determination of coefficient of discharge of Orifice meter.
3) Determination of discharge through Rotameter.
4) Determination of pipe friction and pressure drop due to sudden contraction and expansion during fluid flow.
5) To determine the different types of flow Patterns by Reynolds's experiment.
6) To determine the Friction factor for the different pipes.
7) To determine the loss coefficients for different pipe fittings.
8) To determine the viscosity of fluid by viscometer.

9) Study of various types of pipes and pipe fittings.
10) Study of different types of valves.
11) Study of reciprocating pump.

List of Laboratory/Learning Resources Required : Equipment :

1) Pitot Tube
2) Venturi meter apparatus
3) Reynold's apparatus
4) Pressure Measurement apparatus
5) Orifice meter apparatus
6) Pipe fitting apparatus
7) Metacentric height apparatus
8) Open Channel apparatus (Notches)
9) Nozzle Meter
10) Manometer
11) Viscometer

List of Open Source Software/learning website :

www.ift.org www.rsc.org www.fao.org NPTEL

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
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/Power Point 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 (Technical Trends)	Food sustainability, functional foods, AI in food industry, alternative proteins	1 h per GD	Technical input and 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

- All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
- Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

****