INTRODUCTION TO PROCESS TECHNOLOGY

Topic Name	Objectives
Course Overview	1. Describe the following components (aspects) of the Process Technology Program: • Individual expectations • Program purpose • Program value • Industry involvement 2. Review course objectives
History of the Process Industry	1. Explain the growth and development of the process industries. 2. Report the impact of the industry on: • The community • Other industries • The environment • The economy 3. Identify industry responses to current issues and trends such as: • Global competition • Safety and environmental regulations • Technology advancements 4. Explain and describe the responsibility of the following regulatory agencies: • EPA (Environmental Protection Agency) • OSHA (Occupational Safety & Health Administration • DOT (Department of Transportation) • NRC (Nuclear Regulatory Comission) • Homeland Security • Local and state regulatory agencies
Green Technologies and Related Industries (Optional)	1. Describe Green technologies relevant to the industries in your area. • BioMass • Solar • Wind • Hydro/Water • Nuclear • Recycling Technology
Your Career as a Process Technician	1. Describe the roles, responsibilities, and expectations of the process technician: • Work environment (all weather, drug and alcohol free, team-structured, constantly changing and 24 hours per day operations). • Employer expectations. • Equipment and process operations, maintenance and control. • Physical requirements (lifting, pulling, climbing, etc.).

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Topic Name	Objectives
Your Career as a Process Technician (cont.)	• Following all procedures, safety systems, and rules for everyone's safety and the protection of the environment • Housekeeping/Auditing is 24/7 2. Describe the impact of shift work on: • Individual (Health and Safety) • Family relationships. 3. Describe changes and future trends in the role of the process technician. 4. List the factors responsible for future role changes of the process technician. 5. Describe the difference between organized and non-organized (union and non-union) operations.
Working as Teams	1. Describe the differences between work groups and teams. 2. Describe the different types of teams encountered in the process industries. 3. Identify the characteristics of a "High Performance" or an effective team. 4. Define the terms: • Synergy • Team Dynamics 5. Describe the steps or stages through which a team evolves (forming, storming, norming, and performing). 6. Identify factors that contribute to the failure of a team including: • Failure to achieve the defined outcome • Failure as a team to work together and achieve full synergy 7. Define workforce diversity and its impact on workplace relations: • In a team environment • Work group (co-worker)
Basic Physics	1. Define the application of physics in the process industries. 2. Define matter and the states in which it exists. 3. Use physical property characteristics to describe various states of matter (liquid, gas, and solids). 4. Define and provide examples of the following terms: • Mass • Density • Elasticity • Viscosity • Buoyancy • Specific Gravity • Flow • Evaporation • Pressure • Velocity • Friction • Temperature

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Topic Name	Objectives
Basic Physics (cont.)	• British Thermal Unit • Calorie • Electricity 5. Describe the three (3) methods of BTU (British Thermal Unit) transfer: • Convection • Conduction • Radiation 6. Describe how Boyle's Law explains the relationship between pressure and volume of gases. 7. Describe how Charles' Law explains the relationship between temperature and volume of gases. 8. Describe how Dalton's Law explains the relationship between total and partial pressure of a gas. 9. Describe how the General Gas Law explains the relationship between temperature, pressure, and volume of gas. 10. Describe how Bernoulli's Law explains the flow of liquids and gasses. 11. Describe force and leverage and their application to the process industry. 12. Convert between scales using mass, flow and temperature which are commonly used in the process industry.
Basic Chemistry	1. Define the application of chemistry in the process industries. 2. Describe the relationship between molecules, atoms, protons, neutrons, and electrons. 3. Define the difference between organic and inorganic chemistry. 4. Explain the difference between chemical properties and physical properties. 5. Define and provide examples of the following terms: • Hydrocarbon • Boiling Point • Chemical Reaction • Oxidation/ Reduction • Acidic • Alkaline • Exothermic • Endothermic • Compounds • Mixtures • Solutions • Homogenous • Equilibrium • Catalyst 6. Describe the difference between an acid and a base (caustic). 7. Describe the method of measurement for acids and bases. (What is pH?)

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Safety, Health, and the Environment	1. Discuss the safety, health, and environmental hazards found in the process industries. 2. Describe the intent and application of the primary regulations impacting the process industries: CFR (Code of Federal Regulations) • CFR 29 • OSHA 1910.119 – Process Safety Management (PSM) • OSHA 1910.132 – Personal Protective Equipment (PPE) • OSHA 1910.1200 – Hazard Communication (HAZCOM) • OSHA 1910.120 – Hazardous Waste Operations and Emergency Response (HAZWOPER) • DOT CFR 49.173.1 – Hazardous Materials – General Requirements for Shipments and Packaging • EPA CFR 260 - 270 – Resource Conservation and Recovery Act (RCRA) • 40 CFR 60-63 – Clean Air Act 3. Describe the role of the process technician in achieving successful compliance with regulations. 4. Describe the personal attitudes and behaviors that can help to prevent workplace accidents and incidents. 5. Describe the components of the fire triangle and the fire and fire tetrahedron. 6. Identify the consequences of non-compliance with regulations: • Legal • Moral and Ethical • Safety, Health, and Environmental • Economics 7. Explain the managerial and engineering controls used in the industry to minimize hazards and maximize worker and system protection in the workplace. 8. Describe (demonstrate, if possible) the correct use of personal protective equipment (PPE). 9. Describe the intent of the OSHA – Voluntary Protection Program (VPP). 10. Describe the application of the International Organization of Standards (ISO)-14000 as it relates to the process industries.
Principles of Quality	1. Identify responses in the process industries to quality issues. 2. Describe the role each of the following played in quality implementation: • W. E. Deming • Joseph Juran • Philip Crosby 3. Describe the four (4) components of Total Quality Management (TQM) and how it is applied in today's workplace. 4. Describe the application of the International Organization of Standards, ISO-9000, as it relates to the process industries. 5. Describe the use of Statistical Process Control (SPC) in the workplace. Describe the roles and responsibilities of the process technician in supporting quality improvement within the workplace.

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Topic Name	Objectives
Piping and Valves	1. Describe the purpose or function of piping and valves in the process industries. 2. Identify the different materials used to manufacture piping and valve components: • Carbon Steel • Stainless Steel • Iron • Plastic • Exotic Metals (alloys) 3. Identify the different types of piping and valve connecting methods: • Screwed • Flanged • Welded • Glued or bonded 4. Identify the different types of pipe fittings used in the industry and their application: • Coupling • Elbow • Tee • Cross • Union • Nipple • Bushing • Plug • Cap 5. Identify the different types of valves used in the industry and there application: • Ball • Butterfly • Check • Diaphragm • Gate • Globe • Plug • Relief/Safety 6. Discuss the hazards associated with the improper operation of a valve: • Personnel hazards • Equipment hazards • Production Loss or Product Damage • Environmental Damage and Cost of Cleanup 7. Describe the monitoring and maintenance activities associated with piping and valves:

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Topic Name	Objectives
Piping and Valves (cont)	**Look:** o Inspect for connection leaks o Inspect for wear from corrosion or erosion o Check for loose valve parts o Verify proper positioning of valves **Do:** o Grease and lubricate o Adjust packing o Labeling 8. Identify the symbols used to represent the different types of piping and valve components presented in this session:
Tanks, Drums, and Vessels	1. Describe the purpose or function of tanks, drums, and vessels in the process industries. 2. Explain the relationship of pressure to the vessel shape and wall thickness. 3. Describe the purpose of dikes, firewalls and containment walls around tanks, drums, and vessels. 4. Define and provide examples of the following terms as they relate to tanks, drums, and vessels: • Floating Roof • Sphere • Blanket • Vapor Recovery • Foam Chamber • Vortex Breaker • Sump (Possum Belly) • Baffle • Mixer • Weir • Gauge Hatch • Boot • Manway • Heat Tracing (steam or electrical) 5. Describe the monitoring and maintenance activities associated with tank farm operations: **Listen:** abnormal noise **Touch:** abnormal heat on vessels and piping **Look:** • Monitor levels • Check firewalls and sumps

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Topic Name	Objectives
Tanks, Drums, and Vessels (cont.)	• Corrosion and Discoloration **Feel:** excessive vibration-pumps/mixers **Smell:** abnormal odors-leaks 6. Identify the symbols used to represent the different types of tanks, drums, and vessels presented in this session. 7. Identify and describe the various types of reactors and their purpose. 8. Identify possible impacts from the following: • Improper valve lineup • Loss of nitrogen flow • Cross contamination • Failure of vent system • Leaks/Spills • Chemical Reactions (such as corrosion, pH, etc.)
Pumps	1. Describe the purpose or function of pumps in the process industries. 2. Explain the difference between the two common types of pumps used in the process industries: • Centrifugal (horizontal and vertical) • Positive displacement (rotary and reciprocating) 3. Identify the primary parts of a typical centrifugal pump: 4. Describe the operations of a centrifugal pump. 5. Explain the difference between the rotary and reciprocating positive displacement pumps. 6. 6. Identify the primary parts of various positive displacement pumps: 7. Describe the operations of a positive displacement pump. 8. Discuss the hazards associated with the improper operation of both the positive displacement and centrifugal pump: • Personnel hazards • Equipment hazards • Production • Environment 9. Describe the monitoring and maintenance activities associated with pumps: **Listen:** abnormal noise **Inspect:** excessive heat and vibration (be aware of high temperatures) **Look:** Check oil levels **Look:** Check for Leaks at seals and flanges **Look:** Discharge Pressure 10. Identify the symbols used to represent the different types of pumps.

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Compressors	1. Describe the purpose or function of compressors in the process industries. 2. Explain the difference between a pump and compressor in terms of what function each performs. 3. Explain the difference between the two (2) more common types of compressors used in the process industries: • Dynamic (centrifugal and axial) • Positive Displacement (rotary and reciprocating) 4. Identify the primary parts of a typical centrifugal compressor: 5. Describe the operations of a centrifugal compressor. 6. Explain the difference between rotary and reciprocating positive displacement compressors. 7. Identify the primary parts of a positive displacement compressor. 8. Describe the operations of a positive displacement compressor. 9. Discuss the hazards associated with the improper operation of both the positive displacement and centrifugal compressor: • Personnel hazards • Equipment hazards • Production • Environment 10. Describe the monitoring and maintenance activities associated with compressors: **Look:** • Check oil levels, check for leaks at seals and flange • Check suction and discharge pressures **Listen:** Inspect for abnormal noise **Inspect:** Inspect for excessive heat and vibration (be aware of high temperatures) 11. Identify the symbols used to represent the different types of compressors presented in this session.
Steam Turbines	1. Describe the purpose or function of steam turbines in the process industries. 2. Identify the primary parts of a typical (non-condensing) steam turbine: • Casing • Shaft • Moving and fixed blades • Governor • Nozzle • Inlet (Suction) • Outlet (Discharge) • Trip and Throttle Valve 3. Describe how a steam turbine operates. 4. Discuss the hazards associated with the improper operation of a steam turbine:

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Topic Name	Objectives
Steam Turbines (cont.)	• Personnel hazards • Equipment hazards • Production • Environment 5. Describe the monitoring and maintenance activities associated with a steam turbine: • **Look:** o Check oil levels-lubrication o Check bearings o Check for leaks at seals and flanges o Check RPMs • **Listen:** for abnormal noise • **Inspect:** Check for excessive vibration (be aware of high temperatures) 6. Identify the symbols used to represent the steam turbine and associated equipment presented in this session.
Electricity and Motors	1. Explain the difference between AC and DC current. 2. Identify what current (AC, DC, 3-phase, single phase) is most commonly used in the Processing Industry. 3. Explain basic motor controllers 4. Describe the purpose or function of the electric motor in the process industries. 5. Identify the primary parts of a typical electric motor: 6. Discuss the hazards associated with the improper inspection and operation of an AC motor: • Personnel hazards • Equipment hazards • Production • Environment 7. Describe the monitoring and maintenance activities associated with an electric motor: • **Look:** o Check lubrication o Check for loose covers and shrouds • **Listen:** for abnormal noise • **Inspect:** o Check for excessive heat o Check for excessive vibration (be aware of high temperatures) 8. Identify the symbols used to represent electric motors and associated equipment presented in this session.

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Topic Name	Objectives
Heat Exchangers (Part 1) Shell and Tube	1. Describe the purpose or function of heat exchangers in the process industries. 2. Recall the three (3) methods of heat (BTU) transfer: • Convection • Conduction • Radiation 3. Identify the primary parts of a typical shell and tube exchanger. 4. Describe the operations of a typical shell and tube exchanger. 5. Describe the different applications of a typical shell and tube exchanger: • Reboiler (forced feed and thermo siphon) • Heater/preheater • After-cooler • Condenser • Chiller • Interchanger 6. Discuss the hazards associated with the improper operation of a heat exchanger: • Personnel hazards • Equipment hazards • Production • Environmental 7. Describe the monitoring and maintenance activities associated with a heat exchanger: • **Look:** o Check for external leaks – head, flanges, and bleeders o Check for internal tube leaks – sample results o Check inlet and outlet pressures o Check inlet and outlet temperatures • **Listen:** Inspect for abnormal noise • **Inspect:** Check for excessive vibration **(**be aware of high temperatures) 8. Identify the symbols used to represent the heat exchanger and associated equipment presented in this session.
Heat Exchangers (Part 2) Air Cooled Exchangers	1. Describe the purpose or function of an air cooled heat exchanger in the process industries. 2. Identify the primary parts and support systems of a typical air cooled exchanger. 3. Describe the operation of an air cooled exchanger 4. Describe the different applications or use of water from a cooling tower: • Process condensers • Lubricating system coolers (Rotating Equipment) 5. Discuss the hazards associated with the improper operation of an air cooled exchanger • Personnel hazards • Equipment hazards • Production • Environment 6. Describe the monitoring and maintenance activities associated with an air cooled exchanger: **Look:** Leaks

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Topic Name	Objectives
Heat Exchangers (Part 2) Air Cooled Exchangers (cont.)	**Listen:** Inspect for abnormal noise (fans and motors) **Inspect:** Check for excessive vibration (fans and motors) be aware of high temperatures ntify the symbols used to represent air cooled exchangers, and associated equipment.
Heat Exchangers (Part 3) Cooling Towers	1. Describe the purpose or function of a cooling tower in the process industries. 2. Identify the primary parts and support systems of a typical cooling tower. 3. Describe the operation of a Cooling Tower 4. Discuss the hazards associated with improper operation of a Cooling tower and the potential fire hazard when shutting one down. 5. Describe the monitoring and maintenance activities associated with a Cooling Tower: Look: Leaks Listen: for abnormal noise (fans and motors) be aware of high temperatures 6. Identify the symbols used with cooling towers and associated equipment presented in this session
Furnaces	1. Describe the purpose or function of a furnace in the process industries. 2. Describe the types of fuel used in a furnace • Natural gas • Fuel oil • Process oil • Process gas • Fuel gas 3. Identify the primary parts of a typical furnace. 4. Describe the different types of furnaces by draft: • Natural draft • Forced draft • Induced draft • Balanced draft 5. Describe the different furnace designs: • Cylindrical • Cabin • A-Frame 6. Describe the monitoring and maintenance activities associated with a furnace. **Look:** positive/negative pressure, flame inspection, hot spots **Listen:** abnormal noise (i.e., incomplete combustion **Inspect:** visible emissions, on-line analysis 7. Discuss the hazards associated with the improper operation of a furnace: • Personnel hazards • Equipment hazards

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Topic Name	Objectives
Furnaces (cont.)	• Protection (PPE) • Environment Identify the symbols used with furnaces and associated equipment presented in this session
Boilers	1. Describe the fundamental principles of boiler operation. 2. Describe the operation of boilers in different applications in the process industries. 3. Identify the primary parts and support systems of a typical fuel-fired boiler. 4. Describe the types of fuel used in a boiler: • Natural gas • Fuel oil • Fuel gas • Process oil • Process gas 5. Describe the different types of boilers by draft: • Natural draft • Forced draft • Induced draft • Balanced draft 6. Describe the difference in fire tube and water tube boilers. 7. Describe the monitoring and maintenance activities associated with operating boilers: **Look:** Fire eye, boiler level, boiler pressure • **Listen:** abnormal noises **Check:** safety systems associated with a boiler **Inspect:** water level, water quality 8. Discuss the hazards associated with the improper operation of a boiler: • Personnel hazards • Equipment hazards • Production • Environment 9. Identify the symbols used with boilers and associated equipment presented in this session
	1. Describe the purpose or function of a distillation column or tower in the process industries. 2. Identify the primary parts and support systems of a typical tray-type distillation column: 3. Describe the distillation process. 4. Describe the use of packing as it pertains to distillation. 5. 5. Discuss the hazards associated with the improper operation of a distillation column: • Personnel hazards

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Topic Name	Objectives
Distillation (cont.)	• Equipment hazards • Production • Environment 6. Describe the monitoring and maintenance activities associated with distillation column operations: **Listen:** Inspect for abnormal noise (pumps and reboilers) **Look:** Check for leaks **Look:** Check samples for separation **Look:** Check temperature and pressure differentials **(**be aware of high temperatures) Identify the symbols used with distillation columns and associated equipment presented in this session.
Process Control Instrumentation	1. Describe the purpose or function of process control instrumentation in the process industries. 2. Describe the difference between process control indicators and control loop inputs. 3. Describe the major types of process control instrumentation: • Electronic • Pneumatic • Digital • Analog 4. Define a generic control loop and provide an example. 5. Identify four key variables which are controlled by process control instrumentation: • Temperature • Pressure • Level • Flow 6. Identify typical process control instruments, their applications and functions. 7. Describe distributive control systems and how they are applied in the process industries. 8. Discuss the hazards associated with process control instruments (i.e., positioners, fail open/fail closed, leaks). **Look:** Valve position **Listen:** Leaks on pneumatic air systems **Check:** valve stroke Describe the monitoring and maintenance activities associated with process control instrumentation. 10. Identify symbols used to represent process control instruments.
Process Utilities	1. Discuss the different types of process utilities and their applications: • Water Systems (Boiler feed water, Drinking water, Cooling water, Fire water, Service water, Process water, Potable water, Condensate) • Steam • Electrical • Air Systems (Plant, instrument air, breathing)

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Topic Name	Objectives
Process Utilities (cont.)	• Sour water • Gas Systems (Fuel Gas, Natural gas, nitrogen, etc.) • CO2 (carbon monoxide) 2. Describe the different types of equipment associated with each of the utility systems found in the process industries. Identify symbols used to represent process utilities.
Process Auxiliaries	1. Describe the purpose or function of the different process auxiliary systems and their applications. 2. Discuss the different types of waste water systems and their applications in process: • Treated water • Waste water (Sewer, Storm, Oily) 3. Discuss the equipment associated with flare systems found in the process industries. 4. Discuss the parts associated with refrigeration systems found in the process industries. 5. 4. Discuss the parts associated with lubrication systems found in the process industries. 6. Discuss the parts associated with hot oil systems found in the process industries. Identify symbols used to represent process auxiliary systems.
Process Print Reading	1. Describe the purpose or function of process systems drawings. 2. Identify the common components and information within process systems drawings. 3. Identify the different drawing types and their uses: • Block Flow Diagrams • Process Flow Diagrams (PFD) • Piping and Instrument Diagrams (P&ID) • Plan drawing • Engineering Flow Drawing (EFD) • Electrical Drawings**:** −Mechanical - Wiring Diagrams −Schematics • Isometrics Identify the different components and their symbols in each of the drawings listed above.
Process Facility Tour (optional)	Establish the relationship between content in the course and actual equipment in a process by conducting a facility tour. Consider the following: 1. Transportation 2. Access to the facility/safety orientation 3. Tour Guide 4. Proper clothing (PPE) *****Suggested alternatives to touring process facility: • College physical plant • Public/municipal utilities