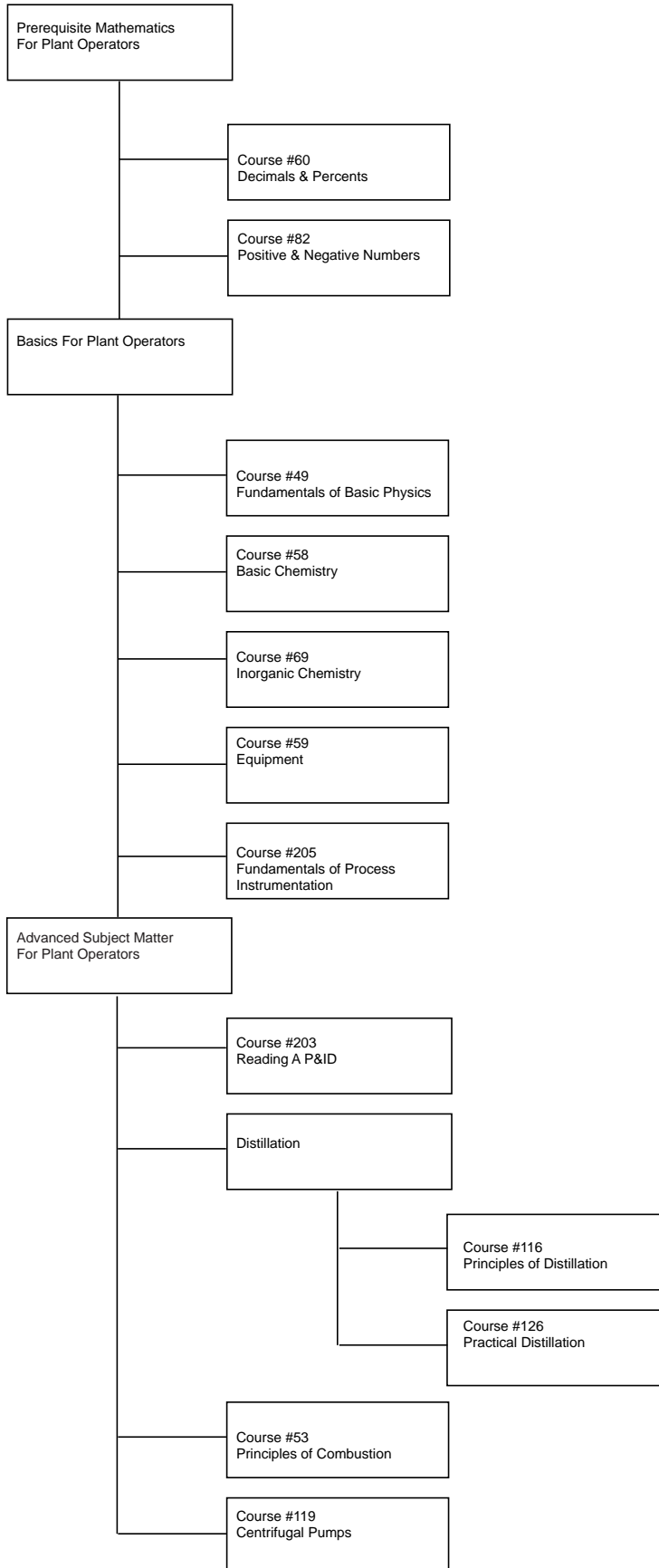


# Sample Plant Operator Curriculum

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# Curriculum Flow Chart



## Summary of Cost and Training Hours

Course #	Course Title	Unit Cost	Hours of Instruction
Prerequisite Mathematics			
60	Decimals & Percents	\$52.00	25 hours
82	Positive & Negative Numbers	\$15.50	4 hours
Total Cost Mathematics		\$67.50	29 hours
Basics For Plant Operators			
49	Fundamentals of Basic Physics	\$58.00	16 hours
58	Basic Chemistry	\$47.00	12 hours
69	Inorganic Chemistry	\$35.00	10 hours
59	Equipment	\$50.00	13 hours
205	Fundamentals of Process Instrumentation	\$135.00	30 hours
Total Cost Basics For Plant Operators		\$325.00	81 hours
Advanced Subject Matter For Plant Operators			
203	Reading A P & ID	\$47.00	6 hours
116	Principles of Distillation	\$26.50	6 hours
126	Practical Distillation	\$34.50	8 hours
53	Principles of Combustion	\$44.00	14 hours
119	Centrifugal Pumps	\$47.50	9 hours
Total Cost of Advanced Subject Matter		\$199.50	43 hours
Summary of Total Curriculum Cost			
Total Curriculum Cost Per Employee		\$592.00	153 Total Hours
Cost Per Hour of Training		\$3.87/hour	

## Prerequisite Mathematics For Plant Operators

Course No. 60

25 hours

### Plant Mathematics – Decimals and Percents

A refresher course on decimals and percents, their relationships to each other and to fractions, and the mathematical processes involving the three. Conversion from one form of notation (fraction, decimal, or percent) to another; adding, subtracting, multiplying, and dividing with decimals; rounding off and checking of decimal answers in problems; converting measurement units to decimals of other units in the same scale; working in decimals in solving multiplication and division problems involving percents; and practical sequential problems in the fields of production, laboratory control, and maintenance.

*Elementary school mathematics.*

Course No. 82

4 hours

### Plant Mathematics –Positive and Negative Numbers

A refresher course on positive and negative numbers and their relationship to each other: using signs to determine positive or negative qualities; reading scale values above and below zero; adding negative numbers, positive and negative numbers; subtracting large positive numbers from smaller ones; and working problems that require the use of positive and negative numbers.

*Elementary school mathematics.*

## Basics For Plant Operators

Course No. 49

16 hours

### Plant Operator Series – Fundamentals of Basic Physics

Basic principles of physics with which all new plant operators should be familiar: concepts of weight, form, volume, temperature, pressure, density, specific gravity, condensates, and vapors: conversion of “psi” to “feet of water” and “inches of mercury” and vice versa; absolute, gauge, and atmospheric pressure, and vacuum; effects of temperature and pressure on gas volumes (Ideal Gas Laws); compression and expansion; and the effects of temperature and pressure on liquids, vapors, and condensates.

*Familiarity with multiplication and division of whole numbers and the use of fractions and decimals.*

Course No. 58

12 hours

### Plant Operator Series – Basic Chemistry

The basic chemistry that a plant operator needs to understand chemical reactions and acids and bases. Highlights include: atoms and molecules; elements and compounds; chemical reactions; catalysts; acidity and alkalinity; pH and the pH scale. Some of the chemical symbols introduced are: HCl, H<sub>2</sub>SO<sub>4</sub>, NaCl, NaOH, Hg, H<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>O.

*Arithmetic ability and basic knowledge of pressure and temperature.*

Course No. 69

10 hours

### Inorganic Chemistry For Plant Operators

Chemical attraction; valence; radicals; synthesis of a compound; decomposition of a compound; relative activity of elements; factors which effect synthesis; action of a catalyst; types of mixtures; solutions and solvents; identification of acids, bases, and salts; and pH scale and measurement of pH.

*A general understanding of the physical and chemical nature of matter, such as the existence of chemical elements and compounds, atoms and molecules, acids, and bases and so on.*

Course No. 59

13 hours

### Plant Operator Series – Equipment

Basic concepts of plant operating equipment and some of its hardware: an introduction to vessels such as tanks and columns or towers, including packing, distributors, and process flow; basic principles of positive displacement pumps, centrifugal pumps, reciprocating pumps, and compressors; fundamentals of heat exchange, including heat exchangers and steam trap principles; the main parts of a valve and an introduction to many types of valves.

In the last section of the course, the trainee follows a process flow using most of the equipment discussed in the course.

*Knowledge of basic physics.*

## Basics For Plant Operators (Continued)

Course No. 205

30 hours

### Fundamentals of Process Instrumentation

An over view of the physics associated with understanding instrumentation and process variables. Direct read instruments, how to read them and how they work. The concept of a simple control loop. The different types of temperature, pressure, level, flow and weight sensors and how they work. The role of a transmitter and how its output and input are related. Types of controllers and control modes. Types of recorders and how they are read. Control valves and other final control elements. Simple, cascade, feedforward and ratio control. The course is divided into three books, Part I - Introduction, Part II - Sensors and Part III - Control Loops and Their Elements. There is a Completion Exercise associated with each book to provide a means of evaluating how the trainee has learned the material.

*Familiarity with multiplication and division of whole numbers and the use of fractions and decimals. Ability to read simple line graphs.*

## Advanced Subject Matter For Plant Operators

Course No. 203

6 hours

### Reading A P&ID

Highlights include parts of a P&ID (body, title block, revisions etc.), using the Master Sheet, equipment symbols, instrument symbols, line designations and identifying process lines, tracing process flow and following instrument control loops

*Understand the basic concepts of process equipment such as pumps, check valves, heat exchangers and control valves.*

Course No. 116

6 hours

### Principles of Distillation

Basic principles of distillation process: high and low boilers; liquid-vapor composition tables; composition of boiling solutions, single-stage batch, and continuous distillation; mass balance around a column; use of temperature-composition diagrams; effect of pressure on boiling and condensing temperatures; and temperature and pressure indicators and recorders for the distillation process.

*Ability to use percent in arithmetic calculations, and familiarity with temperature and pressure units of measurement.*

Course No. 126

8 hours

### Distillation – Practical Distillation

Operating characteristics and identification of parts of distillation columns: a review of Temperature-Composition Diagram use; calandria and heat exchangers; column control systems; effect of base temperature changes on product streams; effect of feed rate changes on product streams; effect of feed composition changes on product streams; identification of types of trays; column temperature profile; internal and external reflux; and effect of reflux ratio on product composition.

*An understanding of the basic principles of distillation, such as the relationship between boiling point and composition; familiarity with terms used to indicate temperature, pressure and flow ( $^{\circ}\text{C}$ , psig, pph, etc.); and the ability to add, subtract, multiply, and divide decimals and percents.*

Course No. 53

14 hours

### Principles of Combustion

The principles of combustion as they apply to the combustion of commercial fuels: the chemical symbols for elements and compounds encountered in combustion; ignition temperatures; chemical formation of  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{O}$ ; products of combustion; complete, incomplete, and perfect combustion; effect of time, temperature, and turbulence on quality of combustion; the BTU; heating value of fuel; effects of excess air; and combustion of solid, liquid, and gaseous fuels.

*Ability to add, subtract, multiply and divide simple fractions and decimal numbers.*

## Advanced Subject Matter For Plant Operators (Continued)

Course No. 119

9 hours

### Centrifugal Pumps

Operating characteristics and identification of parts of centrifugal pumps; flow-through pump; mechanical and packing seals; seal flush; parts of an impeller, identification of impellers; discharge pressure versus flow; power requirements versus flow; effect of specific gravity on power requirements; multistage operation; methods of priming centrifugal pumps; operating characteristics of self-priming centrifugal pumps; types of oil lubrication; grease-lubricated bearings; bearing housing temperatures; and cavitation and gassing of centrifugal pumps.

*Familiarity with terms used to indicate temperature, pressure, and flow ( $^{\circ}F$ , psig, pph, etc.). Ability to add and subtract whole numbers.*

### Training Hours and Cost Information

The curriculum is broken into three parts, (1.) prerequisite mathematics, (2.) basics for plant operators and (3.) advanced subject matter. There are 29 instructional hours of mathematics, 81 instructional hours of basics and 43 hours of advanced material for a total of 153 hours of instructional content. The total cost of materials per employee is \$592.00 which results in an average cost per hour of training of \$3.87. The next page provides detailed information on cost and instructional hours.