



Pipeline Systems: Design, Analysis and Operation

Introduction:

Pipeline systems are very essential parts of any industrial and practical engineering application. The design task of pipelines components and their operation and maintenance as well are in fact one of the very important practices of most engineers and technicians. Availability, efficiency and extended reliable performance of power plants, pumping and fluid handling stations and all similar facilities are greatly influenced by accurate design, selection, efficient operation and proper maintenance of their piping systems and the associated components and flow measurement equipments.

Designing of piping system is to apply relevant "Fluid Mechanics" concepts concerning flow in pipes/ducts to solve various practical problems of engineering importance related to fluid motion in pipelines components. Some involved fluid mechanics concepts are: effect of viscosity of fluids, characteristics of laminar and turbulent flows, critical Reynolds numbers, major pressure/head losses and types of minor losses in different fitting components. Dealing with compressible flow problems may be a major design & operation tasks in some pipeline systems.

Manual/Automatic control valves are very essential parts of all pipeline systems. Valves are used to control flow parameters such as: rate, pressure and direction. Some valves are also very important part of water hammer protection systems. Valves are constructed to withstand specific range of flow rate, temperature, pressure, corrosion, and mechanical stress. Emergency and pressure relief valves and ruptured disks are practically the key elements in the safe operation of any high pressure and high temperature process. The correct selection and application as well as the safe operation and maintenance requirements of those critical components shall affect greatly cost optimisation, plant availability, personnel and equipment safety as well as fluid leakage and many related environmental issues.

Course Objectives:

This Training Course has been designed to give the participants the skills and knowledge to:

- Understand the basics and fundamental backgrounds about fluid flow in pipes and ducts and all various components of pipeline systems.
- Understand the basics and fundamental backgrounds about Viscosity of fluids, characteristics of laminar and turbulent pipe flows, critical Reynolds numbers.
- Care-full examination of how to calculate major pressure and head losses and types of minor losses in different pipeline fittings and components.
- Understand the basics about types of manual and control valves as essential parts of pipelines. This shall include their various functions, materials, sizes, geometry considerations and the most essential flow characteristics through each type.
- Care-full examination of pressure drop relations and flow coefficient calculations for each valve type. How to select the proper valve size for a given flow is also considered.
- Investigate the various international standards for valve rating, material selection and methods for correct valve sizing for different type of fluids..
- Care-full examination of various types of emergency and pressure relief valves and ruptured disks.
- Care-full examination of various types of automatic control valves and water hammer protection valves.
- Care-full examination of various types of pipelines associated flow measurement components and equipments.

The ILO's (Intended Learning Outcomes) of the Course:

a) Knowledge and Understanding:

Having successfully completed this course, the participants should have knowledge and understanding of:

- ✓ Fundamental Aspects of Pipe-Lines, Types and components of Piping Systems, Review of Hydraulic considerations, Major and Minor Losses in Piping Systems.
- ✓ Types of Pipe line Fittings, Piping System Design and pipe-networks calculations problems.



- ✓ Using Computer Software & numerical calculation methods in design & analysis of Piping systems.
- ✓ Types of industrial Valves (functions, selections: hydraulic considerations, construction, ratings, materials, Flow through valves, pressure losses, design facts/parameters-Manual Valves (types, selection, and operation).
- ✓ Hydraulic & Pneumatic control valves (Pressure, Directional, check), and Types of Flow Meters.
- ✓ Water Hammer Problems in Pipe lines.

b) Intellectual Skills:

Having successfully completed this course, the participants should have the ability to:

- ✓ Select and apply appropriate technical and optimum method in doing design and analysis of pipe line problems.
- ✓ Searching for scientific information and adopting self-E-learning capabilities.
- ✓ Analyze & compare component effects, performance, and efficiency of different pipe line systems.
- ✓ Apply the concept of using software for design, simulation, analysis, diagnostics & operation of various types of pipe line systems and networks.
- ✓ Compare between various types of pipe line systems and networks components, and parts.
- ✓ Apply scientific and engineering analysis for pipe line systems and networks.

c) Professional and Practical Skills:

Having successfully completed this course, the participants should have the ability to do:

- ✓ Identify several types of pipe line systems and networks which are essential for the design and operation of mechanical power systems and energy transfer processes.
- ✓ Perform professional design and modelling for pipe line systems and networks.
- ✓ Suggest possible alternative solutions for various types of components for pipe line systems and networks.
- ✓ Diagnose efficiency and performance of different types of control valves in pipe line systems and networks.
- ✓ Analyze different types of flow meters in pipe line systems and networks.
- ✓ Perform engineering assembly of different pipe line system fittings and networks components in one system.
- ✓ Identify practical problems and compare between different technologies used for pipe line systems and networks

d) General and Transferable Skills:

Having successfully completed this course, the participants should have the ability to do:

- ✓ Transfer knowledge, Work in group and Communicate in written and oral forms, in English.
- ✓ Use IT & evolutionary technological tools & PC applications.
- ✓ Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.
- ✓ Organise and manage time & resources effectively; for short-term and longer-term commitments.

Who Should Attend:

Engineers and Field Personnel involved with design, maintenance, operation, selection installation and maintenance as well as plant reliability, condition monitoring and for the day to day servicing and operational efficiency. Also plant and maintenance engineers, process engineers and maintenance managers. It is also be invaluable to supervisors who are involved in pump and compressor maintenance activities.

The Instructor:

Dr. Mohsen Soliman is an Associate professor of fluid mechanics group in Mechanical Power Engineering Department – Cairo university. He has a Ph.D. degree, 1987 from university of California, Irvine and has a long teaching and research experience in the area of fluid flow, turbo machines, and gas dynamics and has many research papers published at international conferences and journals. Dr. Soliman has had many years' experience in organizing and lecturing training courses for engineers inside and outside Egypt. The courses cover design pipe lines, valve technology, water hammer and fire fighting systems. Currently, Dr. Soliman is the manager of the Automatic Control Lab, ACC, and the administrator of the Automatic Control Post Graduate Diploma at Mech. Power Engineering Dept. FECU. See the ACC site: www.acc-vlab.cu.edu.eg



Course Contents:

Chapter [1] : Introduction & Basic Concepts:

Fundamental Aspects of Fluid Flow Piping Systems, Types and components of Piping Systems, Review of Hydraulic considerations, Major and Minor Losses in Piping Systems, Types of Pipe Fittings, Solved Examples.

Chapter [2] : Piping system Design Calculations (Solved Practical Cases)

Chapter [3] : Using Computer Software in the design of Piping Systems

Chapter [4] : Types of Valves (basic functions, selections:

Hydraulic considerations, construction, ratings, materials, Flow through valves, pressure losses, design facts / parameters - Manual Valves (types, selection, connections, operation) - Check Valves (types, selection, design and installation factors)-Reducing and Pressure Relief Valves (direct acting, characteristics) - Automatic Control Valves (spool types, single/multi-stage controls)- Valve Maintenance -Examples for automatic Valves & movies

Chapter [5] : Types of Flow Meters

Daily Course Program

Day one:

9:00 – 9:30	Registration	
9:30 – 11:00	Lecture 1	Fundamentals of Piping Systems
11:00 – 11:30	Coffee break	
11:30 – 13:00	Lecture 2	Fluid Flow Aspects of Pipelines+ Movie
13:00 – 13:30	Lunch break	
13:30 – 15:00	Lecture 3	Practical Pipe Flow Examples + Movies

Day Two:

9:00 – 10:30	Lecture 4	Pipe Networks + practical movies
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 5	Computer software for Piping systems
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 6	Water Hammer,

Day Three:

9:00 – 10:30	Lecture 7	Thermo-Fluid Aspects of pipelines
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 8	Flow Through Valves, fundamentals
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 9	Manual Valves

Day Four:

9:00 – 10:30	Lecture 10	Check Valves
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 11	Pressure Relief Valves
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 12	Movies + Automatic Valves

Day Five:

9:00 – 10:30	Lecture 13	Valve testing and Maintenance
10:30 – 11:00	Coffee break	
11:00 – 12:30	Lecture 14	Types of Flow Meters + Movies
12:30 – 13:00	Lunch break	
13:00 – 14:30	Lecture 15	Applications, case studies, Course Review, Course Evaluation.

أ.م/ محسن سيد سليمان
مدير معمل التحكم ACC ومسئول إدارة دبلوم التحكم الأوتوماتيكي
مدير وحدة ضمان الجودة سابقاً ومرشداً أكاديمي د.ع في قسم ميكانيكا قوى