Process Systems

Topic	Objectives
System Structure	1. Describe how process industry facilities are divided into systems. 2. Identify the types of systems used in the process industry. 3. Discuss how one system affects another. For example, the product of one system is the feed stock for the next. 4. Describe typical process technician responsibilities for each of the following: • Operating systems • Monitoring systems • Troubleshooting systems • Completing rounds • Communication between inside and outside operator • Communication between process technician and other departments • Implementing established procedures and specifications • Completing maintenance tasks as assigned • Monitoring and maintaining auxiliary equipment • Completing related sampling and analysis tasks and responding appropriately to results • Communicating problems to appropriate personnel • Communicating relevant information to other units • Impact on plant economics 5. Discuss the process technician's role in identifying system problems.
System Controls	1. List the variables which must be controlled to ensure proper operation of systems. 2. Discuss systems instrumentation. 3. Demonstrate tracing flows through each system on a diagram. (PFD, Control Diagram, P&ID) 4. Discuss factors that affect normal systems operation.
UTILITY SYSTEMS **Water Systems:** • **Potable Water** • **Fire Water** • **Service/Utility** • **Cooling Water**	1. Explain the purpose and fundamental concepts of water systems. 2. Explain the purpose of equipment components and explain the operating principles and controls of water systems. 3. Define terms associated with water systems. 4. Explain the water systems theory of operation. 5. Give examples of factors that affect normal operations of water systems. Examples include flow, pressure, pH, and conductivity, etc. 6. Trace flows through a water system (UFD – Utility Flow Diagram) and sketch a simple water system. 7. Discuss specific safety, health, and environmental concerns associated with water systems. 8. Discuss the process technician's role and responsibilities in operating water systems.

Topic	Objectives
Waste Water Systems • **Waste Water** • **Storm Water**	1. Explain the purpose and fundamental concepts of waste water systems. 2. Explain the purpose of equipment components and explain the operating principles and controls of waste water systems. 3. Define terms associated with waste water systems. 4. Explain the waste water systems theory of operation. 5. Trace flows through a waste water system (UFD) and sketch a simple waste water system. 6. Give examples of factors that affect normal operations of waste water systems. 7. Discuss specific safety, health, and environmental concerns associated with waste water systems. 8. Discuss the process technician's role and responsibilities in operating waste water systems.

Gas Systems:
• **Air Systems**
  ○ **Instrument Air**
  ○ **Utility Air**
  ○ **Breathing Air**
• **Nitrogen System**
• **Fuel Gas System**
	1. Explain the purpose and fundamental concepts of gas systems.
	2. Explain the purpose of equipment components and explain the operating principles and controls of gas systems.
	  • Pressures, Step-down, contamination, etc. in fuel systems.
	  • Source of fuel gas and heating (BTU) value
	3. Explain the gas systems theory of operation.
	4. Trace flows through a gas system (UFD) and sketch a simple gas system.
	5. Give examples of factors that affect normal operations of gas systems.
	  • Importance of having instrument air at a low dew point and process upsets associated with the failure of the instrument air systems including backup systems.
	6. Discuss specific safety, health, and environmental concerns associated with gas systems.
	  • Flammability issues and addition of methyl mercaptan to fuel gas systems
	  • Concerns of displacement of oxygen with nitrogen in a confined space.
	  • Safety concerns associated with breathing air (cross contamination) and the use of a self-contained breathing apparatus (SCBA).
	  • Safety concerns using highly flammable gases such as hydrogen: highly combustible, auto-ignition, colorless flame, extremely high temperature flame, etc.
	7. Discuss the process technician's role and responsibilities in operating gas systems.

Electrical Power Distribution Systems	1. Explain the purpose of electrical power generation & distribution systems. 2. Identify the basic equipment components found in electrical power distribution systems. 3. Explain the purpose of equipment components found in electrical power distribution systems. 4. Define terms associated with electrical power distribution systems. 5. Explain the electrical power distribution systems theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of the electrical power distribution systems. 7. Give examples of factors that affect normal electrical power distribution systems operation. 8. Discuss electrical power distribution systems instrumentation. 9. Trace flows through an electrical power distribution systems on an electrical one-line diagram. 10. Discuss the specific safety, health and environmental concerns associated with the electrical power distribution

Topic	Objectives
	11. Discuss safety concerns when operating switch gear. 12. Discuss the process technician's role and responsibilities in operating electrical systems.
AUXILIARY SYSTEMS • **Storage & Blending**	1. Describe the various types of storage and blending systems and explain their purpose. 2. Discuss the basic equipment components found in storage and blending systems. 3. Explain the purpose of equipment components found in storage and blending systems. 4. Define terms associated with storage and blending systems. 5. Explain the storage and blending systems theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of storage and blending systems. 7. Give examples of factors that affect normal storage system operation. • Storage time • Temperature • Cross-contamination • Inhibitors 8. Discuss storage and blending system instrumentation. 9. Trace flows through a storage and blending system on a diagram (PFD, Control Diagrams) and sketch a simple storage and blending system. 10. Discuss the specific safety, health and environmental concerns associated with storage and blending systems. • Vapor recovery and control • Blanketing 11. Discuss the process technician's role and responsibilities in operating storage and blending systems.
• **Steam Systems** ○ **Boiler Feedwater** ○ **Steam Generation** ○ **Steam Distribution** ○ **Condensate Return**	1. Explain the purpose of steam systems. 2. Discuss the basic equipment components found in steam systems. 3. Explain the purpose of equipment components found in steam systems. • Include pre-treatment systems such as demineralization and chemical treatment of boiler feedwater. 4. Define terms associated with steam systems. 5. Explain the steam system theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of a steam system (moisture, pH, hardness, conductivity, etc.). 7. Describe factors that affect normal steam system operation. • Freeze protection • Effect or impact of steam trap failure 8. Discuss steam systems instrumentation. 9. Trace flows through a steam system on a diagram (PFD, Control Diagram) and sketch a simple steam system. 10. Discuss the specific safety, health and environmental concerns associated with a steam system. • Expansion • Extreme temperatures/ heat content (BTUs)

Topic	Objectives
	• Pressures 11. Discuss the process technician's role and responsibilities in operating steam systems.
Combustion Systems (waste treatment) • **Relief Systems** • **Flare Systems** • **Thermal Oxidation Systems (Incinerators)**	1. Explain the purpose of combustion systems. 2. Identify the basic equipment components found in combustion systems. 3. Explain the purpose of equipment components found in combustion systems. 4. Define terms associated with combustion systems. 5. Explain the combustion systems theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of the combustion systems. 7. Give examples of factors that affect normal combustion systems operation. 8. Discuss combustion systems instrumentation. 9. Trace flows through combustion systems on a diagram (PFD, Control Diagram) and sketch a simple combustion system. 10. Discuss the specific safety, health and environmental concerns associated with the combustion systems. • Reporting requirements • Environmental and safety impacts during flaring incidents due to incomplete combustion (smoke, noise, thermal radiation, etc.) 11. Discuss the process technician's role and responsibilities in operating combustion systems.
Refrigeration Systems • **Mechanical** • **Absorption**	1. Explain the purpose of refrigeration systems. 2. Discuss the basic equipment components found in refrigeration systems. 3. Explain the purpose of equipment components found in refrigeration systems. 4. Define terms associated with refrigeration systems. 5. Explain the refrigeration system theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of the refrigeration system. 7. Give examples of factors that affect normal refrigeration system operation. 8. Discuss system instrumentation. 9. Trace flows through a refrigeration system on a diagram (PFD, Control Diagram) and sketch a simple refrigeration system. 10. Discuss the specific safety, health and environmental concerns associated with the refrigeration system. • Refrigerant 11. Compare and contrast mechanical and absorption refrigeration systems. 12. Discuss the process technician's role and responsibilities in operating refrigeration systems.
REACTION SYSTEMS • **Reaction Science**	~~1.~~ Distinguish between physical changes/properties and a chemical reaction. 2. Define terms associated with reactions 3. Identify chemical reaction types from their chemical equations. 4. Describe how the mass ratio between reactants relates to the balanced equation. 5. Explain the difference between exothermic and endothermic reactions and how they are controlled 6. Describe how a runaway reaction might occur and the consequences. 7. Explain the role of catalysts, initiators, and inhibitors. 8. Explain how various variables impact reaction rates (temperature, pressure, concentration, particle size,

Topic	Objectives
	mixing) 9. Define residence time and explain its relationship to conversion. 10. Distinguish between continuous and batch reaction systems.
• **Batch Reactor Systems**	1. Describe the types of batch reactors. 2. Explain the purpose and fundamentals of batch reaction systems. 3. Discuss the basic equipment components found in batch reaction systems. 4. Explain the purpose of equipment components found in batch reaction systems. 5. Define terms associated with batch reaction systems. 6. Give examples of variables that must be controlled to ensure proper operation of batch reaction systems. 7. Give examples of factors that affect normal batch reaction system operation. 8. Discuss batch reaction systems instrumentation. 9. Trace flows through a batch reaction system on a (PFD, Control Diagram) and sketch a simple batch reactor system. 10. Discuss the specific safety, health and environmental concerns associated with batch reaction systems. 11. Discuss the process technician's role and responsibilities in operating batch reaction systems.
• **Continuous Reactor Systems**	1. Describe the types of continuous reactors 2. Explain the purpose and fundamentals of continuous reaction systems. 3. Discuss the basic equipment components found in continuous reaction systems. 4. Explain the purpose of equipment components found in continuous reaction systems. 5. Define terms associated with continuous reaction systems. 6. Describe the importance of flow ratios between reactants. 7. Give examples of variables that must be controlled to ensure proper operation of continuous reaction systems. 8. Describe factors that affect normal continuous reaction system operation. 9. Discuss continuous reaction systems instrumentation. 10. Trace flows through a continuous reaction system on a (PFD, Control Diagram) and sketch a simple extraction system. 11. Discuss the specific safety, health and environmental concerns associated with continuous reaction systems. 12. Discuss the process technician's role and responsibilities in operating continuous reaction systems.
• **Furnace Systems**	1. Explain the purpose and function of a furnace system. 2. Describe the different types and designs of furnace systems. 3. Describe the common types of reactions that occur in furnaces 4. Explain the cause of coking and describe common symptoms. 5. Explain the importance of residence time in the tubes of a furnace. 6. Describe the different draft applications associated with furnace systems. 7. Explain the different applications of furnaces in process operation. 8. Explain the equipment components found in a furnace system. 9. Define terms associated with furnace systems. 10. Explain the furnace theory of operation.

Topic	Objectives
	11. Give examples of variables that must be controlled to ensure proper operation of furnace systems. 12. Describe factors that affect normal furnace system operation. 13. Discuss furnace system instrumentation. 14. Discuss the furnace/boiler combination applications in furnace systems 15. Discuss the waste-heat boiler application in a furnace system. 16. Trace flows through the furnace system components on a diagram. (PFD and Control Diagram) and sketch a simple furnace system. 17. Discuss the specific safety, health, environmental, and process operation concerns associated with furnace systems. 18. Discuss the process technician's role and responsibilities in operating furnace systems.
SEPARATION SYSTEMS • **Filtration Systems**	1. Explain the purpose and fundamentals concepts of filtration systems 2. Describe the types of filtration systems. 3. Explain the purpose of the equipment components and explain the operating principles of filtration systems. 4. Define terms associated with filtration systems. 5. Explain the filtration systems theory of operation. 6. Give examples of the variables that must be controlled to ensure proper operation of the filtration system. 7. Discuss the instruments and control of filtration systems. 8. Give examples of factors that affect normal filtration operation. 9. Trace flows through a filtration system on a (PFD, Control Diagram) and sketch a simple diagram of a filtration system. 10. Discuss specific safety, health, and environmental concerns associated with filtration systems. 11. Discuss the process technician's role and responsibilities in operating filtration systems.
• **Adsorption Systems**	1. Explain the purpose of adsorption systems. 2. Discuss the basic equipment components found in adsorption systems. 3. Explain the purpose of equipment components found in adsorption systems. 4. Define terms associated with adsorption systems. 5. Explain the adsorption systems theory of operation. 6. Give examples of variables that must be controlled to ensure proper operation of adsorption systems. 7. Give examples of factors that affect normal adsorption systems operation. 8. Discuss adsorption systems instrumentation. 9. Trace flows through adsorption systems on a (PFD, Control Diagram) and sketch a simple adsorption system. 10. Discuss the specific safety, health, and environmental concerns associated with the adsorption systems. 11. Discuss the process technician's role and responsibilities in operating adsorption systems.
• **Distillation Systems**	1. Explain the purpose of distillation systems. 2. Discuss the basic equipment components found in distillation systems. 3. Explain the purpose of equipment components found in distillation systems. 4. Define terms associated with distillation systems. 5. Differentiate between different types of distillation systems.

Topic	Objectives
	• Batch & continuous • Vacuum, atmospheric and pressurized 6. Describe how the system requirements determine the following: • Tower diameter • Height • Feed entry point • Control points • Tower internals (trays, packing) 7. Explain the distillation system theory of operation 8. Give examples of variables that must be controlled to ensure proper operation of the distillation system. 9. Give examples of factors that affect normal distillation system operation. 10. Discuss distillation system instrumentation. 11. Trace flows through a distillation system on a (PFD, Control Diagram) and sketch a simple distillation system. 12. Discuss the specific safety, health and environmental concerns associated with the distillation system. 13. Discuss the process technician's role and responsibilities in operating distillation systems.
• **Extraction Systems**	1. Explain the purpose of extraction systems. 2. Discuss the basic equipment components found in extraction systems. 3. Explain the purpose of equipment components found in extraction systems. 4. Define terms associated with extraction recovery. 5. Explain the extraction systems theory of operation 6. Give examples of variables that must be controlled to ensure proper operation of the extraction systems. 7. Give examples of factors that affect normal extraction systems operation. 8. Discuss extraction systems instrumentation. 9. Trace flows through an extraction system on a diagram (PFD, Control Diagram) and sketch a simple extraction system. 10. Discuss the specific safety, health and environmental concerns associated with the extraction systems. 11. Discuss the process technician's role and responsibilities in operating extraction systems.
• **Absorption and Stripping**	1. Explain the purpose of absorption and stripping systems. 2. Compare absorption and adsorption. 3. Discuss the basic equipment components found in absorption and stripping systems. 4. Explain the purpose of equipment components found in absorption and stripping systems. 5. Define terms associated with absorption and stripping. 6. Explain the absorption and stripping systems theory of operation 7. Give examples of variables that must be controlled to ensure proper operation of the absorption and stripping systems. 8. Give examples of factors that affect normal absorption and stripping systems operation. 9. Discuss absorption and stripping systems instrumentation. 10. Trace flows through an absorption and stripping systems on a diagram (PFD, Control Diagram) and sketch a simple absorption/stripping system.

Topic	Objectives
	11. Discuss the specific safety, health and environmental concerns associated with the absorption and stripping systems. 12. Discuss the process technician's role and responsibilities in operating absorption and stripping systems.