



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Chemical Engineering

Course / Subject Code: DI03005021

Course / Subject Name: Fluid Flow Operation

w. e. f. Academic Year:	2024-25
Semester:	3 rd
Category of the Course:	PCC

Prerequisite:	Fundamentals of Unit Operations, Understanding of System units and its conversion
Rationale:	Knowledge of fluid mechanics is essential for the chemical engineer because the majority of chemical-processing operations are conducted either partly or totally in the fluid phase. This course deals with basic concepts and principles in hydrostatics and hydrodynamics and their application in solving fluid - mechanics problems. Using various theoretical and practical concepts of fluid mechanics, power requirement for pumps, blowers and compressors can be determined and friction losses through pipes and fittings can also be calculated.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand the Fundamentals concept of fluid statics and Fluid-Flow Phenomena.	R, U
02	Solve various fluid flow problems using governing equations.	A
03	Calculate Friction losses through pipe and fittings.	U, A
04	Select the metering devices and fluid moving machinery for appropriate chemical engineering operations.	U, A
05	Understand the concept of fluidization.	R, U

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150



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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
Unit – I Fluid Statics and its Applications	1.1 Ideal fluid and Real fluid 1.2 Fundamentals of fluid statics and dynamics 1.3 Define pressure, Static pressure, Dynamic pressure, Vacuum 1.4 Compressible and incompressible fluids 1.5 Derivation of equation of pressure in static fluid 1.6 Principle construction and working of: Simple U-tube manometer and Inclined manometer 1.7 Derive equation of pressure difference for U-tube manometer 1.8 Differential pressure cell 1.9 Continuous gravity decanter 1.10 Numericals based on pressure and manometer	7	15
Unit – II Fluid-Flow Phenomena	2.1 Velocity field, velocity gradient, shear stress and rate of shear 2.2 Boundary layer & its formation in straight tubes 2.3 Newton's law of viscosity 2.4 Newtonian and non-Newtonian fluid 2.5 Reynold's experiment and Reynolds Number 2.6 Numerical based on Reynolds Number	5	11
Unit– III Basic Equations of Fluid Flow	3.1 Average velocity and mass velocity 3.2 Continuity equation for mass balance in steady flow 3.3 Derivation of Bernoulli's equation and corrections in Bernoulli's equation 3.4 Hagen-Poiseuille's Equation 3.5 Numerical based on basic equations	6	13
Unit– IV Friction in Flowing Fluid	4.1 Roughness of pipe 4.2 Hydraulic radius and equivalent diameter 4.3 Friction factor chart 4.4 Friction losses from: (a) Sudden expansion of cross section (b) Sudden contraction of cross section 4.5 Friction loss in fittings and valves	4	9
Unit– V Transportation of Fluid	5.1 Types and uses of fittings and joints 5.2 Construction and working of valves like: (a) Gate valve (b) Globe valve (c) Check valve (d) Butterfly valve (e) Ball valve 5.3 Classification of pumps	11	24



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	5.4 Construction and working of centrifugal, reciprocating and rotary pump 5.5 Characteristics curves of centrifugal pump 5.6 Developed head and power requirement in centrifugal pump 5.7 NPSH, and Cavitation in centrifugal pump 5.8 Numerical based on NPSH, efficiency, head and power 5.9 Construction and working of Steam jet ejector and Liquid ring vacuum pump 5.10 Introduction to Fan, Blowers and Compressors		
Unit– VI Flow Measurement	6.1 Classification of flow measuring devices 6.2 Construction, working principles and application of flow meters like Venturi meter, Orifice meter, Rotameter, weirs, Magnetic flow meter 6.3 Derivation of equation of flow rate through Orifice meter, Venturi meter	8	20
Unit– VII Fluidization	7.1 Fluidization and its industrial applications 7.2 Drag and drag coefficient, Stokes' law 7.3 Condition for Fluidization 7.4 Minimum fluidization velocity	4	8
	Total	45	100

Suggested Course Practical List:

Sr. No.	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs Required
1.	Estimate pressure drop using U-tube manometer	2
2.	Estimate vacuum using U-tube manometer	2
3.	Identify types of flow by using Reynolds's apparatus	2
4.	Use Bernoulli's apparatus for mechanical energy balance	2
5.	Estimate viscosity of water using Hagen-Poiseuille's equation	2
6.	Estimate friction losses through pipe, fittings and valves	2
7.	Conduct a performance test on reciprocating pump and plot the operating characteristics	2
8.	Conduct the performance test on centrifugal pump and plot the operating characteristics	2
9.	Estimate friction losses due to sudden expansion and contraction in flow area	2
10.	Determine the Co-efficient of discharge for venturi meter	2
11.	Determine the Co-efficient of discharge for orifice meter	2
12.	Determine the Co-efficient of discharge of the Rotameter and obtain the calibration error	2



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13.	Determine the Co-efficient of discharge for notches	2
14.	Measure minimum fluidization velocity through fluidized bed	2
15.	Determine of friction factor of a given pipe of circular cross section.	2
Total		30

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
20%	37%	43%	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Unit Operations of Chemical Engineering	McCabe, Warren L., Julian C. Smith	McGraw Hill Publication, New York 2004 (Seventh Edition)
2	Introduction to Chemical Engineering	L. Badger, Julius T. Banchero	McGraw Hill Publication, New York 2004 (Seventh Edition)
3	Unit Operations of Chemical Engineering Vol-I	Chattopadhyay, P.	Khanna Prakashan, New Delhi, 1996
4	A text book of Fluid Mechanics	Khurmi, R.S.	S. Chand Publication, New Delhi 2002
5	Unit Operation –I	Gavhane, K.A.	Nirali Prakashan, Pune 2009
6	A Textbook of Fluid Mechanics and Hydraulic Machines	Dr. R. K. Bansal	Publisher: Laxmi Publications, 2005 ISBN 10: 8131808157 ISBN 13: 9788131808153
7	Fluid Mechanics: Fundamentals and Applications	John. M. Cimbala Yunus A. Cengel	McGraw Hill Publication, New York 2006 (1 st edition) ISBN 0-07-247236-7



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Suggested Activities for Students:

Other than the classroom and laboratory learning, following are the suggested student- related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare a chart on different types of vacuum pumps.
- b. Prepare a chart on various types of manometers.
- c. Prepare a power point presentation on classification and demonstration of valves.
- d. Develop a friction factor chart experimentally.
- e. Prepare a model/chart/poster on pneumatic and hydraulic conveying.
- f. Prepare a chart that classifies fluid on various bases.
- g. Prepare a power point presentation on blowers and compressors.
- h. Prepare a power point presentation on classification and demonstration of flow measuring devices.
- i. Prepare a power point presentation on various methods to join pipes and tubes.
- j. Make a report on Cavitation, its identification and prevention.
- k. Make a chart on selection criteria of pumps and valves.

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