Program Description

Course Name	**Two-Phase Pipe Sizing & Pipe Networks**
Course Name as on Certificate	**Certification in Two-Phase Pipe Sizing & Pipe Networks**
Certificate Type	Certificate of Completion by IITM Pravartak and L&T EduTech
Certificate Issued by	IIT MADRAS and L&T EduTech
Course Objectives	**Course Objectives:** This unique course entitled "Two-Phase Pipe Sizing & Pipe Networks" is focused on predicting the two-phase total static pressure drop in a given single-path and multiple-path piping system when both liquid and gas flow concurrently. Looking into the severity of certain two-phase flow regimes on the piping system integrity, the formation of two-phase flow regimes in horizontal and vertical pipes and their identification based on gas and liquid flow rates, the effect of bends on two-phase flow regime formation in both upstream and downstream pipelines are covered. Models like the Homogeneous Equilibrium Model, Separated Flow Model, and Drift Flux Models are covered. Demonstrated the determination of total static two-phase pressure drop in pipes, pipe fittings, valves, and pipe networks using two-phase multipliers and void fraction correlations by solving practical problems. **Course Objectives:** Enables the learner: • To explain two-phase flow regimes in horizontal and vertical pipes, the influence of bend on two-phase flow regime formation in downstream and upstream, and identification of two-phase flow regimes using flow pattern maps • To develop the Homogeneous Equilibrium Model, Separated Flow Model and Drift Flux Model to predict the two-phase total static pressure drop and determine the two-phase pressure drop in a straight pipe, pipe fittings using two-phase multiplier correlations. • To predict the two-phase pressure drop in piping networks which contain most of the pipe fittings
Eligibility	Students pursuing Diploma / UG / PG Programs in Mechanical/Chemical/Petro-Chemical/Petroleum/Instrumentation Engineering
Pre Requisites	**Fluid Mechanics**
Target Segment	Students pursuing Diploma/ UG / PG Programs in Mechanical/Chemical/Petro-Chemical/Petroleum/Instrumentation Engineering, Faculties / Working Professionals in the above domain & other aspiring learners
Course Content	**See Enclosed Progamme details – as Annexure 1**

Pedagogy	Online Self-paced E-Learning Content		
Assessment	One Final Assessment		
Programme Faculty	**Dr. Nakka Muralidhara Rao, Subject Matter Expert – L&T EduTech** As an alumni from IIT Kharagpur, Dr. Nakka Muralidhara Rao has nearly 3 decades of experience in the fields of thermal power plants, heat and mass transfer, fluid modeling and pipe design analysis. While serving as the Head of Rolta Academy, he was instrumental in its establishment as a world-class institution. Spearheaded the Project Control, Proposal & Estimation department. He also led the design and analysis of the Flame Deflector Plate for the Dissipation of Flume Gases in a Semi-Cryo Engine Test Facility, collaborating with ISRO for the Test Facility Centre in Mahendragiri, Tamil Nadu, while utilizing CFD (Computational Fluid Dynamics) analysis techniques.		
Duration	Units: 4 Hours: 11		
Class Schedule	Self-paced		
Programme Highlights/USPs	**Two-Phase:** | Flow Regimes-Straight Pipe Run | Flow Regimes-Pipe Runs with Bends | Two-Phase Notations | Governing Equations | Homogeneous Equilibrium Model | Separated Flow Model | Drift Flux Model | Pressure Drop in Piping Components | Pressure Drop in Piping Network |		
Total Fees		**Total Fees (Rs.)**	
	Total Programme Fee	Rs.1,900 /- inclusive of Tax	

Annexure - 1

Proposed Course outline / programme / plan - Unit wise syllabus details.

Unit I - Two-Phase Flow Regimes and Notations
Flow Regimes - Straight Pipe Run: Horizontal Pipe (Liquid + Gas), Vertical Pipe (Liquid + Gas), Vertical Downward Flow ((Liquid + Gas) **Flow Regimes - Pipe Runs with Bends:** Horizontal to Vertical Downward, Horizontal to Vertical Upward, Vertical to Horizontal Upward **Two-Phase Notations:** Two-Phase Parameters/Terminology, Relationships for Two-Phase Parameters, Flow Pattern Maps **Problem Solving:** Problem Solving on Flow Regimes
Unit II- Two-Phase Flow: Homogeneous Model
Governing Equations: Basic Equation of Two-Phase Flow: Conservation of Mass, Conservation of Momentum, Conservation of Energy **Homogeneous Equilibrium Model:** Homogeneous Model, Two-Phase Friction Factor, Evaluation of Pressure Drop, Application of Theory to Experimental Data **Problem Solving:** Problem Solving on Components of Total Static Pressure Drop in Single & Two-phase flow
Unit III - Two-Phase Flow: Separated & Drift Flux Models
Separated Flow Model: Separated Flow Model, Two-Phase Multiplier, Lockhart-Martinelli, Martinelli-Nelson and Thom Correlations, Barcozy, Chisholm's and Friedel Correlations **Problem Solving:** Problem Solving on Two-phase Graphical Correlations, Problem Solving on Pressure Drop by using Martinelli- Nelson and Thom Correlations **Drift Flux Model:** Drift Flux Model, Slip Ratio Correlations **Problem Solving:** Problem Solving on Void Fraction and Gravitational Pressure Drop by Slip Ratio Correlations, KaH Correlations, Problem Solving on Void Fraction and Gravitational Pressure Drop by KαH Correlations, Drift Flux Correlations, Problem Solving on Void Fraction and Gravitational Pressure Drop by Drift Flux Correlations

Unit IV - Two-Phase Pressure Drop through Piping Components & Networks
Pressure Drop in Piping Components: Pressure Drop due to Sudden Enlargement **Problem Solving:** Problem Solving on Pressure Drop due to Sudden Enlargement, Pressure Drop due to Sudden Contraction, Problem Solving on Pressure Drop due to Sudden Contraction, Pressure Drop through a Sharp-Edged Orifice, Problem Solving on Total Static Pressure Drop Through a Sharp-Edged Orifice, Pressure Drop through a Nozzle, Venturi, Bend, Fittings, Problem Solving on Total Static Pressure Drop Through a Nozzle, Venturi, Bend, Fittings **Pressure Drop in Piping Network:** Pressure Drop Calculation for Parallel Pipes, Pressure Drop Calculation for Series Pipes, Determination of Flow Rate in Pipe Network